A Framework for the Sustainability Assessment of Urban Design and Development in Iraqi Cities

By

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DECLARATION

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DEDICATED TO

I dedicate this work to my family, especially my wife who has supported me throughout the research period, my children, *Maryam*, *Safa*, *Mustafa*, and *Mohammed*, and my father and mother. I would like to express my warm thanks to them all; without their support and encouragement, this thesis would not have been accomplished.

ABSTRACT

The assessment of urban sustainability is increasingly being seen as essential to mitigate the undesirable impacts of urbanisation in cities while improving communities' resilience to environmental, social and economic changes. Several urban sustainability assessment tools (USATs) have been developed to make such informed decision-making. In addition to their role as an enabler for stakeholder engagement and increased public awareness throughout the lifecycle of an urban development project, USATs act as a catalyst to increase market demand for sustainable products and services by providing a mechanism for recognising excellence. Most current USATs have been developed based on the needs of developed nations which are different from those of developing countries, especially those affected by natural disasters and man-made events e.g. wars. Iraq has endured several decades of war and subsequent international sanctions which have affected its overall economy, infrastructure, public services and utilities. In consequence, rebuilding, rehabilitation and the development of new cities and urban areas are currently underway but without evidence of attention to sustainability and public participation in decision-making.

This research aimed to investigate the factors affecting urban sustainability in Iraq through a literature review and stakeholder consultations, leading to the development of a comprehensive sustainability assessment framework for urban design and development projects. The proposed framework included attention to the local environmental, social and economic aspects and urban challenges, in addition to how to promote awareness and stakeholder participation. The methodology included: (a) an analytical comparison of a range of global USATs to define relevant urban indicators; (b) determination of the urban challenges in the Iraqi context, through an extensive review of the literature; (c) investigation of key local urban challenges from the stakeholder perspective by conducting a nationwide questionnaire, and (d) identification and prioritisation of local assessment factors by consultation with a panel of experts, conducting a consensus-built method and application of the Analytic Hierarchy Process (AHP) to allocate credits and rating formulas. This comprehensive consultation methodology is a unique contribution of the research to identify the key quantitative and qualitative assessment factors.

The Iraqi urban sustainability assessment framework (IUSAF) comprises of 89 urban factors, ten of which are mandatory, which can be considered fundamental urban factors to assess the sustainability of a project. The results have revealed that 'water' was ranked as the most important factor with 8.5% of the total weight, 'safety and security' was second at 7.9 %, followed by 'transportation and infrastructure', 'housing', and 'local economy', demonstrating a link between deficiencies in the provision of environmental and socio-economic infrastructure in Iraq. These findings evidence that the IUSAF is based on an understanding of key local urban challenges and issues, this significantly different from a range of USATs currently in use, regarding urban factors (indicators, sub-indicators), their priorities and weighting systems. The IUSAF was validated using three urban development case studies of varying complexities. The applicability analysis reported the IUSAF as appropriate to assess urban sustainability. The final results of the testing process have validated the need for IUSAF to assess existing urban design and development which has been planned and developed in an unsustainable manner. IUSAF stands to create many substantial benefits as it has the capacity to raise awareness about urban sustainability issues for developers, specialists and decision-makers and to constitute a plan of action for current and new urban development projects in Iraqi cities.

LIST OF PUBLICATIONS

Journal papers:

RFM Ameen, M Mourshed (2017), "**Urban environmental challenges in developing countries—A stakeholder perspective**", *Habitat International*, 64 (2017): 1-10, DOI: 10.1016/j.habitatint.2017.04.002.

RFM Ameen, M Mourshed, H Li (2015), "**A critical comparison of environmental assessment tools for sustainable urban design**", *Environmental Impact Assessment Review*, 55:110-125. DOI: 10.1016/j.eiar.2015.07.006.

Conference papers:

RFM Ameen, M Mourshed (2016), "**Environmental, Social and Economic Challenges for Urban Development: Stakeholder's Perception in a Developing Economy**": in Proceeding of the 16th International Conference on Computing in Civil and Building Engineering (ICCCBE2016), Osaka, Japan,6-8 July 2016.

RFM, Haijiang Li, M Mourshed (2014), "**Sustainability assessment methods of urban design: a review**": in Proceeding of the 21st International Workshop: Intelligent Computing in Engineering 2014 (EG-ICE 2014), Cardiff, UK, 16-18 July 2014.

Under review:

The paper entitled "**Urban sustainability assessment in developing cities: The development of a consensus-based framework using Delphi**" has been submitted to the *Cities* Journal.

Working papers:

"**Socio-economic challenges of sustainable urban development in developing countries—A stakeholder perspective**". To be submitted to *World Development* Journal in August 2017.

"**Urban sustainability assessment in developing economies countries: The ranking and weighting of sustainability factors using analytic hierarchy process (AHP)**" To be submitted to *Expert Systems with Applications* Journal in September 2017.

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Chapter 1
Introduction

Chapter 1 begins by highlighting the background of urban sustainability and the key factors that paved the way for its emergence, the importance of studying this topic and its achievements at a global level. Thereafter, the research presents an outline review of the local Iraqi context and the major challenges of urban development. The study also clarifies why it is important to have a study to assess the sustainability of urban development in Iraqi cities. The motivation, aim and objectives, contributions and research plan are described, the chapter concluding with a detailed outline of this thesis.

1.1 Background

Due to rapid urbanisation, more than 50% of the world's population currently live in cities (UN 2014; Prasad et al. 2016) and by the year 2050, that figure is projected to increase to about 70% (Komeily and Srinivasan 2015) as illustrated in Figure **1.1**. Cities are engines of economic prosperity and social development (Mourshed *et al.* 2016), and are responsible for the depletion of natural resources, energy and agricultural land, as well as contributes to more than 70% of total global CO_2 emissions (FAO 2011). The bulk of the present increases in demand for environmental and social services, energy and economic support originate in developing economies, particularly China, India and the Middle East (IMF 2016), coinciding with growing urbanisation rates and population density. Urbanisation rates across the globe are uneven; it is higher in developing countries (Kadhim *et al.* 2016). Urban population in developing countries is projected to rise from 46% in 2010 to about 65% in 2050 (UN 2014). There is, therefore, an urgent need to adopt efficient solutions, for new and existing urban areas, that will mitigate environmental, social, and economic impacts, and achieve a balance between diverse dimensions of sustainability.

Urban sustainability assessment has been suggested as critical to achieving sustainability (Sharifi and Murayama 2015). The concept of sustainable development emerged from the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit (Drexhage and Murphy 2010) held in Rio de Janeiro, 1992. Since then, there has been widespread agreement on the importance of adopting sustainable development, to address urbanisation concerns across different societies (Najam and Cleveland 2003; Bosselmann 2016). This conference also formally acknowledged the concept of sustainable urban development and its application. It can be defined as the capability of urban regions to achieve the quality of life desired by the community without affecting the needs of current and future generations, or producing negative impacts inside and outside said urban region (Wallbaum *et al.* 2010).

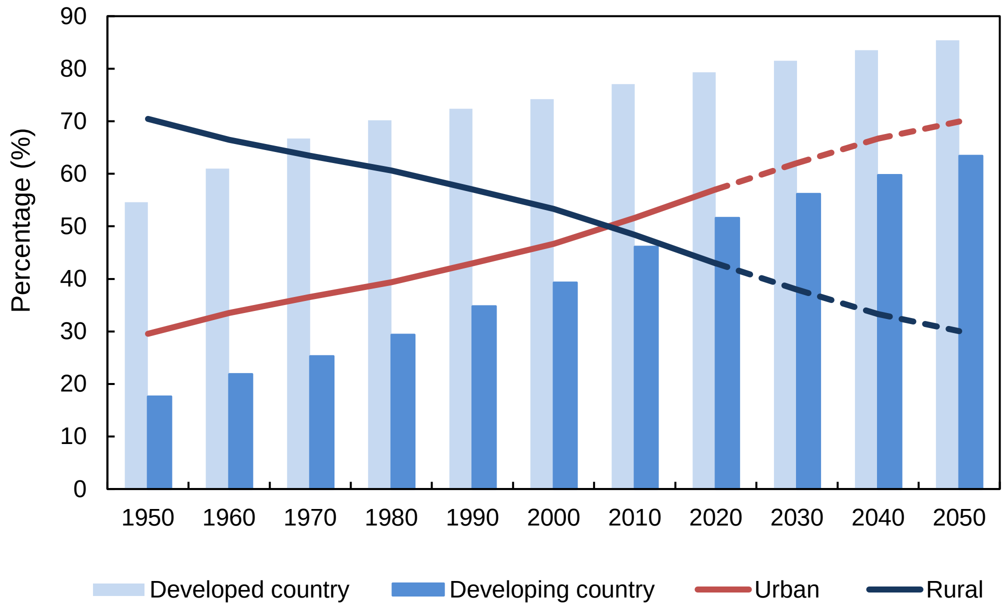


Figure 1.1: Historical and projected urban and rural population percentages and rate of urbanisation in developed and developing countries from 1950- 2050.
Data source: WorldBank (2017); UN (2014)

Urbanisation processes, specifically urban planning and design, vary on a global level but several urban indicators are followed globally to distinguish between urban regions. Those indicators are linked in terms of population, density, employment profiles, services availability and quality.

Currently, there has been an emphasis on sustainable urban development as a fundamental principle to enhance the quality of human life, to control urbanisation, reduce resource consumption, preserve the ecosystem, reduce pollution and promote the economy (He *et al.* 2011). There has been increased global attention directed towards urban sustainability for many countries, this was reflected in the development of strict regulations and built environment methods of assessment, promoting sustainability designed to mitigate undesirable impacts.

The current research concentrates on different global sustainability assessment methods and the relative weight of categories and indicators which reinforce sustainability standards applicable to the local circumstances of various regions worldwide. The focus will be on proving that well-known sustainability assessment methods are not appropriate for developing countries e.g. Iraq, this representing a unique case study in the field of urban development challenges.

1.2 Local Iraqi context

Iraq is in the Middle East, located in the West of Asia occupying an area of approximately 437072 km^2. According to the estimates, the population will reach 38.9 million in 2017 (CSO 2013). Iraq is bordered by six countries: Turkey to the north, Jordan to the west, Kuwait to the south, Saudi

Arabia to the south and south- west, Syria to the north-west and Iran to the east, having a varied topography divided into four geographic zones, as shown in Figure **1.2**a. The mountainous area located in the northern and north-east, occupies a quarter of the country. The western plateau extends from the west of the Euphrates River to the Syrian Desert, Jordan and Saudi Arabia, occupying about half of the country. The alluvial plain extends along the eastern part of the desert plateau to the west, and includes the marshes area. The undulating zone is a transition between the low-lying plains in the south and the high hills and mountains to the far north and northeast, occupying 50% of the mountainous area (Frenken 2009). The Iraqi climate also varies as illustrated in Figure **1.2**b. It is arid in most areas, and semi-arid/ Mediterranean in the north/north-eastern regions.

As shown in Figure **1.3**, temperatures vary significantly. The arid region in the south and south-west is close to one of the hottest areas on Earth, especially during summer months in the Northern hemisphere (Mourshed 2016). Summer in Iraq is hot and arid with temperatures frequently exceeding 45°C while it falls to 5°C and below 0°C during few days in winter. In the summer, dusty desert winds can blow for several days, there may be no rain (Varoujan K *et al.* 2013). Rain falls in small amounts less than 40 mm, between November and April in the north and north-east regions in winter (Zakaria *et al.* 2013).

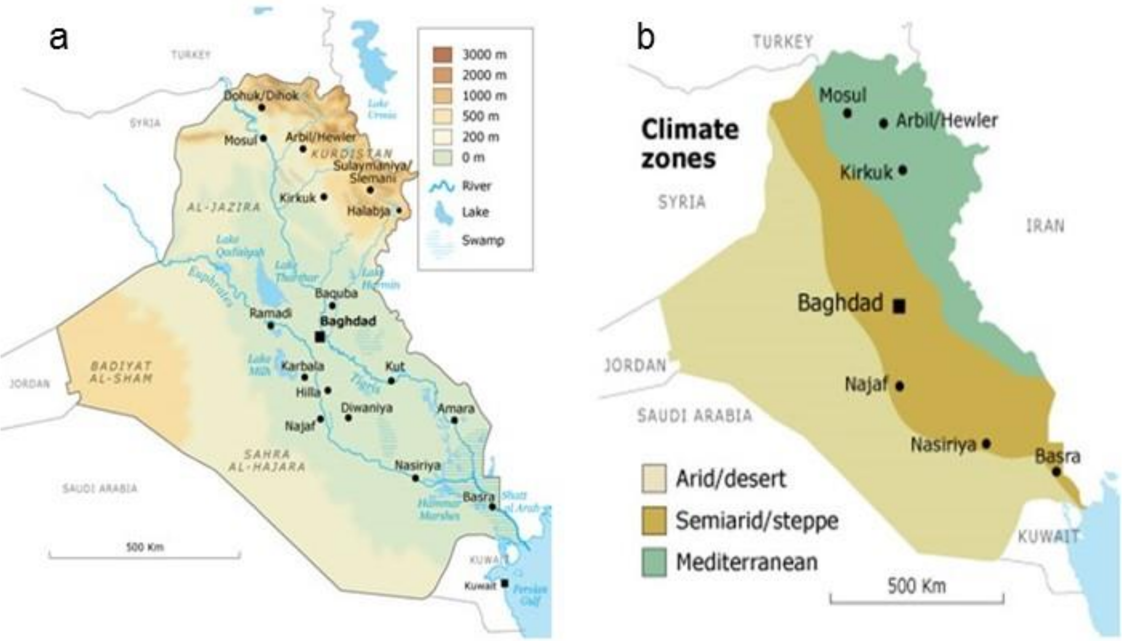


Figure 1.2: Iraq topography and climate. (a) Topography; (b) Climate zones of Iraq. Data source: Fanack (2016)

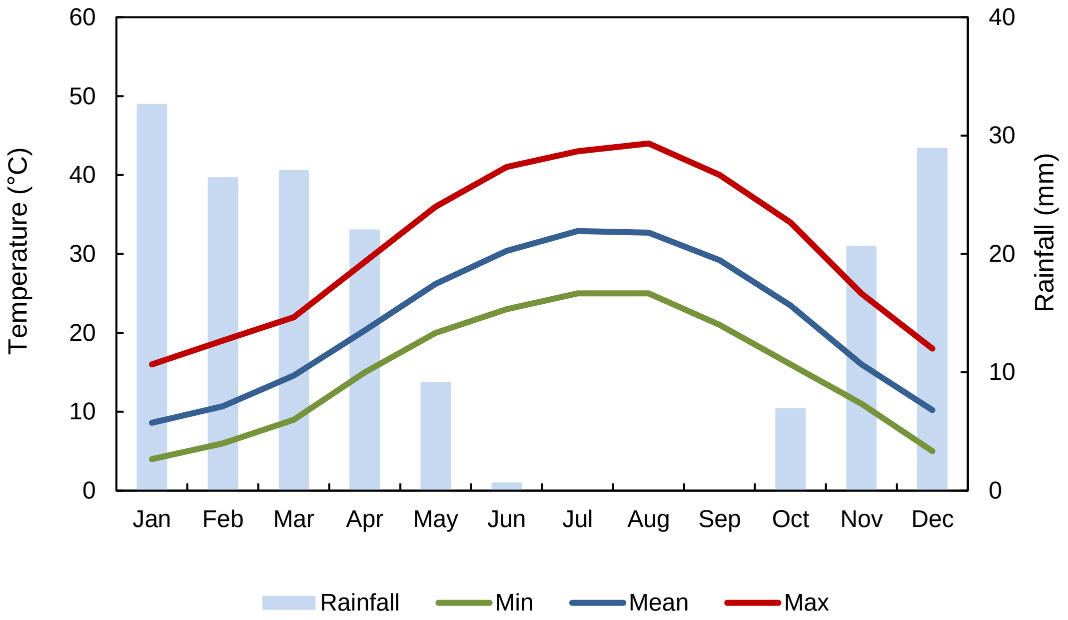


Figure 1.3: Monthly temperature normal and rainfall in Iraq between 1991 and 2015. Data source: WorldBank (2017)

1.3 Urban development in Iraq

Geographical diversity, climate and demographics aside, Iraqi cities have suffered from destruction and degradation because of successive wars and international sanctions, for more than four decades, this severely affecting the environment and economy. There has been serious damage to infrastructure and public utilities, such as insufficient water supply systems for significant portions of the population, lack of sanitation systems, risks of disease proliferation caused by accumulated waste and the spread of dangerous materials and emissions into the air, soil and groundwater (HRW 2013; MOE 2013).

Several studies including the Iraq National Development Plan (2013-2017), have identified major environmental urban challenges within Iraqi cities such as air, water and soil pollution; shortage of water resources; desertification; lack of waste recycling and reuse; untreated contaminated areas and inefficient infrastructure. In addition, there are socio-economic challenges including a severe housing deficit, lack of the efficient public facilities such as hospitals and educations, safety concerns in urban areas; unemployment and an absence of investment in sustainable development (CSO 2013). Both national and international communities recognising the scale of the resultant challenges (Matar 2010; WHO 2015).

However, since the change in political regime in 2003, Iraq has witnessed a new phase of economic recovery, as shown in Figure **1.4**, including an oil boom and high production levels to approximately 4 million B/D, which has increased the Gross domestic product (GDP) significantly. Per capita income has doubled 14 times from 2003 to 2012 (WorldBank 2017).

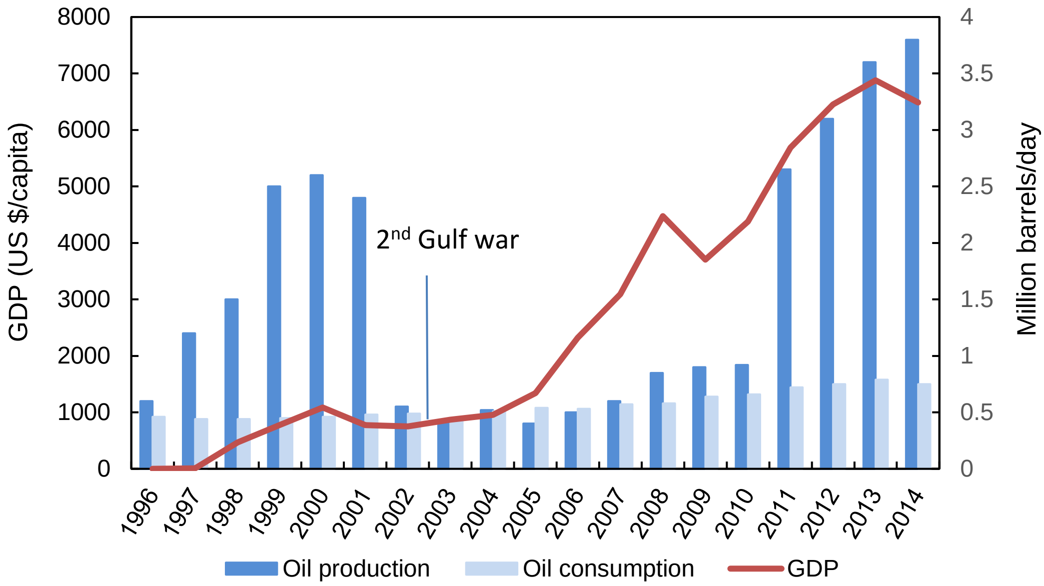


Figure 1.4: Gross Domestic Product (GDP) and oil production and consumption in Iraq from 1998- 2014. The drop in GDP in 2009 and 2014 relates to to the decrease in oil price. The net annual export of Iraqi oil is more than 3 million barrels/day since 2014.
Data Source: WorldBank (2017)

The population has been increasing steadily, as shown in Figure 1.6, from about 27 million in 2005 to currently more than 38 million. This increase is accompanied by a high demand for housing units, a demand exacerbated by a severe housing shortage estimated at more than two million units in 2017 and rising (MOCH 2010), as shown in Figure **1.5**.

Because of this, here has been a move towards rebuilding, expansion and the construction of new cities, in order to meet the growing demands of the population and to improve standards of living.

The National Investment commission (NIC) approved 1336 investment licenses between 2009-2015 in diverse fields, more than 170 licenses in urban development and housing field, as well as announcing 110 new investment opportunities in 2016 (NIC 2017b). A number of large, urban development and regeneration projects are currently underway (Appendix 1); these are considered a means to tackle the severe urban challenges in Iraqi.

However, current practices are implemented without attention to sustainability because of the absence of local sustainability assessment method. The development of such a method can be expedited by taking advantage of well-known urban assessment methods such as BREEAM Communities, LEED-ND, CASBEE-UP and SBTool^{PT}-UP as a base for framework development. In this way, local data can help create solutions to environmental, social and economic problems and help with the organisation of cities. Such a framework can promote awareness and participation among communities, stakeholders and decision-makers, helping developers and planners accommodate key environmental issues, and spread the concept of sustainability among architects, planners and developers.

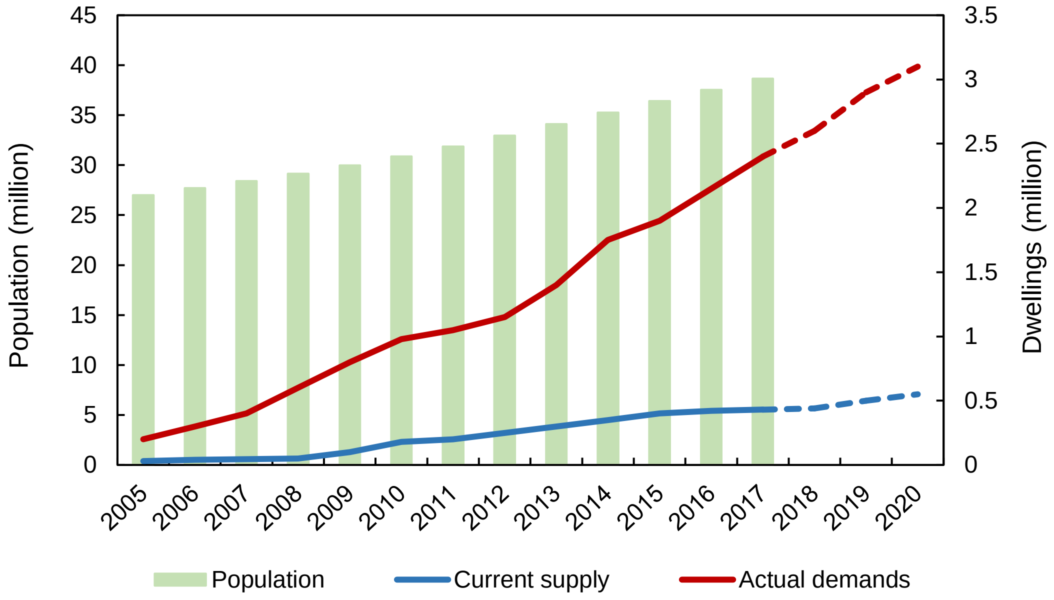


Figure 1.5: Iraqi population numbers with cumulative and projected dwelling units supply and demand from 2005-2020. Data source: EY (2012); WorldBank (2017)

1.4 Research problem

Urban sustainability is critical for the rapid urbanisation of developing countries, not only to mitigate the impact of climate change but also to enhance the quality of life for their citizens. The environmental, economic and social dimensions of sustainability are interrelated and dependent on one another. As such, integrated and holistic assessments of sustainability of the built environment have emerged as a new developmental paradigm (Sharifi and Murayama 2015). Decades of research and development have led to the conclusion that global urban sustainability assessment tools are not universally applicable, specifically for developing countries, because of differences in priorities for urban development (Haapio 2012). Because development priorities are different, they need to be identified according to different contexts, before developing a framework for urban sustainability assessment.

Previous investigations on urban sustainability assessment (Sharifi and Murayana 2014), specifically in the Middle East (Alyami et al. 2015) have focused on secondary data analysis, mainly literature reviews, to identify relevant factors and indicators. They also relied primarily on the opinions of expert stakeholders, leaving out members of the public, the ultimate beneficiaries of urban projects. While this approach is an improvement to the use of out-of-context global assessment tools, identified indicators and priorities cannot be considered as a comprehensive collection of the views of all stakeholders.

In the absence of local assessment methods, there is a need to develop a national framework to effectively realistic assess the sustainability of urban design and development projects in Iraq, and should consider local environmental, social and economic aspects, in addition to promoting awareness and stakeholder participation.

1.5 Aims and objectives

This research aims to investigate factors which affecting urban sustainability in developing countries and the applicability of globally available sustainability assessment methods—leading to the development of a comprehensive urban sustainability assessment framework for Iraqi cities by considering local contexts and urban challenges.

The objectives of this research are to:

a) Review the state-of-the-art on urban sustainability, its constituent components, and the assessment frameworks currently available or under-development, to identify key sustainability indicators (KSIs).

b) Engage stakeholders and assess their perceptions of key urban development challenges in Iraqi cities.

c) Investigate and determine the relevance and importance of KSIs for Iraqi context through a consultative process to reach consensus regarding those urban assessment factors.

d) Identify an applicable weighting system for local KSIs, by prioritising the main assessment factors based on local environmental, social and economic aspects.

e) Develop a framework for assessing urban sustainability.

f) Investigate ways to evaluate the identified KSIs for urban development projects.

g) Validate the developed framework using case studies and through expert reviews.

1.6 Research hypothesis and questions

Urban sustainable assessment has emerged as one of the most significant areas to be considered in urban design and development initiatives. Such assessment needs to cover significant issues related to human life and the environment by decision makers, developers and professionals at various project stages (Haapio 2012). The use of urban sustainability assessment tools (USATs) also acts as a catalyst to increase market demand for sustainable products and services by providing a mechanism for recognising excellence. The majority of USATs have been developed around the needs and urban challenges of developed nations, often significantly different from those of developing countries (Sharifi and Murayama 2015), especially countries and regions affected by natural disasters and man-made events such as wars. Iraq represents a unique example of a war-torn country having endured several decades of war and subsequent international sanctions which have affected its overall economy, infrastructure, public services and utilities. Significant rebuilding, rehabilitation and the development of new cities and urban areas are currently underway but without any evident attention to sustainability and public participation in decision-making. Currently, there is no national urban sustainability assessment framework in place.

Therefore, the main hypothesis of this study is that the current generation of global urban sustainability assessment tools such as BREEAM Communities, LEED- ND, CASBEE-UP and SBTool^{PT}-UP, are not applicable for war-torn countries, including Iraq, due to their environmental, social and economic specificities. This limitation includes a lack of recognition of territorial differences, including restrictions on available resources, vernacular architecture, ecological conditions, socio-cultural factors and economic circumstances. Two specific sub-hypothesises have also been set:

- There is a concern that global urban sustainability assessment tools are not fully applicable to Iraq, they could represent a guide to building a local sustainability assessment framework.
- The weighting system of the well-known sustainability assessment tools currently in use has not been adapted to prioritise the environmental, social and economic specificities of Iraq.

Therefore, this research is underpinned through the following research questions:

RQ1. Are current global sustainability assessment tools fit for purpose/applicable in developing sustainable designs for Iraqi cities?

RQ2. What are the urban development factors needed to assess the sustainability of Iraqi cities?

RQ3. How can identified urban factors be incorporated into a local sustainability assessment framework?

RQ4. What are most appropriate applicable weighting systems, rating formulas and benchmarks, to reflect an accurate assessment of the Iraqi urban context?

1.7 The research plan

This study seeks to assess urban sustainability in Iraq by developing a local assessment framework adopting a multiple techniques approach. For the design of this model, particular attention has been paid to selecting and delivering urban assessment factors (indicators and sub-indicators) and an appropriate weighting system incorporating credit allocation, rating formula and certification.

In order to ensure that, this subject has been addressed in a comprehensive manner, the research was organised into the following theoretical and experimental stages: The first theoretical stage involved (a) an in-depth study and critical review of global urban sustainability assessment tools. (b) A comparative analysis of these tools to identify similarities and differences and consequently determine relevant urban factors for the new framework. (c) Investigation of public perceptions of urban development challenges in Iraqi cities.

This process also provided an extensive theoretical background from which to develop the new method; initially, steps were undertaken to form the potential sustainable assessment framework for Iraqi cities, with a particular focus on the urban context. At the second stage, the components of the model were evaluated using the Delphi technique to reach expert consensus on the most relevant urban factors. The AHP was then applied to deliver a reliable weighting system that prioritises the approved urban factors (indicators and sub-indicators).

Finally, the verification and testing stage of the final outputs will occur via application of the framework to three specific urban development projects in Iraq.

1.8 Contribution to knowledge

Key contributions of this research are twofold: (a) the investigation of urban sustainability indicators and their priorities in a war-torn developing country and whether they varied from conventional wisdom, and (b) the development of a methodology that, in addition to expert's opinions and consensus, integrates public's views on the factors and their priorities for developing an assessment framework.

This research has two key contributions to make to the area of study: (a) the investigation of urban sustainability indicators and their priorities in a war-torn developing country and whether they vary from conventional wisdom, and (b) the development of a methodology that, in addition to expert opinion and consensus, integrates the views of the general public on indicators and their priorities for an appropriate assessment framework.

This research demonstrates that the integration of public perceptions results in a more effective identification of factors, especially those that may not have been acknowledged/recognised in the literature. There are also differences between public and expert perceptions. The general public considered safety and security to be the most important urban development factor, while the experts considered water as the most important. The public perception survey also resulted in an improved overall outcome. Factors were well-identified and refined before the expert consultation stage. The multi-method approach combining a public perception survey with expert consultations using the Delphi and Analytic Hierarchy Process (AHP), is a unique contribution that can be adopted and refined for the future development of urban sustainability assessment frameworks and tools.

This research also presents for the first time, a comprehensive collection of urban environmental, social and economic factors and their importance for a country which has endured several decades of wars and sanctions. Given that the results for Iraq are different to those of other countries, it can be concluded that the factors and priorities in disaster-prone countries may also be different.

In terms of contextual contributions, this research established a unique and comprehensive local framework for urban sustainability assessment projects in Iraq.

This research presents, for the first time, a comprehensive collection of urban environmental, social and economic factors and their importance for a country which has endured several decades of wars and sanctions. Given that the results for Iraq are different to those of other countries it can be concluded that the factors and priorities in disaster-prone countries may also be different. In terms of contextual contributions, this research has established a unique and comprehensive local framework for urban sustainability assessment projects in Iraq. In addition, the new development framework (IUSAF), with all its components, can be applied to neighbouring countries experiencing similar transitions. However, due consideration should be given to the weighting accorded to the indicators being addressed as they are heavily influenced by local conditions. Thus, this framework can contribute towards the establishment of a conceptual platform and a base for developing sustainability assessment frameworks not only for Iraq but for other neighbouring countries within the other region and beyond that have similar circumstances and urban challenges.

1.9 Ethical considerations

The research ethics and ethical considerations can be seen as the appropriateness of the researcher behaviour about the rights of the persons who become the participants in the study or who are influenced by the research work (Saunders and Lewis 2014). Research ethics, policies and regulations of Cardiff University have been followed during this study. All participants received a letter inviting them to participate in this research. This included a brief description of the research, the purpose of the study and commitment to confidentiality of the data provided. Participants were notified that their identities would be kept anonymous and that all the data and information gathered from questionnaires and interviews would be used for scientific research purposes only and kept strictly confidential. To assure participants about anonymity and confidentiality, they were provided with a letter, which stated that their names would not be disclosed to any organisation or third party and that information provided by them would be treated confidentially, only summarised information reported.

1.10 Organisation of the thesis

As shown in Figure **1.6**, the thesis is comprised of eight chapters, each of which deals with a specific part of the research. A summary overview of the content is given as follows:

Chapter One highlights the background of urban sustainability development and introduces the specifics of the Iraqi context, followed by the aims and objectives, underlying research hypotheses and questions. The scope of the study is determined and the contributions of the thesis discussed.

Chapter Two reviews previous related work in the urban development field. A critical comparison and review of global urban sustainability assessment tools (GUSAT) is then conducted to identify the appropriate urban assessment factors that will be used to support the development phase of the new framework.

Chapter Three reviews the main methodology that underpins this study. Specific details and justification of the research methodology and instrument are provided. This the result of critical comparison of several GUSATs, the questionnaire, the consensus-build method (the Delphi technique) and the analytical hierarchy process (AHP) used to customise the weighting system of the new framework.

Chapter Four aims to investigate stakeholders' perceptions of the urban challenges in Iraqi cities. It discusses data collection methods and the results of the nationwide questionnaire in order to identify essential environmental, social and economic issues.

Chapter Five presents the development of the consensual urban sustainability assessment factors (indicators and sub-indicators), deemed to be most suitable for use in the new framework, in addition to justifying the selection of the Delphi technique as a consensus-build method. More specifically, this chapter discusses the urban factors that were generated and approved through the Delphi consultation process. This includes details about evaluation and editing, to build the final list of urban assessment factors.

Chapter Six discusses the prioritisation of the urban factors and weighting system through AHP, along with the weighting allocation, credits allocation, mandatory factors, rating formula and certificates. A discussion is also provided of the significance of the weighting factors disparities with the global schemes. It also discusses the measurement tools for each assessment factor.

Chapter Seven aims to verify and test the suggested framework by applying it to three, Iraqi, urban development case studies. This will test the practical application of the framework and provide explanation of the testing procedures followed during this research.

Chapter Eight concludes the thesis by emphasising the need for the implementation of the new framework, based on the findings obtained during the research. This chapter will also give general recommendations for the application of the suggested framework and some ideas to improve and enhance Iraqi cities. The chapter closes with suggestions for future research work.

1.11 Summary

This chapter discussed the process of the reported research, including an introduction to the Iraqi urban context and the challenges. The key research components have been introduced, including the aim, objectives, hypotheses and research questions. This chapter sought to clarify the contribution to the body of knowledge and literature in the field and provide an initial understanding to the reader on the importance of the research problem.

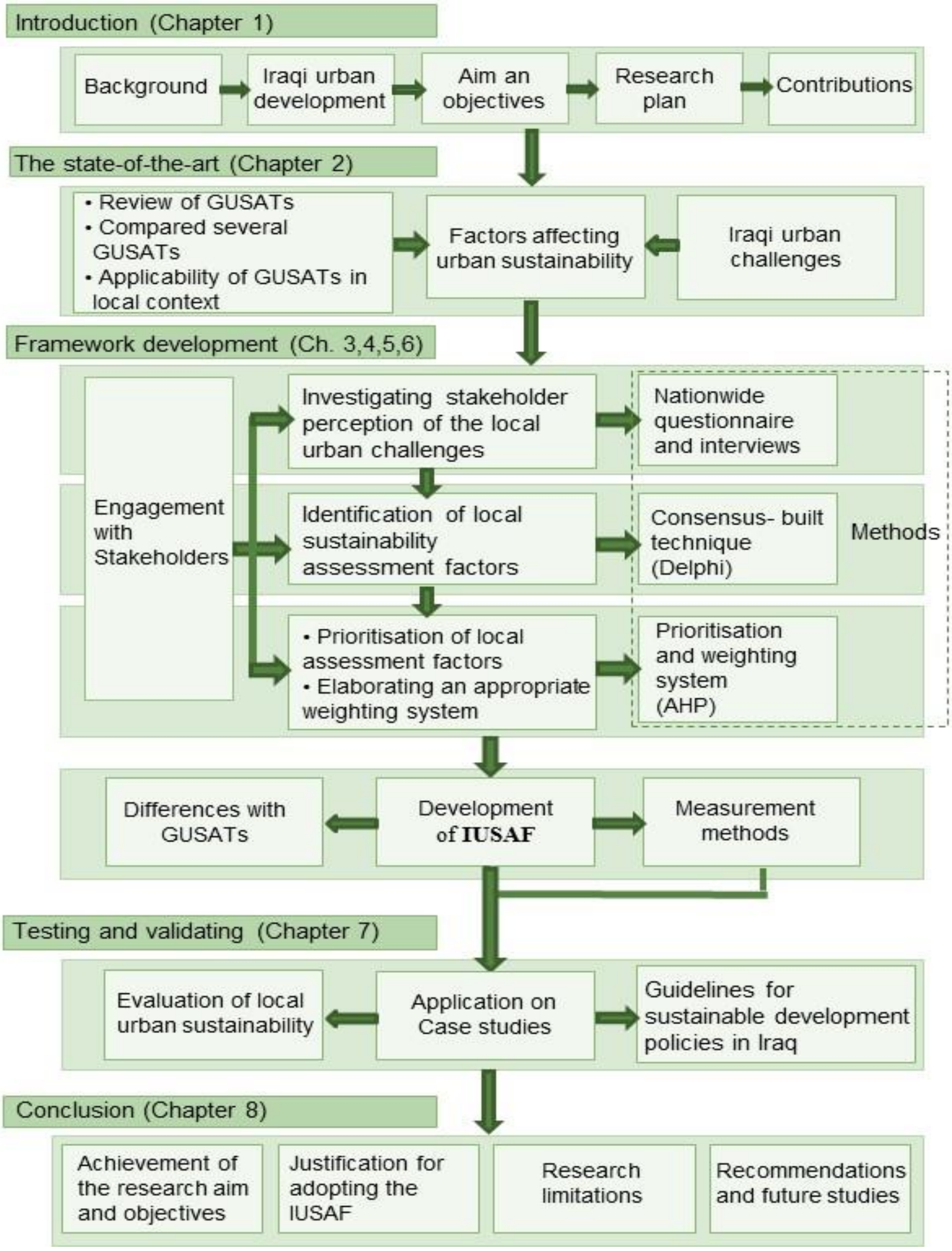


Figure 1.6: The flowchart of the thesis

Chapter 2
Literature Review

This chapter reviews previous related work in the sustainable urban development field. It presents an intensive analytical review of sustainability assessment scenarios (practice and policy) of urban design and development, with a focus on rating systems. It includes discussion of (a) an overview of urban sustainability (b)the need for urban sustainability (c) global and local urban challenges (d) the identification of global sustainability assessment methods (e) a critical review of global urban sustainability assessment tools (GUSAT) (f) a comparative analysis of a selected group of GUSATs and, (g) the identification of common urban factors in leading assessment tools that can be used as a foundation for the development phase of a new local urban assessment framework.

2.1 Overview of urban sustainability

The development of modern human society has been characterised by technological advances that have led to increased production and consumption, contributing to improvements in living standards, health and well-being. This, in turn, has also promoted population growth.

Developments of this scale across industry and global population increase, have caused critical environmental problems such as air pollution and reductions in biodiversity, creating additional pressures on limited natural resources and increases in deforestation and global warming (Tietenberg and Lewis 2016). The rapid expansion of urban areas has triggered some critical social and economic consequences, particularly in developing countries. The most prominent of these are poverty, poor housing conditions, cultural changes, a lack of employment and administrative corruption. This is exacerbated by inadequate social services including inadequate urban infrastructure and utilities, overcrowding and a lack of public transportation (Cohen 2006; Blake and Lawless 2016), as well as some man-made hazards such as escalating wars and conflicts (Annex 2012). Resulting in increasing global awareness of the risks to the planet and its inhabitants (Field *et al.* 2014).

Sustainable development has emerged in response to the pressing, complex and overarching challenges concerning urban areas, representing a new approach to the design and planning of urban areas having been promoted over the last few decades as an ideology in many fields around the world (Muller-Eie and Bjorno 2017). It has now become accepted practice that relevant authorities and planning experts must take into account the guidelines and principles of urban sustainability before making decisions or undertaking/regenerating any urban development project. However, the implementation of this approach is not easy as many environmental, social and economic sustainability dimensions need to be addressed.

Over the past few years, a wide range of governmental, non-governmental (NGOs) and community-based organisations have embraced sustainable urban development as a new paradigm and substantial component of national policy-making (Satterthwaite 2003; CIDA 2012). Output has varied and includes projects, indices, frameworks and sustainable cities paradigms. For example, the DPSIR framework was developed by the U.S. Environment Protection Agency in 1995, and then expanded by the European Environmental Agency (EEA). This framework is used to assess and organise complex environmental problems by describing interactions between society (human activities) and the environment across many countries (Skondras and Karavitis 2015). The International Council for Local Environmental Initiatives (ICLEI) was set up in 1990 as one of the global networks for the regional governments that have made a commitment to sustainable development. ICLEI provides training, technical consultation and information services to share knowledge, build capacity and support local governments to implement sustainable urban development at the local level (CIDA 2012). Members of the World Sustainable Capitals (Middle East and North Africa) have established Vision 2030. The Capitals have committed, by working with global cities, to reach a range of sustainable urban goals by 2030, through addressing environmental, economic, social and cultural objectives to create a sustainable future for cities (WGBC 2013).

Some countries have provided practical paradigms for the most sustainable urban developments in the world. These aim to improve the long-term social, economic and ecological health of cities (Mersal 2016), such as Chongming eco-island in China (2006-2010), Masdar City in UAE (2006-2030), and Ottawa's Zibi project in Canada (2013-2018).

Sustainable urban development need to be one of the key objectives when improving or creating urban communities. This requires finding innovative approaches and concepts, which can be implemented efficiently to achieve the principles of sustainability. Therefore, the main aim of this literature review is to give a comprehensive overview and provide a deeper understanding of urban sustainability. It will discuss the most globally sustainability assessment tools used in urban development projects, such as CASBEE-UD, BREEAM Communities, LEED-ND, and SBTool^{PT}-UP primarily to detail the limitations of these tools with regard to their scope.

2.2 The need for sustainable development

In the past four decades, numerous conventions, directives and international treaties have been held and/or sanctioned. Official reports have been undertaken to address environmental challenges and to secure sustainable development with The World Commission on Environment and Development (WCED) publishing one of the most prominent treaties "Our Common Future" was published report in 1987, focusing attention on caring for the earth defining sustainable development as that which improves the quality of human life, as well as supporting eco-systems (WCED 1987).

The United Nations Framework Convention on Climate Change (UNFCCC) in 1992 was the first global agreement focusing on the consequences of human interaction with their its environment. The Kyoto Protocol was the initial step towards reducing GHG emissions achieving this ultimate target of (UNFCCC), that was endorsed by more than 190 countries (Karadayi and Oguzturk 2012). 1992 saw the first international Earth Summit convened in Rio de Janeiro, Brazil, attended by representatives from 180 countries. Agenda 21 was the main thrust of the Summit aiming to change traditional approaches to development. A comprehensive programme for international action to address the existing pressing problems of environmental protection and socio-economic development was proposed to prepare the world for the challenges of the next century to attain long-term sustainable development targets (Parson *et al.* 1992).

At the Millennium Summit in 2000, the largest gathering of world leaders in the United Nations Millennium Declaration, committed participating nations to a new global partnership mainly to reduce extreme poverty. Their list of goals included addressing hunger, lack of adequate shelter, disease, promoting gender equality, health, education, environmental sustainability, basic human rights for everyone on the planet, shelter and security. These targets are known as the Millennium Development Goals (MDG) (UN 2015).

All these initiatives sought to avoid subjecting future generations to environmental risks and to preserve natural resources (Lafferty 1996). Ecological sustainability as a workable concept, is seen as a key solution to the pressures described above (Drexhage and Murphy 2010).

Even though there are multiple definitions of sustainability, Brundtland's definition that sustainability is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987) appears the most inclusive. It is succinct in its message, but carries with it humanitarian needs together with the aim of achieving environmental balance, social justice and economic feasibility (Brundtland 1985; Muller-Eie and Bjorno 2017).

Sustainable development has attracted the interest and attention of academia and industry, despite having a relatively short history (Jose *et al.* 2006). It coincides with the emergence of other challenges such as unprecedented rapid growth in world populations leading to increasing adverse effects on the environment as well as other social and economic challenges concerning human life, specifically in urban areas. These include decreased agricultural land; rationalisation of production and energy consumption; poor housing conditions; mass unemployment; poverty; inadequate social services; insufficient urban infrastructure and transportation. These issues call for continuous economic growth and development a crucial aspect of sustainability objectives (Basiago 1998; Savard *et al.* 2000; Santoyo-Castelazo and Azapagic 2014).

As seen, sustainable development is applicable across many disciplines and is open to multiple interpretations (Barcellos *et al.* 2016). It is perhaps best viewed as a holistic approach to achieve humanity's desired goal of human-ecosystem equilibrium, supporting the capability of natural systems to provide the essential natural resources (Shaker 2015).

Cities have played a vital role regarding sustainable development as it has, become mainstreamed into policy making and planning processes (Suzuki *et al.* 2010). The term sustainability is increasingly used alongside the word urban to create new scope for sustainability, such as sustainable cities, sustainable urban development, sustainable urban planning and sustainable urbanisation (Maclaren 1996; Haapio 2012).

2.3 Sustainable urban development

Globally, sustainable urban development is recognised as a potential way forward to address urban challenges by building in resilience, safeguarding the ecosystem and promoting the use of renewable energy, with the goal to achieve a symbiotic relationship between the environment, economy and society.

Environmental issues have been adopted as a priority, covering high-energy consumption, the overexploitation of natural resources, increasing GHG emissions, biodiversity reduction and air pollution (Annex 2012; Field *et al.* 2014). But these need to be addressed while managing socio-economic challenges such as those posed by high population densities, urban expansion, poor conditions of the housing, poverty, increasing crime, inefficient social services and utilities, crumbling infrastructure the construction industry and unemployment (Banister 2000; Cobbinah *et al.* 2015; UN-Habitat 2015).

Although some developing economies such as China have made significant progress in achieving the economic dimension of sustainable urban development through improving the quality of its' citizen's lives, the ideals of sustainable urban development remain, in terms of its practical application, unclear in numerous other developing countries (UNDESA 2013).

As a result, many international policies, institutions and programmes over the past three decades, have attempted to make the concept of urban sustainability a reality in developing countries through the activities and programmes of global institutions. These include the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the United Nations Human Settlements Programme (UNHABITAT) (Cobbinah *et al.* 2015).

Bartone *et al.* (1994) and Linares (2003) have identified some organisations who have played a significant role in sustainability development in this, rolling out programmes such as The Urban

Management Programme (UMP), The Metropolitan Environmental Improvement Program (MEIP), and 'The Urban Management Programme' (UMP) in Asia, Africa and South America. They have suggested new directions depending on global experience, to tackle and mitigate environmental urban challenges and thus improve peoples' lives. These programmes have concentrated on strengthening the capability of countries to tackle problems such as urban land management; the maintenance of urban infrastructure; the integration and optimisation of water supply and sanitation services; pollution control and general protection of the urban environment.

Rakodi (2001) and Satterthwaite (2003) reported on initiatives for tackling urban socio-economic challenges in Asia, South Africa and Latin America by repeating successful planning practices seen around the world e.g. by the World Health Organisation (WHO) and International Institute for Environment and Development (IIED). Most of these efforts focused on strengthening national strategies and the capacity of local decision-makers to mitigate urban challenges such as urban poverty, community health, squatter settlement, education and social well- being (Vanclay 2003). Occasionally, efforts fail as a result of a lack of understanding of the urban socio-technical dynamics of the countries adopting the initiatives (Rakodi 2001).

Few developing countries have suffered as much from exceptional circumstances and political instability as a result of successive wars and international sanctions than Iraq. This has resulted in severe damage to the environment, the economy and society in general such as environmental degradation and air pollution; inefficient infrastructure; insufficient water supply systems; unplanned changes in land use; violence and socio-economic insecurity; a lack of basic amenities and environmental goods; traffic jam and accidents; and a deterioration in the local economy (MOCH 2010; HRW 2013; MOE 2013). In addition to the social and economic deterioration represented by housing deficits, lack of safety in urban areas, unemployment, the absence of investment in sustainable development and spread of informal settlements (CSO 2013). These challenges represent obstacles to the creation of urban developments and the ability to embrace sustainable practice.

A practical understanding and substantial effort to achieve sustainable urban development for Iraqi cities may be considered a necessary, in order to mitigate any negative impact, whether long or short-term, on human life and the community. An emphasis on adopting sustainable urban development as an essential principle can help achieve key socio-economic and urban environmental aims, such as enhancing the quality of life of the citizens; controlling urbanisation; encouraging housing projects; improving infrastructure and transportation; the promotion of public services and utilities; reductions in the overexploitation of natural resources; encouraging the use of renewable energy thus supporting the local economy. This will also act to reduce overall stresses on the environment, protect vegetation cover and reduce environmental pollution (Basiago 1998; He *et al.* 2011; CIDA 2012).

2.4 Sustainable urban challenges

Sustainable urban challenges have become a pressing global issue for many of cities and urban areas around the world, which require reconsideration from governments (Mele 2014). There is no doubt that changing urban planning processes from unsustainable to sustainable patterns is challenging. It is not only urban forms, public services, infrastructure, transportation, energy, water, and waste systems that have to be changed, but all the systems and regulations related to process need to be modified to reflect the sustainable agenda.

The three common urban challenges will be discussed in this section; environmental, social, and economic, their links to each other and impact on each other fully explored (Basiago 1998; Nijkamp and Kourtit 2013; Muller-Eie and Bjorno 2017). Paving the way for highlighting the local urban challenges of Iraqi context.

- **Environmental**

Environmental factors include all factors affecting climate change and the natural environment. It represents the most significant challenge to sustainable urban development aiming to reduce environmentally damaging activities such as land use changes, the impact of the construction industry, energy consumption and associated GHGs emissions, water use and availability, waste generation and recycling, pollution, sanitation and infrastructure. These are all factors which are likely to become even more challenging in the immediate future (Clark 2009; Clarke and Ramalingam 2012).

A number of studies have reviewed environmental challenges in-depth; Tippett *et al.* (2007) uncovered a growing public awareness, about how to tackle environmental problems and the emergence of many local actions that have had regional and global impacts. Global environmental change can also affect local ecological issues; for example, one of the most significant concerns is the environmental impact of using fossil fuels in urban areas as well as the global use of crude oil as a primary source of energy (UN-Habitat 2015).

Campbell-Lendrum and Corvalán (2007) pointed out that cities create different environmental problems, related to construction industry patterns of production and consumption and pollution of air, water and waste. Many social problems are also caused by the environmental conditions, such as traffic overcrowding, inadequate urban infrastructure, inefficient public services and, ecological disasters. In addition, a lack of clean water, the absence of adequate sanitation and accumulation of waste can lead to diseases or may cause death, as in some of the third world countries (Tippett *et al.* 2007).

Despite the growing concern about various environmental issues over the past few decades, ecosystems across the world are worsening, action against climate change still in its infancy (Seto and Shepherd 2009).

- **Social**

Cities are growing, both in population and geographical dispersion. This has become the most significant social challenge and the main determinant of environmental quality at local, regional and global levels. The expectation is that the world wide urban population will double to reach 3.5 billion by 2050 (UN 2014). A substantial proportion of this larger population, especially in developing countries, will be living in informal settlements (slums) (Hassan 2012), suffering from problems related to education and health, overcrowding, shortages of water and other human necessities, these in addition to key urban issues including social disruption, the absence of urban planning and housing deficits (Arnott 2008; UNDESA 2013).

Many recent studies have pointed out that several cities, specifically in developing countries, have already been affected by unprecedented population growth and rapid urbanisation (Cohen 2006; Wei and Ye 2014; Molla 2015). These cities have been transformed into sources of negative environmental impacts and drivers for the rapid depletion of natural resources. The scale of the challenge is such that some authors have gone so far as to label these factors uncontrollable and unpredictable, now and in the near future (Freire 2006; Rana 2011).

- **Economic**

Economic challenges represent one of the main reasons for rapid, worldwide urbanisation as people relocate in order to find employment and the hope of an improved standard of living. The rapid increase in population density, particularly in developing countries, has created severe urban challenges, such as widespread poverty, inadequate housing, exacerbation of socio-economic disparities, unhealthy living conditions facilitating the spread of disease and unemployment. This is especially the case when planning efforts are not effective enough to deal with the inflow of new residents. (UN-Habitat 2015; ZURICH 2015).

The value of applying urban sustainability approaches to address environmental socio-economic challenges is evident. Sustainability seeks to achieve fairness and equity regarding the provision of essential public services such as housing, transportation and infrastructure, which in turn improves the standard of human life. This can also be an effective way to tackle the current international poverty crisis (Drexhage and Murphy 2010).

It is important, therefore, to develop effective policies and solutions for sustainable urban development based on local priorities which are often different from the global ones. In addition, these challenges can often differ from those found in developed countries which raises the importance of integrating the views of the local stakeholders in all lifecycle stages of an urban development project.

In general, key environmental and socio-economic challenges have a crucial influence on people, where they live and on the areas that drive economic competitiveness. Implementing a development can change the current and future life of a community (Awosusi and Jegede 2013) and as such, is of significant concern for planners, designers and policy–makers. It requires gathering both quantitative and qualitative information on the impacts of urban development, such as resulting employment opportunities in the community, demand for housing, affordability, preservation of culture and urban safety and security. Therefore, it is essential that any proposed urban development be consistent with the local characteristics of the community (Gavaldà-Miralles *et al.* 2014).

In order to that, the next section will highlight the key local urban challenges in the Iraqi context.

2.5 The local urban challenges in Iraq

The Iraqi urban challenges were divided into two groups; (a) environmental challenges, (b) socio-economic challenges.

2.5.1 Environmental challenges

Iraq presents a unique context with reference to the environmental challenges as a result of lengthy political instability which has resulted in severe damage to the entire infrastructure. (MOE 2013). Related publications, including the Iraq National Development Plan (2013-2017), have identified key urban environmental challenges that need to be addressed as a priority: air, water, and soil pollution; shortage of water resources; desertification; lack of waste recycling and reuse; untreated contaminated areas; and inefficient infrastructure (CSO 2013), as shown in

Table **2.1**. The key challenges associated with these are discussed below.

Ecological aspects. *Vegetation cover* has a significant effect on weather and climate variability. It is considered an effective approach to stabilise dune areas and mitigate the impact of frequent sandstorms (Brovkin 2002). There has been a significant decrease in vegetation cover, in the central and southern of Iraq between 2000-2012 (Abbas *et al.* 2014). Successive wars in Iraq have led to significant chemical pollution, exposing civilians to hazardous materials. *Tackling environmental pollution* is key to ensuring a sustainable future for Iraq. Despite being responsible for only 0.5% of global GHG emissions, Iraq plans to reduce its emissions to tackle global climate change (IG 2015). Cities, being the engine of economic prosperity and growth, are the primary geographies that can help reduce GHG emissions and mitigate the impact of climate change.

Energy, utilities and infrastructure. *Efficient infrastructure and utilities* are essential to support and enhance the living conditions in any community (Fulmer 2009). Wars and international sanctions have resulted in the postponement of new build and upgrading of ageing infrastructure projects such as water distribution systems, sewage, roads, electrical plants and energy distribution systems (Foote *et al.* 2004). Secure, flexible and economic production and distribution of energy, while increasing the share of renewables and reducing the demands, are essential for an environmentally resilient society (SWECO 2015). *Smarter power systems* and the grids require significant investment and effective policies (Widergren *et al.* 2011) as increasing the share of renewable energy results in a cleaner, healthier environment, with improved local air quality and reduced GHG emissions (Siegel *et al.* 2010). Iraq has significant potential for renewable energy resources such as solar and wind. *Diversification of energy mix* is, therefore, an essential component to meet the increasing demand for energy. *Minimising energy consumption* is the cornerstone of policies for energy security and climate impact mitigation (Omer 2008) as it reduces the need for costly investments in energy infrastructure and delays investments required for network upgrades.

Natural hazards. Iraq suffers from many natural disasters common to arid climates. *Desertification*; the transformation of fertile land into desert, is caused by the loss of green cover; drought and hardening of soil; increased salinity rates; and the extension of sand dunes (Geist 2005). Desertification threatens food security and affects social and economic development (Reynolds *et al.* 2007). 39% of the Iraq surface has been affected by desertification, a further 54% is under threat of the same fate (CSO 2010). *Sandstorms* affect large areas and cause environmental pollution, economic loss and health problems (Liu and Diamond 2005). Iraq is considered one of countries most affected by sandstorms due to regional climatic changes such as decreasing annual rainfall, and environmental changes such as drying marshlands, and degrading land (Sissakian *et al.* 2013). *Drought* causes direct environmental damage to plants, forests, animal, air and water quality (Ole-MoiYoi 2013), many agricultural areas in southern Iraq are subject to frequent drought (Shean 2008).

Mobility and transportation. *Choice of transport* is essential for sustainability. The utilisation of alternative transportation modes can help address traffic congestion and minimise undesirable impacts on the environment, especially in areas of high population density.

Iraq lags behind other countries in the provision of public and alternative transportation modes such as trains, subways and buses (Al-Akkam 2012). As a sustainable transport mode, cycling can reduce the use of fossil fuel and associated GHG emissions and can also help tackle risks associated with sedentary lifestyles and obesity (Ege and Krag 2010). Increasing bicycle use can reduce congestion on roads and improve the urban environment. Another sustainable mode of travel, walking, is healthier and has minimal environmental impact (Evans and Jones 2011). *The increased use of public transportation*, especially mass transit systems such as rail, subway, and bus rapid transport (BRT), reduces energy consumption and associated emissions (Hodges 2009). Private cars are the primary means of passenger transport in Iraq due to the under developed public transport infrastructure (UNEP 2015). *Reducing the number of vehicles* on roads is critical to reducing traffic congestion and associated urban environmental impacts but this use can only happen under effective planning for urban transport, in order to address the fivefold increase in the number of cars in Iraq between 2001 and 2012 (CSO 2014a).

Water. Water is one of the most important natural resources in the Middle East and is vital for sustaining life, industry and economy (Waylen *et al.* 2011). By the middle of this century, as populations grow, demand rises and climate changes, per capita water availability is projected to decrease by half (Michel *et al.* 2012).

Table 2.1: Significant environmental impacts in Iraq post 1990.
Data source: Matar (2010); WHO (2015); WorldBank (2017)

Environmental impact	Major effects
Air pollution	• Toxic smoke produced by oil fires. • Toxic gases from the use of weapons and explosives. • The concentration of environmental pollutants has increased eleven times since 1990.
Degradation of agricultural land	• 70% of agricultural land exposed to pollution and destruction. • The decrease of 26,000 acres of arable land due to increased salinity.
Vegetation damage	• Decreasing number of palm trees from 30 million to about 10 million • The reduction of forest area from 1.8 to 1.5% due to desertification.
Lack of safe drinking water	• Reduction in production capacity of the water purification plants from 7 to 1.5 Mm3/day. • 86% of the population had access to an improved water source in 2015, with major differences in consumption between urban and rural areas • 91% of households buy bottled drinking water privately, due to concerns about the quality of water from public utilities • Drinking water shortages causes the death of 1 in 8 Iraqi children under 5.
Destruction of infrastructure, and transportation networks	• Destruction of infrastructures such as power plants, roads and bridges. • Destruction of 96% of power plants. • 57% of infrastructure problems are related to water supply networks. • 70% of school buildings have war damage or are neglected.
Contamination of lands with radioactive depleted uranium	• More than 380 sites were contaminated with radioactive depleted uranium.
Contamination of water sources	• 50% of sewage is discharged directly into mains water resources. • Leaking sewage pipes and septic tanks contaminate public drinking water network with wastewater.
Accumulation of waste	• Lack of separation and recycling of waste. • Waste is dumped in landfill or burned. • Frequent accumulation of waste in residential areas or in rivers.
Contaminated areas by mines and bombs	• ~25 million landmines planted in Iraq. • ~1200 km of the Iraqi-Iranian border is contaminated by mines and bombs. • ~84,000 tonnes of bombs were dropped on more than 6500 km2 southern Iraq.

The Tigris and Euphrates represent 98% of Iraq's surface water and are the primary sources for drinking, irrigation and industrial water use. The availability of water in the two rivers will decrease by between 50% and 80% by 2025 (CSO 2013), which necessitates the search *alternative water sources* such as artesian wells, groundwater, springs, lakes and marshes. *Urban rainwater harvesting* has received renewed interest as an alternative to conventional water supply, despite the scarcity of precipitation across the Middle East (Lange *et al.* 2012). Greywater can be used on-site for landscape irrigation, toilet flushing and constructed wetlands (OECD 2009), thereby reducing the demand for treated water. In addition to diversification of water sources, strategies for *water conservation* also need to be developed and implemented. W*ater recycling* is regarded as a sustainable option to tackle the increasing mismatch between available water resources and the rising demand for water (OECD 2009). Finally, *water consumption needs to be minimised* as only 86% of the population has access to improved water sources in 2015, with significant differences in consumption between rural and urban areas (WorldBank 2017).

Waste and materials. As one of the most underdeveloped sectors, "waste and materials" refers to mainstream recycling and the need to move away from harmful waste processing techniques such as landfill and incineration (Knowles 2009). *Waste recycling and reuse of materials* saves energy and reduces the need for raw materials and natural resources thereby mitigating the impact of climate change (Thormark 2006). *The separation of waste* at source leads to increased recycling (FoEEUROPE 2013). W*astewater treatment* and poor effluent quality from municipal wastewater treatment plants are a fundamental problem in developing countries and the cause of pollution of water in lakes and rivers (ECO 2003). 6.2% of the Iraqi population does not have access to basic sanitation facilities, resulting in a growing risk of disease, particularly among vulnerable groups such as women and children (UN 2013).

2.5.2 Socio-economic challenges

There is an increasing interest in investigating the socio-economic challenges relating to urban development to address the urban problems that impact humans and their home environment or work place (Awosusi and Jegede 2013). Identifying these challenges is a substantial step towards assisting communities with decision making that promotes long-term sustainability, including economic prosperity, a healthy community and social well-being (GRNUHE 2010). This requires attention to both quantitative and qualitative indicators of the impacts of urban development. The key socio-economic challenges in Iraq, according to many relevant publications are: housing deficits, safety and security, unemployment, the local culture issues and the lack of sustainable development investments (CSO 2013). The significant socio-economic challenges of urban development are summarised in Table **2.2**, the key challenges are discussed below.

Housing. Iraq is suffering from a housing deficit currently thought to be more than two million housing units. The provision of housing is therefore a necessity to address the social needs of citizens and to generate direct employment opportunities and income multipliers. The provision of *good-quality housing* is an urban challenge, the meeting of which will enhance the social well-being of citizens (MOCH 2010). *Affordable housing* offers considerable insights into the impact on urban growth management, economics and housing markets (Nelson *et al.* 2002), the creation of an affordable housing policy an urgent issue for poor, low and medium-income families (MOCH 2010). *The spread of informal settlements (unplanned),* has resulted in the deterioration of the environment, social and infrastructure services, land, sewerage and other urban design elements (Aluko 2010); informal settlements constitute about 7.3% of the total housing units available in Iraq (CSO 2013).

Safety and security. Enhancing urban *safety and security* is a fundamental and vital issue underpinning urban development in Iraq (Rathmell *et al.* 2006). The *security of buildings* can be achieved through the employment of urban design elements to prevent environmental and physical crime (Moffatt 1983). *Integrating protective security* measures into the urban design process can mitigate threat and reduce the damage caused by terrorist acts (Coaffee 2009).

Economic aspects. *Tourism* is one of the largest-growing economic sectors worldwide and a relevant factor in the development of economic policies as it can create opportunities for urban projects in developing economies (Steck 1999). Archaeological and religious tourism in Iraq is extremely important, attracting millions of tourists every year (CSO 2015).

Investment in developing economies can encourage a broad range of urban development projects such as affordable housing construction, job creation, healthcare and educational facilities thus promoting long-term economic growth (Wu 2001). *Urban development projects* offer opportunities for economic development, social inclusion and well-being and are considered an integrated approach encouraging growth, jobs and employment strategies (EU 2009). *Lack of investment* is therefore an urban development challenge.

Table 2.2: Significant socio-economic challenges in Iraq in the past four decades. Data source: MOCH (2010); CSO (2013, 2014b)); Flynn and Brooks (2016)

Socio-economic impact	**Major effects**
Terrorism and lack of security	• Terrorist attacks in Iraq exceeded 2,418 incidents from 2006-2016. • More than 350.000 human losses from 2003 to 2016, including women and children. • Financial losses are estimated at more than $36 billion for the period 2003 to 2016.
Housing challenges	• The average family size is 6.7 persons; 6.3 urban and 7.8 rural. • The housing deficit in 2017 is estimated at more than two million residential units. • Informal settlements constitute about 7.3% of the total housing units in the country. • 87.2% of residential units are inhabited by one family, 8.6% are inhabited by two families, while 4.2% are inhabited by three or more families. • 21.7% of the population suffer overcrowding in housing.
Unemployment	• The national rate of unemployment decreased from 28.1% to 11% between 2003- 2014, 7% males and 13% females. • The Government provides 40% of jobs, the private sector 60%. It provides 45% of all employment in urban and 28% in rural areas. • Unemployment for the age group 15-29 constitutes 23% of the total unemployed in 2011. • One of every three female aged 15-29 is unemployed. • 83% of Iraq's labour force are men, 17% women.
Lack of healthcare	• There is a concentration of medical staff (doctors and nursing) and services in specialised hospitals in urban areas with fewer facilities in suburban and rural areas. • There is a noticeable inefficiency of urban standards (adopted in 1985) to determine healthcare facilities which are 1.9 beds /1000 inhabitants, despite the increase in national income. It is lower than current global standards such as 4 beds in Turkey, 9.2 beds in the USA and 13.5 beds/1000 inhabitants in Japan.
Lack of education	• There is an acute shortage of schools, many schools operating two or three times each the day. • The number of students per class in public schools ranges from 60 to 70 students, twice the international standard. • The number of school buildings needed is estimated at 4,500 new schools as well as the rehabilitation of existing schools. • 70% of schools lack drinking water, convenient toilets and waste disposal. • 60-80% of schools lack sanitation systems.
Lack of urban development investments	• Safety and security issues are an obstacle to investment growth in many parts of the country. • The spread of administrative and financial corruption hinders investment in urban development in the country.
lack of preservation of historical and cultural heritage	• There has been looting and vandalism of more than 1000 historical pieces of the Iraqi National Museum contents since 2003. • More than 1000 manuscripts have been looted, 500 burned from the Iraqi National Library. • Many archaeological sites such as the ruins of Babylon and Ur are being robbed as a result of the lack of appropriate protection for archaeological sites.

Local culture and materials. Across Iraq, the rich, historically unique values of *traditional urban cultures* are under threat or have even been destroyed through urbanisation, resulting in cultural, social and even economic loss (Rodwell 2003). The *employment of diverse local cultural elements* in urban development makes cities robust and viable. There is a demand for the protection, conservation and restoration of historic buildings in Iraq, as well as adaptation within the contemporary urban environment. The process of long-term *preservation of vernacular buildings* can promote sustainable development and preserve the local heritage (Filippi and Balbo 2005). This involves the use of *local sustainable materials* which minimises negative environmental impacts and reduces the need to import construction materials (Allwood *et al.* 2012).

2.6 Urban sustainability assessment

The construction industry is starting to re-think its practice in recognition of its responsibility for the consumption of 30-40% of energy, 12-16% of fresh water, 40% of raw materials and the production of 20-30% GHGs emissions (Muhwezi *et al.* 2012). This sector also has to make fundamental changes to reduce their negative impact on the environment and take steps toward the protection of the ecosystem because of the need to improve building practices and an increasing market demand for green and environmentally friendly services and products (Crawley and Aho 1999).

BREEAM was the first sustainability assessment tool for buildings, developed in the UK, by the Building Research Establishment (BRE) in 1990 the aim being to offer an environmental label for buildings (Saunders 2008). This was followed by many other assessment methods, such as LEED from the USA in 1998, Green Star from Australia in 2003, and CASBEE from Japan in 2004, all used to support the emergence of performance improvements in buildings and construction processes. They work to enhance environmental awareness and provide a key direction for the building and construction industry to shift toward environmental protection and the achievement of sustainability (Ding 2008) by evaluating the sustainability of building components such as energy, water, waste, and building materials (Reed *et al.* 2009). Many countries now recognise the importance of such assessment methods as they help key stakeholders to evaluate sustainability (Wong and Abe 2014).

Sustainable assessment systems are defined as the methods that examine the expected performance of the building translating this into a thorough evaluation that allows for comparison against other buildings performance (Fowler and Rauch 2006). A building project can be considered sustainable when it has dealt with all interwoven environmental, social and economic sustainability dimensions, environmental issues and ecological validity taking priority. These include the reduction of pressure on natural resources, reductions of emissions, minimization of energy consumption, the use of environmentally friendly materials and products reduction of pollution, water use and waste recycling. Other objectives can also be added such as optimisation of site potential, preservation of cultural and regional identity, the creation of a healthy and convenient indoor climate, safety and optimised operational and maintenance practices. Sustainability assessments aim to gather and report information for decision-making during different phases of the building design, construction and operation. The sustainability score of a building depends on the various criteria or indicators identified, analysed, valued and adopted (Bragança *et al.* 2010). Sustainability assessment methods of buildings have attracted the attention and interest of the academia (Haapio 2012) and industry (Jose *et al.* 2006).

Despite its importance and role in environmental performance assessment, one of the criticisms levelled against building assessment methods is that they are not particularly suitable for assessing the sustainability of urban areas/neighbourhoods or even a group of buildings (Carmen and Bruno 2014). It is argued that the assessment of buildings and later synthesis does not adequately reflect the complex interaction between the city and its different components such as inhabitants' needs, neighbourhoods, air quality, energy management, mobility and transportation, water management, open spaces, public services, infrastructure and waste management. The integration of these represents the key to the sustainable urban development assessment (Gil and Duarte 2013; Sharifi and Murayama 2015). Due to the formalised nature of sustainability assessment methods, a set of specific objectives is created (Turcu 2013) enabling interested parties such as politicians, decision-makers, stakeholders, sociologists, urban planners, economists and architects to understand environmental impacts together with the economic and social effects of urban development projects (Poveda and Lipsett 2011).

These assessment methods, therefore, have the potential to achieve a balance between human needs and their environment, improving standards of living and the economic competitiveness of the city. The success of these methods depends on urban environment elements being part of the process (Pucci *et al.* 2011) over the long term. As well as promoting sustainable urbanisation, they can guide the reconfiguration of urban areas (Shen *et al.* 2011).

Moreover, it encourages active involvement and partnership between the various stakeholders in the urban area for effective change management at different stages of the urban development process.

2.7 Development of urban sustainability assessment methods

In spite of the fact that these approaches are fairly new, a myriad of assessment methods are available including: life-cycle assessment (LCA), sustainability-assessment projects, sustainable-cities indices, assessment frameworks, rating system tools and certification systems (Gil and Duarte 2013), as shown in Table **2.3**. Many methods have been developed for specific countries and regions, their urban factors adopted to assess different terms; e.g., categories, criteria and indicators according to spatial–temporal variables providing a clear picture of the urban needs of different countries (Moussiopoulos *et al.* 2010).

At the outset, some holistic projects were considered as international initiatives. They were used by different countries and focused on pressing international issues (mostly climate change and global warming) encompassing the environmental, economic and social aspects of sustainability (CIDA 2012). For example, The International Council for Local Environmental Initiatives (ICLEI) emerged in 1990 and provided training, consultancy and assistance to national governments in the application of local sustainable development (Lindseth 2004). Agenda 21, represented a holistic voluntarily—implemented action plan at international, national and local levels, promoting the global sustainability of urban areas. It was produced by the United Nations Conference on Environment and Development (UNCED) in 1992 (UN 1992). This was followed by the Aalborg Commitments, which emerged in 1994 for European cities and towns and provided a general framework for sustainable development (Zilans and Abolina 2007). SUE-MoT appeared in 2003 as a web-enabled framework to encourage key decision-makers to assess urban development systematically by focusing on different values e.g. lifecycle, project location, scale, context and spatial values (Edum-Fotwe and Price 2009).

To add to this, DPSIR framework details (driving forces, pressures, the state of the environment, impacts and response) were submitted for the first time in 1995, then adopted by the European Environment Agency (EEA) (Svarstad *et al.* 2008). The Building Environmental Quality Evaluation for Sustainability through Time (BEQUEST) was established over three years (1998–2001) and updated in 2001, providing a general organisation map of the toolkit and the classification for six urban indicators including waste, energy, water, transport, land use and green areas (Bentivegna *et al.* 2002). The project Creating Innovative Sustainability Pathways (CRISP), aimed to identify potential pathways to assist the European Union in the transition towards sustainable urbanisation and lower carbon emissions (Huovila and Jasuja 2005). The Practical Evaluation Tools for Urban Sustainability (PETUS) emerged in 2003, aiming to identify evaluation tools for a sustainable urban environment in European cities (Jensen and Elle 2007). It is worth mentioning that all these methods, regardless of title (projects, indices, frameworks and tools), call to preserve the global ecosystem and aim to achieve urban sustainability on a global scale.

In recent years, urban sustainability assessment methods have become an active research field, in particular with the introduction of CASBEE-UD, BREEAM Communities and LEED-ND, attracting attention when they expanded their assessment scope from individual buildings to the urban development scale. This made many other assessment tools follow suits such as Pearls Community (PCRS), Green Star Communities, Green Mark for Districts, GSAS/ QSAS Neighbourhoods, DGNB for Urban Development and SBTool^{PT}-UP (Rahardjati *et al.* 2010;

Castanheira and Braganca 2014; Sharifi and Murayama 2014). These tools have attracted the world's attention because of their emphasis on environmental issues such as renewable resources, energy efficiency and the reduction of carbon emissions (Sharifi and Murayama 2013).

2.8 Global urban sustainability assessment tools (GUSATs)

As started above, some well-known sustainability assessment tools have expanded their assessment scope from individual buildings to urban development (Sharifi and Murayama 2015). The Comprehensive Assessment System for Built Environment (CASBEE) for buildings emerged in 2001 and was later expanded to assess urban sustainability in 2007. A similar development occurred with the Leadership in Energy and Environmental Design for Neighbourhood Development (LEED-ND) in 2009. Also, BRE Environmental Assessment Method for Communities (BREEAM Communities) was developed in 2011, the Sustainable Building Tool in Portugal for Urban Projects (SBTool^{PT}-UP) in 2014.

These urban assessment tools have been selected for review due to their reputation and because they have evolved from assessing individual buildings to neighbourhoods and urban development. Their technical documents and guidance are readily available having been widely used in their respective jurisdictions and across varying contexts. They have been a positive force pushing the limits of market recognition for sustainability through assessment and certification.

A body of knowledge exists on their usability, applicability and flexibility. Projects that do not have an organisational presence in the industry were excluded, as they may not be constrained by the issues related to practical implementation, which may introduce bias into the findings. Voluntary international initiatives covering urban sustainability assessment for large geographical areas such as regions, countries or continents, were eliminated as they seldom deal with physical building and construction forms.

To summarise, this study will focus on the most common assessment tools known as global urban sustainability assessment tools (GUSATs); CASBEE-UD, BREEAM Communities, LEED-ND, and SBTool^{PT}-UP in addition to Pearls community (PCRS) and QSAS/GSAS, which have been developed in neighbouring countries, in order to investigate some of the parallels with the Iraqi context. The literature review for the selected GUSATs aims to:

a) Allow for a better understanding of the drivers and goals of each practice.

b) Compare selected GUSATs according to their key characteristics, organisational structure, assessment scope and rating methods.

c) Highlight the particular circumstances in which each tool selected their list of urban factors (indicators and sub-indicators) and categorised them, according to environmental, social and economic dimensions.

Table 2.3: Selected urban sustainability assessment projects, indices, frameworks and tools

Type	Examples	Organization	Country/ Region	Context	Date*
Projects	ICLEI	International Council for Local Environmental Initiatives	Europe	Global	1990
	Agenda 21	United Nation Conference on Environment and Development	UNCED†	Global	1992
	BEQUEST	European Commission (EC)	Europe		2001
	SUE- Mot	SUE- Mot consortium	UK	Global	2003
	Sustainability A- Test	EU and national sustainable development partners	Europe	Global	2006
	Green Cities Programme	The OECD Green Cities Programme	OECD§	Global	2010
Indices	Environmental Sustainability Index	Yale University & Centre for International Earth Science Information Network (CIESIN)	Switzerland and Italy	Global	2005
	Environmental Performance Index	European Commission	Europe	Global	2006
	ICLEI Star Community Index	Local Governments for Sustainability (ICLEI)¶	USA	Global	2008
	Green City Index	Siemens	-------	Global	2009
	Eco- City Development Index System	Chinese Society for Urban Studies	China	Local	2011
Frameworks	Aalborg Commitments	European Commission (EC)	Europe	Global	2003
	DPSIR\\	European Environmental Agency (EEA)	Europe	Global	2007
	Caofeidian Eco- City	Tangshan municipality	China	Local	2008
	Eco2 Cities	The world bank	USA	Global	2009
	RFSC**	European Union	Europe	Global	2013
Tools	PETUS	European Commission	Europe	Global	2003
	CASBEE-UD	(JaGBC) and (JSBC) ††	Japan	Local	2007
	LEED-ND	US Green Building Council	USA	Local	2009
	BREEAM Community	BRE/UK	UK	Local	2009
	Smart cities challenge	IBM	USA	Global	2010
	GSAS/QSAS	Gulf Organization for Research	Qatar	Local	2010
	Green Star Sustainable Communities	Green Building Council of Australia (GBCA)	Australia	Local	2012
	GRIHA LD (Large Developments)	The Energy and Resources Institution, New Delhi (TERI)	India	Local	2013
	SBTool^{PT}-UP	International Initiative for a Sustainable Built Environment (iiSBE)	Portugal	Local	2014
	SITES v2	GBCI and USGBC§§	USA	Global	2015

Notes:
* Date of public release.
† The 21 agenda was adopted by 178 countries.
§ 34 OECD member countries.
¶ ICLEI- Local Governments for Sustainability- USA.
\\ DPSIR (Driving forces, Pressures, the State of the Environment, Impacts and Response).
** The Reference Framework for sustainable cities.
†† Japan Green Build Council (JaGBC) & the Japan Sustainable Building Consortium (JSBC).
§§ Green Business Certification Inc. (GBCI) & U.S. Green Building Council (USGBC)

d) Conduct a contextual assessment of the similarities and differences of sustainability indicators to draw up a list of common urban factors under the main sustainability dimensions.

e) Determine the strength and weaknesses of each.

f) Identify the scope of application of each tool and the possibility of their application in diverse local contexts, including the urban Iraqi context.

The GUSATs will be discussed according to their issuance date.

2.8.1 BREEAM Communities

BREEAM was launched in 1990 by BRE and has a long track record in the UK (Saunders 2008). It is considered as the first commercial attempt to create a green and comprehensive assessment tool for a wide range of environmental concerns (Crawley and Aho 1999). Currently, BREEAM is the leading and most widely used sustainability assessment tool and rating system, with more than 550,000 certifications for diverse projects, having been used in more than 78 countries worldwide (BRE 2017).

In 2009, its scope was widened to include community assessment and urban development projects, which added a new tool to the BRE family that named BREEAM Communities.

It's aim is to create sustainable communities, focusing on mitigating the overall influence of urban development projects within existing or planned projects (Haapio 2012) and addresses the impact of critical environmental, social and economic issues on cities or urban areas. It looks to enable stakeholders to identify the extent to which said issues are tackled within urban areas. It also allows for development projects to be documented according to their environmental, social and economic benefits to the local community, meeting the needs of existing and future populations improving the quality of community life and achieve well-being (BRE 2011).

At present, BREEAM have a family of assessment tools applicable in different regions such as BREEAM Hong Kong, BREEAM Canada and BREEAM International (BRE 2011). According to the technical manual for BRE (2013), this version is for local projects in the UK, and it is not a global assessment tool but the BREEAM Bespoke Process has been developed to assess urban development projects outside the UK (BRE 2015). BREEAM Communities has also been selected due to the constant reference to it in many academic papers (Fowler and Rauch 2006; Tanguay *et al.* 2010; Haapio 2012; Sharifi and Murayama 2015) indicating that it is a popular tool to use in urban sustainability domain.

2.8.2 LEED-ND

In 1993, the United State Green Building Council (USGBC) designed the first version of LEED (Leadership in Energy and Environmental Design). LEED is a voluntary certification program developed through a consensus process carried out with key stakeholders. It aimed to provide a comprehensive assessment tool for building performance to meet sustainability goals, as well as to transform the market towards the construction of green buildings (Zimmerman and Kibert 2007). LEED has been rapidly expanded to include the assessment of urban developments.

In 2007, a pilot version was developed to include neighbourhood development (ND). In 2009. LEED-ND was launched emphasizing environmental issues and land-use in the USA by improving neighbourhood design and land-use patterns. It deals with overall urban design elements starting with smart-growth principles of cities, site selection, individual and clusters of buildings, infrastructure and land use and housing affordability, as well as interest in the landscape of neighbourhood units (USGBC 2011). It has integrated smart building principles, urbanism and green building into a neighbourhood design rating system (Haapio 2012). LEED-ND has been used to assess the sustainability of many urban projects in the USA and as a global assessment tool outside the USA, where it has been used as a guide for developers in England and Germany amongst other countries, in order to obtain formal certification (Sharifi and Murayama 2015). Many studies agree that BREEAM and LEED have been the basis for most assessment rating tools around the world (Reed *et al.* 2011). LEED has become even more flexible and can be applied to all types of projects, regardless of size and now includes a group of assessment tools such as LEED BD+C (Building Design and Construction), O+M (Building Operations and Maintenance), ID+C (Interior Design and Construction), Homes and ND (USGBC 2017).

2.8.3 CASBEE-UD (for urban development)

The Japanese Sustainable Building Consortium (JSBC) developed CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), as a tool to assess the environmental performance of buildings, initially appearing in 2001 as a sustainable assessment tool for office buildings. CASBEE-UD was launched in 2007 and updated in 2014, as a joint product between the Japan Sustainable Building Consortium and the Japanese Green Building Council (JaGBC) to cover the urban development domain (town and city development) (Reed *et al.* 2011; IBEC 2015).

Several generations are represented in CASBEE, e.g. CASBEE temporary construction, CASBEE new construction, CASBEE existing buildings, CASBEE renovation projects, CASBEE market promotion, CASBEE commercial interiors, and CASBEE for heat islands. CASBEE-UD is for use with urban development dealing with entire cities, building components and clusters and multiple functions in addition to urban and ancillary spaces. It was designed to enhance sustainability in cities and regional urban areas and to link to the operation of related laws, ordinances and systems, such as the comprehensive design of diverse districts and the expansions of site plans. CASBEE-UD is used for external and outside spaces (IBEC 2015, 2017).

2.8.4 SBTool^{PT}-UP (for urban planning)

SBTool emerged in 1996 under the name GBTool, as an assessment method for individual and green buildings, established by the International Initiative for a Sustainable Built Environment (iiSBE) in 2005 (Ding, 2008). SBtool^{PT} is one of the important products of SBTool developed in collaboration with iiSBE-Portugal. It was specifically developed to assess the building sector in Portugal. The tool started as a sustainability assessment tool for buildings, providing opportunities for developers, designers, contractors, owners, and users to make decisions during the project and construction of buildings, to increase sustainability levels.

However, its urban sustainability assessment is more comprehensive than just evaluating individual buildings having expanded from a building sustainability assessment towards urban sustainability planning and design. SBTool^{PT}-UP is one of the more recently developed tools and is still under development. It aims to achieve a Zero Impact Built Environment, focusing on zero energy, materials, water, and food, and on the integrated management of all resources that have a significant impact on the built environment (Castanheira and Braganca 2014). The scope of this tool is restricted to urban planning and design operations that are subject to legal frameworks, such as those used in municipal plans and detailed plans of national projects (Guimarães *et al.* 2016). Neither the technical manual of SBTool^{PT}-UP nor the user guide, are publicly available.

2.8.5 The Pearl Community Rating System (PCRS) for Estidama

Estidama means ‘Sustainability’ in Arabic. The Pearls Community Rating System (PCRS) was developed in 2010 by the Abu Dhabi Urban Planning Council (ADUPC), as a result of huge expansion in the construction industry and urban development projects in the UAE. It was the first sustainability assessment tool in the Middle East and linked to Abu Dhabi's plans for 2030, due to the need for the sustainable assessment of buildings, urban planning and design in the UAE, specifically on a local scale (Madden 2011). PCRS launched "culture" as the fourth dimension of sustainability to emphasise local features in the assessment process (ADUPC 2010). PCRS has been developed from BREEAM and LEED as a method to address the similarities, differences and deficiencies between the two tools and takes into account UAE spatial and cultural dimensions. PCRS consists of a unified document for three types of development of varying size: villas, buildings and communities.

The PCRS aims to support the development of sustainable communities and improve the quality of human life. A major part of the PCRS is the requirement for master plan teams to achieve PCRS goals, urban factors and guidelines for all urban development projects within the community. PCRS represents a mandatory standard for all buildings and urban planning and design projects in the UAE as a first step to achieving urban development sustainability (Elgendy 2014).

2.8.6 QSAS/GSAS

The oil boom and a significant expansion in the building industry and construction sectors in the Gulf, created the need for a classification system and assessment of buildings and urban developments to reduce undesirable impacts on the environment, and to meet both national and local needs in Qatar. In consequence, the Gulf Organization for Research and Development (GORD) developed the QSAS/GSAS in 2009, in collaboration with the T. C. Chen Centre for Energy Studies and Building Simulation at Pennsylvania University, USA. At first, it was called the QSAS (Qatar Sustainability Assessment System), but was later changed to GSAS (Global Sustainability Assessment System) (Writer 2009). GSAS/QSAS was developed based on wider international practices and global assessment of the sustainability of buildings and urban environment, by taking into account spatial characteristics and local considerations (Horr 2013). Sustainability assessment tools are increasingly being integrated in academic curriculum[1], the GSAS/QSAS taught in Qatar universities as part of the curriculum to achieve the urban sustainability targets in the future (Ayoubi 2010). It represents a mandatory standard for building projects and urban planning depending on the QCS (Qatar Construction Specification). GSAS issued a technical manual in 2013, in addition to a set of assessment manuals including GSAS Districts and GSAS Parks, and typologies GSAS Design assessment, GSAS Railways, GSAS Health Care, Construction Assessment, Technology GSAS Operation Assessment and Commercial & Residential (Horr 2013).

2.9 Comparison of the selected GUSATs

A comparative analysis of different practices and purposes of GUSATs allows for better understanding of the drivers and goals of each. It also assists developers of assessment methods and users to identify shared knowledge and directions for future research and development. The selection of GUSAT requires the inclusion of the tools that have been classified at the international level meaning that it is important to include BREEAM Co., LEED-ND, CASBEE-UP, and SPTool^{PT}-UP (Castanheira and Braganca 2014; Sharifi and Murayama 2015). Other assessment tools from neighbouring contexts such as the PCRS and QSAS/GSAS, will also be included because of the potential similarities of some urban factors to those in Iraq.

The main purpose of the comparison is the examination of the environmental, social and economic performance of the tools, involving a list of urban factors to evaluate the degree of sustainability of the urban project.

In order to fully understanding these assessment methods, each tool has been examined to summarize their key characteristics, strengths, weakness and rating scores to determine the potential for the development of new systems. The six GUSATs that have been selected were

[1] QSAS has been adopted in the KFUPM curriculum. www.emiratesweek.com/2010/12/5520

compared according to two aspects: the key characteristics and their structure.

2.9.1 The key characteristics of the GUSATs

The key characteristics of urban sustainability assessment tools are presented in Table **2.4** with a view to highlighting the organisation of each tool, in terms of assessment scope (local or global), and certification scheme. They have been organised into five main categories, namely: the version date, size and nature of the development that can be assessed, assessment scope (local or global), rating system and rating benchmark. The comparison clarified the following:

- **Convergence timeline to emerge**:

All GUSATs have been developed over a short period of time 2007, for CASBEE-UD, and 2014 for SBTool^{PT}-UP (still under development. Receiving considerable attention by the scientific community, numerous studies of sustainable urban assessment have been published over a short period (Sharifi and Murayama 2013). Most have focused on the theoretical aspects of assessment tools, and have included comparative studies to explore the diversity and role of urban factors (Haapio 2012). Some have focused on the practical aspects of GUSATs to examine the differences between theory and application (Sharifi and Murayama 2013).

- **The size of projects that can be evaluated**:

According to Table **2.4** GUSATs have no scale of city preconditions for assessing sustainability excepting LEED-ND which focuses on assessing neighbourhoods or parts of neighbourhoods. The majority deal with small, medium and large cities, regardless of whether they have multiple sectors or ones with small size neighbourhoods comprising a few buildings.

- **National or local scope**:

As shown in Table **2.4**, GUSATs have been designed to assess the sustainability of local urban development projects (Haapio 2012). The importance of an understanding of local cultural considerations is being increasingly recognised worldwide (Revi and Rosenzweig 2013), this the focus of both PCRS and CASBEE-UD.

- **The international scope**:

GUSATs are not implemented on a global scale, excepting LEED-ND which has been used to assess the sustainability of many urban projects outside the United States. It has been used as a guide for developers 68 countries (USGBC 2017) including Canada, Malaysia, China and South Korea, to obtain formal certifications (Sharifi and Murayama 2015). CASBEE-UD was used in Sweden, as shown in Table **2.4**.

BRE issued BREEAM Communities Bespoke International (BRE 2013), in order to make the tool correspond with global contexts. The characteristics of the urban development project must be identified, the tool making adjustments in accordance with local conditions and urban challenges; e.g., climate conditions; development and planning standards; the quality of services; and land use pressures across the local area. The Bespoke International tools are specific versions for use outside the United Kingdom (BRE 2015). CASBEE issued CASBEE for Cities (for worldwide use) in 2015 as a tool to assess the environmental performance of any city around the world. This tool is designed to make assessments and to provide feedback to the public to facilitate understanding of the sustainability of their city. This process can be developed as a market mechanism and provide city governments with strong incentives to improve the conditions of their cities and to address urban environmental problems (IBEC 2017).

There has been wide discussion about the viability of developing global standards for GUSATs, debate ongoing, for example in the case of LEED, which follows USA recognised standards (e.g. the U.S. National Institute of Standards and Technology (NIST)) (USGBC 2011) . Having already been applied to assess urban developments projects across of the world, concerns have been raised may mislead developers and decision makers due to the differences in standards and regulations in different parts of the world and unfamiliarity with national USA standards (Fowler and Rauch 2006).

- **The rating benchmarks**:

GUSATs have adopted various rating benchmarks, as shown in Table **2.4**. making each assessment tool specific in the way it assesses sustainability. The same can also be said of local cultural values, as seen with PCRS selecting Pearls due to its cultural importance in the UAE.

2.9.2 The structure of the GUSATs

Although urban sustainability assessment tools have been developed to achieve the same objective, they vary widely regarding shape, potential and application (Gil and Duarte 2013). The selection of GUSATs was based on similarities in their organisation, components, processes and procedures, to fulfil the objectives of the review. The general structure of the GUSATs are shown in Table **2.5**, comprising three levels.

- **Sustainability dimensions**:

Sustainability is usually considered as a guide for social and economic policymaking to achieve equilibrium with environmental conditions (Seghezzo 2009). All assessment tools emphasise these three interrelated and interconnected dimensions of sustainability, with differing emphases according to particular local circumstances.

Table 2.4: The key characteristics of the selected GUSATs

Categories	**Urban sustainability assessment tools**					
	BREEAM Communities	**LEED-ND**	**CASBEE-UD**	**SBTool^{PT}-UP**	**PCRS**	**GSAS**
Version year	**2012**	**2009**	**2007 update in 2014**	**2014[*]**	**2010**	**2010[†] update in 2013**
Size and nature of the development that can be assessed	No limits to the size or nature of the development	No limits, but emphasis on neighbourhoods or parts of neighbourhood	Minimum: A group of buildings on two or three adjoined plots. Maximum: A combination of tens, hundreds, or thousands of building plots and non-built lands such as roads and parks.	No limits, but emphasis on urban scale	No limits, but emphasis on city and enterprises projects	Minimum: A wide range of building typologies. Maximum: city built environment.
Assessment scope						
National and local	Yes	Yes	Yes	Yes	Yes	Yes
Global[‡]	No[§]	Yes[¶]	Yes[\\]	No	No	No
Rating method	The final rating is the sum of the weighted percentage of credits achieved under each BREEAM section, provided that minimum standards be met for the rating level.	The sum of points gained under different credits provided that the prerequisites be met.	Based on the ratio between building environmental quality (Q) and building environmental loadings (L), known as building environmental efficiency (BEE = Q/L).	Not issued	All mandatory credits (AMC) need to be met for 1 pearl rating. The following ratings are based on AMC plus the cumulative credit points (cp) of the optional indicators.	The credits gathered from the collection points every individual indicator during the assessment process for the project.
Rating benchmark	**Unclassified** (<30%) **Pass** (≥30%) **Good** (≥45%) **Very good** (≥ 55%) **Excellent** (≥70%) **Outstanding** (≥85%)	**Certified** (40-49) **Silver (**50-59) **Gold** (60-79) **Platinum** (≥80)	**Poor** (<0.5), ☆ **Fairly poor** (0.5-1), ☆☆ **Good** (1-1.5)**,** ☆☆☆ **Very good** (1.5–3)**,** ☆☆☆☆ **Excellent** (≥3)**,** ☆☆☆☆☆	Not issued	AMC ** = **1 Pearl** AMC+ 60 cp = **2 Pearl** AMC+ 85 cp = **3 Pearl** AMC+ 115 cp = **4 Pearl** AMC+ 140 cp = **5 Pearl**	$X< 0.0$[††] $0.0 \leq x \leq 0.5$, ☆ $0.5<x\leq 1$, - ☆☆ $1<x\leq 1.5$, - ☆☆☆ $1.5<x\leq 2$, - ☆☆☆☆ $2<x\leq 2.5$, - ☆☆☆☆☆ $2.5<x\leq 3$, - ☆☆☆☆☆☆

Notes:
[*] No technical manual is available for SBTool^{PT}-UP as of yet.
[†] Updated in 2013. [‡] Represents the claim made by the assessment tools, not the author's assertions.
[§] Guidance for international implementation has been issued in the Bespoke version 2012.
[¶] Has been implemented in Canada, Malaysia, China and South Korea.
[\\] Has been implemented in Sweden.
** All mandatory credits.
[††] Certification denied.

Differences are reflected in the nature, quality and the scope of the selection of indicators that are adopted, which serve as the guidelines for urban development (Dawodu *et al.* 2017). Some assessment tools have an overlap in both sustainability dimensions and their indicators to achieve multiple purposes simultaneously.

'Social and economic wellbeing' in BREEAM Co., 'neighbourhood patterns and design' and 'green infrastructure and buildings' in LEED-ND, and 'cultural and economic value' in GSAS/QSAS are example of this.

Customising and minimising overlaps indicates the strength and importance of the dimension and its indicators. This is seen for example with environmental conditions, energy resources and land used and ecology in BREEAM Communities: urban form, ecology and biodiversity, energy and water in SPTool^{PT}-UP; natural systems, liveable communities and precious water in PCRS, and cultural and economic value in GSAS/QSAS.

Economic, social and environmental issues are not the only challenges that the world is facing. One of the duties of communities is to promote continuity of local indigenous cultures around the world preserve their identity. Many voices, such as Agenda 21, UNESCO and the World Summit on Sustainable Development, have called for the inclusion of culture as a sustainable development dimension, because culture ultimately expresses and forms the meaning of development and determines how people behave in different regions of the world (UCLG 2013). Cultural dimensions refer to community identity, preservation of traditions, local belief systems and shared values. This issue is implicit in many of the assessment tools with varying degrees of importance. Several studies have attempted to add culture as a fourth dimension of sustainability allowing focus on important issue specific to regions, as seen with PCRS (ADUPC 2010).

Seghezzo (2009) went further highlighting the need for a new conceptual framework which helps to make sustainability more relevant to human life by suggesting five dimensions: Place: three dimensions of space (x, y, and z); Permanence: this includes the fourth dimension of time, and Person humans being the fifth dimension.

- **Identifying and assessing urban factors (indicator and sub-indicators):**

The concept of sustainability varies from region to region. Urban factors (indicators and sub-indicators) that assess sustainability should be suitable for the context-specific conditions of that region (Braulio-Gonzalo *et al.* 2015).

Since the mid-1990s, research has focused on policies and municipal strategies, mainly in North America and Europe, local authorities facing many policy implementation challenges. The first indicators of sustainable development originated from a recommendation made by Agenda 21 to simply identify and develop a list of urban indicators for sustainable development. These indicators could provide a foundation for decision-making at regional, national and global levels

(Bulkeley 2010).

Urban sustainability indicators can be defined as parameters or tools, which describe conditions or circumstances allowing for the diagnosis of pressures and urban challenges of a particular city or region, which may not be directly observable. They enable stakeholders to identify and measure the key environmental and socio-economic impacts that need to be addressed in new urban developments or the existing built environment. They also allow for cities and urban regions to monitor the success and impact of sustainability interventions over the short and/or long term as they allow for the collection of of qualitative data and evaluate quantitative information reflectign different aims of urban development (CIDA 2012; SCU 2015).

Sets of urban indicators have been utilised as tools to generate relevant and usable information, collected from a wide range of sources, to increase the size of databases (Singh *et al.* 2012). The labels given to indicators can be varied (categories, criteria, indicators), and various types of indicators from different urban development fields e.g. energy, infrastructures, water, waste, and ecology, can be used (Weiland 2006). These usually include factors beyond environmental dimensions such as public health, education, housing, public services, governance, employment, income and business opportunities (Shen *et al.* 2011).

Each GUSAT consists of a list of criteria or indicators associated with aspects of urban development, as shown in Table **2.5**. Sub-indicator/s are also included to illustrate the multiple aspects of indicators. Urban factors (indicators and sub-indicators) are variables having certain values and roles in the measurement of performance design (Shen *et al.* 2011), such as a distance to walk between common spaces (open spaces) and neighbourhood components, the reduction in the impact of noise and the distance between the home and workplace. It is important, therefore, to highlight any disparities between the GUSATs regarding urban factors in terms of type, number and weighting values.

From Table **2.5**, it can be observed that BREEAM Communities has five categories with 40 indicators, 30% being mandatory indicators. LEED-ND has five categories with 56 indicators in total, with just 21% mandatory. CASBEE-UD has three major items (environment. society, and economy), 13 main categories (middle items), 15 indicators (small items), and 36 sub-indicators (minor items) in total. None of these are mandatory. SBTool^{PT}-UP has 13 categories with 41 indicators in total, none of which are mandatory. RCRS has seven categories with 44 indicators; it has the highest rate of mandatory indicators at 45%. GSAS/QSAS has eight categories with 44 indicators in total, 11% of which are mandatory.

All the GUSATs have some common indicators, which emphasise environmental protection and the conservation of energy and natural resources, such as ecology and energy. However, the determination of urban indicators and their importance varies between tools. For example, BREEAM Communities places more emphasis on resources and energy at 21.6%; social well-being at 17.1%; economic aspects at 14.8% and transport and movement at 13.8%. It gives less emphasis to governance and environmental conditions. In the LEED-ND, the two most significant categories are neighbourhood pattern and design with 44 points, and green infrastructure and buildings with 29 points. These two categories cover a number of issues including transportation, energy, water, waste and infrastructure.

CASBEE-UD considered safety and security, whether natural or man-made hazard, of particular significance, as well as culture as important indicator. It also regards the natural environment as an important category, performing an assessment of environmental load (LUD) by limiting CO_2 emissions from traffic, building and green sectors. Waste as a factor was referred to implicitly within the sub-indicators of environment and safety indicators in CASBEE-UD. In contrast to the SBTool^{PT}-UP, where waste is a main indicator. The remaining tools see waste as a sub-indicator. BREEAM Communities, CASBEE-UD, SBTool^{PT}-UP and GSAS/QSAS considers transportation as a main category, while, LEED-ND and PCRS include transportation within their sub-indicators. LEEN-ND and PCRS give particular importance to innovation unlike the other GUSATs.

Two categories of urban indicators can be distinguished: common indicators for all assessment tools, and specific indicators that deal with the issues and urban challenges for designated urban regions, e.g., plan 2030 in PCRS; flood risk assessment and floodplain avoidance in BREAM Communities. and LEED-ND; and desertification in GSAS/QSAS. There are also differences in weighting points and ratios depending on the importance of indicators in different assessment tools according to the circumstances of the specific region, e.g. precious water in PCRS and GSAS/QSAS, and economic categories in PCRS.

- **Rating method:**

The primary aim of designing and implementing rating systems is to manage environmental, social and economic impacts of development, and to manage stakeholder's expectations. A secondary aim is to provide market recognition for buildings and urban areas with a low environmental impact (Poveda and Lipsett 2011). Indicators are evaluated both individually and as a group, to achieve a level of quality for the urban region under assessment. The final evaluation provides flexible values and not fixed numbers (Gil and Duarte 2013).

The weighting ratios, or weighting points, are shown in Table **2.5** and are designated, depending on the international and local databases that are available, by using a quantitative multi-criterion analysis (MCA) to allocate weight to each indicator to obtain a final weighted summation.

Table 2.5: Urban factors (indicators and sub-indicators) in GUSATs

GUSATs	Categories or Indicators	No. of sub-indicators	Mandatory	Optional	Weight	
					Points	%
BREEAM Communities	Governance	4	2	2		09.3
	Social and economic wellbeing	17	4	13		42.7
	Resources and energy	7	3	4		21.6
	Land use and Ecology	6	2	6		12.6
	Transport and movement	6	1	6		13.8
	Total 5	**40**	**12(30%)**	**28(70%)**		**100**
LEED-ND	Smart Location and Linkage	9	5	9	27	24.54
	Neighbourhood Pattern and Design	15	3	15	44	40.00
	Green Infrastructure and Buildings	21	4	21	29	26.34
	Innovation and Design Process	2		2	6	5.46
	Regional Priority Credit	1		1	4	3.63
	Total 5	**56**	**12(21%)**	**88(79%)**	**110**	**100**
CASBEE-UD	Resource (water, resource recycling)	4		4		N/A
	Natural (greenery, biodiversity)	4		4		N/A
	Contribution to the local community (history, culture, scenery & revitalization)	7		7		N/A
	Artifact (Environmentally friendly building)	1		1		N/A
	Impartiality/Fairness (compliance, area management	2		2		N/A
	Safety/ security (disaster prevention, traffic safety, crime prevention)	4		4		N/A
	Amenity (convenience/welfare, culture)	4		4		N/A
	Traffic and urban structure	4		4		N/A
	Growth potential (population, economic dev.)	3		3		N/A
	Efficiency/ Rational (information & energy)	3		3		N/A
	CO_2 emissions from traffic sector	1		1		N/A
	CO_2 emissions from building sector	1		1		N/A
	CO_2 emissions from green sector	1		1		N/A
	Total 13	**39**	**0%**	**39(100%)**		
SBTool^{PT}-UP	Urban form	3				N/A
	Land use and infrastructure	5				N/A
	Ecology and biodiversity	4				N/A
	Energy	3				N/A
	Water	3				N/A
	Material and wastes	3				N/A
	Comfort of outdoor area	4				N/A
	Safety	2				N/A
	Amenities	3				N/A
	Mobility	3				N/A
	Local and culture identify	3				N/A
	Employment promotion & investment	3				N/A
	Extra	2				N/A
	Total 13	**41**	**0%**	**41(100%)**		**N/A**
Pearl community	Integrated Development Process	4	3	4	10	6.29
	Natural Systems	5	3	5	14	8.80
	Liveable Buildings	12	5	12	35	22.01
	Precious Water	5	3	5	37	23.27
	Stewarding Materials	8	3	8	18	11.33
	Resourceful Energy	8	3	8	42	26.415
	Innovating Practice	2		2	3	1.89
	Total 7	**44**	**20(45.45%)**	**24(54.5) %**	**159**	**100**
GSAS/ QSAS	Urban Connectivity	9		9		8.00
	Site	8		8		9
	Energy	5		5		24
	Water	1		1		16
	Materials	5	2	5		8
	Indoor Environment	10	1	10		14
	Cultural & Economic Value	2		2		13
	Management & Operations	4	2	4		8
	Total 8	**44**	**5(11.4%)**	**39(88.6%)**		**100**

An analytical hierarchy process (AHP) has been used to achieve this in some GUSATs (BREEAM Co., CASBEE-UD, and LEED–ND), to identify the weights system of each category of indicators (IBEC 2008; USGBC 2011; BRE 2013). The process is conducted using a panel of key experts in the sustainability assessment domain who represent both local and global expertise (Poveda and Lipsett 2011; Sharifi and Murayama 2013). In terms of assessing urban factors, BREEAM Co., has an individual weighting ratio and a variable number of credits (from 1-3) for each of the forty assessment factors, which differ in value depending on the weighting of evaluation for each issue. The final rating is the sum of the weighted percentage of credits achieved under each assessment (BRE 2013). PCRS is similar to BREEAM Communities regarding the distribution of weighting ratios and credits. The main difference is that all mandatory credits (AMC) need to be met for one pearl rating to assess the first stage of rating. The four other stages are based on AMC plus the cumulative credit points of the optional indicators (ADUPC 2010).

With LEED-ND and GSAS/QSAS, the assessment factors are not equal in value; they are assessed differently depending on the weighting points. Some of the urban factors are worth ten points, while others only one point. The final rating is equal to the sum of points, gained under different credits, of every individual urban factor during the assessment process for the project (USGBC 2011; Horr 2013). CASBEE-UD, uses a five-step scale based on the rationale of achieved and maximum score of points. The final rating is calculated based on the ratio between building environmental quality (Q) and building environmental loadings (L), known as building environmental efficiency (BEE = Q/L) (IBEC 2015).

As for SBTool^{PT}-UP, the rating method has not yet been determined, the technical manual and user guide have not been issued yet.

Rating methods are one of the main differences between the global sustainability assessment tools because they reflect the perception and evaluation of stakeholders regarding local urban challenges.

2.10 Urban factors common to the selected GUSATs

Urban indicators are instruments to direct sustainable development and select appropriate policies to achieve urban sustainability. As such, there can be as many as needed and as specific as required, in order to interpret sustainable development and reduce overlap between dimensions.

A list of common indicators has been identified through the critical review of all criteria of the GUSATs, as shown in Figure 2.1.

These factors have been selected and are characterised by clarity, pluralism and inclusiveness, in an attempt to reduce the overlap between sustainability dimensions. This has also been done in an effort to introduce culture as a new, extra dimension to determine its importance in addition to including community involvement at various stages.

2.11 Inapplicability of GUSATs in the local context

Many countries and organisations around the world have developed urban sustainability assessment tools to conserve their ecological systems and to lead their urbanisation process forwards in an effective manner. (Shen *et al.* 2011). Although various assessment tools have been developed to meet different needs and aims, they share the common goal of identification of human activities that will potentially affect environmental, social aspects and economic elements, in order to achieve sustainable urban development (Wallhagen *et al.* 2013).

However, different cultural features, regulations and varying urban challenges in different countries, may make these tools suitable for certain countries more so than others. This makes the situation even more complicated for the adoption of one of the tools for application in a particular context.

Because of this, a critical review of the GUSATs was made to identify the most relevant domains that support the setting of the current research objectives. An analytical comparison between GUSATs resulted in the identification of major disparities and differences which restrict their flexibility. These critical aspects are summarised in the following key points.

2.11.1 Urban assessment factors

Urban factors (indicators and sub-indicators) are highly significant contributors to the decision-making process for sustainable urban development projects, applicable from initial design through the multiple phases of construction, implementation to completion (Wedding and Crawford-Brown 2007). They should be clear, workable and measurable, and reflect the priorities of local urban challenges (Ugwu and Haupt 2007; Behzadfar and Abdi 2013). This suggests that the ideal number and type of urban indicators are open to conjecture, reliant on the specific situation (Levett 1998; Tanguay *et al.* 2010).

The number of indicators vary between the GUSATs despite the relative compatibility of these tools. Some indicators receive more attention by having the highest rates and points weightings, while others received low attention according to their priority for the locality (Häkkinen 2007).

It is important to give precise information about indicators, their importance and extent of success for the evaluation, as well as determining compliance within specified contexts through an analysis of sub-indicators that shows indicators' total content (Shen *et al.* 2011). The analysis of indicators confirms the strength of the connection and the links between all urban factors (indicators and sub-indicators), which contributes to delivering correct information to community experts and decision makers (Wedding and Crawford-Brown 2007).

The current review has highlighted the importance of indicators for GUSATs and clarified the consistency and differences among and between them. Attention must also be paid to the sets of indicators and sub-indicators, which are considered central assessment dimensions. As is the case in the indicators, there are wide differences with sub-indicators in terms of the type and number. Differences give a clear sign that geographic, demographic, environmental, social, and economic factors and the nature of the local community, represents the main determinant of the types, numbers, limitations (optional and mandatory) and priorities of indicators. Therefore, it is not possible to nominate one of the global assessment tools as a ready recipe to fit for all contexts.

Numerous tools have tended toward generalisation to capture the majority of assessment criteria within their assessment structure, which allows for overlap and multiple interpretations. However, embracing overlapping indicators limits the accuracy of the assessment tool and does not lead to a specific reflection of performance. It is, therefore, important for urban factors to be specific and to determine the weightings for more accurate results (Behzadfar and Abdi 2013). Consulting experts on identifying the most relevant factors to meet the aim of the assessment can aid this.

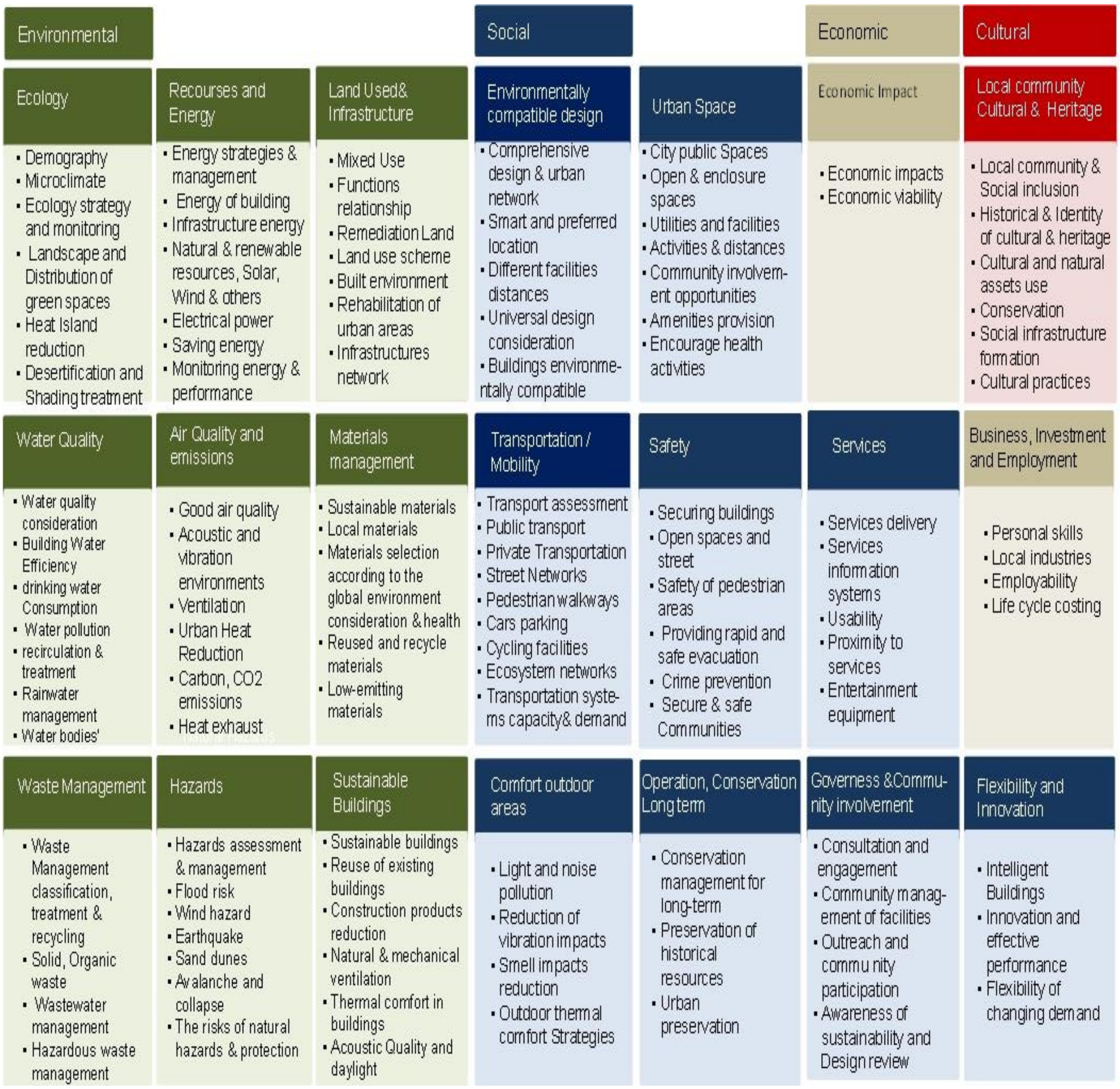


Figure 2.1: Common urban sustainability assessment factors (indicators and sub- indicators) from the selected GUSATs

2.11.2 Weighting system

It is a major challenge for any sustainability assessment method to be appropriate to all countries, where every region has its specific individual components related to geographical, cultural and environmental differences (Lee 2013; Wong and Abe 2014). A weighting system represents a means to manage an appropriate credit distribution for each urban factor, according to local priorities (Lee and Burnett 2006; Ali and Al Nsairat 2009). The GUSATs employ different strategies and weighting systems for assessment, for example, the BREEAM Co. and CASBEE-UP employ a weighted system that prioritises ecological issues, LEED focuses on design factors and transportation, while PCRS and GSAS/QSAS give high priority to water and energy.

To develop a new sustainability assessment method, it is important to customise the weighting system so that it can meet local and regional priorities, through a consensus- built process between the professionals and decision makers (Chew and Das 2008; Giannarou and Zervas 2014).

2.11.3 Regional Variations

As mentioned, the GUSATs have emerged in different countries and some studies argue that because of this, these tools could be more suitable for one country over another. For example, Haapio (2012) states that CASBEE-UD is suitable for use Japan, while LEED-ND is strongly directed at the North American market area. BREEAM Co. however, can be applied to many neighbourhoods and urban areas. According to Alyami (2015), all urban projects that used the LEED tool must initially follow USA urban development standards. Before the development of PCRS and QSAS, LEED and BREEAM were proposed for use after making necessary adjustments resulting in the Emirates LEED and BREEAM Gulf. However, the LEED used in the UAE was mainly based on the USA LEED, including the almost identical construction of assessment categories and criteria. The differences noticed in LEED UAE concerned raised overall credits, which aimed to grant additional loans for the efficient use of water. Concerns were also raised about its lack of suitability for use in a desert environment and that it did not meet the numerous social and economic features apparent in any UAE urban development (Sharma 2010; Al Salmi *et al.* 2013). The UAE government, therefore, decided to develop its own local sustainable assessment system, Estidama (pearls), as LEED was not appropriate to the UAE context (Sharma 2010).

Differences in standards, regulations and the priorities given to urban challenges in different parts of the world constitute the most common difficulties faced by GUSATs on the global scale. Reijnders and Van Roekel (1999) indicated that it is highly unlikely that a list of pre-designed urban indicators could be developed for worldwide use, for instance, the use of geographically adapted databases, without many further modifications.

2.11.4 Sustainability dimensions

There is a difference in emphasis on sustainability dimensions. The comparison identified that GUSATs mainly focus on environmental sustainability performance issues and, to some extent, on social issues. There are concerns that economic and cultural dimensions are not emphasised in any of the tools, as shown in Figure **2.2**. This makes these dimensions marginal (Haapio and Viitaniemi 2007). However, the argument here is that all sustainability dimensions are significant, particularly in developing countries.

2.12 The need for a new urban sustainability assessment framework

Most urban sustainability assessment tools have been designed to fit a particular urban context and range of local issues; they are not applicable to all regions. Certain environmental, social and economic factors can actually hinder the direct application of existing global assessment tools. Examples of such diverse elements are ecological conditions, geographical characteristics, national urban infrastructure and utilities, resource availability consumption (e.g., energy, water, and waste), the potential of renewables, construction materials used, local policy and regulation, local culture and historical value, urban population and economic growth.

A critical appraisal of a group of global assessment tools can contribute to the exchange of experience and highlight urban indicators in accordance with their priority in diverse contexts. This may also explain their exclusion from some tools such as quality of infrastructure, utilities and local services (strength, operations, maintenance, etc.). Credit distribution will be connected with global direction implying that local urban projects should comply with the international regulations, codes and environmental standards to be awarded credits. This can influence policymakers to encompass particular standards which may surpass local factors and standards achieving a consensus from Iraqi experts regarding applicable sustainability urban indicators based on local urban challenges, the optimum solution, contributes to strengthening the sustainability of urban development projects taking place in Iraqi cities. This will include building a suitable weighting system for local conditions which also includes issue which have been overlooked, such as improving essential services for developing cities, promoting infrastructure, local culture, specific social issues and the current economic situation.

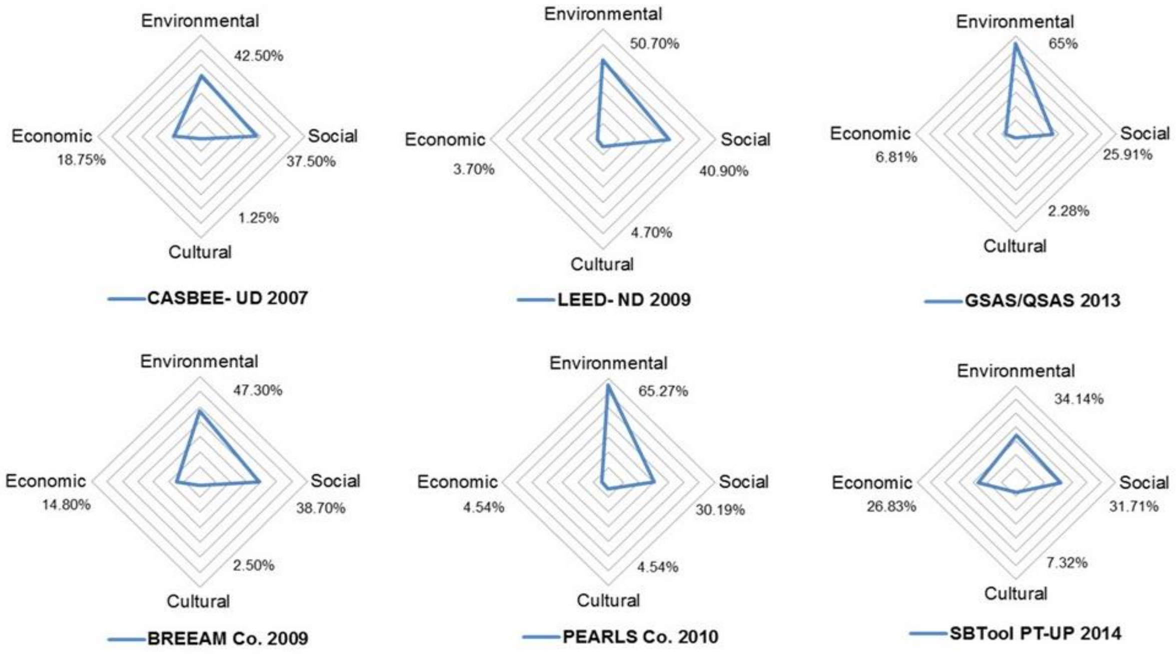


Figure 2.2: Differences in importance of sustainability dimensions in the GUASTs

2.13 Summary

Urban sustainability is a relatively new concept which has been adopted by many cities, including in some developing countries, which aims to address the urban challenges and improving the quality of the citizens' life, in addition to meeting the needs of present and future generations. The call for cities to become involved in best practice for sustainable urban development has increased, but many still struggle to adapt their strategic plans to combine different aspects of sustainability.

The above review represents an inclusive view of the current concepts of sustainable urban development and a comparative study of the most reliable and commonly used urban assessment tools in the global context; BREEAM Communities, LEED-ND, CASBEE-UP, SBTool^{PT}-UP, in addition to PCRS and QSAS/GSAS reflecting the neighbouring context of Iraq. Specific attention has been given to urban criteria and indicators, weighting systems and credit allocation in each tool, with a focus on determining the similarities, differences and conceptual structures.

Although the GUSATs were presented as an essential element to a successful implementation of the principles of urban sustainability, major disparities and differences restrict their flexibility of adaptation and utilisation in different contexts. This study will pave the way to develop a new assessment framework to achieve sustainable urban development in Iraq.

Chapter 3
Methodology

This chapter discusses the research methodology used to collect and analyse data in order to answer the research questions and increase theoretical and practical knowledge. Details are given on data collection techniques, the qualitative and quantitative data analysis of the questionnaire, the consensus-based method and the Analytical Hierarchy Process (AHP). Each phase tests a hypothesis and gives a comprehensive answer to the research questions.

3.1 Research methodology

The research methodology describes the strategy used to collect and analyse data in order to address the research questions and achieve the research objectives. There is no universal philosophical paradigm of research method, but there are many universal schools of thought. Three principal and predominant schools are positivism, interpretivism and critical theory (Oates 2005).

Positivism as a philosophical theory states that certain knowledge is based on natural phenomena, their properties and relations. Information derived from sensory experience, therefore, can be interpreted through reason and logic and can be described by measurable properties, this forming the exclusive source of all certain knowledge (Myers 1997). Positivism is strongly related to qualitative studies. In contrast, interpretivism, an approach to social science, explains the knowledge of reality as a social structure formed through a specific person or observer. The reality, therefore, derived from the observation of this person is likely to be different from another because of their different social point of views, meaning that interpretive researchers must seek to explore the truth from the participants' perspective. As such, interpretivism is also more related to social qualitative research such as contemporary jurisprudence and the law philosophy (Saunders and Tosey 2012).

Critical theory (critical social theory) is the third paradigm. It states that people can consciously act to change and improve their diverse social and economic conditions. The meaning of critical theory is the ability of judgment or discernment, the core concepts of critical theory is directed to all groups of society, in order to improve their understanding by integrating different major social sciences such as history, sociology, geography, political science, economics, anthropology and psychology (Klein and Myers 1999).

Urban sustainability is a multidisciplinary domain, which adopts a collective thinking approach towards different issues resulting in informed decision-making. It is concerned with knowledge and understanding of the sustainability discourse, particularly on how it can be validated and properly understood by the investigation of different opinions and perspectives thus building new knowledge. Therefore, interpretivism philosophy, according to Saunders and Tosey (2012) determines the dissimilarities between humans as social actors, the fundamental idea for the researcher to realise and understand these differences. This approach emphasizes research with the people who are living and working in designated environments, the underlying assumption that people can work consciously to change their social, economic and environmental conditions (Klein and Myers 1999).

Interpretivism philosophy emphasises the meaningful nature of people's character and engagement, specifically in their social and cultural lives. It advocates that research methods should adopt the position that people's knowledge of reality is a social construction. In consequence, interpreters often look for meanings and motives behind people's actions such as behaviour and interaction with others in society and culture. Similarly, cultures can be understood by studying people's ideas and thoughts and the meanings that are important to them.

This theory also strongly supports the notion that qualitative research is more likely to make sense of human experience and knowledge, typically is associated with social and cultural investigations. Qualitative research involves a systematic process that is concerned with studying social science phenomenon, enabling researchers to understand various aspects related to people, social and cultural problems (Myers 997). This is particularly important in regions that have entrenched concerns over their local cultural specificity such as the Middle East, or those countries that have suffered from unstable political conditions, such as Iraq, where public participation in decision-making is a necessity which should not be overlooked or ignored.

This section of the study emphasises the fundamental classification of research methodology, in terms of quantitative and qualitative approaches, as a representative of the above paradigms.

Qualitative research is based on human experience and knowledge, and usually related to cultural and social investigations. This type of research involves a systematic process of studying the phenomenon of social sciences, enabling researchers to understand various aspects associated with social and cultural problems of society and people (Myers 1997; Yin 2011). Qualitative research is employed in many academic disciplines, such as social and natural sciences, as well also in non-academic fields including business, and market research.

In contrast, quantitative research methods are typically linked with the natural sciences and aim to investigate and explain different natural phenomena utilising mathematical approaches, as well as measuring and controlling the theoretical variables that affect the phenomenon under study. Quantitative researchers rely on statistical and numerical measurements to develop or expand diverse knowledge related to social life. The quantitative research process seeks to: (a) Collect data using unified approaches on a range of variables. (b) Explore patterns of causal relations between the variables, and (c) Examine group theory by confirming or rejecting the hypothesis (Saunders and Tosey 2012).

According to Saunders and Tosey (2012), the most common research methods are divided into quantitative and qualitative research as follows:

3.1.1 Mono method

This is the use of a single data collection process and analysis technique, either a mono approach quantitative or qualitative design. It is argued that construct validity can be an issue with this method because of using a single measure which may introduce bias, known as mono-method bias.

3.1.2 Multiple method

This involves the use of more than one qualitative or quantitative method to explore and examine a particular topic or phenomenon. It is used to provide evidence and to validate findings to add accuracy to the research. The main strength of a multiple method approach is the generation of various types of data which provide a more comprehensive picture of the findings.

3.1.3 Mixed method

Also known as the hybrid approach, this uses mixed methods, combining quantitative and qualitative methods, data collection techniques and analyses procedures. These methods have been widely accepted over the last decade and aim to take advantage of using multiple approaches to explore diverse research problems.

Sustainability assessment paradigms are complex and dynamic schemes, conducted to promote policy and decision-making about the actions that should be followed to make society more sustainable in an environmental, social and economic context (Sala *et al.* 2015).

Because of this complexity, this study employs an exploratory, mixed methodology (hybrid) approach to best understand the environmental, social and economic dimensions in the urban sustainability domain (Ding 2008). Many studies have adopted this approach for both theoretical and empirical research (Ness *et al.* 2007; Hacking and Guthrie 2008; Sala *et al.* 2015).

Four techniques are used: (a) triangulation; investigations that combine multiple data sources and multiple methods (Tashakkori and Teddlie 2003); (b) explanatory; used to develop concepts more clearly and determine an explanatory relationship between urban factors and establish their priorities; (c) embedding; the provision of one type of method to supplement other techniques, and (d) case studies; the experimental part of the research applied to validate the results (Bryman 2006).

3.2 Research structure design

The development of an urban sustainability assessment framework for Iraqi involves different theoretical and empirical investigations, as shown in Figure **3.1**. The structure of the framework comprises five key stages as follows:

- A review of previous literature helps to clarify the dimensions of the research problem and determine the focus of the study, helping to create a better understanding and insight into work in specified domains and to identify similar work and the results that have emerged (Saunders *et al.* 2009). It is generally held that the comparison of several common and reliable urban assessment methods reveals their areas of convergence and divergence. This is a potentially viable starting point to develop a new sustainability assessment framework (Cole 2005).
- Investigating stakeholder perceptions to identify the main local urban challenges can be considered a key means of determining existing local urban priorities. These local factors should occupy an appropriate area in the new assessment framework to achieve local urban sustainability (Fraser and Zarkada-Fraser 2003).
- Consultation with a panel of experts is crucial to collect expert views from a wide range of different areas on a common platform, such as academia, government, and the private sector (Chang *et al.* 2007). This will allow the development of a consensus-based approach, this considered the most suitable approach for the development of comprehensive and effective sustainability assessment indicators (Chew and Das 2008).
- Development of an appropriate weighting system which expresses local needs as accurately as possible, prioritising local urban challenges.
- Verification and testing of the new framework by applying it to some case studies in order to ensure that the framework is reliable.

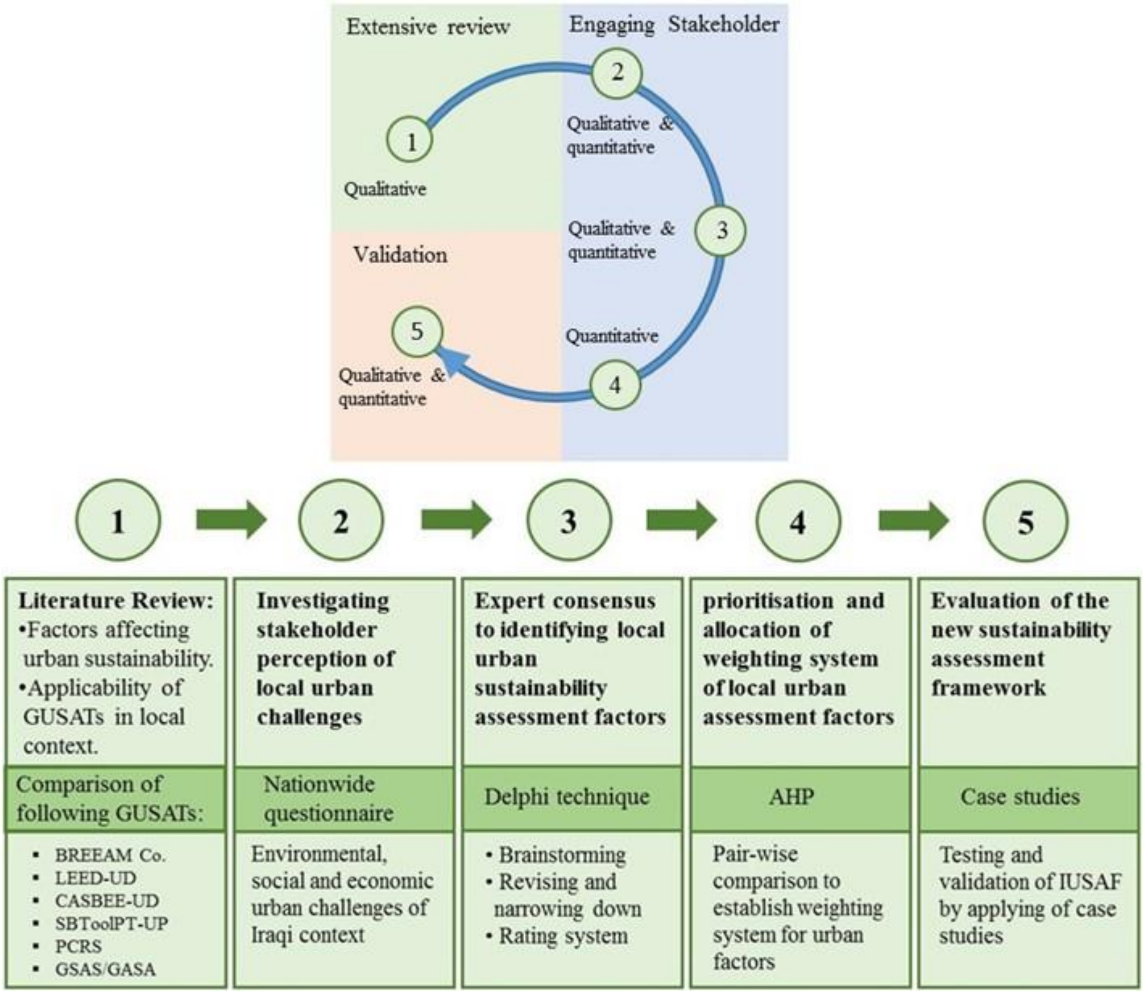


Figure 3.1: Theoretical model for the development of urban sustainability assessment framework using mixed research approach

3.3 Stage one: comparison of the GUSATs

It is important when developing a new urban sustainability assessment framework to start with a comparative analysis of a selection of global tools in the specified domain (Cole 2005). The GUSATs chosen provide a source, or platform, to collect all types of urban indicators so the first stage was a critical comparison and analysis between global tools, as reported in Chapter One. The selection of these methods depended on the credibility of the tool and the organisations who developed them as well as the success achieved in the marketplace by their application. The review of these tools allowed the identification of contents, aims, structure, assessment methodologies, scoring, weighting and suitability for application in different geographical contexts. The strengths and weaknesses of each tool was also critically discussed.

The technical manuals for the six selected tools (BREEAM Communities, LEED-ND, CASBEE-UD, SBTool^{PT}-UP, Pearl Community Rating System (PCRS) and GSAS/QSAS) were used in addition to related publications and reports that compared and analysed the major components (categories and indicators) for each tool. . The comparison was conducted in order to determine the main similarities and differences among these approaches, thereby identifying the common urban factors in the GUSATs.

CASBEE, BREEAM, LEED, and SBTool are the leading assessment systems that operated by global organisations (JSBC, BRE, USGBC, and iiSBE) having a proven track record in the sustainability assessment domain. BREEAM has granted, up to 2017, more than 550,000 certifications for different types of projects and has been used in 78+ countries around the world (BRE 2017). It has also been used as a template for the development of numerous other tools for different locations, such as the BREEAM Hong Kong, BREEAM Canada and BREEAM International (BRE 2011).

With regards to LEED, USGBC have granted, (up to the end of 2016), more than 79,000 diverse projects across 160 countries and territories, comprising over 15 billion square feet (USGBC 2017).

CASBEE and SBTool were selected for slightly different reasons. CASBEE has been selected due to its assessment weighting system which incorporates special features allowing for environmental aspects to be prioritised (IBEC 2015). The SBTool aims to achieve a Zero Impact Built Environment, focusing on zero energy, materials, water and food and also on the integrated management of all resources that have a significant impact on the built environment. In addition, SBTool was selected due to the comprehensive nature of its urban indicators. It has been adopted in many countries within Africa and Asia (Castanheira and Braganca 2014).

The final two tools PCRS and QSAS/GSAS have been selected due to their development in the neighbouring countries of the Iraqi in order to identify similar features.

All the selected GUSATs have evolved in assessment scope from individual buildings to neighbourhoods and urban developments.

Comparisons of the GUSATs resulted in a list of common urban factors (indicators and sub-indicators) as reported in Chapter Two. The urban factors have chosen are characterised by clarity, pluralism and inclusiveness in an attempt to reduce overlap between sustainability dimensions. This list of urban factors will be the foundation for the next stages of this study, the development of an Iraqi urban sustainability assessment framework (IUSAF).

3.4 Stage two: Stakeholders' perceptions of local urban challenges

A portion of previous research on urban development has focused on meeting the demands policy-makers and planners, without examination of stakeholders' perceptions. Contemporary social research however, has attracted attention to the importance of stakeholders' perceptions as these attitudes can play an essential role in the identification of local urban challenges.Stakeholders' perceptions also represent a primary means of successfully achieving urban sustainability (Fraser and Zarkada-Fraser 2003).

Therefore, it is important to understand local urban challenges as well as to ascertain their importance to stakeholders, with a view to developing effective policies and solutions based on local priorities. It is just as important to acknowledge the differences in environmental and socio-economic trajectories in the context of local challenges as opposed to those found in developed countries, e.g. a healthy environment, social cohesion and capital. It is possible to achieve sustainability goals through the effective management of resources, processes and actors (i.e., stakeholders); however, importance must be given to the integration of the views of local stakeholders across the lifecycle stages of an urban development project.

One of the main objectives of this study, is to explore stakeholders' views as a significant first step towards integrating their aspirations into the development of policies and activities, as well as encouraging their participation in a shared and sustainable future. These perceptions will be collected using questionnaires as this method represents the most common technique to investigate stakeholder's perceptions, having been used in many different domains (Huang 2006), including sustainable urban development (Balram and Dragićević 2005).

3.4.1 Questionnaire design and respondents

The questionnaire technique has been selected to collect, analyse and interpret the data as it is regarded as an effective technique to obtain different views, attitudes and perceptions from a varied group of people (Ghauri and Grønhaug 2005; Mathers *et al.* 2009).

A well-designed questionnaire impacts the type of responses obtained, in terms of their number and accuracy. To achieve this aim, it is important to focus on several key aspects of the questionnaire such as simple structure, clarity, appropriate length and keeping questions and answers together (Bowling 2005). The questionnaire for this study, has been developed according to the steps shown in Figure **3.2**. The questions have been structured as follows:

- Classification questions to determine demographic information, such as gender, age, occupation, qualification levels, region and location.
- Knowledge questions to determine what factual information the respondents have about environmental, social and economic urban challenges in their cities and regions.
- Responsibility questions to determine urgent urban challenges and their priorities.
- Perception questions to understand and determine the local stakeholder's awareness of sustainable urban development issues.

The completed questionnaire is designed for both genders, above 18 years of age, over different social backgrounds, qualifications and diverse disciplines.

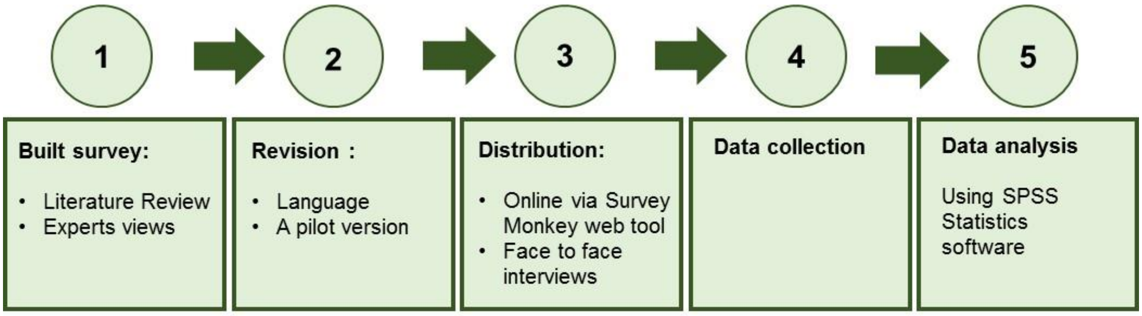


Figure 3.2: Questionnaire design

It was distributed to all three Iraqi regions, the northern, central and southern regions, which comprise 18 governorates. Respondents were informed in writing that taking part in the survey is voluntary that data would be kept confidential in compliance with ethical approval rules.

3.4.2 Responses types

Bowling (2005) emphasised the importance of clarity of questions as this improves the quality of responses and not distract responders.

In general, there are two types of questions: open-ended and closed-ended. In the first type, respondents answer in accordance with their perceptions, while in the closed-ended questions, participants will select an answer from the available options (Bryman 2015). It is permissible to use both types' in a questionnaire. One of the most popular tools for measuring the public perceptions is the Likert-type scale, developed by Dr Rensis Likert of the University of Michigan (Saunders *et al.* 2009). In this study, participants were asked to rate their perceptions of the questionnaire items on a 5-point Likert-type scale, ranging from 1 to 5.

3.4.3 Conducting the questionnaire

Due to the large sample size required to cover large areas of Iraq, an online distribution technique was used. It is a fast method compared to using a manual survey, as well as being less costly (Stanton 1998; Huang 2006), especially when it needs to be distributed over multiple regions (Hamilton-MacLaren *et al.* 2013). A snowball sampling technique was adopted as it considered a robust academic approach and appropriate for large-scale distribution (Dragan and Maniu 2013). The questionnaire was conducted via SurveyMonkey. This web tool facilitates the widespread distribution of questionnaires and enables the researcher to monitor responses and to begin a preliminary analysis of the data in a short time (Baker *et al.* 2010). Face-to-face interviews were also conducted to include individuals who had low internet usage rates.

3.4.4 Data Analysis

Statistical Package for the Social Studies (SPSS), is considered one of the most commonly available and most widely used in the social and behavioural sciences (Bryman 2015). Descriptive statistics and all data analysis, were conducted using IBM SPSS Statistics for Windows, Version

20.0.

SurveyMonkey has an advanced spreadsheet export facility which is an appropriate option if the data is in a numerical format. One of the main advantages of using SurveyMonkey is that data can be transferred to SPSS very quickly. This option also makes it easier to save data so saves time, effort and money.

3.4.5 Data Quality

Questionnaire data needs to be checked for internal reliability before being analysed. Internal consistency reliability was assessed via Cronbach's alpha coefficient (α) (Cronbach 1951). The coefficient provides a single estimate to determine internal consistency or average correlation of questionnaire items to measure the reliability (Webb *et al.* 2006). Several social studies suggested $\alpha = 0.70$ and higher are deemed to be acceptable reliability (Katz *et al.* 2007; Tavakol and Dennick 2011).

Principal Component Analysis (PCA) is also considered an important statistical tool to determine underlying structure by characterising a group of correlated variables. The importance of a component is evaluated by testing scree plots and the contribution of each component to the total variance (> 5%). Variance Maximization (varimax), as an orthogonal rotational strategy, is applied using the results of the PCA. Rotation reduces the number of factors on which the variables under investigation have high loadings making interpretation of the analysis easier (Floyd and Widaman 1995; Mourshed and Zhao 2012). A factor loading greater than 0.40 is the criterion for including an item. Following this, internal consistency and validity are established for the questionnaire items. Bartlett's Test of Sphericity is used to identify significant correlations between items. Sampling adequacy is assessed using Kaiser-Meyer-Olkin (KMO); if the value of KMO is greater than 0.8, it can be considered good and indicates that PCA is a useful way to interpret these variables (Cerny and Kaiser 1977).

3.5 Stage three: Identification of urban sustainability assessment factors

Consensus methodologies are robust tools used to establish agreement for decisions made by experts to determine key research and practice about critical issues, to create choices and develop effective strategies (Ager *et al.* 2007; Kauko and Palmroos 2014). The consensus method is not a new concept; it has a healthy history going back hundreds of years (SFC 2013). In more detail, these methods aim to structure and define levels of agreement on controversial topics, as well as to pass proposals approved by a majority.

Primarily, consensus methods seek to control for bias in the discussion process. Such bias may have the potential to influence conclusions inappropriately and the loss of minority proposals within discussions (Ager *et al.* 2007). They provide a free and independent means for participants to express their proposals and opinions offering the opportunity for direct or indirect discussion, debate and the defence of suggestions. That can give a deeper understanding of issues and practice under discussion, and highlight areas of both agreement and disagreement.

A wide range of diverse disciplines and business areas have embraced consensus methods including: programs of planning, determination of policy programs and the utilisation of resources to develop a full variety of alternatives and to explore or expose assumptions (Hutchings *et al.* 2006; Nair *et al.* 2011; Wu *et al.* 2013). It has been applied in healthcare, medicine, education, social service, physics, economic studies, business, industry, commerce and government organisations (Fink *et al.* 1984; Potter *et al.* 2004).

With the acceleration of globalisation, there has been an increasing use of consensus methods as globalisation has seen increased levels of interdependence among human populations including multinational corporations, governments and nongovernmental organisations (NGOs) (Ager *et al.* 2007; Hsu and Sandford 2007).

Due to the growing interest in sustainable development, consensus decision-making methods have become more visible and have been used to settle and solve urban development problems, which are linked to a broad range of issues integral to the main dimensions of urban sustainability (Hashemi and Siong 2014). Urban sustainability indicators are gradually becoming recognised as a robust tool that can help stakeholders such as urban planners, designers and urban managers to make decisions about the selection of sustainable urban indicators for the future (Ding 2008; Hashemi and Siong 2014).

3.5.1 Consensus techniques

The appropriate choice of research technique is crucial to the success of any research project. Despite the increasing use of consensus methods, there is a lack of information about their application in the previous literature making it difficult to find evidence that supports using a particular approach. In addition to a lack of information of the characteristics of consensus processes, there is a scarcity of data on structure and limitations, fields of application and the relative performance of prediction markets (Fink *et al.* 1984; Nair *et al.* 2011) implying the need to determine an optimal consensus approach for the identification and selection of urban sustainable factors.

A systematic review of some common consensus methods provides an evidence-based starting point for the three categories of decision-making consensus techniques (Graefe and Armstrong 2008; Raine *et al.* 2014) as follows:

- **Consensus-based surveys:** A survey/questionnaire(s) based means of communication among stakeholder groups to poll their proposals and ideas and reach a consensus decision. The Delphi Technique is a widespread technique that has been applied in various fields. The method does not require any face to face meeting between participants.

- **Consensus-based group meetings:** Formal group meetings, with different group sizes, provide the opportunity for a panel of experts to generate and discuss ideas face to face and to reach a consensus. This category has numerous techniques such as Brainstorming meetings, Simon Circles, Focus groups and Nominal Group Technique (NGT). NGT has been applied in many studies over different fields (Potter *et al.* 2004).
- **Consensus based data synthesis and group meetings:** These methods have been developed by combining the questionnaire approach with collective expert judgments. The RAND/UCLA Appropriateness Method (RAM) is one of the most important approaches in this category.

3.5.2 Overview of the selected Consensus techniques

This study has conducted a review of three formal consensus techniques; Delphi, Nominal Groups (NGT) and RAND/UCLA. The review focuses on their methodologies along with the relative advantages and disadvantages of each method. These techniques have been selected due to their extensive application in the sustainable urban development domain (Nair *et al.* 2011).

- **Delphi technique**

Developed in 1960 by the RAND Corporation as a method to build consensus, the Delphi technique is designed to achieve the reliable consensus of a group of experts on any topic in a systematic method. It is applied through conducting successive rounds of questionnaires for data collection based on surveys and feedback (Dalkey and Helmer 1963).

The Delphi technique builds group consensus from experts' judgments (Habibi *et al.* 2014). It has been used to identify and categorise different problems, according to their priority, developing forecasting frameworks. In order to achieve this, skilled specialists and experts with broad knowledge of related issues need to participate (Okoli and Pawlowski 2004).

The Delphi technique involves the distribution of series of questionnaires to a panel of experts. After each round, the administrator provides an anonymous summary of the experts' judgments and asks the experts to review their earlier responses in view of the replies of the other panellists. This operation continues until a consensus is reached on the problem. The Delphi technique has four key essential features (Hsu and Sandford 2007) as follows:

a) **Iteration of rounds**: the Delphi technique is a multi-stage process requiring the involvement of panellists in more than one round. This iterative application allows participants to observe the responses from the other experts to revise their decisions and give additional insight and detail if need be.

b) **Anonymity**: The organiser of the Delphi technique must maintain expert anonymity throughout the process to eliminate the influence of position and the socially dominant nature of some experts. In this way, experts can express their opinion freely without any influence from others.

c) **Controlled feedback**: Data exchange among experts is subject to observation and filtration. The Delphi administrator receives the experts' judgments after each round and carries out the relevant analysis to prepare the next round. This process avoids personal debate and facilitates a smooth transition to the next round of questions. Electronic communication is used to facilitate the information exchange process, making it cost effective and economical in terms of time.

d) **Statistical agreement of group response**: Because the Delphi technique often deals with complex cases, it is essential to use reliable methods of statistical analysis to reflect an accurate overall group judgment. The statistical indices Mean, Median, Standard Deviation (SD) or Interquartile Range (IQR) are used to achieve this aim.

The main uses for the Delphi technique are generating alternatives and forecasts of ideas and opinions and to examine the situation driving any underlying hypothesis. Delphi looks for as much additional information as possible, to inform and lead to consensus by combining a broad range of expert views (Alyami *et al.* 2013).

Despite the positive aspects of the Delphi technique, certain weaknesses are recognised in that the methodology is not uniform in its application, meaning it lacks a unified theoretical framework; coordinating several rounds can be complicated and time-consuming. There are also ambiguities about the requirements of the panel of experts and their number (Hsu and Sandford 2007; Nair *et al.* 2011). Another criticism of the Delphi technique is the withdrawal of experts over successive rounds which may affect the reliability of the final results. Nair et al. (2011) suggested that withdrawals in-between rounds can be acceptable if the remaining panellists still met the panel size criteria and the balance of representation i.e. field/area, opinion, level of qualification and experience. The panel should not become biased by over-representation in one area to the detriment of the other through loss of panellists.

- **Nominal Group Technique (NGT)**

The NGT is a group decision-making tool. It was developed from social-psychological research and social studies management to facilitate efficient group decision making. It has been utilised since 1960 in a broad range of knowledge fields including social services, education, health, government organisations, industry (Potter *et al.* 2004), and recently in sustainable development field. NGT has been used to identify challenges, develop solutions, and establish priorities (Carney *et al.* 1996). The essential purpose of this technique is to eliminate dominance by one/a few individual/s in the selection process. The term "nominal" refers to the fact that individuals are not allowed to communicate verbally.

The Nominal Group Technique, also called "brainstorming NGT" in some of the literature (Hallowell and Gambatese 2009), is a way of organising face-to-face group meeting of experts, led by an experienced moderator (Fink *et al.* 1984). It aims to enhance the productivity of the group and achieve a balance in participation among experts, to reach consensus. It uses various processes over different phases to create efficient solutions (Nair *et al.* 2011). There are usually between 5 - 9 panellists but this figure may be larger. Large panels of experts can be divided into several smaller groups to work simultaneously on the same questions. NGT seeks to generate and establish independent ideas and to prioritise issues, by using numerical voting within different phases (Van de Ven and Delbecq 1972). The NGT consists of four stages as follows (Potter *et al.* 2004; Nair *et al.* 2011):

a) **Generating Ideas**: the moderator asks each panellist to generate and write down their ideas on specific questions and records the answers privately.

b) **Recording Ideas**: the panellists summarise each idea so that everyone can see all ideas submitted. No discussion takes place until all ideas are presented and recorded.

c) **Discussing Ideas**: an open summary discussion of the submitted ideas follows to explain and classify different ideas or statements, especially those least understood and vague ideas. No attack or defence is allowed.

d) **Voting on Ideas**: the group votes secretly on the ideas that have the highest ranking in order of priority. The final decision of the NGT is the vote result.

The NGT methodology has several advantages. It is efficient at generating ideas which accelerates data collection thus reducing the time needed to reach consensus solutions. In contrast, the use of NGT can lead to biased results, especially when there is a dominant experts present. The feedback process is conducted through face to face meetings, which are sometimes difficult to conduct because of geographical limitations. The technique also suffers from restricted discussion, which can limit the extraction of solutions. Therefore, it can be a less stimulating group process due to individual moderator-participant discussions (Rowe and Wright 1999; Hallowell and Gambatese 2009).

• The RAND/UCLA Appropriateness Method

RAM (RAND/UCLA Appropriateness Method) is a group consensus method developed by the Research and Development Corporation and University of California-Los Angeles (UCLA), in 1980, in the USA. It is a formal consensus technique modified from consensus based-questionnaires method and consensus based-group meeting methods to derive consensus indices (Raine *et al.* 2014). The method is applied by using scientific evidence in conjunction with specialists' opinions. It was initially developed for use in medical fields to assess the minimum requirements for surgical procedures (Fitch *et al.* 2001) before being applied within a narrow range of other areas. The technique involves two interrelated rounds:

a) *Round 1*: preparation of a core information panel and formation of a group of experts. The information panel is the synthesised data that will be sent first to the experts. The core information panel is the result of a systematic, synthesised literature review to provide the group of experts with all the relevant information and quantitative data in a questionnaire, which will guide evidence-based decision-making. The assessments from round 1 are then used to develop an indications list that describes the essential characteristic features.

b) *Round 2:* multidisciplinary experts are asked to attend a face-to-face meeting which is organised by an experienced moderator. The number of experts' ranges from 7 – 15. An odd number is preferred to avoid a tied result when voting (Nair *et al.* 2011). The selection of a multidisciplinary panel can reduce the bias in the group (Fraser *et al.* 1994). All experts are provided with the individual ratings of other specialists to discuss their appropriateness. At the end of the discussion, each expert can reconsider their initial evaluation and re-rate the indicators. Finally, a final list of indicators is prepared based on consensus about those that are appropriate for inclusion (Nair *et al.* 2011).

Despite the advantages of RAND/UCLA, certain drawbacks have been identified specifically regarding the scarcity of application in the sustainable development field. It is also complicated to apply and time consuming. There is the potential for bias in the selection of experts and final judgments can be affected by feedback offered during the process. Face-to-face group meetings are sometimes difficult to conduct because of geographical limitations. RAND/UCLA appropriateness technique has mainly been applied in healthcare studies.

3.5.3 Consensus methods comparison

In order to select an appropriate consensus technique that leads to the selection of optimal indicators in the sustainable development field, a comparison of on the three formal consensus methods: Delphi Technique, NGT, and RAND/UCLA, was carried out. The comparison was based on seventeen basic technical characteristics thought to make the consensus process effective and constructive for the sustainable urban development field.

As shown in Table **3.1**, the Delphi technique was the better tool, achieving 70.6% of full compatibility with the characteristics list that was chosen, while RAND/UCLA came second reaching 64.7%, followed by 41.2% for NGT technique.

3.5.4 Justification for selecting the Delphi technique

The results of the comparison reveal three characteristics that make Delphi the better technique. 'Anonymity' and' avoiding face-to-face contact' essential primary features of the Delphi method and helps to avoid groupthink and to promote confidentiality.

The panel of experts used do not know each other, usually never having met (Somerville 2008). 'Geographical aggregation efficiency', matters when consensus among a large number of participants is needed and who cannot meet simultaneously for logistic, geographic or economic reasons (Habibi et al. 2014).

Some characteristics were applicable to all three techniques such as: 'avoids focusing on a single concept', 'encourages equal input from all panellists', 'highly structured process', and 'formal controlled feedback'. The RAND/UCLA technique includes ‘private decisions elicited before group discussion’ and ‘incorporates evidence’ individually while the NGT technique rates on speed of delivery and 'economy of time’, making the NGT technique the fastest and the most economical time in comparison to the other methods.

Since the emergence of the Delphi approach was published, a number of modifications have been introduced to overcome certain limitations and allow an application to particular research objectives and circumstances (Okoli and Pawlowski 2004). There are many versions of Delphi method including classical Delphi, policy Delphi, decision Delphi, and ranking Delphi.

Classical Delphi focuses on obtaining responses and acquiring consensus among professionals on a particular portion of the research. Data is collected through successive rounds, providing outcomes to participants in subsequent rounds. The process is completed after the round that achieves consensus, demonstrating stability. Usually three, but sometimes more, rounds are required. Confidentiality is required regarding the professionals' names (Linstone and Turoff 1975).

Decision Delphi is considered an alternative to classical Delphi, organising decision-making processes for future issues, rather than just forecasting (Rowe and Wright 1999). In keeping with this aim, participants involved in a decision Delphi must be selected according to their position and willingness to solve the problem. The expert panel, therefore, does not need to be large, because the process will be implemented to make imminent decisions by the panel. Data is gathered by processing repeat rounds and managing the response. The number of rounds vary, and it may not be necessary to have three (Hasson and Keeney 2011). In this approach, it is not possible to maintain confidentiality of the names of participants meaning it could be termed quasi-anonymity. Panellists' names are stated from the beginning of the process to promote responsibility but the responses are kept confidential (Linstone and Turoff 1975).

Table 3.1: A comparison of the characteristics of formal consensus techniques

Characteristics	**Formal Consensus Techniques**		
	Delphi	NGT	RAND/UCLA
Emailed survey	●	○	⭘
Private decisions elicited prior to group discussion	○	○	●
Anonymity	●	○	○
Iteration of rounds	●	○	⭘
Geographical aggregation efficiency	●	○	○
Avoidance of face-to-face contact	●	○	○
Interaction structured	⭘	●	●
Incorporates evidence	○	○	●
Generates a large number of ideas	●	⭘	●
Avoid focusing on a single concept	●	●	●
Encourages equal input from all panellists	●	●	●
Highly structured process	●	●	●
Avoid quick decision-making	●	⭘	●
Formal controlled feedback	●	●	●
Measures the importance of ideas generated	●	⭘	●
Speed of delivery	○	●	○
Economy of time	○	●	○
Inclusion percentage of the characteristics ○	23.5%	41.2%	29.4%
⭘	5.9%	17.6%	11.8%
●	70.6%	41.2%	58.8%
Key: ○ Not- applicable ⭘ Semi- applicable ● Fully- applicable			

Policy Delphi, in contrast with classical Delphi, involves iterative questionnaire rounds aiming to gather data from professionals. This process does not require agreement between panel members as contrasting opinions on particular issues like policy options are actively promoted. The panellists are the policy makers selected to obtain various views in different rounds. Regarding mode of communication, this can include indirect connections and group meetings as needed. Confidentiality for this type of Delphi is discarded after the first round and there is a need to hold meetings to collect different perspectives (Linstone and Turoff 1975; Hasson and Keeney 2011).

Ranking Delphi is another common technique, which shares the same overall principles as the other Delphi versions. However, it includes three key rounds: brainstorming of ideas, narrowing dawn and rating. This type of Delphi was found to be the most suitable for this research, as it involves the development of sustainability assessment studies and the customisation of urban assessment factors. It requires the participation of any concerned and/or expert individual (Keeney *et al.* 2001; Hanafin 2004) who are selected depending on their specialisation, position and proficiency, in addition to knowledge about diverse environmental aspects, social, economic, urban planning and design, and political issues regarding urban areas (Hanafin 2004). The process does not require experts to meet physically, making it more suitable and practical for international experts (Okoli and Pawlowski 2004). Professionals can complete the data analysis individually and in the absence of external social influences (Rowe and Wright 1999; Keeney *et al.* 2001; Kauko and Palmroos 2014).

3.5.5 Delphi technique applications in the urban sustainability field

The Delphi technique has been applied in various studies, across a wide range of academic fields.

Carrera and Mack (2010) implemented a Delphi consultation technique to assess the impact of social dimensions on sustainable energy systems. European scientists in the field of energy systems from four countries (Germany, France, Switzerland and Italy) were gathered, their aim to identify sixteen different energy indicators. The outcomes included many relevant criteria such as security and reliability of energy provision, political stability and legitimacy, social and individual risks and the quality of life (Carrera and Mack 2010).

The same technique was employ to develop a sustainability assessment toolkit for upland estates in Scotland by Glass *et al.* (2013). The management of and use of land estates are wide-ranging and increasingly attract the attention of stakeholders across a wide range of areas including biodiversity protection, agriculture, renewable energy, property ownership, sporting interests and the promotion of tourism. Land ownership in Scotland has a specific pattern; the majority of the land is divided into estates which belong to private individuals, public agencies, organisation, non-governmental institutions and civil society institutions. For that reason, the Delphi technique was used as a comprehensive method to translate sustainability principles onto the complicated land management situation with a panel of 19 participants from different interested areas, who worked through four stages of development. The outcome was a toolkit which provided a framework for sustainability assessment for estate owners and stakeholders to evaluate progress towards delivering a series of practical actions on individual upland properties (Glass *et al.* 2013).

Schuckmann *et al.* (2012) applied the Delphi technique to examine significant factors with reference to transport infrastructures up to the year 2030. The study determined important indicators for future development such as the intensification of globalisation, an ongoing lack of public finances, increasing urbanisation and the growing needs of the world population. These represented some of the challenges that global transport infrastructures will face in the future, the study testing the subject on an international scale. A panel of experts from more than 29 countries participated to ensure diversity in the composition of the Delphi team. The results were presented in a final potential scenario to bridge the gap in global transport infrastructure domains. Four scenarios were suggested as fundamental solutions: supply and demand, competitiveness, finance operations and sustainability.

Finally, the Delphi technique was conducted by Vatalis *et al.* (2012) to identify environmental performance indicators that encourage procurement for construction sector projects. The development of green procurement, formerly known as Affirmative Procurement, has been recognised as a tool that strengths sustainable development. The Delphi technique was used in the Greek context to develop an instrument to determine sustainable perspectives for green procurement. Green performance indicators were categorised as follows: reduction of waste, customer satisfaction, service and quality, education of personnel capacity, use of technology and utilisation of client cooperation.

The results of the comparison to other tools and the wide use of this technique in the urban sustainability domain allow the Delphi technique to be used as an efficient and constructive consensus process for the current study.

3.5.6 Delphi technique design in this study

The Delphi survey is derived of several stages, as shown in Figure **3.3**.

3.5.7 The selection of the panel of experts

The selection of qualified experts to participate in the Delphi process represents a crucial step to ensure the achievement of critical and reliable results (Linstone and Turoff 1975; Rowe and Wright 1999). Experts, as defined in the literature, are people who have a high level of knowledge or skill in a particular field (Okoli and Pawlowski 2004). The experts here were selected based on acquaintance with the researchers; it is acknowledged that this may not be the best reason for choosing to address specialised areas. Some researchers have expressed concern about bias resulting from poor methods of selection, while others dismiss these concerns (Loo 2002). The implication is that random sampling is not always appropriate when selecting experts, specifically in the sustainable development field; it is more appropriate to select specialists in that domain. The selection of the panel of experts for the Delphi technique was guided by the criteria recommended by Edgell & Seely (1980), where individual panellists should:

- Be well versed and up to date in the area of study;
- Have experience of working in the study area, and
- Be willing and available to take part in the Delphi process.

In a previous Delphi study among urban sustainability professionals, Alyami et al. (2013) suggested that the panellists could come from the following groups:

- Academics, professionals and specialists in the domain of sustainable development;
- Practitioners, managers and decision-makers in the field of sustainability, and
- Professionals from cognate fields who have practical experience and knowledge of sustainable development.

Bryant and Abkowitz (2007) suggested the involvement of experts from diverse backgrounds to balance opinions, philosophies and experience that are critical in determining the quality of the results of the study. The number of experts on a panel can vary from 10 to 50, a key consideration being that the panel ought to be sufficiently large to allow a range of diverse responses to be clearly heard (Okoli and Pawlowski 2004).

At the outset of the study, potential panellists were contacted via phone, email and social networks, inviting them to take part in the research. Bryant & Abkowitz (2007) and Alyami et al., (2013) reported that direct communications coupled with a criteria-based selection at the onset, enhances completion rates and the quality of the outcome of the Delphi process at the same time reducing field-related bias in the identification of the expert panel. Another benefit of initiating personal contact with experts is to be able to assess their willingness to participate and the extent of their knowledge of the criteria and scope of the study.

The Delphi panel in this study comprises thirty-seven members, representing diverse urban development related fields, including environmental engineering, urban design and planning, architecture, engineering and construction (AEC). The panellists' work experience relates to the practice, decision-making, research and teaching of sustainability and environmental policy and regulations. They have national and/or international experience and/or recognition for their work. To ensure a balanced representation, panel members were recruited from governmental and non-governmental organisations and the private sector, as shown in Table 3.2.

3.5.8 Development of the Delphi survey

The Delphi technique questionnaire was designed using potential urban factors identified from a comparative study of global assessment tools, as well as the results of the nationwide questionnaire of the Iraqi cities. The respondent's opinions were gathered on a 5-point Likert-type scale, ranked from 'Unimportant' to 'Very important'.

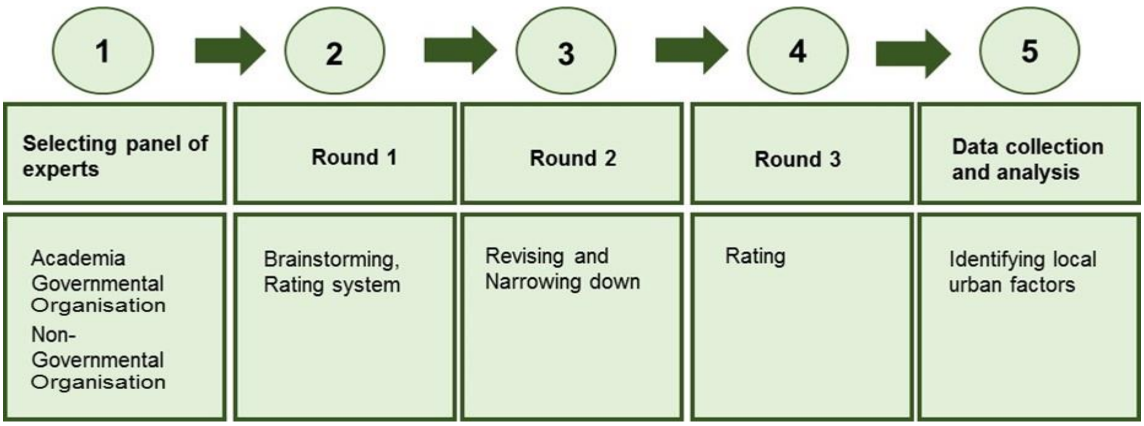


Figure 3.3: Selection the Delphi panel of experts

For this study, the Delphi survey consisted of three successive rounds, in line with the ideal Delphi format (Powell 2003). Chapter 5 provides a detailed explanation of the Delphi rounds.

3.5.9 Data collection and analysis process

The survey was conducted via SurveyMonkey, the first Delphi round presenting a list of urban potential sustainable assessment factors (indicators and sub-indicators) applicable to the Iraqi context. This round was based on brainstorming processes using open-ended questions to facilitate further suggestions of any other urban factors by the panellists.

The second round allowed the panel of experts to anonymously view the responses and summary feedback of the results from the first round in order to give them the opportunity to revise their thoughts and their initial judgements and make changes. The third round summarised the results of the previous two rounds.

The mean and standard deviation (SD), as statistical tools, were computed for all responses as an accredited measurement, to identify the level of importance of the urban factors and the degree of consensus (Geist 2010). Many studies utilize SD to assess the level of consensus of the experts by showing the spread of responses. These studies indicated that the value should be between 0 and 1 ($0 < \sigma > 1$) (Rayens and Hahn 2000; Giannarou and Zervas 2014).

Table 3.2: The background of the Delphi panellists

Experts Groups	Organization	Distribution (%) Round 1	Distribution (%) Round 3
Academia	**National:** University of Baghdad University of Karbala University of Technology University of Babylon University of Al- Kufa University of Bassrah **International:** University of Kentucky, USA University of Arkansas, USA Liverpool John Moores University, UK VHS for education & training, Germany	**34%:** • 42% PhD • 33% MSc • 25% BSc	**32%:** • 49% PhD • 31% MSc • 20% BSc
Government Organizations	Ministry of Municipality and Public Services Ministry of Housing Ministry of Health Ministry of environment The Directorate of Urban Planning The Institution of Urban and Regional Planning	**42%**	**40.7%**
Non-government Organisations (Research and Development)	**National:** The Iraqi Engineers Union Engineering Consulting Bureau- University of Karbala Imam Hussain Organization Mahadin Engineering Consulting Shnashel Consultants Alharam for Engineering Constructions Aljadwa company for construction Almerqal construction company Nahr Al Salsabeel for construction Al- Emara engineering and contracting **International:** The United Nations Educational, Scientific and Cultural Organization (UNESCO) Parsons Corporation – USA Llewelyn Davies - Architects Designers, UK	**24%**	**27%**

It is worth mentioning that 17 respondents withdrew over the three successive rounds of the Delphi technique. Those who left were from all three categories, as shown in Figure 3.2. The number of academics accounted for 34.3% in the first round, this decreasing slightly to 32.5% by the third round. Governmental Organisations accounted for 41.7% in the first round, this dropping slightly to 40.6% by the third round. The percentage of non-governmental organisations increased slightly from 24% to 27% between the first and the third rounds. The level of group representation, therefore, remained similar between rounds and met Nair et al.'s (2011) criteria of the balance of representation in the case of withdrawal, and Edgell & Seely 's (1980) criteria for panel selection. The size of the final panel was 37, which can be considered more than acceptable. Together, these two aspects of panel size and balance of representation demonstrate the final panel was not biased.

3.6 Stage four: Prioritisation of urban sustainability assessment factors

Since the main goal of this study is to develop a framework for assessing urban sustainability, the analysis is continued using an Analytic Hierarchy Process (AHP). The AHP has been used as a methodology for measuring, structuring and the synthesis of diverse factors. It was developed and introduced by Saaty in the 1970s and has since been used as a multi-criterion, decision-making method for decision makers and researchers (Vaidya and Kumar 2004). It has been used to solve complex decision- making problems by arranging potential indicators, based on their importance, into a hierarchical structure descending from the main goal to indicators, to sub-indicators in subsequent levels (Saaty 1994). AHP takes into consideration various quantitative and qualitative indicators related to the problem (Samari *et al.* 2012). It can also help to reduce bias in decision-making, as well as minimise common disparities of an expert team, such as lack of planning, focus, or participation, which ultimately cause costly distractions that can prevent expert teams from making the right decision (Poveda and Lipsett 2011).

The initial step in the AHP is the subdivision of the research problem into smaller interrelated components, in order to compose them into a coherent framework. The process occurs by conducting a set of pair-wise comparisons between the relevant data, to identify the overall weights and the priorities of the indicators and the relative performance measures of the sub-indicators. It also provides a mechanism to improve consistency, where there are comparisons that are inconsistent (Saaty 1990). AHP draws its strength by diverting the subjectivity of the research problem into a mathematical matrix. Once the evaluation of relative importance, probability or preference has been analysed, these are reflected in a list of priority ratio scale and overall weights for all the factors (Alexander 2012). The advantages of AHP is that it can reconcile differences and inconsistencies in the data, as well as using accessible commercial software, such as Microsoft Excel or Expert Choice, to analyse all the mathematical calculations required according to the multi-criteria decision-making (Mani *et al.* 2014).

AHP has been widely used across multiple knowledge domains, due to its simplicity and ease of use including business, industry, government, benchmarking, layout design, social studies, public policy decisions, health care, defence and engineering (Vaidya and Kumar 2004; Samari *et al.* 2012). AHP is a theoretical and practical method accepted globally as a new creative model for decision-making (Alexander 2012).

3.6.1 Justifying the use of AHP

The character of construction industry performance and associated environmental factors continues to generate debate between experts and professionals working in the field. To date, no single-dimensional technique/procedure has been accepted as offering accurate and specific results upon which to measure the impact of construction on ecology and habitats (Ding, 2008). Thus, the concept of sustainable development establishes a basis for the best suitable practice regarding human communication with the environment including, as it does, multiple-criteria techniques, ecological, economic and social viewpoints (Ali and Al Nsairat 2009).

Building a sustainability assessment technique promotes the application of urban development sustainability and establishment values (Cole 2005). The determination and promotion of best practice in the construction industry field considered a key strength of sustainable and ecological appraisal schemes.

A well-developed programme, with a dependable weighting structure, ought to be selected to establish the significance of a variety of sustainable considerations (Ali and Al Nsairat, 2009). Consequently, there are several multiple-criteria, decision-making (MCDM) methods that have been created by available construction appraisal structures (Alyami 2015). These methods are impacted by numerous factors, such as climatic circumstances, geographical and regional differences, socio-economic and cultural elements. Therefore, every country/region requires its structure of local indicators, to assess whether the construction industry is working in accordance with sustainability practices (Cole 2005). The AHP method as an MCDM technique provides applicable weighting systems in different areas.; It is an efficient method to identify the weighting structure for construction appraisal and assessment programs/schemes in different countries such that many global assessment tools such as BREAM, LEED, and CASBEE have employed AHP to develop their weighting systems (Curwell et al. 2005; IBEC 2011; Attaran 2013). SBTool has used AHP for its weighting system as used in Taiwan the result being that regional and cultural elements were prioritised to suit the Taiwanese urban sustainability assessment (Chang et al., 2007).

A study performed by Hikmat and Ainsairat (2009) intended to strengthen ecological appraisal tools in Jordan. Following the analysis of several well-known building assessment tools and recognising indicators appropriate to the Jordanian setting, AHP was utilised to offer an appropriate weighting structure. The result of this was the SABA Green Rating System (Ali and Al Nsairat, 2009).

A related technique, using a similar process to the AHP method, includes the Analytic Network Process (ANP) (Cheng and Li 2007). Both techniques employ pair-wise comparisons to identify the weights of factors in the primary structure, followed by the ranking of alternatives, reflecting the dominance of one aspect over another concerning shared features (Görener 2012). The ANP structure is a network, its main components consisting of clusters, factors, interrelationships between clusters and interrelationships between factors. The AHP structure consists of a goal hierarchy comprising a goal, indicators or criteria and sub-indicators (Poveda and Lipsett 2011). AHP provides the most advanced approach compared with ANP (Sipahi and Timor 2010). According to Saaty (2004); "AHP with its independence assumptions on upper levels from lower levels and the independence of the factors in a level is a special case of the ANP". Research shows that the use of the AHP technique has dominated and increased exponentially in diverse knowledge fields (Poveda and Lipsett 2011), all this indicating that AHP is the more suitable approach for the development of a weighting system for sustainable indicators (Lee and Burnett 2006; Chew and Das 2008; Ali and Al Nsairat 2009; Wong and Abe 2014). The dimensions of an urban sustainability framework are arranged in a hierarchical structure in order to meet a common target (at the top of the hierarchy). They have to achieve that goal and not implicate independent indicators that might be considered as multiple goals, such as those developed by ANP (Görener 2012).

3.6.2 Application of AHP

AHP was employed in this study, to evaluate the different categories that form the suggested Iraqi urban sustainability assessment framework (IUSAF), in order to establish an appropriate weighting system. The weight that will be given to each factor depends on a follow-up consultation with the panel of experts, in addition to using the analytical functions of Microsoft Excel software to simplify the application of the AHP steps. The AHP model, as illustrated in. Figure **3.4**, presents the hierarchy levels of the research problem. The model is divided into three levels: the goal, the highest level of the research problem; the indicators in the second evaluation level, the third level representing the sub- indicators. According to Saaty (1990), the effectiveness of the AHP hierarchical structure is that it can explain changes in priority for elements at the upper-level as they influence the priority of sub-indicators in the lower level. The hierarchical structure of this model therefore facilitates the determination of interrelationships among the framework components.

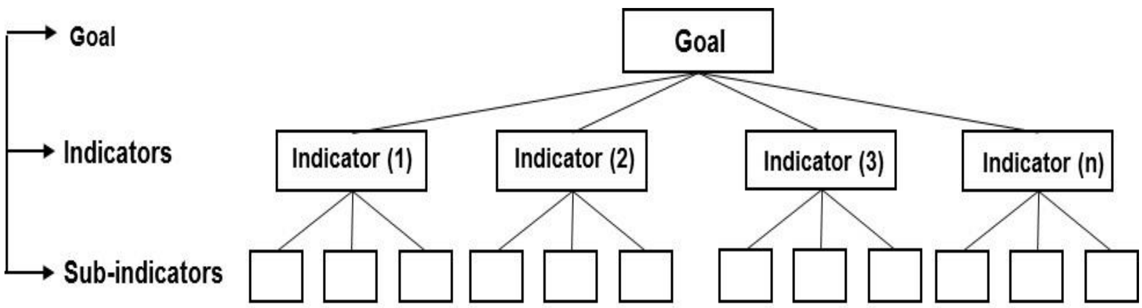


Figure 3.4: Suggested IUSAF hierarchy structure model

3.6.3 Pair- wise comparisons

The pair-wise comparisons (PCs) method represents a key stage in AHP (Table **3.3**: The Pair-wise comparison example of Delphi technique results). The method includes a mathematical structure (Matrixes) that has been built on the paired comparison of each indicator/sub-indicator over another (Saaty 1994) while also using the experts' judgment (intensity of importance), depending on Saaty's nine-point, relative importance scale (1-9), as shown in **Table 3.4**.

Table 3.3: The pair-wise comparison example

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Ecology																		Energy
Ecology																		Water
Ecology																		Waste
Ecology																		Hazard
Ecology																		Land use
Ecology																		Transportation & Infrastructure
Ecology																		Safety
Ecology																		Well-being
Ecology																		Governance
Ecology																		Innovation
Ecology																		Management & construction
Ecology																		Local culture
Ecology																		Urban space
Ecology																		Layout
Ecology																		Housing
Ecology																		Local economy
Ecology																		Jobs & businesses

Table 3.4: Relative importance scale (1-9) of AHP (Saaty 1994)

Scale	Degree of importance	Reciprocal (decimal)
1	**Equal Importance**	1 (1.000)
2	Equally to Moderately	1/2(0.500)
3	**Moderately Importance**	1/3(0.333)
4	Moderately to Strong	1/4(0.250)
5	**Strong Importance**	1/5(0.200)
6	Strongly to very strong	1/6(0.167)
7	**Very strong Importance**	1/7 (0.143)
8	Very strong to extremely	1/8 (0.125)
9	**Extreme Importance**	1/9 (0.111)

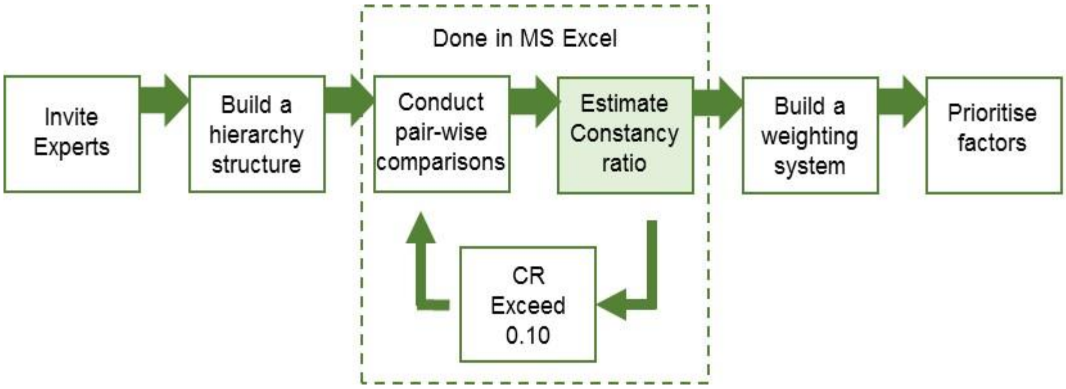


Figure 3.5: The AHP operational process

Finally, judgements can be made according to the importance of factors and their priority in the hierarchical structure, despite that fact that in some cases, priorities can be re-evaluated, either with or without changing the expert's judgements (Saaty 2008). The AHP operational process is illustrated in Figure **3.5**.

3.6.4 The AHP analysis

The consistency of judgments that the experts reached through the comparisons is an important consideration regarding the quality of the decision (Saaty 1990). AHP focuses on measuring the consensuses of experts' judgments by calculating the Consistency Ratio (CR) (Liedtka 2005) where a CR of ≤ 0.10 is considered acceptable (Saaty 1994; Triantaphyllou and Mann 1995). CR is calculated using Equation 1. Inconsistency may occur in judgments as this is inherent in the judging process, therefore, if inconsistency exceeds > 0.1, judgments are considered unreliable as they are too close to being random meaning that a further review of judgements may be required (Saaty 1990; Andijani 1998). The mathematical formulation for CR is given in Equations (1-2).

$$CR = \frac{CI}{RCI} \tag{1}$$

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{2}$$

Where, CI is the degree of consistency, $\lambda_{\max}$ is the maximum eigenvalue of the judgement matrix and RCI is random consistency index. The value of the Random Consistency Index (RCI) are based on the number of factors (size of the matrix), as acquired by estimating RCI, as shown in Table **3.5** (Donegan and Dodd 1991; Saaty and Tran 2007).

Table 3.5: Random Consistency Index (RCI)

Size of the matrix	≥2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
RCI	0	0.57	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.54	1.56	1.57	1.59

3.7 Testing the applicability of the IUSAF

To achieve the main aim of this research, case study approach utilises to test the applicability of the proposed assessment framework, its theoretical underpinning and reliability (Riege 2003; Bryman 2006), and can be completed by using either qualitative or quantitative methods or both (Darke *et al.* 1998). This process is considered an essential part of the framework development, increasing confidence in its performance (Kennedy *et al.* 2006). In this study, three urban development projects will be selected from Iraqi cities. The various features of the testing process will be discussed in Chapter Seven.

3.8 Summary

This chapter presented the various methodologies utilised in this study, in order to meet the research aim and objectives. Given that the field of urban sustainability assessment involves the examination of a wide spectrum of urban factors, a mixed methodology has been selected as the appropriate. This comprises five key stages: (a) a theoretical stage, which involved a comprehensive review of urban sustainability focusing on the comparison of global assessment tools. (b) A nationwide questionnaire conducted to investigate stakeholder perceptions of local urban development challenges. (c) Consultation with an expert panel, employing the Delphi technique, to build a list of local assessment factors. (d) Application of AHP to deliver an appropriate weighting system for each urban factor in the IUSAF, and (e) Verification of the IUSAF by applying the tool using a case study approach.

The theoretical stage focused on a comprehensive literature review of the sustainable urban development assessment field rating systems. A range of global tools were subjected to comparative analysis with the aim of consolidating urban sustainability assessment factors. The second stage is an investigation of stakeholder perceptions in order to identify key urban challenges and priorities for Iraqi cities. This is a significant step towards integrating stakeholders' aspirations into urban development policies and activities. The third stage is consultation with an expert panel to seek consensus on the most relevant urban sustainability assessment factors for the Iraqi context. The Delphi technique plays an important role in achieving this objective. It is a systematic process, based on three consecutive rounds, including brainstorming, revision and narrowing down and rating. This technique identified the urban assessment factors that will comprise the weighting system, AHP applied to achieve this demand, based on a pair-wise comparison strategy to identify the priority of each urban factor. Finally, the proposed framework will be applied to the three existing case studies from Iraqi to test out its applicability.

Chapter 4
Investigation of stakeholders perceptions of urban challenges

This chapter investigates stakeholders' perceptions of urban development challenges, their importance and level of priority. A nationwide questionnaire (n = 643) was designed based on the findings of a comprehensive review of state of the art quantitative methodologies to investigate environmental, social and economic urban challenges. The survey was conducted using a 44-item, structured questionnaire where responses were rated on a 5-point Likert-type scale, in addition to collecting demographic information, e.g., gender, age, occupation, qualifications, region and location. Principal component analysis (PCA) and statistical tests to measure the consistency reliability and sampling adequacy of the questionnaire items were applied to investigate the relationship between perceptions of urban challenges and demographic factors.

4.1 Questionnaire development

The questionnaire was developed in five stages:

First, an initial list of urban challenges indicators was identified based on an extensive review of the literature on sustainable urban development goals. Attention was paid to the relevance of the identified environmental and socio-economic indicators to the cities of Iraq and the Middle East.

Second, the author visited four Iraqi governorates from the central and southern regions, namely Baghdad, Babel, Karbala and Al-Najaf, between November and December 2014. Stakeholders from public, professional and government groups were contacted by mobile phone, through social media and via internal communications with relevant government departments (e.g., the Ministry of Housing), and municipalities (e.g., the Municipality of Karbala, Najaf and Babylon) The Institute of Urban and Regional Planning, National Investment Commission, and the civil society and NGOs were also contacted. Several interviews were held with interested stakeholders in order to investigate their views on the identified urban indicators as well as other relevant local socio-economic challenges of urban development. In light of these interviews, the list of urban indicators was refined to enhance clarity, resulting in a final list of 44 items, 25 environmental items and 19 socio-economic items.

Third, a draft online questionnaire was developed based on the first two stages. The questionnaire was first created in English then translated into Arabic to enable wider participation from participants who might not be well-versed in English. Two professional translators reviewed the final draft to check for accuracy and clarity of the survey material. The draft was then evaluated in a pilot survey to analyse the thoroughness and clarity of the urban items related to the psychometric features of the instrument. There were 16 pilot study participants including urban designers, city planners, university professors, architects, engineers and different members of the public. All participants were asked to comment on content deficiencies (if any), the length of the survey, the comprehensibility of the components, other potential perceptions and the importance of the urban items. The results of the pilot questionnaire were adopted in the amended final questionnaire, thus improving content validity.

Fourth, the ‘online distribution technique’ approach was used in this study. It is a quick method, compared with using a manually distributed questionnaire, and is less expensive (Weible and Wallace 1998; Huang 2006), especially when it needs to be distributed at the national level (Hamilton-MacLaren *et al.* 2013). A snowball sampling technique was also applied, considered a robust and appropriate academic approach for large-scale distributions across cities/regions of a country (Dragan and Maniu 2013). The questionnaire was distributed between December 2014 and April 2015 using SurveyMonkey. This web tool facilitates the broad distribution of questionnaires and enables the authors to control and monitor responses and to quickly start a preliminary analysis of the responses (Baker *et al.* 2010).

Fifth, face-to-face interviews were conducted with two age groups, those aged 55-60 years and 61 years and above, as they have the lowest internet usage rate. One of the researchers went through the questions from the questionnaire during the interviews and recorded the responses on the SurveyMonkey web tool using an internet- enabled Tablet.

In both the fourth and fifth stages, participants were asked to rate their perceptions of the questionnaire items on a 5-point Likert-type scale, ranging from 1 to 5, where 1= unimportant; 2= of little importance; 3= moderately important; 4= important, and 5= very important. The questionnaire also contained open-ended questions to enable respondents to provide comments on items, or other significant factors they thought were important. Demographic information; age, gender, occupation, academic qualification, governorate (i.e. region) and the location of their home (i.e. urban, suburban or rural) was requested.

4.2 The respondents’ characteristics

A total of 643 responses were received, of which 411were complete. The remaining analysis is on these 411 valid responses. Table **4.1** summarises the demographic characteristics of the respondents, which are described below.

- **Gender**: Approximately two-thirds of the respondents (68.4%) were male, 31.6% female.

- **Age**: 19.2% were aged between 25 and 30 years, this age representing the highest rate of participation, followed by 15.8% for 41–45 years. The >61 age group had the lowest participation, at 4.4%.
- **Occupation**: 53% of the respondents were government employees, primarily because Iraqi Government provides more than 40% of jobs; 45% in urban and 28% in rural area (UNDP 2017). The unemployed, students and homemakers, represented the second largest group of respondents (16.5%).
- **Qualifications**: 49.1% of the respondents had an undergraduate degree as their highest qualification, followed by 32.8% with a post-graduate degree. 18% had either studied up to secondary school or had no formal qualifications.
- **Geographical coverage**: the highest participation was from the southern region (65.9%), followed by the central (32.4%) and northern (1.7%) regions.
- **Location**: most of the respondents lived in urban areas (83%), followed by suburban (13.9%) and rural (3.2%) areas.

Table 4.1: Respondent's demographic factors

Variable	Scale	Frequency	Total (%)
Gender	Male	281	68.4
	Female	130	31.6
Age group (year)	18- 24	57	13.9
	25- 30	79	19.2
	31- 35	58	14.1
	36- 40	57	13.9
	41- 45	65	15.8
	46- 50	34	8.3
	51- 55	19	4.6
	56- 60	24	5.8
	>61	18	4.4
Occupation	Government employee	218	53.0
	Non-government employee	62	15.1
	Self-employed	63	15.3
	Other	68	16.5
Qualification	Post-graduate degree	135	32.8
	Undergraduate degree	202	49.1
	Up to secondary school	74	18.0
Region*	Central	133	32.4
	Southern	271	65.9
	Northern	7	1.7
Location	Urban	341	83.0
	Suburban	57	13.9
	Rural areas	13	3.2

Notes:
* Region are defined as comprising the following governorates; i.e. administrative units:
- Central: Baghdad, Dayala, Al- Anbar, and Salah Al-Deen.
- Southern: Babylon, Karbala, Al-Najaf, Wasit, Al-quadisiya, Maysan, Al-Muthanna, Thi-Qur, and Al-Basrah
- Northern: Erbil, Sulaymaniya, Douhok, Kirkuk, and Nainawa.

4.3 Data analysis and interpretation of the environmental factors

4.3.1 Descriptive analysis

The 25 environmental items were ranked based on the mean scores which ranged between 3.40 and 4.56, on a Likert-type scale of 1–5, as shown in Table **4.2**.

The results suggest that Iraqi stakeholders are more concerned about wider environmental aspects such as water, transport modes, infrastructure, vegetation cover, and energy management. The respondents' views broadly coincide with prior findings regarding environmental challenges identified through the literature review. 20 of the total 25 environmental items had mean scores greater than 4 (= important), the remaining 5 having mean scores greater than 3 (= moderately important).

Table 4.2: Descriptive analysis of the environmental factors

Environmental Items	**Response* (%)**					**Mean**	**Mode**	**SD**
	1	2	3	4	5			
Water conservation	1.0	1.7	5.6	22.8	68.9	4.56	5	.759
Increase choice of transport modes	2.4	1.7	5.8	26.7	63.4	4.46	5	.872
Efficient infrastructure and utilities	1.2	1.6	14.5	15.5	67.2	4.45	5	.886
Increase vegetation cover	1.6	2.0	16.2	11.7	68.5	4.43	5	.943
Promote the use of public transport	1.0	1.5	10.2	34.3	53.0	4.36	5	.802
Effective and smart management of energy resources	2.4	3.4	10.0	26.5	57.7	4.33	5	.959
Reduce environmental pollution	2.0	3.3	16.2	19.1	59.4	4.30	5	.990
Desertification of lands	1.9	3.8	12.9	24.7	56.7	4.29	5	.968
Sewage treatment	3.4	4.9	9.2	24.1	58.4	4.29	5	1.046
Waste separation and recycling	2.9	3.9	11.4	29.0	52.8	4.24	5	1.000
Sandstorms	1.5	3.8	15.3	29.0	50.4	4.22	5	.945
Maximise the use of renewable energy	3.4	6.8	14.6	21.7	53.5	4.15	5	1.113
Minimise water consumption	2.0	5.5	19.5	21.4	51.6	4.14	5	1.047
Reduce vehicles on road	2.0	4.7	19.5	25.8	48.0	4.12	5	1.016
Minimise GHG emissions	3.9	5.5	17.8	20.3	52.5	4.11	5	1.123
Drought	2.4	6.8	15.6	27.0	48.2	4.11	5	1.057
Minimise energy consumption	1.6	4.9	23.8	23.6	46.1	4.07	5	1.019
Water recycling	3.9	5.1	14.4	33.3	43.3	4.07	5	1.032
Increase waste recycling	3.9	4.3	19.5	27.0	45.3	4.05	5	1.062
Walking as a means mobility	3.9	7.8	20.0	25.7	42.6	3.95	5	1.134
Reuse of materials	3.2	6.5	21.2	35.3	33.8	3.90	4	1.035
Use of greywater	4.6	4.4	23.8	32.1	35.1	3.88	5	1.044
Promote the use of alternative sources of water	3.4	7.5	23.6	29.7	35.8	3.86	5	1.089
Rainwater harvesting	6.6	10.7	19.2	30.4	33.1	3.72	4	1.213
Promote the use of the bicycle	8.5	17.3	24.6	24.3	25.3	3.40	4	1.267

Notes:
*Response scales are as follows:
1. Unimportant; 2. Of little importance; 3. Moderately important; 4. Important; 5. Very important

Overall, approximately 70% of the respondents considered ‘water conservation’ the most significant urban environmental challenge for Iraqi cities. This item achieved the highest mean score ($\bar{x}$ = 4.56) and the lowest SD (σ = 0.759), followed by increase in choice of transport modes. The indicator ‘efficient infrastructure and utilities’ was ranked third, followed by ‘increase vegetation cover’ and ‘promote the use of public transport’, respectively. The respondents considered ‘promote the use of the bicycle’ the least important item, with the lowest mean score ($\bar{x}$ = 3.40) and the highest SD (σ = 1.267), preceded by rainwater harvesting.

The results suggest that Iraqi stakeholders are more concerned about wider environmental aspects such as water, transport modes, infrastructure, vegetation cover, and energy management. The respondents’ views broadly coincide with prior findings regarding environmental challenges identified through the literature review.

4.3.2 Principle Component Analysis (PCA)

The results of the PCA, the scale factor values (loading) after rotation, eigenvalues and percentages are presented in Table **4.3**. All environmental items had a substantial factor in the range of 0.4 to 0.8. An initial analysis was run for each component to obtain eigenvalues over Kaiser’s criterion, which is greater than 1.0. The eigenvalues of the five factors ranged from 1.044 to 9.549. Bartlett’s test of sphericity as a factor solution showed a significant correlation among questionnaire items ($p<0.000$), suggesting that all selected variables were related to each other and suitable for further analysis. KMO= 0.918 verified the sampling adequacy, indicating that the environmental variables were appropriate for factor analysis and can be considered of high value (Zhao and Mourshed 2012). The total variance extracted was 63.72%. PCA was applied to investigate the relationship between the perceptions of the environmental challenges. Five principal components were identified, namely: environmental impact; water, waste, and materials; natural hazard; personal mobility, and transport. The first component, ‘environmental impact’, was clustered by ten items, and represented the largest percentage of explained variance (38.19%). While the fourth and fifth components had only two items, accounting for 5.4% and 4.17% of the variance respectively.

None of the 25 items had dual loading, which is an indication of questionnaire clarity. Given the large sample size, the convergence of the scree plot and Kaiser’s criterion results, five components have been retained for final analysis. Reliability estimates (Cronbach’s alpha) for all generated components were greater than 0.60, as shown in Table **4.3**, indicating a robust internal reliability

Table 4.3: Rotated Component Matrix of the survey items

Items	Component				
	Environ-mental impact	**Water, waste & materials**	**Natural hazards**	**Personal mobility**	**Transport**
Reduce environmental pollution	**.837**	-	-	-	-
Increase vegetation cover	**.826**	-	-	-	-
Efficient infrastructure and utilities	**.816**	-	-	-	-
Minimise GHG emissions	**.806**	-	-	-	-
Minimise water consumption	**.763**	-	-	-	-
Reduce vehicles on road	**.755**	-	-	-	-
Minimise energy consumption	**.744**	-	-	-	-
Increase waste recycling	**.719**	-	-	-	-
Effective and smart management of energy resources	**.506**	-	-	-	-
Maximise the use of renewable energy	**.458**	-	-	-	-
Promote the use of alternative sources of water	-	**.711**	-	-	-
Use of recycled/ grey water	-	**.705**	-	-	-
Water recycling	-	**.688**	-	-	-
Reuse of materials	-	**.669**	-	-	-
Sewage treatment	-	**.667**	-	-	-
Waste separation and recycling	-	**.633**	-	-	-
Rainwater harvesting	-	**.632**	-	-	-
Water conservation	-	**.497**	-	-	-
Desertification of lands	-	-	**.817**	-	-
Drought	-	-	**.762**	-	-
Sandstorms	-	-	**.678**	--	-
Promote the use of the bicycle	-	-	-	**.815**	-
Walking as a mean of mobility	-	-	-	**.803**	-
Increase choice of transport modes	-	-	-	-	**.659**
Promote and provide for the use of public transport	-	-	-	-	**.641**
Cronbach's alpha coefficient (0.925)	.918	.866	.751	.706	.657
Eigenvalues	9.549	2.477	1.509	1.351	1.044
Percentage of explained variance 63.721	38.194	9.910	6.036	5.404	4.177

between the questionnaire items with similar attributes (Cerny and Kaiser 1977). Cronbach's alpha was 0.925 indicating a very high level of reliability between the environmental items (Tavakol and Dennick 2011).

4.3.3 Relation between personal information and perception of environmental challenges

Participants were regrouped, the variables re-categorised to summarise the data analysis and interpretation. Data distribution was not normal so non-parametric tests were applied on all survey items. Mann-Whitney U-test was applied for 'gender', while a Kruskal-Wallis test was carried out on 'occupation', 'qualification', 'region' and 'location'. All demographic characteristics, except location, showed statistically significant differences in perceptions, as indicated in Table **4.4**: Non-parametric test results

.

Table 4.4: Non-parametric test results

PCA	Questionnaire items	Non-parametric test (p- value*)					
		Gender†	Age group‡	Occupation‡	Qualification‡	Region‡	Location ‡
Minimise environmental impact	Efficient infrastructure and utilities	.427	.067	.877	.223	.581	.324
	Increase vegetation cover	.946	**.046***	.798	.117	.424	.430
	Effective and smart management of energy resources	.427	.067	.877	.223	.581	.324
	Reduce environmental pollution	.281	.153	.273	.085	.589	.882
	Maximise the use of renewable energy	.835	.295	.181	.249	.696	.477
	Minimise water consumption	.057	.095	.864	.160	.784	.346
	Reduce vehicles on road	.121	.110	.935	.055	.556	.898
	Minimise GHG emissions	.405	**.018***	.261	.650	.263	.799
	Minimise energy consumption	**.001***	.575	.821	.061	.845	.689
	Increase waste recycling	.052	.062	.245	**.033***	.696	.534
Water, Waste and Materials	Water conservation	.529	.058	.431	.353	.943	.697
	Sewage treatment	.901	.903	.135	.212	**.047***	.139
	Waste separation and recycling	.099	.089	**.010***	.108	.172	.995
	Water recycling	.810	.188	**.018***	.314	.263	.650
	Reuse of materials	.892	.866	.087	.163	.660	.592
	Use of greywater	.436	.186	**.031***	.249	**.002***	.422
	Promote the use of alternative sources of water	.972	.059	.510	.931	**.022***	.548
	Rainwater harvesting	.240	.361	.132	.293	.832	.301
Natural Hazard	Desertification of lands	.480	.128	.592	.838	.306	.843
	Sandstorms	.180	.311	.271	.341	.147	.235
	Drought	.861	.144	.211	.824	.057	.719
Personal mobility	Walking as a mean of mobility	.053	.168	.356	.836	.174	.701
	Promote the use of the bicycle	**.013***	.723	.796	.241	.922	.985
Transport	Increase choice of transport modes	.463	**.004***	.947	.716	.793	.094
	Promote the use of public transport	.756	.663	.416	.631	.448	.982

Notes:
* $p < 0.05$, † Mann-Whitney *U-test*, ‡ Kruskal-Wallis test

Gender has a significant effect on perceptions about minimising energy consumption, while ‘age group’ has a significant effect on perceptions about increasing vegetation cover, minimising GHG emissions and increasing choice of transport modes. Occupation has a significant effect on the perception of water, waste and materials and the use of recycled/greywater, water recycling waste separation and recycling items.

The region variable has a significant effect on perception about the items water, waste, and materials, promoting the use of alternative sources of water, use of recycled/grey water and the need for sewage treatment. Finally, qualification has a significant effect on perceptions regarding minimising the environmental impact component of increase waste recycling items. The environmental challenges indicators have a high level of significance ($p < 0.05$).

4.3.4 Discussion of environmental results

The results of the PCA identified five structured components that have high internal consistency. The discussion of environmental challenges, therefore, will be based on the PCA components, according to their importance and priority, as shown in Table **4.3** above. This structure of local urban environmental challenges can be considered a keystone to steer decision makers to achieve sustainable urban development (O'Faircheallaigh 2010).

- **Environmental impact**

Environmental impact is the biggest PCA component, comprising ten items with a mean score greater than 4.00, indicating high importance for all constituent items. ‘Efficient infrastructure and utilities’ was the most important item in the group. Infrastructures in Iraqi cities have suffered severe damage due to political instability (Foote *et al.* 2004). Despite significant investment and the development of partners in reconstruction, most efforts to update the infrastructure have been largely unsuccessful. This is due to a lack of security, corruption, insufficient funding and a lack of coordination between local Iraqi officials and specialised global actors (GAO 2005). Reconstruction efforts in Iraq are ongoing but unprofessional and slow (EIA 2013).

‘Increase vegetation cover’ was rated second most important. This represents a global environmental trend and has a significant effect on weather and climate variability, influencing the amount of water vapour and CO_2 in the air (Bonan *et al.* 1992), as well as its more immediate role stabilising dune areas and mitigating the impact of sandstorms (Brovkin 2002). There has been a significant decrease in vegetation cover in central and southern Iraq, where the number of palm trees decreased from 30 million to about 10 million during 2000-2012 (WHO 2015). ‘Vegetation cover’ can play a crucial role in physical, social and ecological planning to achieve urban socio-ecological sustainability of the Iraqi environment (Abbas *et al.* 2014).

‘Effective and smart management of energy resources’ was rated third most important, representing another global aim for flexible and economic production and distribution of energy, while increasing the share of renewables. Smarter power systems and electricity grids can enable Iraq to provide flexible services at the local level. The challenge is how to adapt current institutions to make the country a ready market for new applications, as well as to enhance energy efficiency in a cost-optimal way (SWECO 2015). Smart management of electricity generation and distribution grids can meet environmental sustainability and energy-efficiency policy goals (Mourshed *et al.* 2015), but requires significant investment and effective policies (Widergren *et al.* 2011).

‘Reduce environmental pollution’ was rated fourth. Pollution increases with population and economic growth, increased consumption, transportation and industrial production (Yang *et al.* 2005). For example, in Iraq, the dependence on fossil fuels for economic activities has increased by more than 92% (UNEP 2015). Pollution has significant and dangerous effects in developing countries, a situation which has yet to be sufficiently addressed, the evidence demonstrating that environmental risk factors regularly play a role in more than 80% of diseases (YCELP 2008). Four decades of war in Iraq has resulted in significant chemical pollution, exposing civilians to hazardous materials. Some Iraqi regions are suffering from depleted uranium (DU) pollution, as a result of the Gulf War and military operations of 1991 and 2003—impacting on public health and increasing the incidence of cancers and congenital disabilities (Fathi *et al.* 2013). Reducing environmental pollution, therefore, will lead to improving environmental health, and it should be the top policy priority.

The item ‘maximise the use of renewable energy’ is the fifth item in the environmental group. Nowadays, energy is considered the lifeblood for various sectors implying that effective and efficient energy management is required (Kharaka and Dorsey 2005). Increasing the share of renewable energy results in a cleaner, healthier environment, with improved local air quality and reduced GHG emissions (Siegel *et al.* 2010). Despite being a major hydrocarbon producer and exporter, Iraq has significant potential for renewable energy resources such as solar and wind energy. Diversification of the energy mix is essential for the development of Iraq’s energy infrastructure to meet the growing demand for energy.

The remaining environmental items in this component have also been identified in previous studies as global urban challenges such as ‘minimise water consumption’, ‘reduce vehicles on road’, ‘minimise GHG emissions’, ‘reduce energy consumption’, ‘minimise water consumption’, ‘minimise energy consumption’, and ‘increase waste recycling’(Omer 2008; Siegel *et al.* 2010) but their importance varies across regions. While these global challenges need to be addressed through collective action, responses are critical to enhancing local capacity, increasing public awareness and providing solutions for nations with regional commonalities. Responses at national and international levels interact to tackle urban challenges and can generate a gradual, structural and transformational modification in the management of environmental issues in the future

(Sharifi and Murayama 2013).

- **Water, waste and materials**

Representing the second component from the PCA, this has eight different items linked mainly to resource efficiency, mean scores ranging from 3.72 to 4.56, which highlights the disparity in the importance of various indicators in the component. ‘Water conservation’ was rated as the most important, also considered the most important indicator in the whole questionnaire. The Arab world is considered the most water-scarce region in the world. By the middles of this century, as populations grow, demand rises and climate changes; it is projected that the amount per capita water available will decrease by half (Michel *et al.* 2012). The water in Iraq’s rivers (Tigris and Euphrates) will decrease by between 50% and 80% by 2025 (CSO 2013). A government report showed that Iraq's per capita share of water decreased by 35.2% in 2014 compared to 2012 (CSO 2015). Drinking water supplied to Iraqi cities, at present is projected to be insufficient in the future and may cause humanitarian crises (UNESCO 2010).

‘Sewage treatment’ was rated second. This is seen as a fundamental problem for developing countries, where poor quality effluent from municipal wastewater treatment plants, causes the pollution of water in lakes and rivers (ECO 2003). Political instability in Iraq has resulted in the destruction of vital infrastructures, including sewage plants. 6.2% of the Iraqi population does not have access to basic sanitation facilities, resulting in an increased risk of disease, particularly among vulnerable group such as women and children (UN 2013). This requires an effective solution for wastewater treatment in existing and future urban development projects.

‘Waste separation and recycling’ was rated third and is considered one of the fundamental processes towards achieving urban sustainability. Recycling waste reduces air and water pollution by decreasing the need for waste disposal and bringing about lower GHG emissions. Many studies have found that separating and recycling waste (rubbish) is a preferable solution in comparison to incineration or landfill (FoEEUROPE 2013), however, some reports suggest that only 30% of the waste generated in cities in developing countries is collected and separated (Ezeah *et al.* 2013). In Iraqi cities, waste and resource management services have seen years of deterioration. Traditional solid waste treatments are still prevalent, despite their negative impact on the environment (Knowles 2009)

‘Reuse and recycle water’ is regarded as a sustainable option to tackle the increasing mismatch between available water resources and the rising demand for water (OECD 2009). With the gradual decrease in availability of water in the Arab region in general, water recycling will play a fundamental role in the coming decades.

The rest of the component factors have been ranked with mean scores less than 4.00. They ranged from 3.72 to 3.9 for ‘reuse of materials’, ‘use of greywater’, ‘promote the use of alternative sources of water', and 'rainwater harvesting' respectively, which indicates moderate importance. The item 'rainwater harvesting' was considered 'moderately important' to the public probably due to the scarcity and lack of rainfall in all Middle East countries (Lange *et al.* 2012) and Iraq in particular. The average annual rainfall is less than 100 mm over 60% of the country specifically in the central and southern regions which also sees high rates of evaporation (Al-Ansari 2013).

- **Natural hazards**

The third group is comprised of natural disasters, 'desertification of land' coming first, receiving the highest mean score of 4.29, indicating that stakeholders perceive it as a priority. Desertification in Iraq threatens food security and affects social and economic development. 75% of Iraq's total arable (Saidi and Al-Jumaiali 2013) and 61% of agricultural land are affected by desertification (Abbas *et al.* 2014). Desertification received the highest mean score of 4.29, indicating that stakeholders perceive it as a priority.

'Sandstorms' was rated second. Considered as extremely violent and unpredictable phenomena, Iraq experiences a high incidence of sandstorms. They occur unexpectedly and affect regional climatic changes such as decreases in annual rainfall and environmental changes such as drying marshlands, land degradation land and desertification (Sissakian *et al.* 2013). 'Sandstorms' was followed by 'Drought', which came third. Many of agricultural areas in southern Iraq are vulnerable to drought, one of the worst occurring in 2007, affecting agricultural crop production (Shean 2008).

Natural hazards, therefore, need innovative environmental solutions at the forefront of urban sustainability. It is worth mentioning that natural hazards such as earthquakes and volcanic eruptions are rare or non-existent in Iraq.

- **Personal mobility**

The fourth component has two items: 'walking as a means of mobility' and 'promote and provide the use of the bicycle' both ranked as moderately important by the respondents. Walking is considered the most efficient means of mobility in many Iraqi regions, especially in the capital Baghdad, because of ongoing security issues such as security checkpoints, the sudden closure of main roads and the lack of car parking. These factors have changed traffic movement completely, reducing the use of private cars, thereby promoting walking or using bicycles or motorcycles, especially for short distances (Sarsam 2013). However, intense heat in summer, dusty air and a lack of shaded walkways discourage people from walking or cycling. It is rare for those aged forty years and over to cycle because of social concepts and prevailing constraints. This was revealed by the face-to-face interviews.

- **Transport**

The final component, transportation, also comprises two items. 'Increased choice of transport modes' was ranked as the second most important item overall. Diversity in transportation modes represents an urban challenge for many Iraqi cities as transport systems suffer from shortages regarding alternative means of public transport such as trains, buses and subways as well as a clear lack of marine transport systems (Al-Akkam 2012). This indicator has not received much attention in the past and has not been emphasised in the previous literature as an urgent public need. The questionnaire findings indicated that respondents were highly aware of transport issues by emphasising the need for diversity in transportation modes and the use of public transport. As seen in Table 4.2, 'promoting the use of public transport' was rated second in this component, regarded as the fifth most important environmental indicator with a mean score of 4.36. In Iraq, public transportation systems are not fully developed meaning that private cars are the dominant type of road transport (UNEP 2015).

It is important to mention that face-to-face interviews revealed some participants as having quite strong opinions, such as an unwillingness to reduce energy consumption to compensate for the lack of electricity. Some considered that 'water recycling' and 'the use of grey water' was inconsistent with the concepts of social and religious norms relating to being unclean and thus these measures could not be used. There is therefore, an urgent need to establish campaigns to increase public awareness of some sustainability aspects to achieve sustainable urban development in the present and the near future.

4.4 Data analysis and interpretation of the socio-economic factors

4.4.1 Descriptive analysis

19 socio-economic items were ranked, based on the mean scores ranging between 3.56 and 4.59, on a Likert-type scale of 1–5, as shown in Table **4.5**.

Overall, approximately 73% of the respondents considered 'safety of public places' the most significant urban socio-economic challenge. This item had the highest mean score ($\bar{x} = 4.6$) and the lowest SD ($\sigma = 0.764$), followed by 'minimise unplanned housing' ($\bar{x} = 4.59$). The indicator 'provision of affordable housing' was ranked third, followed by 'promote the tourism sector' and 'preservation of historical buildings' respectively. Respondents considered 'promote high-rise housing' the least important item, with the lowest mean score ($\bar{x} = 3.56$) and the highest SD ($\sigma = 1.312$), preceded by the item 'use of sustainable local materials in construction'.

The results suggest that Iraqi stakeholders are more concerned about the current security conditions, as well as the importance of enhancing housing aspects. The respondents' views broadly coincide with prior findings regarding socio-economic challenges initially identified through the literature review. Sixteen of the nineteen socio-economic items had mean scores greater than 4 (= important), while only five had mean scores greater than 3 (= moderately important).

Table 4.5: Descriptive analysis of the socio- economic factors

Items	Response* (%)					Mean	Mode	SD
	1	2	3	4	5			
Safety of public places	1.1	1.6	6.0	19.0	72.3	4.6	5	.764
Minimise unplanned housing	2.9	1.8	5.6	12.4	77.3	4.59	5	.901
Provision of affordable housing	1.3	2.2	5.9	20.6	70.1	4.55	5	.809
Promote the tourism sector	.8	1.9	8.3	19.3	69.7	4.55	5	.790
Preservation of historical buildings	.8	2.1	7.9	21.1	68.1	4.53	5	.793
Promote integrated urban security systems	.8	2.4	7.9	22.4	66.5	4.51	5	.804
Use of traditional building methods	1.9	2.1	16.6	34.3	45.1	4.51	5	.804
Increase housing projects	.3	1.8	7.9	29.3	60.7	4.48	5	.742
Security in buildings	1.1	1.1	9.5	27.4	60.9	4.46	5	.793
Encourage investments in urban projects	.3	3.2	10.2	23.6	62.7	4.45	5	.823
Preservation of vernacular buildings	2.1	1.1	12.1	24.3	60.4	4.39	5	.895
Contribution of urban projects in the provision of employment opportunities	.8	3.5	12.6	27.3	55.8	4.33	5	.885
Promote identity and local culture	.8	2.9	12.4	35.4	48.5	4.27	5	.848
Provide quality housing	1.4	4.9	20.3	27.9	45.5	4.11	5	.986
Preservation of the hierarchy in public and private places	1.8	3.5	20.3	38.0	36.4	4.03	4	.933
Provide minimum standards based on household size	2.9	5.8	16.4	37.2	37.7	4.01	5	1.018
Promote individual housing units	4.2	13.2	25.3	28.0	29.3	3.64	5	1.155
Use of sustainable local materials in construction	5.3	10.6	30.5	25.6	28.0	3.60	3	1.153
Promote high-rise housing	9.5	12.9	21.4	24.0	32.2	3.56	5	1.312

Notes:
*Response scales are as follows:
1. Unimportant; 2. Of little importance; 3. Moderately important; 4. Important; 5. Very important

4.4.2 PCA results

The PCA results, scale factor values (loadings) after rotation, eigenvalues and percentages, are presented in Table **4.6**.

All questionnaire items had an acceptable factor in the range 0.4 to 0.8. Five summated indices were extracted from the 19 items: economic; cultural; safety and security; design context and housing demand. A preliminary analysis was run for each component to obtain eigenvalue over Kaiser's criterion, which was found to be greater than 1.0. The eigenvalues of the five factors ranged from 1.033 to 7.068. Bartlett's test of sphericity as a factor solution, revealed significant correlations between questionnaire items ($p<0.000$), suggesting that all selected variables were related to each other and suitable for further analysis. The KMO (0.892) measure verified the sampling adequacy, indicating that the questionnaire variables were appropriate for factor analysis and can be considered high value (Zhao and Mourshed 2012). The total variance extracted was 63.86%. The first component, 'economic', was a cluster of six items representing the largest percentage of explained variance (37.199%). The third, fourth and fifth components had three

Table 4.6: Rotated Component Matrix of the socio-economic items

Item	Component				
	Economic	Cultural	Safety and security	Design context	Housing demand
Encourage investments in urban projects	**.825**	-	-	-	-
Promote the tourism sector	**.809**	-	-	-	-
Provision of affordable housing	**.765**	-	-	-	-
Contribution of urban projects in the provision of employment opportunities	**.656**	-	-	-	-
Minimise unplanned housing	**.483**	-	-	-	-
Preservation of vernacular buildings	-	**.824**	-	-	-
Preservation of historical buildings	-	**.792**	-	-	-
Preservation of the hierarchy in public and private places	-	**.609**	-	-	-
Promote identity and local culture	-	**.595**	-	-	-
Use of sustainable local materials in construction	-	**.534**	-	-	-
Security in buildings	-	-	**.828**	-	-
Safety of public places	-	-	**.766**	-	-
Promote integrated urban security systems	-	-	**.692**	-	-
Promote individual housing units	-	-	-	**.754**	-
Ensure minimum standards dwelling size based on household size	-	-	-	**.536**	**.524**
Use of traditional building methods	-	**.427**	-	**.499**	-
Promote high-rise housing	-	-	-	-	**.864**
Provide quality housing	-	-	-	-	**.470**
Increase housing projects	-	-	-	-	**.446**
Cronbach's alpha coefficient (0.867)	.827	.803	.801	.546	.544
Eigenvalues	7.068	1.625	1.273	1.134	1.033
Percentage of explained variance 63.860	37.199	8.552	6.702	5.971	5.436

items, accounting for 6.7%, 5.97% and 5.43% of the variance, respectively. Two of the 19 items had dual loadings, 'provide minimum standards based on household size' had loadings of 0.524 and 0.536 on housing demand and design context factors, respectively. 'Use of traditional methods of natural lighting and ventilation for buildings' had loadings of 0.427 and 0.499 on 'cultural' and 'design context' factors, respectively. If the items were deleted, the value of Cronbach alpha would decrease to less than 0.8. In contrast, with a mean score of 4.01 out of 5.00, the respondents ranked the item 'provide minimum standards based on household size' as very important. Considering the above, both factors were retained in the 'design context' component along with the original loadings of the items.

4.4.3 Relationships between personal information and perception of socio-economic challenges

Participants were regrouped and the variables re-categorised to analysis and interpretation the data. Firstly, the data was not normally distributed so non-parametric tests were applied to all survey items. A Mann-Whitney U-test was carried out on 'gender' while a Kruskal-Wallis test was carried out on 'occupation', 'qualification', 'region' and 'location'.

Table 4.7: Results of non-parametric tests

PCA	Questionnaire items	Non-parametric test (p- value*)					
		Gender†	Age group‡	Occupation‡	Qualification‡	Region‡	Location‡
Economic	Encourage investments in urban projects	.176	.455	.103	.659	.593	.587
	Promote the tourism sector	**.035***	.820	.511	.396	.093	.678
	Provision of affordable housing	.868	.366	.456	.402	.950	.728
	Contribution of urban projects in the provision of employment opportunities	.483	.235	.368	.246	.685	.345
	Minimise unplanned housing	**.026***	**.016***	.151	.397	.142	.726
Cultural	Preservation of vernacular buildings	.677	**.023***	.301	**.040***	.173	.866
	Preservation of historical buildings	.691	**.006***	.502	.143	**.030***	.452
	Preservation of the hierarchy in public and private places	.389	.936	.685	.961	.104	.904
	Promote identity and local culture	.583	**.016***	.877	.826	.262	.784
	Use of sustainable local materials in construction	.412	.562	.463	.410	.867	.161
Safety and security	Security in buildings	.117	**.042***	.548	.060	.984	.979
	Safety of public places	.107	**.025***	.270	.954	.182	**.055***
	Promote integrated urban security systems	.450	.293	.484	**.050***	.830	.373
Design context	Promote individual housing units	.276	**.003***	.998	.840	.134	.156
	Ensure minimum standards dwelling size based on household size	.623	**.025***	.523	.519	.881	.722
	Use of traditional building methods	.885	.068	.503	.290	.313	.472
Housing demand	Promote high-rise housing	.187	.920	.900	.713	**.042***	.793
	Provide quality housing	.370	.071	.725	.389	.389	.872
	Increase housing projects	.632	**.012***	.480	.537	.074	.962

Notes:
* $p < 0.05$, † Mann-Whitney *U-test*, ‡ Kruskal-Wallis test

All demographic characteristics, except occupation, showed statistically significant differences in perception, as shown in Table **4.7**. Age group has a significant effect on perceptions of all components, especially the items: 'minimise unplanned housing', 'preservation of vernacular buildings', 'preservation of historical buildings', 'promote identity and local culture', 'security in buildings', 'safety of public places', 'promote individual housing units', and 'increase housing projects'. Gender has a significant effect on perceptions about 'promote the tourism sector' and 'minimise unplanned housing'. Qualification has a significant effect on perception about 'preservation of vernacular buildings' and 'promote integrated urban security systems'. Region has a significant effect on perceptions regarding the 'preservation of historical buildings' and 'promote high-rise housing'. Finally, location has a significant effect on perception about 'safety of public places'. All the urban socio-economic challenges indicators reached a high level of significance ($p < 0.05$).

4.4.4 Discussion of socio-economic results

Among the socio-economic urban factors, 'safety of public places' was ranked as the most important challenge ($\bar{x} = 4.598$), followed by ‘minimize unplanned housing’ and ‘provision of affordable housing’. The importance of safety is an indication of how concerned this society is about the current security situation in Iraq so much so that safety is perceived as more important than the provision of housing, a recognized necessity.

Conversely, the item ‘promote high-rise housing’ with the highest standard deviation ($\sigma = 1.312$), was considered to be the least important. Items ‘use of sustainable local materials in construction’ and ‘promote individual housing units’ were the second and the third least important items.

A lack of importance given to key determinants of sustainability such as materials and urban densification highlights the gap in what is considered important between theorists and end–users.

Stakeholders are more concerned about socio-economic aspects such as safety, housing, healthcare, investments, tourism sector and culture. The findings from the PCA resulted in five structured components. Internal consistency was high, even when some of the components included only three items. The discussion on the indicators, therefore, will be based on these PCA components according to the importance and priority given to them as shown in Table **4.5**. These components are in line with the results of past academic and government studies confirming the importance of identifying socio–economic urban challenges at a local level. These factors are considered the cornerstone for guiding decision–makers to achieve sustainable urban development (CSO 2013; Cammett *et al.* 2015).

- **Security and safety factors**

The findings indicate that ‘safety of public places’ was the most important urban socio–economic challenge in Iraq, followed by ‘provide integrated urban security systems’ and ‘security in buildings’ respectively, as shown in Figure **4.1**a. 72% of the respondents considered ‘safety of public places’ to be very important. The items ‘provide integrated urban security systems’ and ‘security in buildings’ received a rating of 5 (= very important) by 66.5% and 60.9% of the respondents respectively (Figure **4.1**b).

Despite the deterioration of security and the increase in political violence that swept Iraq after the regime change in 2003, especially in the north-west region (Rathmell *et al.* 2006), many areas, more than two-thirds of Iraq, can be considered relatively stable with very low levels of violence.

Figure 4.1: The level of importance and public evaluation of the safety and security factors in Iraqi cities

This is especially true of the northern region, and the areas to the south and east of Baghdad, all the way to the port city of Basra, which is southernmost (MOE 2013; WorldBank 2015). That said, terrorist acts have become one of the key urban challenges in certain areas. It is, therefore, necessary to consider security issues and the reduction of terrorism, to mitigate threat and to reduce the damage to individual buildings and urban areas. It is also important to ensure that the required level of protection is provided without compromising the capability to create aesthetic and functional urban spaces (UN 2007).

- **Economic factors**

The phenomenon of unplanned[2] housing in Iraq emerged after 1990 and worsened after 2003 (MOCH 2010). It represents an economic and social urban challenge reflecting deficits in infrastructure and public services in addition to the fact that these areas house those living in extreme poverty and under unsanitary conditions. Predictably, the item ‘minimise unplanned housing’ was ranked as the second-most important indicator, its’ mean score 4.593, very close to item 1, ‘security and safety’, reflecting its importance. It was the most important factor among other economic factors, as seen in Figure **4.2**, followed by the ‘provision of affordable housing' with a mean score of 4.557.

Tourism is one of the largest-growing economic sectors worldwide. Investments in urban projects can generate extra revenue if tourism is included in policy development as additional employment economic activities often result from tourism oriented urban development (Steck 1999), something of high relevance in Iraq with reference to the diversification of economic activities.

[2] Often referred to as random housing, locally

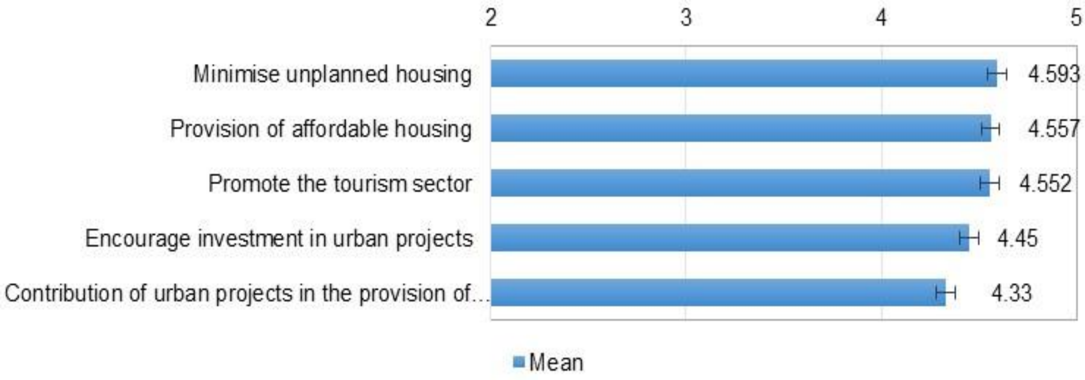


Figure 4.2: The economic development factors in accordance to their priority in Iraqi cities

- **Housing development challenges**

As seen in Figure **4.3**a, the item 'increase housing projects' was ranked as the most important factor, indicating that the questionnaire findings are compatible with government reports and expert opinion on the importance of housing sector development in Iraq. The item 'provide quality housing' was next, followed by 'ensure minimum standards dwelling size based on household size', 'promote individual housing' and 'promote high-rise housing' respectively. Figure **4.3**b highlights housing preferences for Iraqi citizens. 61% of the respondents felt that it was 'very important' to 'promote qualitative housing', followed by 37.7% for the item 'provide minimum standards based on household size', while the item 'promote high-rise housing' was supported by 32.2% with 29.3% for 'promote individual housing'.

Housing represents one of the most important social factors for developing countries and is considered one of a nation's fundamental needs. It is an essential socio-economic urban challenge for Iraqi cities because housing requirements are simply not being met due to the country's inability to produce new homes in sufficient quantities to cover the needs of an increasing population. As a consequence, overcrowding has emerged as a social problem in Iraq, especially in low-income neighbourhoods. Research suggests that 13% of Iraqi households have more than 10 occupants living together in one residential unit (UNDP 2017).

The survey also explored regional preferences for housing developments, as shown in Figure **4.4**. Suburban regions expressed the highest preferences to establish urban and housing projects ($\bar{x}$=

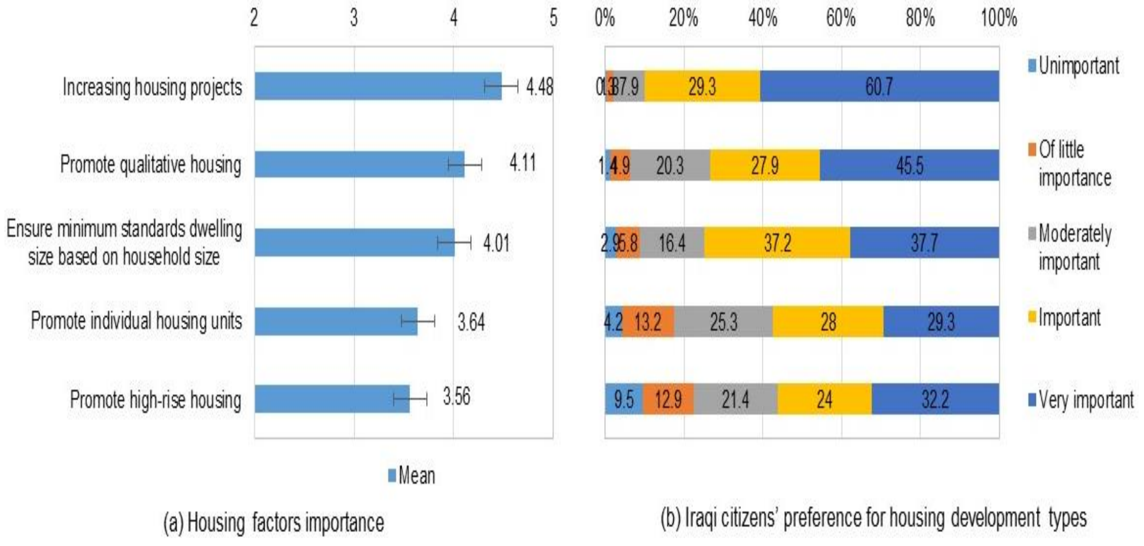


Figure 4.3: The importance factors and Iraqi citizens' preference for housing types

4.31), followed by the rural regions ($\bar{x}$= 3.80), city centres ($\bar{x}$=3.49) and lastly, desert regions ($\bar{x}$= 3.19). These results reflect the urgent need to accelerate housing production to meet the demands/needs of communities and to enhance economic growth. Socio-economic policies are fundamental to the housing sector's ability to respond to changing societal needs. Public investment is key for housing developments, both for social and economic growth, as well as the provision of housing for poor and low-income groups.

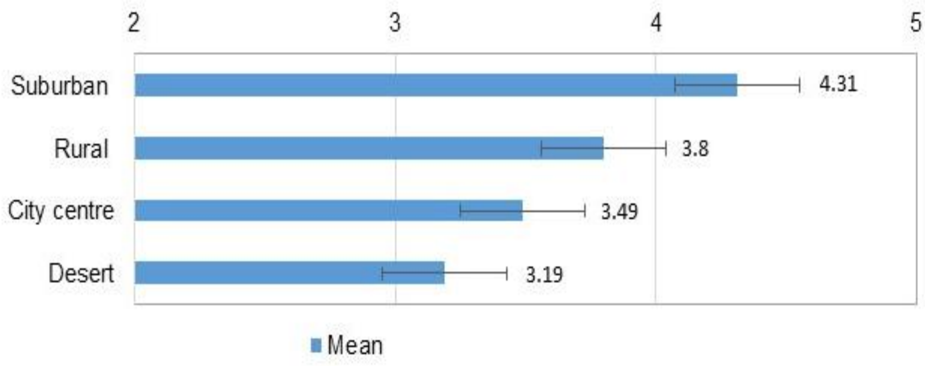


Figure 4.4: Regional public preference for establishing housing development in Iraq

- **Historical and cultural factors**

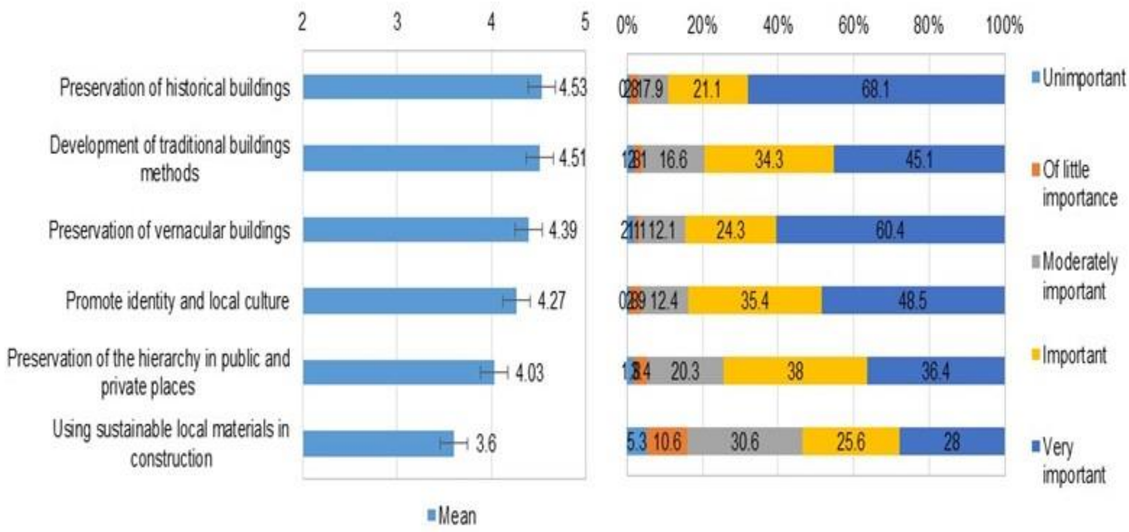
Stakeholders' perceptions highlighted the importance of restoring the historical legacies of Iraqi cities. The respondents placed great emphasis on restoring Iraqi cultural heritage through new urban projects using traditional building methods. As shown in Figure **4.5**a, the item 'preservation of historical buildings' was ranked the most important factor ($\bar{x}$= 4.53), followed by 'use of traditional building methods' ($\bar{x}$= 4.51), and 'preservation of vernacular buildings' ($\bar{x}$= 4.39). The item 'promote identity and local culture' came in fourth ($\bar{x}$=4.27), followed by 'provide minimum standards based on household size', and 'preservation of the hierarchy in public and private places', both with a mean score ($\bar{x}$= 4.03). The item 'use of sustainable local materials in construction' had a mean score less than 4, indicating that it is less important than the rest of the component items from the perspective of the respondents.

The history of Iraqi cities is the most diverse in the Arabic world, as they are the birthplace of history and the first civilisation of the ancient world. Iraqi culture presents a rich mixture of traditions from many civilisations (Tripp 2002) rich in architectural heritage. Nevertheless, there is an absence of local style in current architecture, especially in the development of new architectural forms at the urban level (Al-Thahab 2013).

The employment of diverse local cultural elements in urban developments would introduce robust features ensuring that cities are viable by providing a fertile ground for future generations to develop urban projects with local characteristics (Filippi & Balbo, 2005).

Figure **4.5**b shows stakeholders' evaluations of cultural factors for Iraqi cities. The item 'preservation of historical buildings' received the highest rating (68.1%) seen as a 'very important' factor, followed by 60.4% for 'preservation of vernacular buildings', and 48.5% for 'promote identity and local culture'. 'Use of traditional building methods' received 45.1%, followed by 36.4% for the item 'preservation of the hierarchy in public and private places', while 'use of sustainable local materials in construction' received 28% as an 'important' factor.

The findings indicate that the employment of heritage elements, by adopting environmental practice (vernacular) in new urban projects, was more important than the abstract use of traditional materials in external facades to give an intimation of cultural heritage to the country or region.



(a) The importance of cultural factors

(b) The stakeholders' evaluation of the cultural factors

Figure 4.5: and the stakeholders' evaluation of the cultural factors in Iraqi cities

4.5 Public assessment of the current projects in Iraq

It is important to identify and review the urban challenges relevant to existing projects in Iraqi cities through the eyes of stakeholders to determine the extent of problems by measuring their quality and if projects are currently underway in various urban environments. The questionnaire results present a negative image, the majority of participants confirming they were dissatisfied with existing urban development projects in their cities or regions, while it has been detected that some projects and services are not underway at the urban level.

As illustrated in Figure **4.6**, more than one-third of the participants (37.4%) assessed 'infrastructure services' projects as 'very bad', followed by 36.2% for 'electricity availability', 35.5% for 'roads and streets quality', and 30.9% for 'designated activities play area for children', respectively. 30.9% of the respondents evaluated 'homogenous spatial grouping of activities' projects as 'bad' in terms of quality, followed by 28.1% for 'roads and streets quality', and 27% for 'evaluation of existing housing quality', respectively. 35.43% of the respondents considered 'educational facilities quality' projects ranking as 'neither good nor bad', followed by 31.3% for 'health facilities quality', 27% for 'drinking water quality', 24.7% for 'evaluation of existing housing quality', and 22.2% for 'evaluation of existing housing quality', respectively.

Few respondents confirmed that they were satisfied with all of the urban projects, for example 'drinking water quality' projects have been evaluated as 'good' by only a quarter of the participants (24.7%), an even lower number of participants (19.9%) giving the same rating for both 'educational facilities quality', and 'health facilities quality'. No participants gave a rating of ‘very good’ to any of the questionnaire items. It is important to note that these results were recorded in the northern autonomous region of Iraq. This area has political and economic stability, this reflected positively by improvements in some urban development projects (WorldBank 2015), in comparison to other Iraqi cities.

Some important items have been classified as ‘not available’ currently, for example where the majority of the participants (61.9%) indicated that ‘using renewable energy' projects was not an option. This was followed by ‘designated activities areas for the elderly and disabled’ which accounted for 59.9%, 'waste separation and recycling availability' (55.4%), 45.9% for 'shaded streets and protected open spaces', and 42.4% for 'reclamation of decertified and contaminated lands'.

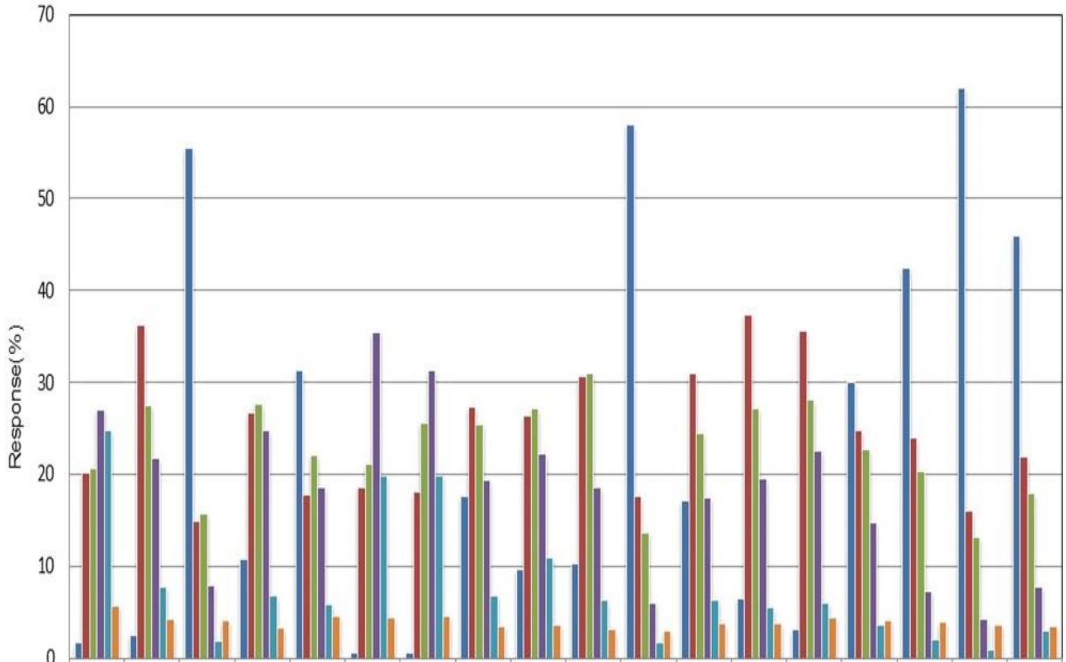
Urban development projects suffer from numerous challenges, both in terms of the quality of services provided to the public or that they are currently not an option in Iraqi cities. The results reflect an urgent need for a preliminary strategy to improve the conditions of citizens in different areas with attention paid to housing, education, health care, recreational facilities, basic infrastructure, social and general services, as well as creation of periodic assessments of the construction sector and current urban development projects.

4.6 Assessing public awareness of urban sustainability

Another aim of the survey was to assess public awareness of urban sustainability. The results show that people are informed and interested in sustainable urban development issues, in so far as they would be willing to pay more to live in a sustainable city in the future.

Regarding the concept of the sustainable city, as shown in Figure **4.7**, 42% of the respondents claimed that they are extremely concerned and well informed, 31% considering the concept very interesting. Only 1% of the respondents did not have any idea about sustainability.

On the other hand, over half the respondents, 57% totally agreed that the Iraqi cities are developed in an unsustainable way (Figure **4.8**). Figure **4.9** shows that 71% of the respondents are ready to pay extra money to live in a sustainable city, this a strong indication of public awareness. This is an encouraging result for Iraqi authorities who wish to adopt sustainability as an approach to address urban challenges while meeting the needs of the community and respecting culture.



	Drinking water	Electricity	Waste separation &recycling	Evaluation of existing housing	Availability of housing	Educational facilities	Health facilities	Public amenities	Recreational facilities	Homogenous spatial grouping of activities	The elderly and disabled	Children's play areas	Infrastructure services	Roads and streets	Conservation of green spaces & forest	Reclamation of desertified lands	Using renewable energy	Shaded streets & open spaces
Not available	1.66	2.54	55.41	10.82	31.24	0.55	0.66	17.55	9.71	10.26	57.95	17.11	6.51	3.2	30.02	42.38	61.92	45.92
Very bad	20.2	36.2	14.9	26.71	17.77	18.65	18.1	27.26	26.38	30.68	17.66	30.91	37.42	35.54	24.83	23.95	16	21.96
Bad	20.64	27.48	15.78	27.7	22.08	21.08	25.5	25.39	27.15	30.91	13.69	24.39	27.15	28.15	22.74	20.31	13.13	17.88
Neither good nor bad	27.04	21.74	7.95	24.72	18.54	35.43	31.35	19.43	22.19	18.54	5.96	17.44	19.54	22.63	14.68	7.28	4.3	7.73
Good	24.72	7.73	1.88	6.73	5.85	19.87	19.87	6.84	10.93	6.4	1.77	6.4	5.52	6.07	3.64	2.1	0.99	2.98
Very good	5.74	4.3	4.08	3.31	4.53	4.42	4.53	3.53	3.64	3.2	2.98	3.75	3.86	4.42	4.08	3.97	3.64	3.53

Figure 4.6: Stakeholder assessment of existing urban development projects in Iraq

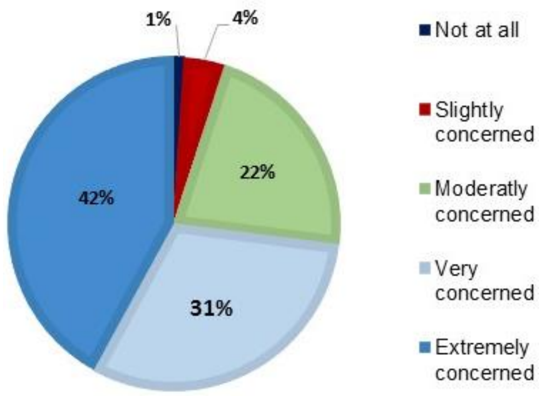


Figure 4.7: Public attention regarding sustainability of urban development

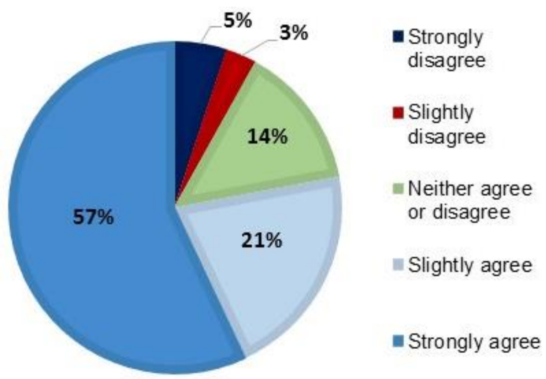


Figure 4.8: Public assessment of the sustainability of existing urban projects in Iraq cities

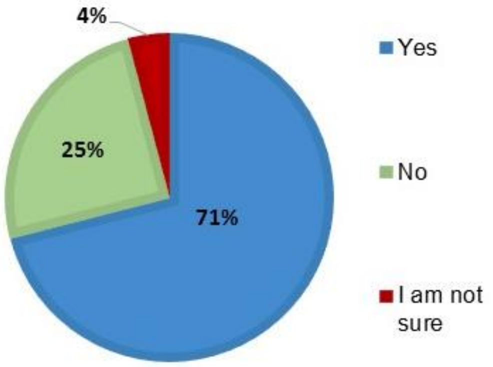


Figure 4.9: Public readiness to pay additional cost to live in a sustainable city

4.7 Limitations of the questionnaire application

This survey was conducted across all eighteen Iraqi regions. The responses, therefore were, inherently a snapshot of stakeholder perceptions. Differences in public perceptions were due to disparities in age, educational qualification, occupation, and the extent of the participants' appreciation of the indicators. The major obstacle that faced the survey was its dependence on respondents using a computer to access the internet to answer the questionnaire. Iraq still has the lowest internet usage among its regional counterparts. (Heshmati *et al.* 2014) and, in general, the internet services available can be considered inefficient. Internet usage among educated people in Iraq is 86.4% (Al-hammadany and Heshmati 2011), so the online questionnaire was biased towards educated people, but a mobile team solicited the opinions of non-educated people, more so those in rural areas, and those who do not have access to internet facilities. Another limitation was the difficulty in obtaining views from the older population; i.e. those aged 55 years and above. Together with those without any qualifications, they are less unlikely to have access to the internet on a regular basis, compared to the younger population, who access the internet at their places of work and study. Chronic electricity outages across Iraq and the lack of access to electricity in rural areas further exacerbated the challenges in reaching these rather marginalised sections of society. However, the face-to-face interviews ameliorated some of these problems and helped reach a wider population.

4.8 Summary

There is now broad agreement that urban issues are of paramount importance for communities both in the present and for the future. Stakeholder engagement in identifying environmental and socio-economic urban challenges is essential for decision making and the effective implementation of policy. This chapter has reported on an interactive experience between communities and the urban challenges that are facing their cities and regions, and goes some way to compensate for the severe shortage of comprehensive environmental, social and economic studies in the context of Iraq.

By conducting a nationwide survey, a number of urban development challenges were investigated. 44 structured items were developed on a 5-point Likert-type scale. Descriptive analysis and principal component analysis (PCA) were conducted on the collected data. PCA distributed the dimensional structure of the questionnaire items for ten components, with high levels of internal consistency and reliability. These components revealed the key environmental and socio-economic development challenges from the stakeholders' perspective, which represent the main obstacles to establishing sustainable urban development in Iraqi cities. Non-parametric tests were applied to identify for significant differences in stakeholders' opinions of the PCA items, based on the application of indicators as a measure of public perception.

The findings of this study indicate that is suitable to propose sustainable development policies for urban planning and design for Iraqi cities. These same findings can provide critical urban data to develop a local urban assessment framework for achieving sustainable development for current and new urban projects in Iraq.

Chapter 5
The identification of urban sustainability assessment factors

This chapter aims to identify urban sustainability assessment factors (indicators and sub-indicators) for Iraqi cities. The Delphi technique, as a consensus-build approach, is used conducted in three consecutive consultation rounds with leading experts and professionals in the urban sustainable development domain from academia, government and industry. These local assessment factors were categorised and discussed regarding their relative importance in the local context, after which the new Iraqi urban sustainability assessment framework (IUSAF) will be structured.

5.1 Delphi survey design

A Delphi questionnaire was designed initially using 18 structured urban indicators and 54 sub-indicators. Respondents' rated their opinions on a 5-point Likert-type rating scale, ranked from 'Unimportant' to 'Very important'. The survey was conducted using SurveyMonkey and consisted of three rounds. Each round started with a notification and link to the questionnaire sent via email and social networks to the participants. After the first round, only the panellists who completed the previous round were invited to participate in subsequent rounds. Approximately three weeks were allotted for the experts to complete each round, with many reminder emails and text messages sent in the interim.

The opening web page clarified the main purpose and structure of the Delphi survey, with an emphasis on anonymity. Panellists were required to provide professional information and an email address before beginning. In the first round of the survey, panellists were required to assess and score the initial list of urban factors that had been prepared. This list included a series of three sections addressing environmental, social and economic urban factors, applicable to Iraqi cities. The panellists were asked to rate the importance of all the factors, each question requiring them to assign a score between 1 and 5 points on a Likert-type rating scale. They were also requested to suggest further comments, through a brainstorming process, in order to add new factors, important from their point of view, to those already included. The comments section gave them opportunity to express any ambiguities or confusions they may have had with any of the assessment factors (Gordon 1994).

At the end of the first round, several steps were taken to prepare the feedback and responses to be used in the second round including: (a) statistical analysis of the results, (b) consolidation of the panellists' comments to eliminate duplicate views, and (c) the addition of 17 new factors based on the comments of participants, to be assessed in the subsequent round. The new factors were worded as closely as possible to the experts' suggestions, in order to reduce the influence of the survey moderator. The comments that were collected suggested there was no confusion about any of the new proposed factors (Wakefield and Watson 2013).

The second round allowed the panel of experts to view all the other anonymous responses and provide feedback about each evaluated factor from the first round. This was achieved by providing the mean value ($\bar{x}$) of each factor, to help the experts visualise the distribution of the data, this giving them the opportunity to revise their previous answers and judgements. The experts were asked to re-evaluate and score the entire list, which now included 89 urban factors, and to comment further if need be.

After the second round, all the responses were collected and analysed in the same way as in the first round. The third round focused on shortening the survey to control for participant attrition. In the third round, the panellists were requested to re-evaluate the factors that had been suggested by the experts from the first round. This arrangement ensured that all urban factors under consideration were evaluated twice. A Delphi technique with a double assessment built in is guaranteed to be sufficient to identify group consensus (Richey *et al.* 1985; Platzer 2006; Bryant and Abkowitz 2007).

5.2 The Delphi survey respondents

Of the 67 prospective panellists initially invited to participate in the survey, 54 participants completed the first round, 40 the second and 37 the third. These numbers are adequate compared with the size of expert panels used in previous studies (Okoli and Pawlowski 2004; Bryant and Abkowitz 2007).

5.3 Data analysis

The mean ($\bar{x}$) and standard deviation (SD) were computed and used for all responses as an accredited measure, to identify the level of importance of the urban factors as well as the degree of consensus (Platzer 2006; Geist 2010). SD's have been used in many previous studies to assess consensus by showing the spread of the responses said studies indicating that their value should be between 0 and 1 ($0 < \sigma < 1$) (Rayens and Hahn 2000; Giannarou and Zervas 2014).

The statistical analysis for all rounds of the survey are shown in Table **5.1**. The factors that were suggested by the panel of experts are listed in italics. ($\bar{x}$) ranged between 3 and 5 and never fell below 3.45 in any rounds, the SD for all questionnaire items 0.69. It is worth noting that the responses showed a move towards consensus from the first to the second assessment for the majority of factors as evidenced by a decrease in the SD value. There was an increase of SD in 9 of the 89 urban factors, ranging from 1- 27%, eight factors in the first round and one in the second round. All urban factors were accepted because all SD values were within the consensus limits (Bryant and Abkowitz 2007).

5.4 Key urban sustainability indicators

The urban factors have been grouped into three main categories; environmental, social and economic. The scope of each factor was described in detail during the Delphi technique rounds to remove any ambiguity or confusion and to avoid repetition in the second round. The key urban indicators that achieved consensus are shown in Table **5.1**.

5.4.1 Environmental

This includes seven urban indicators:

- **Ecology**: This includes six factors to ensure the creation of an appropriate on-site micro-climate for occupants achieved through the employment of project components such as building configuration, air movement and direction, topographic characteristics, solar orientation, materials, green cover and water bodies. Attention also needs to be given to reducing undesirable environmental impacts due to dust, emissions and industrial pollution.
- **Energy**: The emphasis here is on minimising energy consumption and setting up safe energy distribution networks such as underground cabling and piped gas networks. This is in addition to recognising the importance of using an energy management system and taking advantage of renewable energy technology.
- **Water**: ‘Water quality’ and ‘water conservation’ strategies were deemed to be extremely important. The remaining strategies, ‘diversity of water resources’, ‘rainwater harvesting systems’ and ‘onsite wastewater recycling’, are also considered as viable processes to reduce overall water consumption.
- **Waste**: Modern waste management methods such as on-site collection, separation and recycling facilities, are seen to have a significant role in waste reduction. ‘Recycling waste’ is the most important factor, followed by ‘waste separation and treatment’, a factor suggested by the experts.
- **Hazard**: This subcategory includes three factors, the most important deemed to be ‘evacuation during disasters’. ‘Natural hazard mitigation and protection’, in particular from sandstorms, drought and desertification were considered an important factor and relevant to the prevailing climate in the Arab region (CSO 2010).

Table 5.1: The statistical analysis of the survey responses by round*

Questionnaire items	**Round 1**		**Round 2**		**Round 3**		Increase SD
	Mean	SD	Mean	SD	Mean	SD	
Environmental							
Ecology							
Site micro-climate	4.16	0.91	4.20	0.68	-	-	-
Landscape and vegetation cover	4.35	0.67	4.50	0.55	-	-	-
Environmental impact of materials	4.00	0.91	4.20	0.75	-	-	-
Lifecycle GHG emissions	3.98	1.05	4.35	0.76	-	-	-
Conservation of agricultural lands	-	-	*4.43*	*0.74*	*4.62*	*0.54*	-
Development and conservation of urban water bodies	-	-	*4.38*	*0.58*	*4.43*	*0.59*	~ 2 %
Energy							
Energy efficiency	4.13	0.95	4.30	0.78	-	-	-
Renewable energy	3.89	1.04	4.22	0.82	-	-	-
Energy management	3.69	1.02	4.25	0.73	-	-	-
Safe energy distribution network	-	-	*4.28*	*0.67*	*4.35*	*0.78*	~16 %
Water							
Water quality	4.26	0.82	4.63	0.66	-	-	-
Water conservation	4.09	0.82	4.33	0.65	-	-	-
Onsite wastewater recycling	3.67	1.05	4.08	0.79	-	-	-
Diversity of water resources	3.76	1.13	4.18	0.80	-	-	-
Rainwater harvesting system	-	-	*4.20*	*0.78*	*4.11*	*0.73*	-
Waste							
Reuse of construction waste	3.45	1.16	3.70	0.93	-	-	-
Recycle waste	4.05	1.07	4.53	0.59	-	-	-
Waste separation and treatment	-	-	*4.33*	*0.65*	*4.43*	*0.55*	-
Hazard							
Natural hazard mitigation and protection	3.60	1.05	3.83	0.83	-	-	-
Evacuation during disasters	3.84	1.07	4.13	0.84	-	-	-
Shelters for disaster mitigation	-	-	*3.85*	*1.01*	*3.89*	*0.83*	-
Land use							
Green vs. built-up area	4.42	0.80	4.53	0.63	-	-	-
Ancillary facilities	3.95	0.80	4.28	0.77	-	-	-
Children play areas	4.09	0.92	4.45	0.67	-	-	-
Inclusive design (aging & disabled)	3.95	0.90	4.20	0.71	-	-	-
Public car parking availability	4.31	0.74	4.45	0.67	-	-	-
Land reclamation	4.20	0.82	4.33	0.65	-	-	-
Flexibility of future expansion	4.20	0.72	4.25	0.62	-	-	-
Buffer zones	-	-	*4.38*	*0.70*	*4.19*	*0.77*	1 %
Development outside cities	-	-	*4.53*	*0.67*	*4.49*	*0.60*	-
Transport and Infrastructure							
Diversity of transport modes	4.46	0.69	4.68	0.52	-	--	-
Bicycle network	3.81	1.00	3.83	0.80	-	-	-
Walkability	3.94	0.93	4.15	0.73	-	-	-
Infrastructure networks	4.44	0.79	4.65	0.53	-	-	-
Safe streets	-	-	*4.55*	*0.59*	*4.54*	*0.64*	~ 8 %
Social							
Safety							
Security by design	4.20	0.68	4.30	0.64	-	-	-
Safety of public places	4.35	0.70	4.33	0.85	-	-	~ 21 %
Protection from high temperatures and sunlight	-	-	*4.15*	*0.76*	*4.24*	*0.79*	~ 3 %
Well being							
Light and Noise pollution	3.94	0.85	4.08	0.79	-	--	-
Ventilation potential	4.04	0.84	4.22	0.72	-	-	-
Daylight availability	4.15	0.87	4.18	0.89	-	-	~ 2 %
Thermal comfort strategies	4.07	0.84	4.18	0.74	-	-	-
Governance							
Smart and appropriate location	3.81	0.98	4.10	0.70	-	-	-
Stakeholders consultation	4.44	0.74	4.40	0.70	-	-	-

Continued overleaf

Continued from the previous page (Table 5.1)

Questionnaire items	Round 1		Round 2		Round 3		Increase SD
	Mean	SD	Mean	SD	Mean	SD	
Innovation							
Intelligent buildings	4.09	0.91	4.22	0.69	-	-	-
Innovative urban solutions	4.09	0.87	4.15	0.69	-	-	-
Information modelling (BIM 2)	-	-	*4.22*	*0.94*	*4.32*	*0.77*	-
Management & construction							
Long- term management	4.37	0.78	4.43	0.70	-	-	-
Work environment (Health and safety)	4.11	0.90	4.28	0.63	-	-	-
Equality and diversity	3.43	0.97	3.65	0.79	-	-	-
Planning Policies and legislations	-	-	*4.43*	*0.70*	*4.49*	*0.50*	-
Local culture							
Identity and local culture	4.06	0.93	4.00	0.89	-	-	-
Adaptation for social inclusion	4.09	0.89	4.10	0.77	-	-	-
Conservation of buildings	-	-	*4.28*	*0.87*	*4.46*	*0.76*	-
Urban space							
Public space	3.89	0.85	4.03	0.65	-	-	-
Amenities	4.22	0.76	4.45	0.63	-	-	-
Layout							
Urban space hierarchy	3.96	0.96	4.00	0.84	-	-	-
Streets network	4.20	0.78	4.30	0.64	-	-	-
Harmony with the surroundings	-	-	*4.08*	*0.79*	*4.08*	*0.75*	-
Housing							
Residential scheme	3.89	0.87	4.28	0.71	-	-	-
Diversity of the residential units	4.11	0.79	4.38	0.70	-	-	-
Affordable housing	4.43	0.74	4.55	0.63	-	-	-
The quality of housing units	-	-	*4.33*	*0.65*	*4.38*	*0.63*	-
Economic							
Local economy							
Diversity in economic activities	4.06	0.85	4.08	0.57	-	-	-
Local and sustainable industry	4.22	0.90	4.33	0.65	-	-	-
Encourage new investments	4.11	0.83	4.38	0.66	-	-	-
Life cycle cost	4.04	0.86	4.25	0.62	-	-	-
Adaptable housing	-	-	*4.28*	*0.71*	*4.11*	*0.80*	~ 12 %
Jobs and business							
Employability	4.15	0.97	4.40	0.58	-	-	-
Qualification and skills	4.17	0.86	4.33	0.52	-	-	-
Demonstrable experience in similar projects	-	-	*4.75*	*0.43*	*4.57*	*0.55*	~ 27 %
Overall							
Ecology	4.39	0.73	4.38	0.62			
Energy	4.46	0.71	4.40	0.66			
Water	4.48	0.76	4.70	0.46			
Waste	4.35	0.75	4.60	0.49			
Hazard	3.96	0.88	4.13	0.84			
Land use	4.09	0.89	4.28	0.63			
Transport and Infrastructure	4.28	0.83	4.50	0.67			
Safety	4.28	0.78	4.35	0.73			
Well being	3.81	0.80	4.00	0.74			
Governance	4.04	0.96	4.03	0.85			
Innovation	4.07	0.94	4.18	0.77			
Management and construction	4.22	0.85	4.30	0.68			
Local culture	3.98	0.85	4.18	0.67			
Urban space	4.02	0.83	4.30	0.78			
Layout	4.41	0.76	4.47	0.67			
Housing	4.24	0.69	4.58	0.59			
Local economy	4.28	0.70	4.45	0.63			
Jobs and business	4.31	0.72	4.43	0.63			

* Italicised items were suggested by the experts in the round 1.

- **Land use**: The nine factors in this indicator encourage sustainable green practices all were rated as very important. 'Green vs. built-up area' was the most important due to the importance of promoting the incorporation of green areas in urban projects. 'Development outside cities' involves reducing demographic pressures on city centres followed by promoting 'children's play areas' and 'public car parking availability', these having the same levels of importance and consensus.

- **Transport and infrastructure**: This requires the evaluation of key aspects of urban project's performance such as public transport, pedestrian areas, walkability, safe cycling networks and streets. The most important factor was 'diversity of transport modes' to compensate for the lack of alternative modes of transportation such as trains, subways, shipping and air shipping (Al-Akkam 2012). This was followed by 'efficiency of infrastructure networks', an essential urban challenge because of the acute damage to the infrastructure as a result of successive wars leading to the deterioration of most public service projects across the country (Foote *et al.* 2004). 'Diversity of transport modes' and 'infrastructure networks' achieved the highest mean scores.

5.4.2 Social

This includes nine urban indicators that deal mainly with community social issues.

- **Safety**: The experts agreed that safety and security factors were considered a significant issue because of the deterioration of security and increase in political violence that swept many areas after the regime change in 2003 (Rathmell *et al.* 2006). Three safety factors emphasised promoting protection practices, both at the urban level or in individual buildings. 'Safety of public places' was deemed to be the most important factor, followed by 'security by design'.

- **Well-being**: The four factors related to the well-being indicator were all rated as very important because they enhance the quality of the urban environment. The most significant factor was 'ventilation potential', which aims to allow for natural ventilation. This was followed by 'daylight availability' and 'thermal comfort strategies' given the same level of importance but with a different level of consensus.

- **Governance**: Of the two factors related to governance, the most significant is the 'stakeholder consultation' factor, which promotes the exchange of ideas and knowledge by stakeholders to improve the quality and acceptability of the development during the design process.

- **Innovation**: The innovation indicator shows that 'information modelling (BIM 2)' was rated as the most significant of the three factors. It aims to establish an integrated information network centred on design, construction and the management of urban projects. This was added during the first round of the Delphi technique. It was followed by 'intelligent buildings', which promotes the use of technology in buildings to enhance safety, productivity and efficiency.

- **Management and construction**: A total of four factors for management and construction were revised and rated. Compliance with local 'planning policies and legislation', which was suggested by the experts, was deemed to be the most important. It was followed by 'long-term management' which aims to ensure long-term management and maintenance of all activities to maximise the efficiency of urban projects.
- **Local culture**: Iraqi culture presents a rich mixture of many civilisations (Tripp 2002). Nevertheless, there is an absence of local style in current architecture, especially in the development of new architectural forms at the urban level (Al-Thahab 2013). In order to address this, three factors which constitute the socio-cultural criteria, were seen as necessary to evaluate certain requirements of building design and to preserve traditional and cultural heritage. 'Conservation of buildings' was the most important, followed by 'adaptation for social inclusion'.
- **Urban space**: Both factors related to the urban space indicator were rated as being very important. The most significant of these was 'amenities'; the provision of street furniture, benches, outdoor sports facilities and toilet services, designed according to urban project's standards. This was followed by the identification of 'public space' seen as essential in order to establish social activities and provide opportunities for all residents of, and visitors to, urban development projects.
- **Layout**: The three layout factors were all rated as being very important, the most significant being 'street network' which ensures a hierarchy of street networks and connecting nodes in projects, followed by 'harmony with the surroundings'.
- **Housing**: This represents one of the most important social factors for developing countries, a total of four factors revised and rated. 'Affordable housing' was deemed to be the most significant, aiming to provide a mix of housing types for different income levels by adopting housing policies such as repayment by long-term instalments and promoting non-profit housing schemes. This was followed by 'quality of housing units' which was suggested by the experts, and 'diversity of residential units'. Both factors obtained the same level of importance but with a different level of consensus.

5.4.3 Economic

This category includes two urban indicators that deal mainly with key, local economic issues.

- **Local economy**: This is considered one of the essential aspects of sustainable urban development but one which has not received much attention from global urban sustainability assessment tools (as mentioned in Chapter two). 'Encourage new investments' was rated as the most significant factor, followed by ‘local and sustainable industry’ and ‘life cycle cost’.

- **Jobs and business**: The three factors for this indicator were all rated as very important. ‘Demonstrable experience in similar projects’ which was suggested by the experts, was deemed to be the most significant. This aims to involve leading experts to help develop local expertise when establishing urban projects. It was followed by the factor ‘employability’ and ‘qualification and skills’, both providing opportunities to develop the skills of local businesses.

5.5 Overall ranking of the urban indicators

The Delphi panel agreed that all the indicators are very important and essential in the Iraqi context. Figure **5.1** lists all indicators according to their mean values, ranging from 4.00- 4.70, determining their level of importance. This offers a clear indication to local stakeholders about the prioritisation of urban indicators. The panel of experts agreed that the water indicator is the top priority ($\bar{x}$ = 4.70). Waste management ($\bar{x}$ = 4.60) and housing ($\bar{x}$ = 4.58) are almost at the same level, as was transport and infrastructure which was rated fourth (mean, $\bar{x}$ = 4.50). The levels of agreement with reference to these four categories ($\bar{x} \geq$ 4.50) are highly compatible with current concerns about the critical challenges in most Iraqi cities. It also demonstrates a link between experts’ views and the lack of adequate infrastructure and service provisions in Iraq due to political instability (UN-HABITAT 2006; CSO 2015).

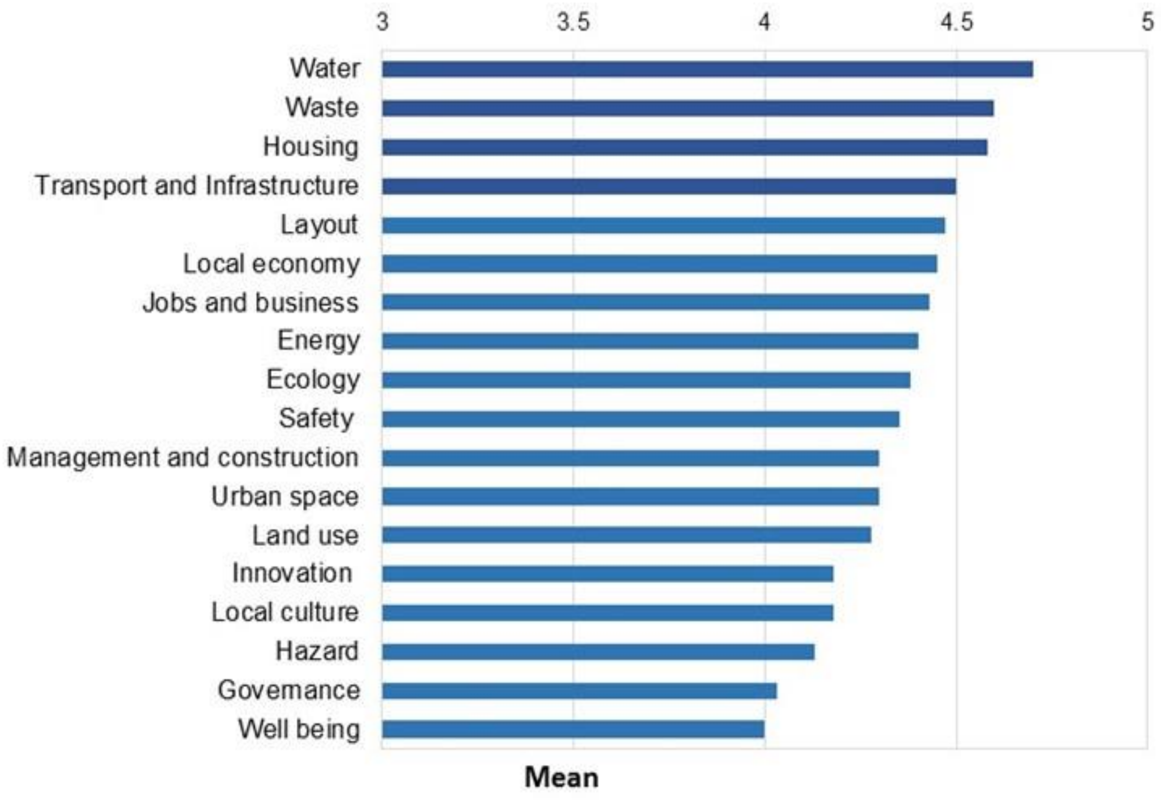


Figure 5.1: Importance of overall urban indicators

The second group includes 14 urban indicators with a slight disparity in level of importance (4.00 $\leq \bar{x} \leq$ 4.47), starting with layout and ending with well-being. The mean scores for other urban indicators were as follows: ecology, safety, management and construction, and urban space ranged between 4.3 $\leq \bar{x} \leq$ 4.38. Land use, innovation, local culture, economic, hazard, governance and well-being aspects also achieved almost the same level of importance (4.0 $\leq \bar{x} \leq$ 4.28).

5.6 Discussion of the Delphi results

Table **5.2** shows the final list of urban sustainability indicators and factors. The SDs of all the Delphi questionnaire urban items were less than 1 ($0 < \sigma < 1$), which indicates that consensus between the experts was achieved, with only a slight disparity ($0.5 \leq \sigma \leq 0.93$). The experts have focused on items that address critical and urgent issues such as water, housing, enhancement of utilities and infrastructure, energy conservation, safety requirements, planning factors and support for the local economy. This is in addition to factors which tackle the causes of environmental pollution such as waste recycling, green cover and agricultural land conservation. Attention is also drawn to reducing the impacts of natural hazards.

The factors were grouped into four consensus categories, based on the SD values, as shown in Figure **5.2** and detailed below:

5.6.1 Very high consensus (0.5 ≤ σ ≤ 0.59)

12 factors achieved the highest level of consensus. The factor 'planning policies and legislations', which was suggested by the panellists, reached the highest level of consensus at $\sigma = 0.50$. There was an emphasis on transportation, management and infrastructure which are considered as vital to support and enhance the standard of living in Iraq (Fulmer 2009). The importance of building new systems to compensate for those which were destroyed by war such as water, sewage, public services, bridges, roads, electrical plants and energy grid systems, was also emphasised (Foote *et al.* 2004).

Environmental conservation issues were also subjects of interest, in particular, conservation of agricultural lands and water bodies, increasing green cover and recycling waste. Currently, some attention is paid to local climate change, efforts to reduce environmental pollution and to stabilise dune areas and mitigate sandstorm effects (Brovkin 2002). Redressing this balance plays a fundamental role in achieving urban socio-ecological sustainability (Abbas *et al.* 2014).

An interesting factor is a demonstrable experience in similar projects ($\sigma = 0.55$) from the job and businesses indicator, again suggested by the panellists. This can be considered a unique factor as it is rarely found in other urban sustainability assessment methods. Local economic issues have also been highlighted, especially diversity of activities ($\sigma = 0.57$) and employability ($\sigma = 0.58$) in order to create a local, market-based economy to develop other sectors such as housing, education,

Table 5.2: Final statistical results of the questionnaire responses *

Delphi Questionnaire factors	Mean	St. dev. *(SD < 1)*	Consensus status	Mandatory factor
Ecology				
Site micro-climate	4.20	0.68	✓	
Landscape and vegetation cover	4.50	0.55	✓	✓
Environmental impact of materials	4.20	0.75	✓	
Lifecycle GHG emissions	4.35	0.76	✓	
Conservation of agricultural lands	*4.62*	*0.54*	✓	✓
Development and conservation of urban water bodies	*4.43*	*0.59*	✓	
Energy				
Energy efficiency	4.30	0.78	✓	
Renewable energy	4.22	0.82	✓	
Energy management	4.25	0.73	✓	
Safe energy distribution network	*4.35*	*0.78*	✓	
Water				
Water quality	4.63	0.66	✓	✓
Water conservation	4.33	0.65	✓	
Onsite wastewater recycling	4.08	0.79	✓	
Diversity of water resources	4.18	0.80	✓	
Rainwater harvesting system	*4.11*	*0.73*	✓	
Waste				
Reuse of construction waste	3.70	0.93	✓	
Recycle waste	4.53	0.59	✓	✓
Waste separation and treatment	*4.43*	*0.55*	✓	
Hazard				
Natural hazard mitigation and protection	3.83	0.83	✓	
Evacuation during disasters	4.13	0.84	✓	
Shelters for disaster mitigation	*3.89*	*0.83*	✓	
Land use				
Green vs built- up area	4.68	0.63	✓	✓
Ancillary facilities	4.28	0.77	✓	
Children play areas	4.45	0.67	✓	
Inclusive design (aging & disabled)	4.20	0.71	✓	
Public car parking availability	4.45	0.67	✓	
Land reclamation	4.33	0.65	✓	
Flexibility of future expansion	4.25	0.62	✓	
Buffer zones	*4.19*	*0.77*	✓	
Development outside cities	*4.49*	*0.60*	✓	
Transport and Infrastructure				
Diversity of transport modes	4.68	0.52	✓	✓
Bicycle network	3.83	0.80	✓	
Walkability	4.15	0.73	✓	
Infrastructure networks	4.65	0.53	✓	✓
Safe streets	*4.54*	*0.64*	✓	✓
Safety				
Security by design	4.30	0.64	✓	
Safety of public places	4.33	0.85	✓	
Protection from high temperatures and sunlight	*4.24*	*0.79*	✓	
Well being				
Light and Noise pollution	4.08	0.79	✓	
Ventilation potential	4.22	0.72	✓	
Daylight availability	4.18	0.89	✓	
Thermal comfort strategies	4.18	0.74	✓	
Governance				
Smart and appropriate location	4.10	0.70	✓	
Stakeholder consultation	4.40	0.70	✓	

Continued overleaf

Delphi Questionnaire factors	Mean	St. dev. *(SD < 1)*	Consensus status	Mandatory factor
Innovation				
Intelligent buildings	4.22	0.69	✓	
Innovative urban solutions	4.15	0.69	✓	
Information modelling (BIM 2)	*4.32*	*0.77*	✓	
Management and construction				
Long- term management	4.43	0.70	✓	
Work environment (Health and safety)	4.28	0.63	✓	
Equality and diversity	3.65	0.79	✓	
Planning Policies and legislation	*4.49*	*0.50*	✓	
Local culture				
Identity and local culture	4.00	0.89	✓	
Adaptation for social inclusion	4.10	0.77	✓	
Conservation of buildings	*4.46*	*0.76*	✓	
Urban space				
Public space	4.03	0.65	✓	
Amenities	4.45	0.63	✓	
Layout				
Urban space hierarchy	4.00	0.84	✓	
Street network	4.30	0.64	✓	
Harmony with the surroundings	*4.08*	*0.75*	✓	
Housing				
Residential scheme	4.28	0.71	✓	
Diversity of the residential units	4.38	0.70	✓	
Affordable housing	4.55	0.63	✓	✓
The quality of housing units	*4.38*	*0.63*	✓	
Local economy				
Diversity in economic activities	4.08	0.57	✓	
Local and sustainable industry	4.33	0.65	✓	
Encourage new investments	4.38	0.66	✓	
Life cycle cost	4.25	0.62	✓	
Adaptable housing	*4.11*	*0.80*	✓	
Jobs and business				
Employability	4.40	0.58	✓	
Qualification and skills	4.33	0.52	✓	
Demonstrable experience in similar projects	*4.57*	*0.55*	✓	✓
Overall				
Ecology	4.38	0.62	✓	
Energy	4.40	0.66	✓	
Water	4.70	0.46	✓	
Waste	4.60	0.49	✓	
Hazard	4.13	0.84	✓	
Land use	4.28	0.63	✓	
Transport and Infrastructure	4.50	0.67	✓	
Safety	4.35	0.73	✓	
Well being	4.00	0.74	✓	
Governance	4.03	0.85	✓	
Innovation	4.18	0.77	✓	
Management & construction	4.30	0.68	✓	
Local culture	4.18	0.67	✓	
Urban space	4.30	0.78	✓	
Layout	4.47	0.67	✓	
Housing	4.58	0.59	✓	
Local economy	4.45	0.63	✓	
Jobs and business	4.43	0.63	✓	

* *Italicised items were suggested by the experts in round 1.*

health and industry (UNDP 2017). Economic aspects are essential for the sustainability of urban developments in developing countries and are often as important as ecological considerations (Libovich 2005).

5.6.2 High consensus (0.6 ≤ σ ≤ 0.69)

22 factors achieved this level of consensus. It is interesting that the factor ‘development outside cities’ suggested by the panellists, reached the highest level of consensus ($\sigma = 0.60$). This factor aims to encourage urban investment in suburban areas, in order to improve the standard living of the community and reduce population pressures on city centres (CSO 2013). In this group, there was a focus on core considerations such as ‘urban planning and design’, ‘water conservation’, ‘housing’ and ‘innovation’. Diverse planning factors dominated this group, such as ‘flexibility of future expansion’ ($\sigma = 0.62$), ‘green vs. built-up areas’ ($\sigma = 0.63$), ‘provision of amenities in urban spaces’ ($\sigma = 0.63$), ‘safe streets’ ($\sigma = 0.64$), ‘land reclamation’ ($\sigma = 0.65$), ‘public spaces’ (0.65), ‘children’s play areas’ ($\sigma = 0.67$), and ‘public car parking availability’ ($\sigma = 0.67$). These factors are essential and considered keystones for sustainable urban development.

Water factors were also included, for example, ‘water conservation’ ($\sigma = 0.65$) and ‘water quality’ ($\sigma = 0.66$), due to their importance for Iraq. Water levels in Iraqi rivers are expected to decrease between 50% and 80% by 2025 (CSO 2013), which threatens to bring about a humanitarian crisis. ‘Water conservation’ is therefore one of the more relevant issues for present and future urban development. ‘Innovation’ was also included covering inelegant buildings ($\sigma = 0.69$) and ‘development outside cities’ ($\sigma = 0.69$). Innovation is recognised as a vital contributor to urban innovation in order to achieve urban sustainability (Macaulay and Mitchell 2009).

5.6.3 Moderate consensus (0.7 ≤ σ ≤ 0.79)

25 factors achieved this level of consensus. There was a focus on factors related to governance, housing, energy consumption and well-being. ‘Smart and appropriate location’ ($\sigma = 0.70$) and ‘stakeholder consultation’ ($\sigma = 0.70$) represented the governance factors. This indicates the importance of public participation in the planning process to reflect perceptions toward urban challenges which, in turn, help to develop effective policies for decision making.

Housing is also a key issue for developing countries. Currently, the Iraqi government is not able to fulfil housing requirements because of its inability to produce new residential units to meet the demands caused by population growth, this causing a sharp deficit in the housing sector (UN 2010). The experts agreed that ‘diversity of residential units’ ($\sigma = 0.70$) and ‘residential schemes’ ($\sigma = 0.71$) are important.

‘Energy management’ ($\sigma = 0.73$) and ‘energy efficiency’ ($\sigma = 0.78$) have been included as the main energy indicator factors in this group. There is a need to reduce the rate of depletion of the world’s energy and to support environmental conservation through minimising energy consumption (Omer 2008). This is a major concern for all countries, including Iraq, which suffers from a massive deficit in meeting the population's requirements for electricity (CSO 2013). Energy management is therefore a key factor and needs to be performed effectively and efficiently. Well-being factors also were included such as 'ventilation potential' (σ = 0.72), 'thermal comfort strategies' (σ = 0.74) and 'light and noise pollution' (σ = 0.79), all aiming to ensure that inhabitants are living in a comfortable environment.

Finally, the incorporation of local cultural influences provides a foundation for future generations to continue to integrate local characteristics into urban projects. This is especially so for the Iraqi culture which is considered a mix of diverse traditions and civilisations which have evolved during the country's history (Tripp 2002). Local cultural factors were represented in this group as 'conservation of buildings' (σ= 0.76) and adaptation for 'social inclusion' (σ= 0.77).

5.6.4 Low consensus (0.8 ≤ σ ≤ 0.89)

11 factors achieved this level of consensus. The encouragement of the 'use of renewable energy' is one of the prominent factors achieving the highest level of consensus (σ = 0.82). Iraq has multiple and diverse ranges of energy sources (e.g., solar and wind power), but there is a growing demand and increasing gap between system load and system capacity to fulfil actual demand (Shell 2011). While there is an urgent need to employ alternative, clean energy resources to meet resource requirements, it is important to decrease GHG emissions.

Hazard factors also were included. Natural hazard mitigation, protection and shelters for disaster mitigation were most prominent regarding levels of consensus (σ= 0.83), followed by evacuation during disasters (σ=0.84). Desertification of land and sandstorms represent common natural hazards in Gulf countries causing environmental pollution, losses to the national economy and health problems (Geist 2005). Natural hazards, therefore, require immediate environmental solutions.

'Safety of public places' within the safety indicator was also included (σ=0.85), something considered an urgent issue for some Iraqi cities (Rathmell *et al.* 2006).

The factor 'reuse of construction waste' was at the bottom of the list, achieving σ= 0.93.

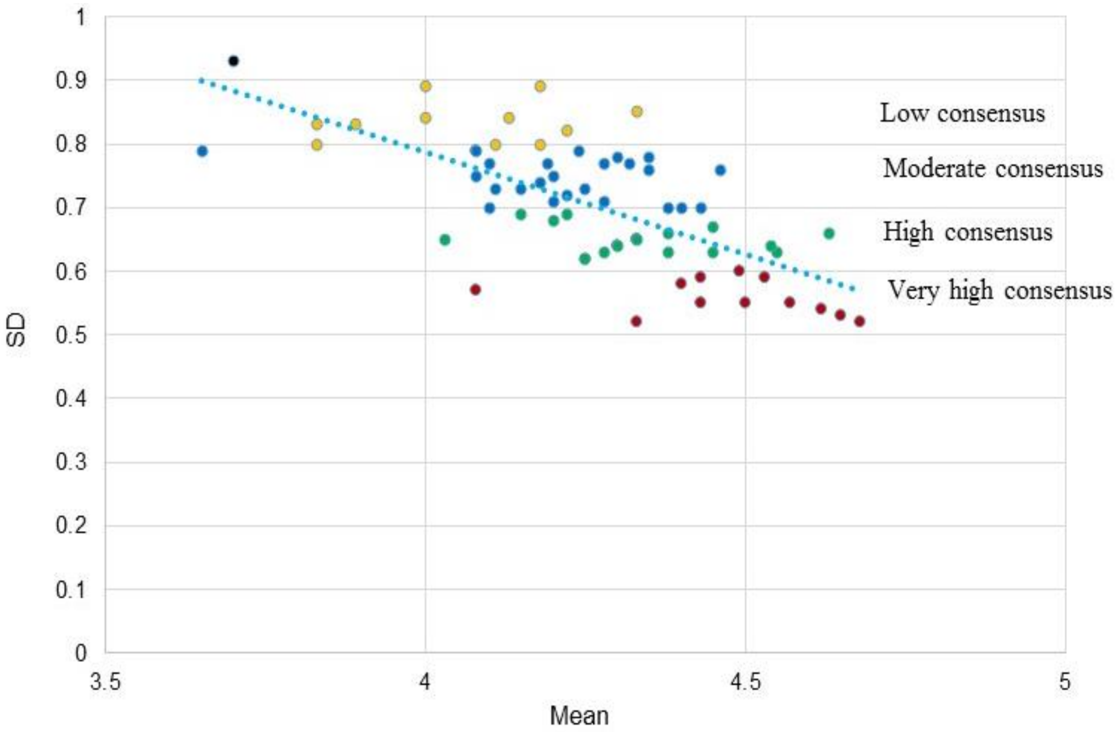


Figure 5.2: Disparities in the level of consensus among the panellists

5.7 The urban Iraqi sustainability assessment framework (IUSAF)

The new framework identified 89 key urban factors comprising three hierarchical levels, as shown in Figure **5.3**. The first consists of three major dimensions: environmental, social and economic. The second level includes 18 key urban indicators while the third includes 71 sub-indicators. Ten factors, the most important ones ($\bar{x} \geq 4.5$), were designated as mandatory factors in the proposed assessment framework as shown in Figure **5.3**. These are the elements that need to be achieved in the early stages of assessment, the remaining 79 optional.

The field of sustainable urban development generally lacks an exchange of knowledge among experts in dispersed regions on a global level. The Delphi technique can facilitate knowledge sharing and idea generation, providing itself efficient re-its application in abstract conceptual fields such as social and culture, as well as its usefulness in areas such as healthcare and industry. With a view to making consultative decisions using stakeholders and decision makers, this technique is a useful and robust tool to promote dialogue and build consensus among experts regarding the development of sustainability assessment tools.

In contrast, due to the absence of a non-subjective approach for the development of new weighting systems for urban sustainable assessment frameworks, the use of the Analytical Hierarchy Process (AHP) may be considered a viable alternative (Ali and Al Nsairat 2009). This constitutes the next chapter of this research, which will describe a weighting system for the generated urban indicators and sub-indicators.

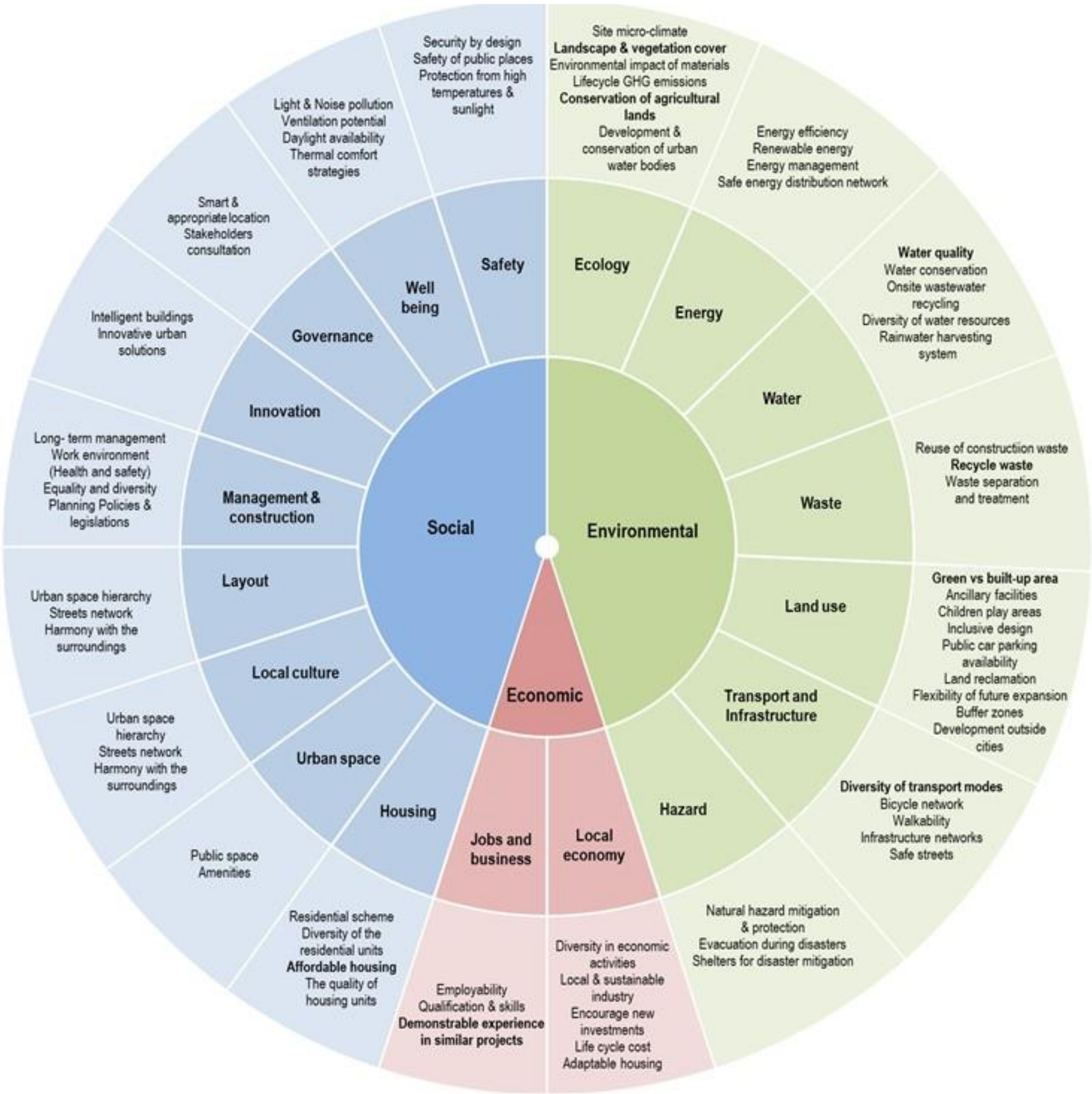


Figure 5.3: Hierarchical levels of the Iraqi Urban Sustainability Assessment Framework

5.8 Summary

This chapter represents a unique contribution in the search for a robust and comprehensive methodology to identify quantitative and qualitative indicators of urban challenges in the Iraqi context. The methodology was based on a multi-dimensional approach that involved the engagement of key stakeholders and decision-makers in order to develop a local sustainability assessment framework. It is suggested that this approach can provide substantial benefits that are not likely to result from the application of different global tools.

The Delphi technique, used as a consensus-based approach, incorporated stakeholders' experience and knowledge in a collaborative process, over a two-and-a-half-month period. Thirty-seven of the selected experts achieved a high level of consensus on indicators and sub-indicators regarding urban development sustainability for Iraqi cities. The outcomes of the Delphi consultation approach suggest that global assessment tools are not appropriate due to the specific and unique issues which need addressing.

This research has successfully achieved its primary objective of identifying a list of local urban assessment factors which represent the core of the assessment framework. The framework consists of 18 indicators and 71 sub-indicators, comprising environmental, social and economic aspects. The main finding is that it is crucial to develop an IUSAF that is compatible with urban challenges, local culture, resources, public priorities and institutions.

Chapter 6
Prioritisation of urban sustainability assessment factors

This chapter suggests customising an appropriate weighting system that prioritises criteria in the Iraqi urban sustainability assessment framework (IUSAF). AHP was used to achieve this as it is considered one of the more appropriate processes to use. AHP involves a follow-on consultation with a number of professionals and highly-informed experts, who have local and global experience in this field, from academia, government and industry. The reliable weighting system for the IUSAF includes the weight of each indicator and sub-indicator, the credit allocation strategy, the chosen rating formula, mandatory indicators and the IUSAF rating benchmarks. This chapter concludes an approved weighting system for the Iraqi cities, along with a comparison between it and some global assessment tools, and discussion of the measurement methods.

6.1 Development of IUSAF weighting system

Categories of indicators that form the IUSAF, will be evaluated using AHP. A weighting value has been given to each indicator and sub-indicator based on a follow-on consultation with a number of experts. The analytical function of Excel Microsoft software has been used to analyse the input data, which simplifies the implementation of the AHP process. The IUSAF weighting system was built based on the following:

6.1.1 The hierarchical structure

The AHP model is normally used to solve complex problems and turn them into manageable elements, presented in hierarchical levels, e.g., goal, indicators and sub-indicators (Saaty 1990). The first level of the IUSAF hierarchy model is the goal. This is the central issue which defines the scope of the subject matter subsuming indicators and sub-indicators, as shown in Figure **6.1**. The hierarchical structure of AHP modelling also allows for the identification of interrelationships among components. 18 key indicators represent the 3 main dimensions of urban sustainability: environmental, social, and economic having 71 sub-indicators each (2- 9 per indicator) as detailed in Chapter 5.

6.1.2 The experts' selection

The IUSAF expert panel comprised 20 professionals and highly-informed experts, chosen to avoid potential inconsistencies and information overlap (Lin *et al.* 2010). Only16 experts agreed to participate, this is an acceptable number (Omar and Jaafar 2011). Although the number of experts was smaller, several studies have indicated that the size of the panel is not a limitation as the AHP process can be conducted with a small number of competent respondents (Lee and Walsh 2011; Tsyganok *et al.* 2012).

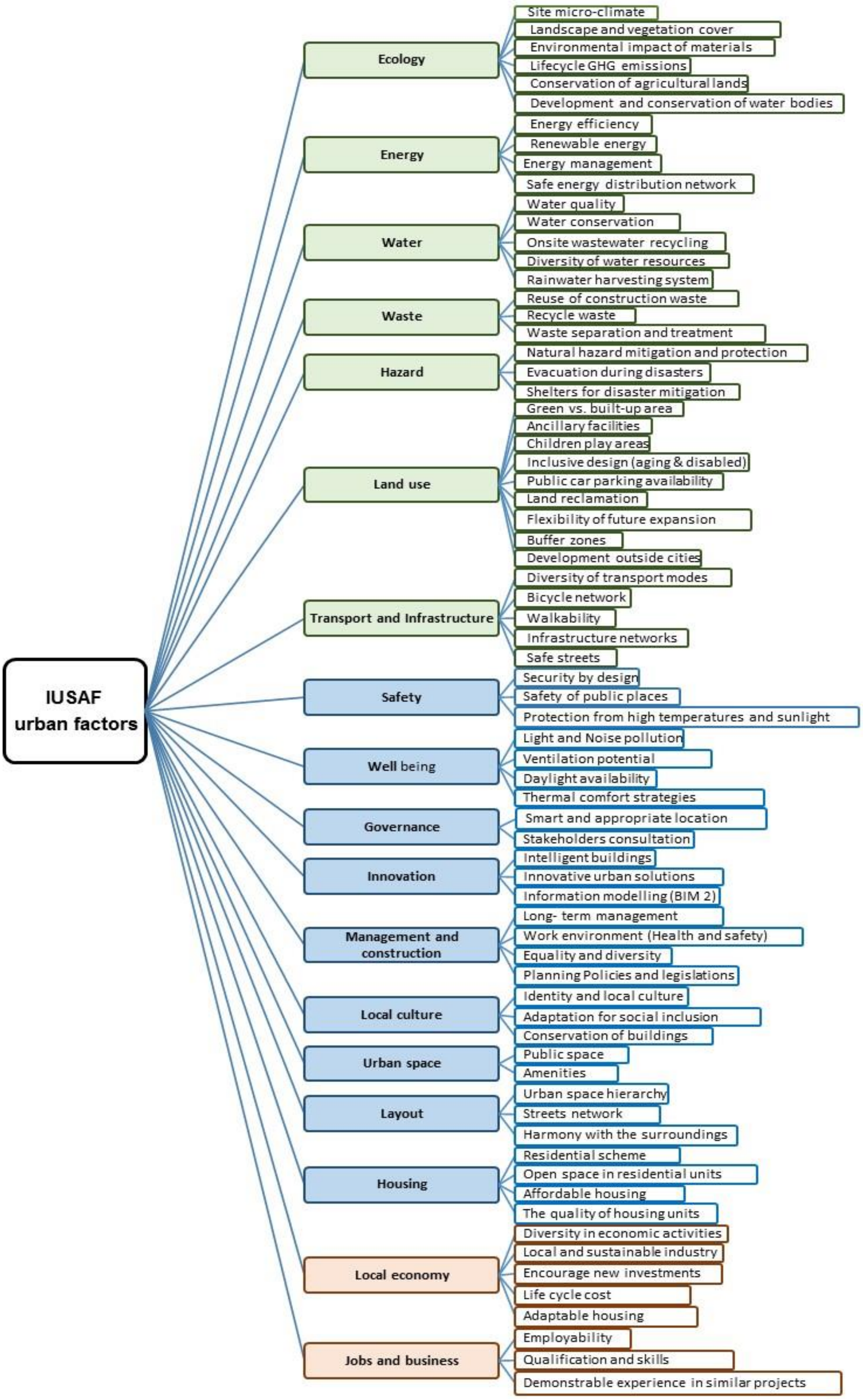


Figure 6.1: the hierarchical structure of the IUSAF

6.1.3 Pair-wise comparisons

The pair-wise comparisons (PCs) method is the main stage of the AHP used to build a hierarchy model (Tavana *et al.* 1996; Luzon and El-Sayegh 2016). The size of the comparison matrix varies depending on the numbers of urban factors. Table **6.1** shows the largest combined pairwise comparison matrix (Reciprocal Matrix = 18x18). Pair-wise comparisons were carried out for the all urban factors of the IUSAF this then sent to the pool of experts via email. Three expert responses were rejected due to their consistency ratio (RC) exceeding 0.1, while the 13 remaining answers were used to determine the ratings. Finally, the consensus of the groups was calculated by using Excel Microsoft software to generate the total weights for the IUSAF. Excel Microsoft software was used as the main tool for implementing the AHP concepts (Goepel 2013).

6.1.4 Allocation of weights

The results of the pair-wise comparisons reflected reliable judgments as evidenced by a consistency ratio (CR) of less than 0.1. This value was used to determine the inconsistency of responses (Triantaphyllou and Mann 1995) and is equivalent to 0.047 in this study, which is considered valid (Saaty 1994; Salmeron and Herrero 2005). The scope of IUSAF factor weights differ from existing rating systems such as BREEAM Communities and LEED-ND, which prioritise energy efficiency and promote ecology factors (USGBC 2011; BRE 2013). There are important variations that relate to the credit ratings, the development of urban assessment indicators and the overall weighting system.

Table 6.1: The pair-wise comparison matrix

	EC	EN	WT	WS	HZ	LU	TI	SA	WB	GO	IN	MC	LC	US	LO	HO	LE	JB
Ecology (EC)	1	4	4	7	2	3	2	4	7	3	4	2	3	7	3	3	1	1
Energy (EN)	0.25	1	0.333	0.333	0.5	0.25	0.2	0.2	0.5	0.5	0.2	0.25	0.167	0.5	0.2	0.2	0.14	0.14
Water (WT)	0.25	3	1	6	3	1	1	1	6	3	1	3	1	6	3	3	1	1
Waste (WS)	0.143	3	0.167	1	1	1	1	1	3	3	1	2	1	3	1	1	0.33	0.5
Hazard (HZ)	0.5	2	0.333	1	1	0.333	0.333	1	2	1	0.333	0.25	0.25	2	0.25	0.25	0.17	0.17
Land use (LU)	0.333	4	1	1	3	1	1	1	4	1	0.5	0.5	0.333	2	1	1	0.33	0.33
Transportation & Infrastructure (TI)	0.5	5	1	1	3	1	1	1	4	1	1	1	1	3	1	1	1	1
Safety (SA)	0.25	5	1	1	1	1	1	1	1	1	4	4	1	4	4	4	7	7
Well-being (WB)	0.143	2	0.167	0.333	0.5	0.25	0.25	1	1	1	0.2	0.2	0.143	1	0.14	0.14	0.14	0.14
Governance (GO)	0.333	2	0.333	0.333	1	1	1	1	1	1	0.333	1	0.5	3	1	1	0.5	0.5
Innovation (IN)	0.25	5	1	1	3	2	1	0.25	5	3	1	3	0.333	1	1	0.5	0.5	0.5
Management & construction (MC)	0.5	4	0.333	0.5	4	2	1	0.25	5	1	0.33	1	0.333	3	1	1	1	1
Local culture (LC)	0.333	6	1	1	4	3	1	1	7	2	3	3	1	4	4	4	1	1
Urban space (US)	0.143	2	0.167	0.333	0.5	0.5	0.333	0.25	1	0.333	1	0.333	0.25	1	0.33	0.33	0.2	0.2
Layout (LO)	0.333	5	0.333	1	4	1	1	0.25	7	1	1	1	0.25	3	1	1	1	1
Housing (HO)	0.333	5	0.333	1	4	1	1	0.25	7	1	2	1	0.25	3	1	1	0.33	0.33
Local economy (LE)	1	7	1	3	6	3	1	0.143	7	2	2	1	1	5	1	3	1	1
Jobs & businesses (JB)	1	7	1	2	6	3	1	0.143	7	2	2	1	1	5	1	3	1	1

The synthesis of the pairwise comparisons, as shown in Figure **6.2**, reveals the weighting system arranged in descending order, to provide a clear picture of the priority of urban indicators. The indicator 'water' was top priority with 8.5% of the total weight with ‘safety’ indicators second at 7.9 %. This was followed by 7.80 % for ‘transportation and infrastructure’, 7.60% for the ‘local economy’, 7.00% for the ‘jobs and business’, and 6.3% for ‘housing’. The lowest weighting was for 'well- being' at 3.00% which was just behind ‘urban space' at 3.70%.

Water has the highest weight according to the experts, this compatible with concerns about severe water shortages in most Middle East countries. This result is also the same as that identified by other rating tools such as PCRS and GSAS, which have been developed in the UAE and Qatar.

That said, the uniqueness of the IUSAF framework is because it focuses on several urban indicators, such as safety, transportation and infrastructure, economic factors and housing, which are considered vital and fundamental to the existing circumstances in Iraqi cities (CSO 2013).

The third level of AHP aimed to determine the weight of the sub-indicators under each indicator, based on the pair-wise comparisons, as illustrated in Table **6.2**.

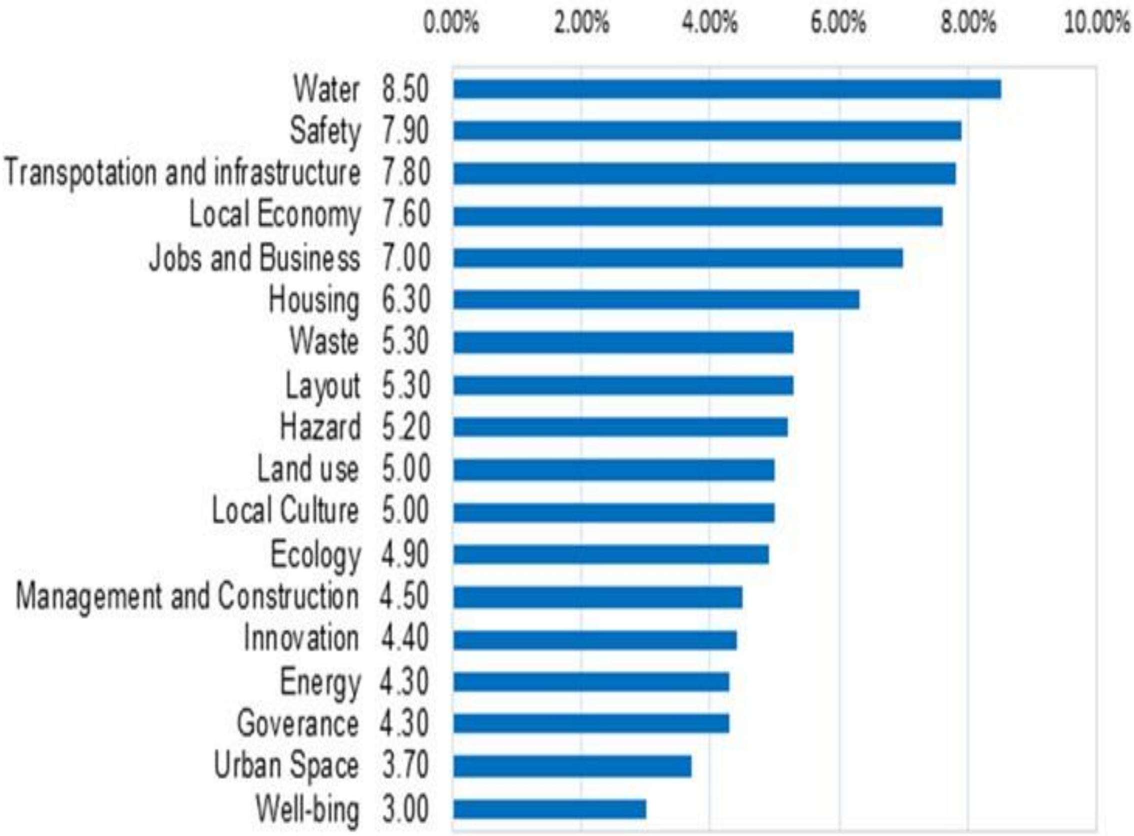


Figure 6.2: The priority of IUSAF indicators derived from pair-wise comparisons

6.1.5 Allocation of Credits

Given that the Delphi expert panel reached consensus on urban factors according to their relative importance, the IUSAF credits will inform on ways to distinguish between these factors. The sub-indicators that exceed 70% or 3.5/5, because their lowest mean score is higher than 3.5, are considered appropriate for use. This level is usually employed in Delphi studies (Okoli and Pawlowski 2004; Alyami 2015). To differentiate between various urban factors, the IUSAF suggests allocating three levels of credit. Factors rating above 3.5/5 can be awarded one credit, those rated more than 4.0/5 awarded two credits while those rated more than 4.5/5 can be awarded three credits. This strategy will allow identification of the highest rated urban factors. As can be seen in Table **6.2**, credits have been distributed for all indicators and sub-indicators. The total available criteria for IUSAF are 150 credits.

6.1.6 Mandatory factors (MF)

The IUSAF adopts a mandatory and optional urban factor rating approach in order to achieve a flexible system. This means compliance in two areas; credit numbers are awarded to reach the target for IUSAF rating and the required weighting percentages. Mandatory factors are considered the most important local urban factors and these are the ones which achieved the higher mean scores ≥ 4.5 at the Delphi panel stage. These factors (MF) aim to identify key, local sustainability issues to achieve a minimum level of sustainability throughout planning stages. They add to sustainability requirements and are embedded within other IUSAF rating stages. This implies that to achieve a rating of 1, ten mandatory factors which have been determined as 'required' in Table **6.2**, must be achieved. This represents the minimum limit of the rating score. The IUSAF rating system has ten mandatory factors of performance: a development proposal cannot achieve an IUSAF certificate and rating without addressing all of these.

Table 6.2: The IUSAF weighting system

Urban Indicators	Sub Indicators	Weight %	Maximum Credits	Credit value %
Ecology		**4.9**	**14**	
	Landscape and vegetation cover	Required		
	Conservation of agricultural lands	Required		
	Site micro-climate	0.4	2	0.2
	Landscape and vegetation cover	0.8	3	0.266
	Environmental impact of materials	0.6	2	0.3
	Lifecycle GHG emissions	0.6	2	0.3
	Conservation of agricultural lands	1.2	3	0.4
	Development and conservation of water bodies	1.3	2	0.65
Energy		**4.3**	**8**	
	Energy efficiency	0.9	2	0.45
	Renewable energy	1.6	2	0.8
	Energy management	0.9	2	0.45
	Safe energy distribution network	0.9	2	0.45
Water		**8.5**	**11**	
	Water quality	Required		
	Water quality	1.5	3	0.5
	Water conservation	1.6	2	0.8
	Onsite wastewater recycling	1.7	2	0.85
	Diversity of water resources	2.1	2	1.05
	Rainwater harvesting system	1.6	2	0.8
Waste		**5.3**	**6**	
	Recycle waste	Required		
	Reuse of construction waste	1	1	1
	Recycle waste	2.1	3	0.7
	Waste separation and treatment	2.2	2	1.1
Hazard		**5.2**	**4**	
	Natural hazard mitigation and protection	1.7	1	1.7
	Evacuation during disasters	2	2	1
	Shelters for disaster mitigation	1.5	1	0.75
Land use		**5**	**19**	
	Green vs. built-up area	Required		
	Green vs. built-up area	0.3	3	0.1
	Ancillary facilities	0.3	2	0.15
	Children play areas	0.6	2	0.2
	Inclusive design (aging & disabled)	0.6	2	0.3
	Public car parking availability	0.8	2	0.4
	Land reclamation	0.6	2	0.3
	Flexibility of future expansion	0.6	2	0.3
	Buffer zones	0.5	2	0.25
	Development outside cities	0.7	2	0.35
Transportation & Infrastructure		**7.8**	**12**	
	Diversity of transport modes	Required		
	Infrastructure networks	Required		
	Safe streets	Required		
	Diversity of transport modes	1.8	3	0.6
	Bicycle network	1	1	1
	Walkability	1.1	2	0.55
	Infrastructure networks	2.1	3	0.7
	Safe streets	1.8	3	0.6
Safety		**7.9**	**6**	
	Security by design	2.5	2	1.25

To be continued

Urban Indicators	Sub Indicators	Weight %	Maximum Credits	Credit value %
	Safety of public places	2.6	2	1.3
	Protection from high temperatures and sunlight	2.8	2	1.4
Well-being		**3**	**8**	
	Light and Noise pollution	0.7	2	0.35
	Ventilation potential	1	2	0.5
	Daylight availability	0.6	2	0.3
	Thermal comfort strategies	0.7	2	0.35
Governance		**4.3**	**4**	
	Smart and appropriate location	1.7	2	0.85
	Stakeholders consultation	2.6	2	1.3
Innovation		**4.4**	**6**	
	Intelligent buildings	1	2	0.5
	Innovative urban solutions	1.5	2	0.75
	Information modelling (BIM 2)	1.9	2	0.95
Management & Construction		**4.5**	**8**	
	Long- term management	1	2	0.5
	Work environment (Health and safety)	1	2	0.5
	Equality and diversity	1	1	0.5
	Planning Policies and legislations	1.5	3	0.5
Local culture		**5**	**6**	
	Identity and local culture	2	2	1
	Adaptation for social inclusion	1.4	2	0.7
	Conservation of buildings	1.6	2	0.8
Urban Space		**3.7**	**4**	
	Public space	1.6	2	0.8
	Amenities	2.1	2	1.05
Layout		**5.3**	**6**	
	Urban space hierarchy	1.5	2	0.75
	Streets network	1.6	2	0.8
	Harmony with the surroundings	2.2	2	1.1
Housing		**6.3**	**9**	
	Affordable housing	Required		
	Residential scheme	1.1	2	0.55
	Diversity of the residential units	1.2	2	0.6
	Affordable housing	2.1	3	0.7
	The quality of housing units	1.9	2	0.95
Local Economy		**7.6**	**10**	
	Diversity in economic activities	1.3	2	0.65
	Local and sustainable industry	1.8	2	0.9
	Encourage new investments	2.1	2	1.05
	Life cycle cost	1.1	2	0.55
	Adaptable housing	1.3	2	0.65
Jobs and business		**7**	**9**	
	Demonstrable experience in similar projects	Required		
	Employability	1.9	2	0.95
	Qualification and skills	2.1	2	1.05
	Demonstrable experience in similar projects	3	3	1
The total		**100%**	**150**	

6.1.7 The rating formulas

According to the weighting system in Table **6.2** above, the IUSAF will be able to provide a single score, or its constituent parts, which will reflect the sustainability level of urban development projects. This can be achieved as follows:

(a) Identifying the rate of each sub-indicator, as shown in Equation (1); The IUSAF has 18 urban indicators, this resulting in 18 different rating scores.

(b) Identification of the summation of these 18 rating scores, as shown in Equation (2). This will provide the overall score within a maximum 150 credits available.

$$RSSI = \frac{CA}{AC} X\ W\% \qquad \textbf{(1)}^{3}$$

$$Overall\ Rating = \sum_{n=1}^{n=18} RSSI\ n \qquad \textbf{(2)}$$

6.1.8 IUSAF certifications

Since the emergence of the BREEAM, the results of any assessment method are converted into a single ranking expression, normally called the rating benchmark, in order to be awarded certifications. Other global assessment methods such as CASBEE, LEED, SBtool and PCRS have followed the same strategy (Kamaruzzaman *et al.* 2016). Rating benchmark levels aim to enable stakeholders to compare the performance of any individual indicator with other factors of any assessment tool.

The IUSAF adopts a similar approach to BREEAM Co. and PCRS by using a percentage-based scale. It includes seven different levels of certifications, as shown in Table **6.3**. The first level fulfils the mandatory factors, which reflect the main challenges in this context, whereby the project will be accepted for rating. The mandatory requirements will be deemed fundamental because they reflect primary urban factors. The second level is rated below 30%; it will be considered **'Unclassified'**, and the project will not award any star. The third level is rated between 30-44%; it will be awarded one star and considered **'Classified'**. The fourth level is rated between 45- 59%, awarded two stars and considered **'Good'**. The fifth level is rated between 60- 74%; it will be awarded three stars and considered **'Very good'**

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[3] Where:
RSSI: Rating score of the sub-indicator
CA: Credits Achieved
AC: Available Credits
W: Weighting Percentage

Table 6.3: The IUSAF rating benchmarks

Requirement	USAF rating achieved	Assessment Description
All mandatory factors (MF)		**Accepted to assess**
MF + < 30 % score		**Unclassified**
MF + ≥ 30 % score	☆	**Classified**
MF + ≥ 45 % score	☆☆	**Good**
MF + ≥ 60 % score	☆☆☆	**Very good**
MF + ≥ 75 % score	☆☆☆☆	**Excellent**
MF + ≥ 85 % score	☆☆☆☆☆	**Outstanding**

The sixth level is rated between 75- 84%; it will be awarded four stars and considered **'Excellent'**. The seventh level is rated 85% and above and will be awarded five stars and considered **'Outstanding'**. This final level is the aim for innovative urban solutions and to meet the majority of urban factors.

6.2 Comparisons between GUSAT's and the IUSAF

The global assessment tools BREEAM Co., LEED-ND, CASBEE-UP, SPTool^{PT}- UP, PCRS, and QSAS/GSAS are the most valuable rating systems in the field of sustainable urban development. Developed countries are more conscious and concerned about environmental issues (Sharifi and Murayama 2014) while developing countries are trying to achieve many other aspects that describe the state of urban sustainability. Despite that there are common aims between all global rating systems such as emphasis on energy consumption, water efficiency, environmental quality, resources management, site strategies and transport and services, each assessment method focuses on some specific aspects more than others, depending on the local context. Table **6.4** illustrates differences between the IUSAF and some of the more well-known assessment tools. The highest compatibility was with CASBEE-UP factors by 70%, followed by 62% for LEED-ND, 59% for PCRS respectively, and approximately 50% for both BREEAM Communities and SPTool^{PT}-UP. The lowest level of compatibility was with QSAS/GSAS (42%).

The results of comparisons revealed common concerns but with variance in ratings, as shown in Figure **6.3**. BREEAM Communities, for instance, rated 'ecology' and 'transportation' highly (approximately 20% for each), considering them the most important urban indicators. 'Energy' and 'governance' came third in terms of importance at 9.5%. Regarding LEED, 'ecology' did not achieve a high weighting (4%), but LEED-ND identified 'transportation' as a highly significant indicator, with a high weighting score (22%). LEED-ND also focused on 'land use', 'governance', and 'energy' in its assessment, awarding them high weightings of 14%, 12%, and 11.5% respectively (USGBC 2011; BRE 2013). As for the PCRS and GSAS, both tools compliment IUSAF in considering 'water' as an extremely important indicator, due to the scarcity of drinking water and lack of water resources in the Middle East countries. At the same time, GSAS and

PCRS ranked 'energy' as a highly important indicator, with weightings of 20% and 17% respectively (ADUPC 2010; Horr 2013).

Table 6.4: Comparison among urban factors of IUSAF and selected GUSATs

The questionnaire suggested indicators		**BREEAM Com.[1]**	**LEED -ND[2]**	**CASBEE-UP[3]**	**SPTool[PT]-UP[4]**	**PCRS[5]**	**QSAS/ GSAS[6]**
Indicator	**Sub- indicator**						
Ecology	Site micro-climate	✓	✓	✓	✓	✓	✓
	Landscape and vegetation cover	✓	✓	✓	✓	✓	✓
	Environmental impact of materials	✓	✓	✓	✓	✓	✓
	Lifecycle GHG emissions		✓	✓	✓	✓	✓
	Conservation of agricultural lands		✓	✓			
	Development and conservation of water bodies	✓	✓	✓		✓	
Energy	Energy efficiency	✓	✓	✓	✓	✓	✓
	Renewable energy	✓	✓	✓	✓	✓	✓
	Energy management	✓	✓	✓	✓	✓	✓
	Safe energy distribution network						
Water	Water quality	✓	✓	✓			
	Water conservation		✓		✓	✓	✓
	Onsite wastewater recycling	✓	✓	✓	✓	✓	✓
	Diversity of water resources			✓			
	Rainwater harvesting system	✓	✓	✓		✓	✓
Waste	Reuse of construction waste		✓		✓	✓	✓
	Recycle waste		✓	✓	✓	✓	✓
	Waste separation and treatment		✓	✓	✓	✓	✓
Hazard	Natural hazard mitigation and protection	✓	✓	✓	✓		✓
	Evacuation during disasters			✓			
	Shelters for disaster mitigation						
Land use	Green vs. built-up area			✓		✓	✓
	Ancillary facilities	✓	✓	✓	✓	✓	
	Children play areas			✓			
	Inclusive design (aging & disabled)	✓	✓	✓			
	Public car parking availability	✓	✓	✓		✓	
	Land reclamation		✓	✓	✓	✓	✓
	Flexibility of future expansion						
	Buffer zones		✓	✓		✓	
	Development outside cities						
Transport & Infrastructure	Diversity of transport modes	✓		✓	✓	✓	✓
	Bicycle network	✓	✓	✓	✓	✓	✓
	Walkability	✓	✓	✓	✓		✓
	Infrastructure networks	✓	✓	✓	✓	✓	✓
	Safe streets	✓	✓	✓	✓		
Safety	Security by design		✓	✓		✓	✓
	Safety of public places			✓	✓	✓	
	Protection from high temperatures and sunlight						
Well being	Light and Noise pollution	✓	✓	✓	✓	✓	✓
	Ventilation potential			✓	✓	✓	✓
	Daylight availability		✓	✓		✓	✓
	Thermal comfort strategies	✓	✓	✓	✓	✓	✓
Governance	Smart and appropriate location	✓	✓				
	Stakeholders consultation	✓	✓			✓	
Innovation	Intelligent buildings	✓	✓	✓	✓	✓	✓
	Innovative urban solutions		✓	✓		✓	
	Information modelling (BIM 2)			✓			
	Long- term management		✓			✓	✓

Management & construction	Work environment (Health and safety)	✓		✓			
	Equality and diversity						
	Planning Policies and legislations						
Local culture	Identity and local culture	✓		✓	✓	✓	✓
	Adaptation for social inclusion		✓	✓	✓	✓	
	Conservation of buildings	✓	✓	✓	✓	✓	
Urban space	Public space	✓	✓	✓	✓	✓	
	Amenities	✓	✓		✓	✓	
Layout	Urban space hierarchy		✓				
	Streets network		✓	✓	✓	✓	
	Harmony with the surroundings	✓		✓	✓		
Housing	Residential scheme	✓	✓				
	Diversity of the residential units	✓				✓	
	Affordable housing						
	The quality of housing units	✓		✓			
Local economy	Diversity in economic activities	✓	✓	✓	✓		✓
	Local and sustainable industry	✓		✓	✓	✓	✓
	Encourage new investments						
	Life cycle cost		✓	✓		✓	
	Adaptable housing						
Jobs and business	Employability				✓		
	Qualification and skills	✓		✓			
	Demonstrable experience in similar projects					✓	
The compatible with IUSAF urban factors		**50%**	**62%**	**70%**	**49%**	**59%**	**42%**
References: [1] (BRE 2013), [2] (USGBC 2011), [3] (IBEC 2015), [4](Castanheira and Braganca 2014),[5](ADUPC 2010), [6] (Horr 2013)							

Through these comparisons, it can be observed that each assessment method prioritises urban factors differently, according to the local urban challenges of its country. It is important therefore to illustrate the relevance of the customisation of IUSAF and its divergence from other global tools, which demonstrate conclusively that these other methods are not appropriate in the Iraqi context. At a different level, these comparisons also provide evidence for the importance of weighting systems as central to any urban sustainability assessment process (Haapio 2012).

The final IUSAF factors will play the main role in promoting the sustainability of urban development projects, as well as enabling stakeholders and urban decision-makers to assess the environment. These factors have, therefore, been displayed as a multi-stage process, in order to achieve reliable customization.

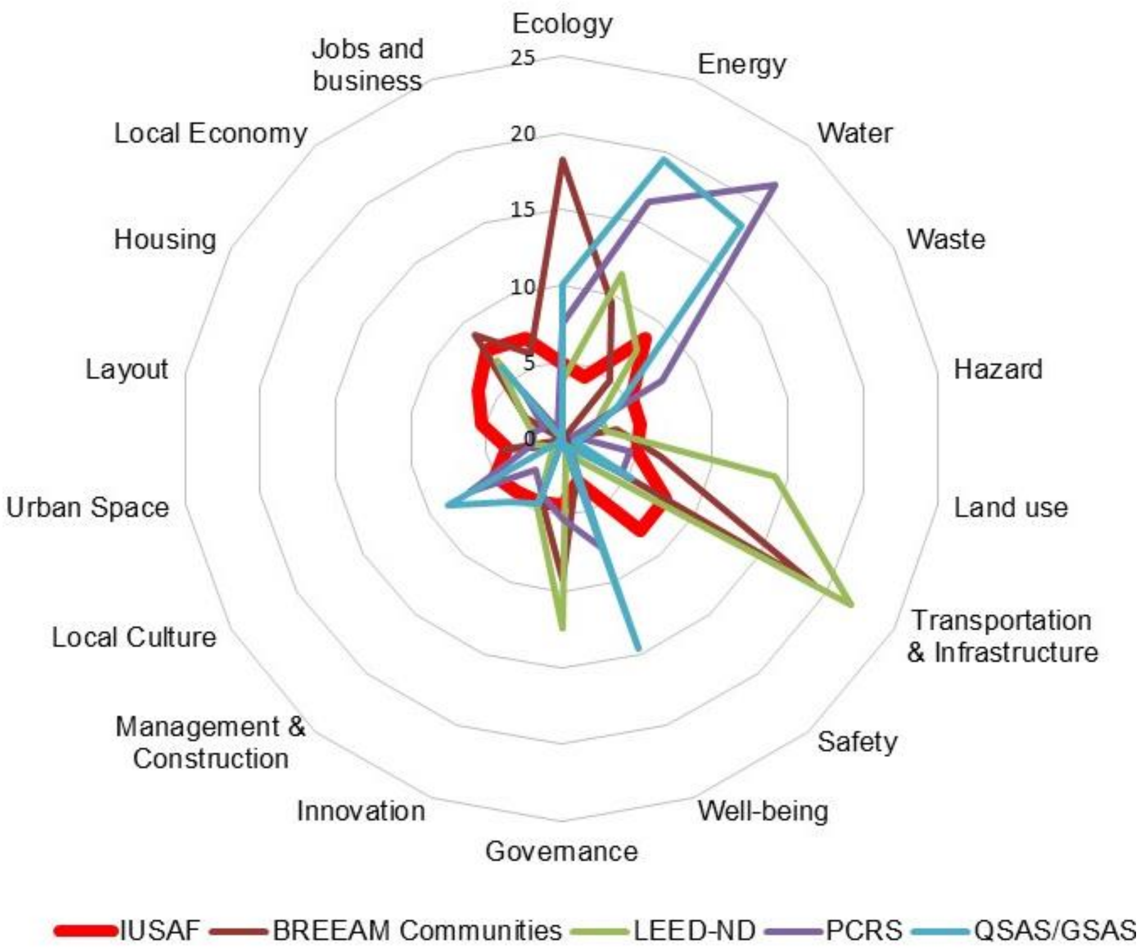

Figure 6.3: Disparities in weighting scores between IUSAF indicators in comparison with other global tools

6.3 The scope of urban factors and measurement methods

The IUSAF's have been structured at two levels; indicators and sub-indicators, the scope of any urban factor should focus on fulfilling a particular urban objective, as well as being understandable and easy to measure.

The qualitative and quantitative factors presented in this study are advisory in nature and provide a broad foundation for the development of sustainable urban measurement tools within the Iraqi context. The suggested measurement methods for the IUSAF have been derived based on local urban planning standards and legislations, which should be taken into consideration when designing urban development schemes, in addition to a selection of global assessment methods, in order to cover assessing all urban factors of IUSAF.

Table **6.5** provides a description of the scope of all the urban factors of IUSAF, in addition to the measurement methods used to assess urban factor performance.

Table 6.5: The scope of the IUSAF's urban factors and measurement methods

The suggested indicators		The scope	Measurement method
Indicator	**Sub- indicator**		
Environment			
Ecology	Site micro-climate	Consideration of site; building configuration; air movement and direction; topographic characteristics; solar orientation; dust and pollution.	- Compliance with guideline - Simulation (energy, wind, shading, etc.)
	Landscape and vegetation cover	Parks; gardens and green areas; landscaping; planting design.	- m2/inhabitant - % of project area.
	Environmental impact of materials	Use sustainable construction materials with least impact on the environment, in terms of production, use and ability to be recycled.	Yes/ No, % by mass
	Lifecycle GHG emissions	Minimize GHG emissions during construction and operation stages.	- Compliance with guideline - kg-CO_2e/m^2/year - kg-e/m^2/year
	Conservation of agricultural lands	Preserve valuable agricultural lands, forests, soils and ecological diversity.	- % of total agricultural lands. - % of total project area.
	Development and conservation of urban water bodies creation	Develop water bodies and conserve those already in existence to support the ecosystem and biodiversity.	- Yes/ No, - %
Energy	Energy efficiency	Minimize energy consumption from HVAC systems (heating, ventilation and air conditioning), hot water systems and lighting.	- Compliance with guideline - KWH/m^2/year
	Renewable energy	Use renewable energy sources (e.g. solar and wind) onsite or near-site.	- Compliance with guideline - % of conventional energy
	Energy management	Use energy management systems to monitor, control and optimise the energy and environmental performance of buildings.	- Compliance with guideline - Energy distribution strategy
	Safe energy distribution network	Use safe and efficient energy distribution networks, such as underground cabling and /or piped gas networks etc.	By Design
Water	Water quality	Provide safe water to the site.	- No. of plants - m^3/inhabitant - ppb, µg contaminants concentrations
	Water conservation	Onsite water conservation strategies by sector: residential, industrial and commercial.	- m^3/year - m^3 /inhabitant/year
	Onsite wastewater recycling	Recycling and treatment of wastewater and sewage in the site	m^3, % of total reused water
	Diversity of water resources	Use diverse water resources such as lakes, marshes and underground water etc.	- Yes/No - m^3/year - % of total water used
	Rainwater harvesting system	Collect and store rainwater for later use.	- m^3 of storm water collected - % of total water used
Waste	Reuse of construction waste	Use construction and demolition waste such as concrete, bricks, gypsum, wood and glass etc., which can be remanufactured.	% by mass
	Recycle waste	Ensure efficient waste management by collecting, treating and disposing of solid wastes generated in urban projects.	% of total
	Waste separation and treatment	Separation of waste to recover useful materials thus, minimising the amount of material sent to landfill.	% by mass

Hazard	Natural hazard mitigation and protection	Protection against earthquakes, hurricanes, desertification, sandstorms, drought and etc., and installation of disaster sensors.	- Compliance with guideline -By design
	Evacuation during disasters	Prepare a hazard map for rapid and secure evacuation when disasters occur, providing an evacuation route network from danger points.	- Yes/No, - Disaster hazard map
	Shelters for disaster mitigation	Provide security, personal safety and protection to affected populations to recover from the impact of disasters. Shelter and settlements also play an essential role in reducing vulnerability and building communities' resilience, in addition to multi- purpose use.	- Compliance with guideline -Yes/No, - No./1000 inhabitant
Land use	Green vs. built-up area	Compare ratio of green and open areas with built-up areas.	% of total area
	Ancillary facilities	Facilities such as social, health, educational and entertainment.	- Compliance with guideline - m^2/inhabitant
	Children play areas	Comprises indoor and outdoor play areas specifically designed for children.	m^2 per inhabitant based on project's size
	Inclusive design (ageing & disabled)	Refer to broad concepts of building and urban spaces that meet the needs of older populations and people with disabilities.	- Yes/No - By design
	Public car parking availability	Ensure balance in car parking numbers for the project, dependent on Iraqi standards.	No. of car parking/ 1000 inhabitant
	Land reclamation	Treatment of contaminated and degraded lands via planting or other productive uses.	% of treated land/ total project area
	Flexibility of future expansion	Satisfy the growing and changing needs for activities, services and necessary infrastructure.	- Compliance with guideline - By design
	Buffer zones	Protect residential and commercial areas from industrial accidents and environmental pollution.	- Compliance with guideline - By design
	Development outside cities	Establish urban projects in the suburbs and rural areas, outside overpopulated cities.	- By design, - km, distance from the city
Transportation and Infrastructure	Diversity of transport modes	Promote public transport, taking into account users' needs and abilities.	- By design - % users of each transport mode
	Bicycle network	The provision of safe cycling networks.	- By design - m - % of the total area
	Walkability	Encourage people to walk to gain health benefits, reduce travelling time and energy consumption. Distances are measured from the house to the activity.	m, distance from home to work, and other activities
	Infrastructure networks	Ensure the performance of infrastructure systems such as roads, bridges, tunnels, water supply, sewers, drainage systems and telecommunications, etc. as per standards.	- By design - Infrastructure and services reports
	Safe streets	Design and operate the roads to enable safe access for all users, including pedestrians, private and public transport, motorcyclists, crossings, pavements and other features to improve safety.	- Compliance with guideline - By design
Social			
Safety	Security by design	Safety considerations in the buildings and site layout.	- By design - Security consultants report
	Safety of public places	Reduce and prevent the effects of hazards such as fires, explosions, car accidents and crimes.	Compliance with guideline
	Protection from high temperatures and sunlight	Provide external protection from high temperatures and sunlight in urban areas.	- By design - % of the total project area
Well being	Light and Noise pollution	Eliminate external light pollution through efficient design to control or remove	- Compliance with guideline

		unnecessary exterior lighting and control sources of noise.	- % of luminaire street lamps - ≥ 65 dB for noise
	Ventilation potential	Adopt effective design to allow for the application of natural ventilation.	- By design - Simulation calculation
	Daylight availability	Use daylight to decrease the need for artificial lighting.	- Compliance with guideline - Simulation calculation
	Thermal comfort strategies	Maintain thermal comfort for occupants in both internal and external environment.	- Compliance with guideline - PMV index
Governance	Smart and appropriate location	Encourage development near existing communities, infrastructure and public transport to improve and redevelop existing cities and suburban areas.	≥ 25% of the total project boundary is adjacent to the city
	Stakeholders consultation	Exchange ideas, needs and knowledge with stakeholders to improve the quality and acceptability of the development during the design process.	No. consultations/No. adopted decisions
Innovation	Intelligent buildings	Use technology in buildings to promote safety, productivity and efficiency.	- By design - % intelligent applications/total
	Innovative urban solutions	New solutions to address urban challenges in integrated ways.	- Yes/No, - No. of solutions
	Information modelling (BIM 2)	Establish an integrated information network centred on design, construction and management of urban projects.	Yes/No
Management and construction	Long- term management	Ensure long-term management and maintenance of all activities to maximize efficiency.	Management report
	Work environment (Health and safety)	Ensure safe and healthy work environment during construction.	Security and Safety Engineering Code
	Equality and diversity	Ensure a fair representation of gender and background.	%
	Planning Policies and legislations	Compliance with local laws and legislation for urban construction.	- Compliance with local standards - Compliance with guideline
Local culture	Identity and local culture	Revive and enrich physical and cultural identity for project components.	- By design
	Adaptation for social inclusion	Create various opportunities for people to participate in social, political, cultural and economic life.	- By design - Low income population/Total population
	Conservation of buildings	Preserve traditional, cultural heritage and importance economic buildings.	No. of conserved buildings/ No. of total buildings
Urban space	Public space	Identify appropriate areas to set up significant social activities, as well as opportunities for all residents and visitors to the project to meet.	- By design - Compliance with guideline
	Amenities	Provide street furniture, benches, outdoor sports facilities and toilets services that are designed according to the urban projects standards.	- Compliance with guideline - No. of Amenities/ No. of total activities - No. of Amenities/ 1000 inhabitants
Layout	Urban space hierarchy	Focus on the privacy of different activities besides the general uses of the urban space.	- By design - Compliance with guideline
	Streets network	The hierarchy of street networks and connecting nodes, for example, major, minor, and cul-de-sac streets.	- By design - Compliance with guideline
	Harmony with the surroundings	Project harmony with the surrounding neighbourhoods, whether with nature, heritage, historical factors and others.	By design

Housing	Residential scheme	Achieve the highest ratio possible of houses in urban projects.	Accommodation density= dwelling/ hectare
	Diversity of the residential units	Provide a range of residential units to meet the different housing needs of the community.	- % types of housing units based on area
	Affordable housing	Provide a mix of housing types for different income levels, by adopting housing policies such as repayment of long-term instalments and promote non-profit housing process.	Housing sales plan
	The quality of housing units	Provide adequate housing to meet the basic needs of the dwellers.	Housing quality indicators (HQI)
Economic			
Local economy	Diversity in economic activities	Achieve integration with commercial activities within the urban project.	- No. of economic activities - Economic activities/ 1000 inhabitants
	Local and sustainable industry	Involve local and sustainable industries in urban projects to promote local production.	- % of local industry/ total materials used
	Encourage new investments	Provide small- medium investment opportunities to bridge investment gaps and overcome urban development challenges.	- % of financial businesses/ total businesses - No. of investment opportunities
	Life cycle cost	Determine the most cost-effective option among diverse competing alternatives at various stages of the project.	- LLC consultant report - US$/m^2/year
	Adaptable housing	An adaptable house accommodates household changes without the need to demolish or substantially modified in the structure or existing services.	- Compliance with guideline - By design
Jobs and business	Employability	Contribute to local employment and job growth.	% of local employments/ total employments
	Qualification and skills	Provide opportunities for local businesses and develop qualifications and skills.	-Training courses - No. of trainees
	Demonstrable experience in similar projects	Involvement of leading expertise to develop local expertise in the establishment of urban projects.	- Yes/ No, - Developer CV

6.4 Summary

The need to stimulate market demand for urban sustainable development practices requires the adoption of urban assessment methods on a large scale. While developing countries are still using a range of assessment schemes that have been developed for other contexts. As Iraq presents a unique case study for the construction and reconstruction of new urban centres in a sustainable manner, developing a local weighting system is a necessity to assess the principles of urban sustainability construction.

The weighing system developed here has been tested using the AHP technique to analyse pair-wise comparisons. The findings strongly suggest that the weighting system of global urban assessment tools such as BREEAM Co., LEED-ND, CASBEE-UP, SBTool^{PT}-UP, PCRS, and GSAS, are not applicable for the Iraqi context. By using AHP, IUSAF indicators have been prioritised in this study, reflecting the most accurate weighting values of urban sustainability factors for Iraqi cities. Due to scarcity water experienced by all Middle Eastern countries, the 'water' indicator occupies top priority in the IUSAF weighting system. 'Safety', 'transportation and infrastructure', ‘local economy’, ‘jobs and business’ and 'housing’ indicators followed by their importance.

The priorities of urban indicators, reflect the local context and essential requirements for Iraqi cities. Table. 6.4 gives a full illustration of the weightings of the other urban factors, in line with the first research question, revealing the disparities with other assessment tools.

This chapter combined the AHP with the Delphi technique to devise a credits allocation system for urban indicators and rating formulae. This completed the IUSAF weighting system. This chapter also revealed the differences between IUSAF and other selected assessment tools in terms of inclusiveness of urban factors, in addition to providing a brief description of the scope of local urban factors and the measurement methods suggested to calculate the performance of urban factors.

It is appropriate now to test the IUSAF by applying it to existing case studies, under design or construction, to investigate the effectiveness of the performance of the factors and their influence on different urban development projects.

Chapter 7
Implementation and testing

A case study approach is used in this chapter to test the applicability of the IUSAF, its theoretical basis and reliability. Three urban development projects were selected as case studies covering important aspects in terms of size, dwellings number, location, data availability, construction pattern and the stage of development. Urban indicator analysis is conducted to determine their key sustainability characteristics in accordance with the IUSAF factors. The method of granting credits to and assessment of projects factors is discussed as well as the application of the proposed framework, and final results.

7.1 Urban development in Iraq

After the political changes of 2003, the Iraqi Ministry of Planning started preparing urban development strategies and policies, customising locations for local development projects and promoting investment to attract local and foreign capital to support the economy and creating jobs. Many major post-war development projects have been planned as a means to repair what has been destroyed, to fulfil growing housing demands and to improve standards of community living.

The Iraqi Ministry of Construction and Housing and the National Investment Commission (NIC) are the official departments responsible for the provision of all urban development projects to a value of US$ 280 billion (2010 to 2017) (CSO 2013). Housing projects have been their focus, in particularly major projects such as Bismayah new city, which will contribute to addressing the chronic housing shortage by providing more than 100.000 dwellings (NIC 2017b).

The Ministry of Construction and Housing has adopted a plan including 92 projects to build 70 thousand housing units, due to complete in 2017, in the central and southern Iraq.

However, to date only 20 projects have been completed, providing about 9250 dwellings (IMCH 2017). This plan, therefore, has not provided a solution to the housing crisis.

Official reports documented a number of constraints faced by these projects (IMP 2009; CSO 2013):

- Lack of allocation of financial resources to the housing sector.
- Reliance on local employees, in terms of planning, design and implementation and continued use of 1970 style designs.

- Repetition of the same project in different regions of the country.
- Limited use of innovative construction methods, materials and alternative energy systems.
- Focus on the provision of residential units only and no attention to other needs of a community.
- Lack of clarity on minimum housing standards.
- Lack of project-wide quality control over many construction activities that carried out by local contractors.

In contrast, the Iraqi Investment Law issued in 2006, adopted a plan which focused on reducing the housing deficit. The number of investment licenses granted by the Iraqi National Investment Commission (NIC) number 1300+ investment opportunities, between 2010 and 2016, in various sectors such as residential, commercial, health, agriculture and tourism. More than 170 licenses are in the housing and urban development field (NIC 2017a). These projects are local housing programs which aim to provide nearly one million housing units by 2020, relative to the housing deficits in each region.

These projects comprise medium and large size developments ranging from 500 to 100000 dwellings, including a wide range of related activities and infrastructure. The projects vary and include the expansion of cities, new urban centres, re-planning of urban areas and the reconstruction of infrastructures.

7.2 The selection of the case studies

Due to the large number of existing and potential urban development projects in Iraq, random selection is not typically an appropriate approach in comparison to when there are a small number of projects (Seawright and Gerring 2008). The information-oriented strategy however, provides the access required by offering a wide range of characteristics for case study selection, focusing on the diverse organisational mix of typical, most similar, most different, diverse, and dominant, influential, and deviant case studies (NCHRP 2008).

Case study selection in the urban development domain should include the objectives of sustainable urban development, environmental and physical aspects including size, region, location, social and cultural importance and economic issues (Brebbia and Florez-Escobar 2015). In addition to this, the current study aims to link the selection strategy to key local IUSAF indicators such as housing scheme and affordability, water, safety, transportation and infrastructure, to determine how these are represented in the selected case studies, to test the validity, theoretical basis and reliability of the IUSAF. The availability of data also represents a major obstacle to selection (Mohammed and Ali 2016). The selection process in this research was carried out according to the following:

7.2.1 Project size

The consideration of the project size is twofold:

Number of dwelling units: the NIC investment opportunities did not determine the number of dwellings required; this decision was left to the economic feasibility estimates of investors. To identify numbers, 173 NIC projects were reviewed. These projects were either under construction, approved or in the planning phase. Iraqi urban development standards were adopted to categorise the projects according to four groups (MCH 2010), as shown in Figure **7.1**a. Neighbourhood urban projects were in the majority with 63.6% providing less than 1,600 dwellings, followed by district urban projects with 19.7% and 11.4 for new city projects providing more than 9600 dwellings. NIC has promoted small urban projects due to the need for acceptable levels of funding, this allowing many local and foreign companies to invest. This has resulted in only 6.3% of sector (quarter) projects. Larger companies are involved in the construction of district and city projects providing a wide range of activities, facilities, infrastructure and public services related to housing, based on Iraqi urban development standards and the project size. These projects require considerable resources in terms of equipment, finance and specialised and technical staff. This need to be reflected in the selection of case studies.

Area: Despite the diversity of urban development projects, there is no specific and clear criterion for determining their area. NIC uses available lands and locations both: inside and outside cities, regardless of area. After a review of the areas of urban projects, whether under construction, approved or just an investment opportunity, they were grouped into four main categories, shown in Figure **7.1**b. An area covering 50000 to 250000 m^2 was dominant with 46%, followed by 19.7% for > 250000 m^2. 9.5% cover areas < 50000 m^2, indicating the low adoption of this size for urban projects.

4% of areas are not specified this referring to some projects that are located far away from urban areas, e.g. deserts. These tend to be governmental companies and strategical projects such as mining or oil extraction.

The selection of case studies, therefore, focuses on dwellings number and project area.

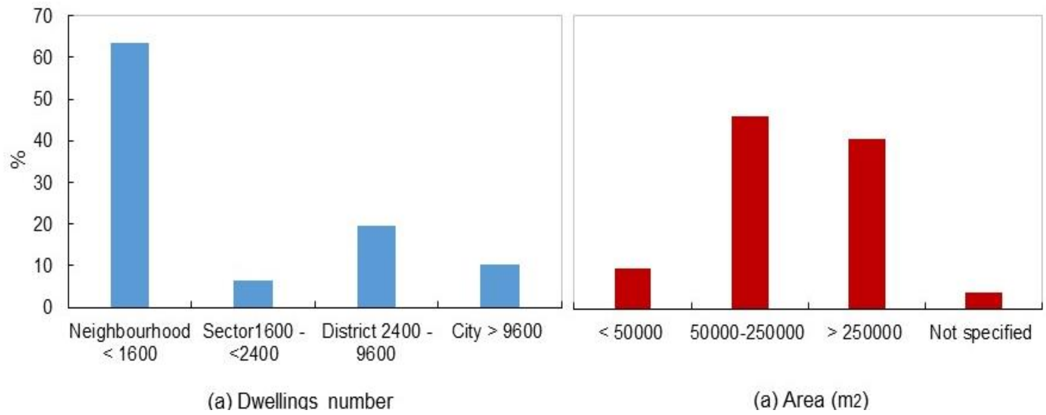

Figure 7.1: Urban development project classification based on: (a) number of dwellings, and (b) The area of the project

7.2.2 Building height

As seen in Figure **7.2**a, urban development patterns, in terms of height of buildings varied between three main types, high-rise, low-rise and mixed height. High-rise construction dominated with 40.9%, followed by 36.6% for low-rise and 32% for mixed height. The case studies, therefore, represent all construction patterns.

7.2.3 Development phase

Urban development projects were classified according to three phases of development, as shown in Figure **7.2**b:

- 39.8% are under construction.
- 34.5% have been granted investment licenses and approved, the projects ready to start but stalled because of administrative and technical problems, such as plot delivery.
- 25.7% are at-the planning stage, architectural design or preparation of final schedules and reports in order to obtain investment licenses.

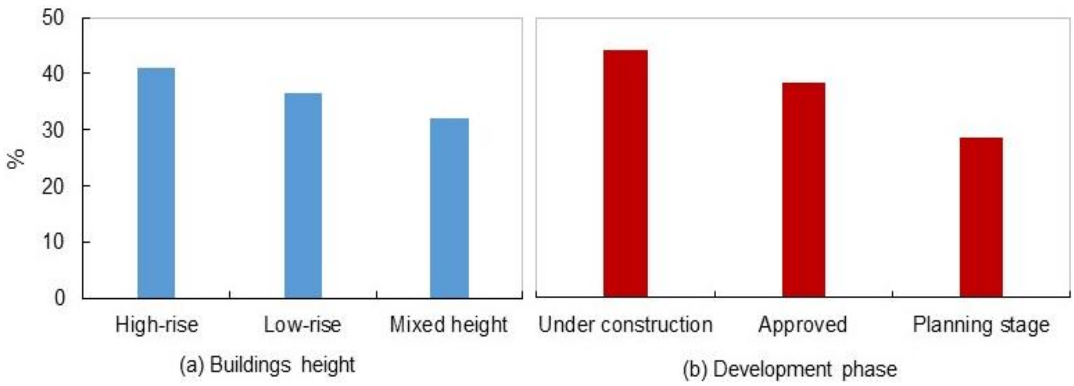

Figure 7.2: Differences in urban projects in terms of: (a) Height of buildings, and (b) Phase of development.

The possibility of any required modification for projects in the planning phase or under construction to increase its sustainability is more flexible than the existing projects. The selection of case studies, therefore, focuses on the under construction and approved project (planning phase)

7.2.4 Availability of data

Due to political changes in 2003, major obstacles have emerged limiting the availability and accessibility of official information and data, particularly from official bodies and institutions. The obstacles can be summarised as follows (Mohammed and Ali 2016):

- Critical security situations and the increase in terrorism have increased security checks increasing the amount of time taken to obtain approval/refusal to give data.
- Lengthy government administrative routines to gain the approval form official bodies.
- The spread of financial and administrative corruption in the Iraqi Government and classified by Transparency International (TI). This has resulted in licenses granted for many urban projects that do not conform to local urban standards, as well as an acute shortage of documents and technical reports.
- The lack of e-government in most government departments, including NIC, and the adoption of traditional paper communications. E-government provides citizens with access to decision-makers and government facilitators in order to obtain a quick and inexpensive service as well as helping to reduce corruption.

Moreover, available data for energy and environmental assessment during pre-construction stages are unstructured, and often incomplete (Mourshed *et al.* 2003). Together, these obstacles significantly limit the access, availability and utility of data required for many projects. Therefore, the availability of data is one of the main factors when selecting case studies.

7.3 The selected case studies

Three urban development projects have been selected as case studies, the projects are reviewed according to their size, inhabitants and dwellings number, project area, and availability of urban indicators in decreasing order, as well as other related aspects such location, data availability, buildings height diversity and development phase as follow:

7.3.1 Case study 1 (CS1): Bismayah New City

Bismayah is the first and largest urban development project in Iraq. It is categorised a city, based on number of inhabitants and dwellings according to Iraqi urban housing standards (MCH 2010), and will provide dwellings for about 600.000 inhabitants (NIC 2017b). As shown in Figure **7.3**, the city is located 10 km south-east of the capital city Baghdad, on the Baghdad-Kut highway, covering a total area of 18.30 km^2 (1830 hectare). The development aims to provide 100,080 different types of high-rise residential units.

It will provide infrastructure and services utility networks such as electricity, drinking water supplies, sewage treatment plants, irrigation systems and networks of streets, as well as public facilities such as education, healthcare, social activities, hotels, religious and commercial properties. The project site selected is in the suburbs of the capital and aims to redevelop the entire district and to develop a model for urban development which could pave the way for future urban renewal. It is also designed to take advantage of existing agricultural areas in the region and promote vegetation cover.

The design of the city focused on two main areas; commercial properties occupying the centre, surrounded by residential properties including facilities such as educational institutions, healthcare centres and some entertainment spaces. This decision was intended to make the area a vital and attractive district, drawing in a variety of inhabitants and cultures. The designer also proposed a direct link with the capital Baghdad through a public transport network plan.

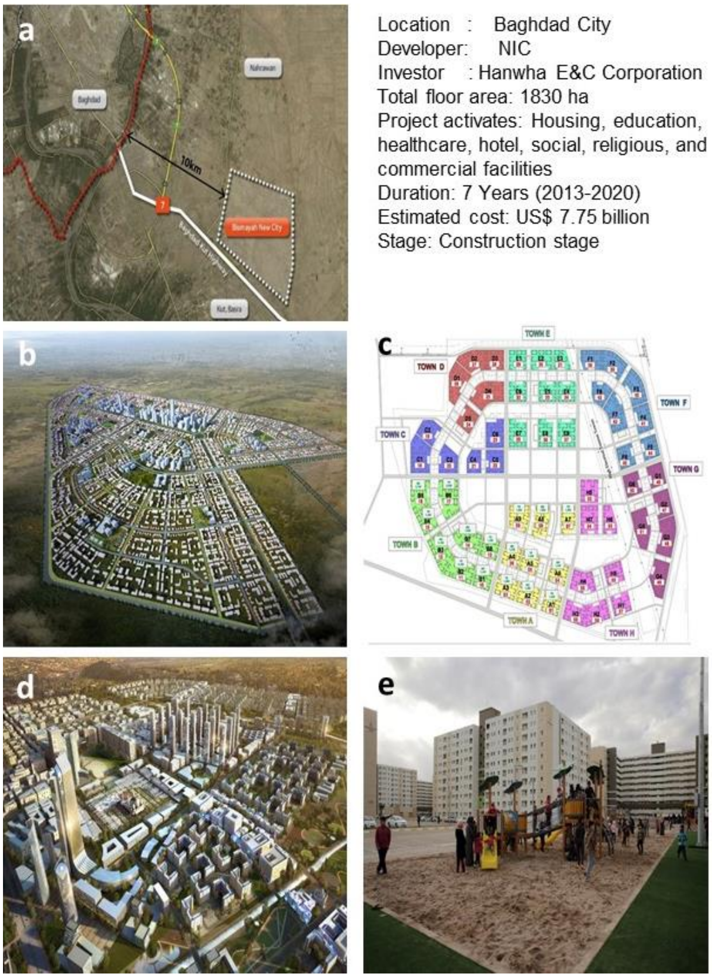

Figure 7.3: Details on case study 1: Bismayah city. (a) Location map. (b) Master plan. (c) The eight main parts (towns). (c) The Central area. (d) Completed part of construction.

The construction process began in early 2013, works carried out by the Hanwha E&C Corporation, a South Korean construction company, and is predicted to be completed between 2019 and 2020. The city consists of eight main parts (towns), 59 blocks and 834 apartment complexes, consisting of ten stories and 120 residential units. In June 2015, the first part was complete, accommodating 25,000 citizens and their social requirements.

7.3.2 Case study 2 (CS2): Jannat Al Hussain residential project

The Jannat Al Hussain residential project is one of the new urban developments in the city of Karbala, central Iraq, approximately 100 km south-west of the capital Baghdad. Karbala is considered as an important holy city that tens of millions of Muslims people visit several times a year (NCCI 2015). This has strengthened the planning and construction of many urban development investment projects in the city.

This is considered a residential district based on dwellings number, according to the Iraqi urban housing standards (MCH 2010). It is located about 7 km from the city centre (the Holy Shrines), as shown in Figure **7.4** located within a new development area near the green belt surrounding the city (0.15 km). It is anticipated that upon completion, the plot will include a variety of mixed-use facilities such as residential, commercial, leisure, green areas and public services. The project area covers approximately 1.4 km^2 (140 hectares) and will contain 5166 dwellings to accommodate about 25000-30000 residents giving them direct access to the centre of Karbala city. The project aims to establish a housing complex which respects local culture through modern architecture and construction compatible with the heritage of Karbala.

The project will provide green coverage areas, streets, open spaces and water bodies provided with commercial and infrastructure services such as electricity networks, water availability, sewage systems, irrigation, communications network, heat and sound insulation materials and liquid gas networks according to international standards. As a residential city, it will provide different types and sizes of dwellings, for both individuals and families. Retail recreation spaces have been provided including a shopping mall which houses a number of restaurants, cafes and retail shopping areas, within and outside the mall. In addition, there is also provision of car parking, children playgrounds, indoor and outdoor swimming pools and a sports complex. The project will also include healthcare and medical centres, educational services, a mosque a fire station, police station, civil defence centre and petrol station.

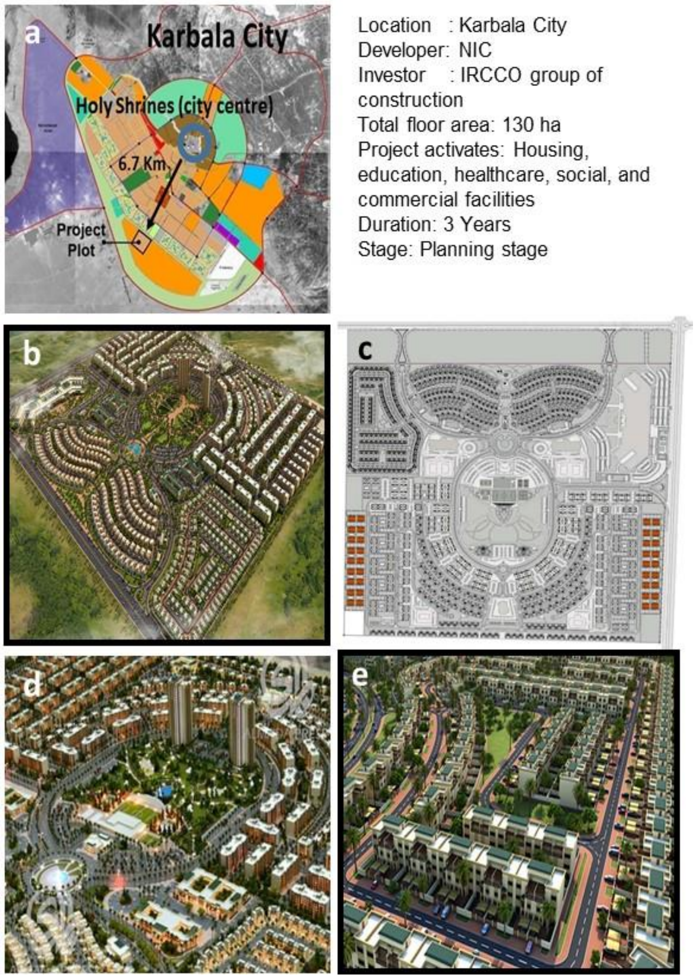

Figure 7.4: Details on case study 2: Jannat Al Hussain project. (a) Location map. (b) Site plan. (c) Master plan. (c) The Central area. (d) Several housing patterns.
Data source: http://jannatalhussain.com/wp/downloads/

7.3.3 Case study 3 (CS3): Durrat Karbala residential project

This project is one of the new urban developments in Karbala city; it is the nearest project to the city centre, located 6.8 km from the city centre and the Holy Shrines, as shown in Figure **7.5**. It is classified as a residential neighbourhood according to the number of dwellings determined by Iraqi urban development standards (MCH 2010). The project is under construction expected to be complete by the end of 2017. The project provides horizontal housing patterns (low-rise), as well as mixed-used facilities such as commercial, leisure, green areas and public services. A shopping mall has been included to serve the residents and visitors, in addition to children playgrounds, swimming pools and sports arenas. The project covers an area of 0.66 km^2 (66 hectare) and will include 1266 individual housing units to accommodate approximately 7600 residents. The project includes green cover areas and plans to integrate commercial and infrastructure services such as electricity networks, water availability, sewage systems, irrigation, and communications network.

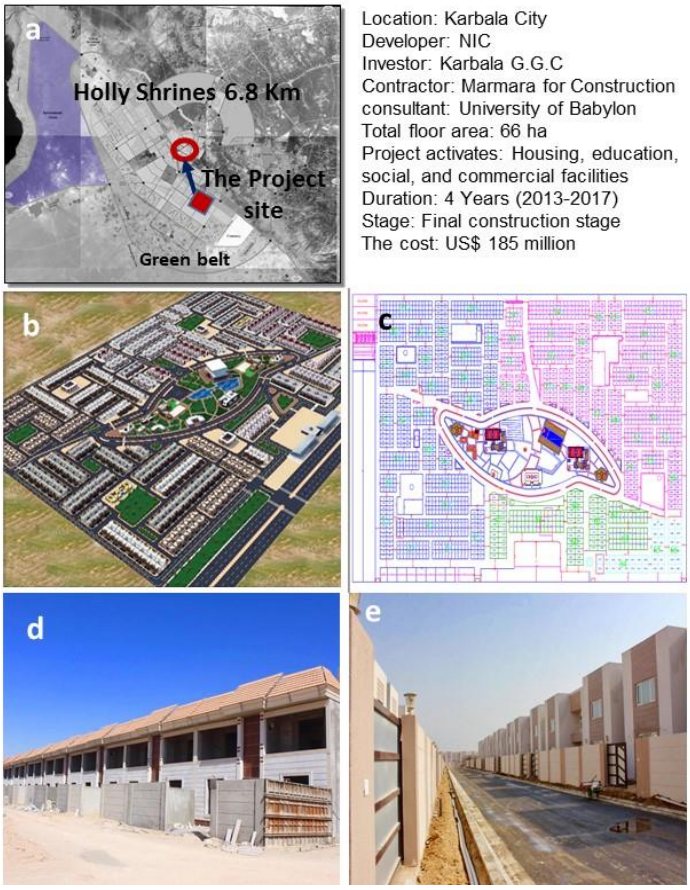

Figure 7.5: Details on case study 2: Durrat Karbala residential project. (a) Location map. (b) Site plan. (c) Master plan. (d and e) Housing units under construction.
Data source: www.kggc.net/index.php

7.4 Data collection

A number of official bodies and institutions were contacted to obtain the data required for each case study. In order to ensure this data was accurate multiple data sources were used as detailed in Table **7.1**.

1. Drawings sheets (designing and detail drawings), data and reports were requested via personal communication with the relevant official organisation responsible for design, such as NIC and the local governments.

2. The main investor and consulting offices (designer) for the project were contacted to ask questions about the data including any possible changes, especially for the projects under construction.

3. Local consulting bodies responsible for checking and auditing all project drawings sheets, data and reports were contacted, in order to verify their validity and compliance with local laws and regulations.

4. General Managers, supervision teams and the resident engineering department staff were contacted, (specifically for projects under construction), to examine the implementation

process in detail and to gather additional information about changes being made on-site.

5. The official websites for each project were visited regularly to check for updates and related information.

Table 7.1: Data sources and collection methods against assessment factors

Factor	Data type*			Source†					Method§			
	DR	DT	RT	NIC	PM	LG	CB	DR	OR	PC	OW	CVE
Case study 1												
Conservation of agricultural lands	Y			Y	Y				Y	Y	Y	
Vegetation cover	Y	Y		Y	Y				Y	Y		
Energy		Y			Y					Y		
Water quality	Y	Y	Y	Y	Y				Y	Y	Y	
waste separation and treatment	Y			Y	Y				Y	Y	Y	
Green vs. built-up area	Y	Y		Y	Y				Y	Y		Y
Ancillary facilities	Y			Y	Y				Y	Y		Y
Children play areas	Y	Y		Y	Y				Y	Y		Y
Inclusive design (aging & disabled)		Y			Y					Y		Y
Public car parking availability	Y	Y		Y	Y				Y	Y		Y
Security by design	Y	Y		Y	Y				Y	Y		
Long- term management			Y		Y					Y		Y
Work environment			Y		Y					Y		Y
Planning Policies and legislations			Y		Y					Y		Y
Identity and local culture	Y	Y		Y	Y				Y	Y		
Adaptation for social inclusion	Y	Y		Y	Y				Y	Y		Y
Housing factors	Y	Y	Y	Y	Y				Y	Y		Y
Adaptable housing			Y	Y	Y					Y	Y	
Qualification and skills			Y	Y	Y				Y	Y		
Case study 2												
All data of the project	Y	Y	Y	Y		Y	Y		Y	Y		Y
Case study 3												
Landscape and vegetation cover	Y					Y		Y	Y	Y		Y
Environmental impact of materials		Y	Y				Y	Y		Y		Y
Safe energy distribution network	Y	Y	Y			Y	Y	Y		Y		Y
Water quality	Y	Y						Y		Y		
Recycle waste, separation and treatment		Y	Y			Y		Y		Y		
Green vs. built-up area	Y						Y	Y	Y	Y		Y
Ancillary facilities	Y						Y	Y	Y	Y		Y
Public car parking availability	Y	Y					Y	Y	Y	Y		Y
Walkability	Y	Y					Y	Y	Y	Y		Y
Infrastructure networks	Y	Y	Y			Y	Y	Y	Y	Y		Y
Security by design		Y	Y				Y	Y		Y		Y
Safety of public places		Y	Y				Y	Y		Y		Y
Affordable housing			Y			Y	Y		Y	Y		
The quality of housing units		Y	Y				Y	Y		Y		Y

Notes:

- DR=Drawings, DT= Details, RT= Report.

† PM= Project manager, LG= Local Government, CB= Consultant Bureau, DR= Developer.

§ OR= Official request, PC= Personal communication, OW= Official website, CVE= Communication via email.

7.5 Scoring of assessment factors

The scoring methods of granting credits, percentages or points and medium levels are not necessarily uniform for all GUSATs; measurement methods are subject to different global urban standards for each tool. BREEAM Communities adopts granting between 1-3 credits, and weighting percentages based on ISO 9002 standards. CASBEE-UD also adopts granting assessment items in five ranks, based on CASBEE standards, while LEED-ND grants 110 points based on the U.S. National Institute of Standards and Technology (NIST) standard (BRE 2011; IBEC 2011; USGBC 2011).

CASBEE-UD differs from other assessment tools in that, it provides a detailed scoring method, whereby each item is scored over five ranks, there being intermediate levels between main levels if needed. Each level is scored according to CASBEE standard criteria, weighting coefficients applied to assessment fields to calculate the results (IBEC 2015).

In common with the CASBEE-UD, the scoring approach for the IUSAF assessment factors were determined as shown in Figure **7.6**, according to the following concept:

1. Each factor is assessed and scored based on its credit numbers, from 1-3, the average credit values 0.5, 1, and 1.5.
2. In terms of practicality of measurement, the factors are assessed over three levels; L1, L2, and L3. Each level represents characteristics of each urban factor as follows:
   - Level 1: The factors meet the minimum necessary conditions required by local urban development standards or compliance to global standards and regulations.
   - Level 2: The factors correspond to the medium necessary conditions required by urban standards at the time of assessment.
   - Level 3: The factors correspond to the highest levels of urban standards at the time of assessment.
3. Intermediate levels are interpolated between the three levels. When the factors exceed the requirements of the available standards and regulations, the indicators are assessed level 3.
4. The social level is assessed according to the degree of the project's social contribution etc. to the surrounding area, regardless of whether guided by regulations and law.

In order to give further clarity this process, an urban factor has been assessed as an example (Table **7.2**). This example was selected due to the importance of housing indicator in the selected case studies. The same process was followed for assessing the sustainability of other indicators for all case studies, the evaluation results in Appendix I.

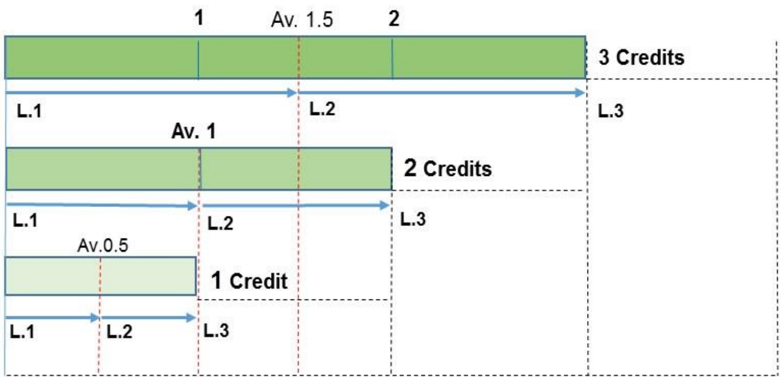

Figure 7.6: The approach for awarding credits in IUSAF

Table 7.2: An assessment of housing factors for Bismayah city project

Housing indicator	Credits available	Credits achieved (CA)	Credits Value (CV)%	Assessment score= (CA) X (CV)%	Measurement method	Scope	
Assessment Factors						Local	Global
Residential scheme	2	1.5	0.55	**0.825**	- Accommodation density= dwelling/ hectare. (According to: (a) number of dwelling. (b) Buildings height such as low rise and high rise (three stories, more than 3 stories). (c) 20% high rise buildings in mixed height projects)	✓	
Diversity of the residential units	2	0.5	0. 6	**0.3**	- Population density= inhabitant/ hectare. (According to: (a) Dwelling area (m^2) based on housing type, detached, semi-detached, courtyard, and high-rise building. (b) Dwelling rooms' no. / Area.	✓	
Affordable housing	3	2	0.7	**1.4**	Housing sales plan: According to the (a) Dwelling prise/ m^2. (b) Instalment sales program, e.g. 1 year, 1-5 years, 5-10 years, up to 15 years, etc.	✓	
The quality of housing units	2	1	0.95	**0.95**	- Basic spaces of dwelling. - Min. area of dwelling spaces (m2). - Housing Quality Indicators (HQI), related to a quality of material, services, utilities, ventilation, thermal comfort, etc. inside the dwelling.	✓	✓
Total	**9**	**5**		**0.916%**			

7.6 Application of the IUSAF

The IUSAF aims to assess sustainability and certification based on its urban factors, taking into consideration the issues and opportunities that affect sustainability and addressing key environmental, socio-economic sustainability objectives that have an impact on urban development projects. The IUSAF assesses the project designs (suggested or under construction) at an urban scale.

All AEC drawing sheets, the available studies and reports of the projects are reviewed following four key steps applicable to the master plan level.

All AEC drawing sheets, the available studies and reports of the projects are, therefore, reviewed. IUSAF applies using four key steps involved in the assessment of urban sustainability at the master planning level:

1. Mandatory urban factors were examined in terms of commitment, a fundamental step to accept the project for assessment or rejected.
2. Assessment of the principles of the development involving an in-depth examination of the project master plan documents and strategic plans for the wider region, to determine future growth and development of the project; demonstration of the suitability and need for specific types of developments and buildings on-site as part of the planning application; checking compliance with local planning requirements and building laws, and assessment of the degree to which the design team are aiming to improve sustainability, this necessitating a site-wide response to include energy generation, water conservation, waste recycling, and social and economic aspects.
3. Determining the layout of the development, which includes detailed plans for a site's population, housing, economy, community facilities, and land use. Evaluating the relationships between developments; the connection between buildings; social settings and their surrounding environments; people movement around and through the site and buildings and amenities location.
4. Reviewing the detailed design of the project, including the design and specification of landscaping, the built environment, sustainable drainage solutions and transportation facilities.

There can be considerable overlap between steps 2 to 4, with less difference between the assessment actions taken at each stage. While the IUSAF issues are grouped into three main dimensions, it can be difficult to categorise sustainability issues definitively as they often affect all dimensions of sustainability (environmental, social, and economic). By assigning categories, IUSAF seeks to provide some clarity about the intention of each issue.

7.7 The sustainability characteristics

The key sustainability characteristics identified after the application of IUSAF, are highlighted according to the selected case studies as follow:

7.7.1 Case study 1: Bismayah city:

The main sustainability characteristics achieved are as follows:

- **Ecology**
    - Conservation of existing agricultural lands amounting to 5% of the site area.

- The creation of a vegetation cover zone covering 17.6% of the site area, cultivating long-and medium-sized trees in addition to palm trees.

- **Energy**
  - The establishment of an electrical power distribution network which includes 134 secondary transfer stations (11 / 0.4 kV) and the extension of high-pressure lines between the central stations (33/11 kV) to substations.
  - Concrete underground tunnels for services allowing safe energy distribution, e.g., electricity and gas piping and communication networks. The tunnel has a length of 20.3 km, a width 2.10 m and height 2.85 m with different depths ranging from 6 to 10 m, as shown in Figure **7.7**.
- **Water**
  - The establishment of drinking water treatment system with an area 98.7 m^2, as shown in Figure **7.8**. It includes water treatment plant with a total capacity 255,000 m^3/day in addition to supplying plastic pipes and 59 break tanks with a total storage capacity of more than 90,000 m^3 to pump water throughout the project.
  -

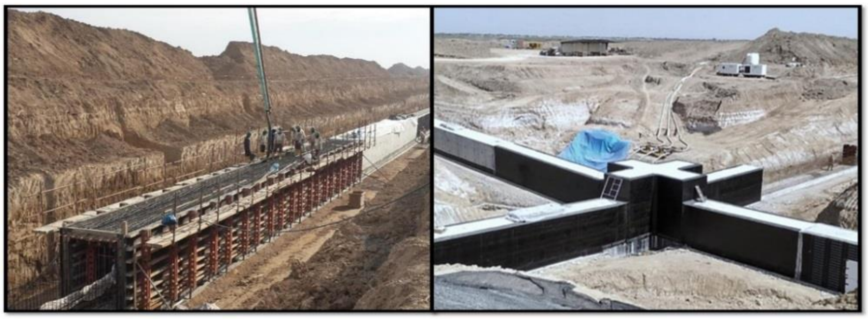

Figure 7.7: Underground concrete services tunnel

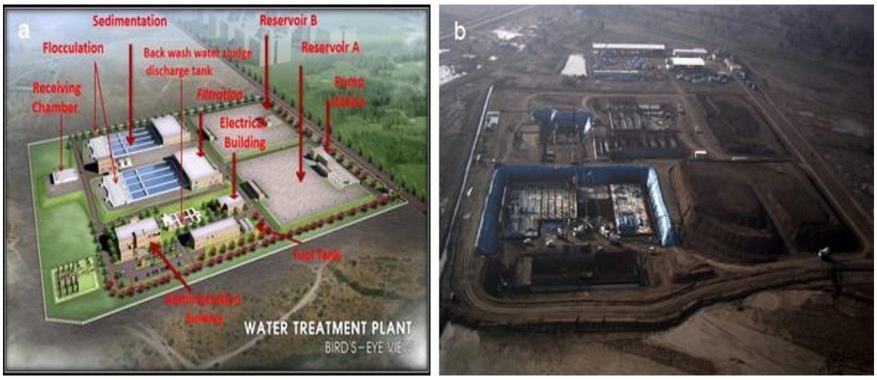

Figure 7.8: Water treatment system plant. (a) Planning phase. (b) Construction phase.

- **Waste**
  - The project includes a waste incineration plant with a total area of 16,500 m^2 and efficiency of up to 300 tonnes/day. The plant includes space for waste collection, an automatic control system and the steam generator to generate electricity for the station and prevent air pollution (Figure **7.9**).
- **Land use**
  - As shown in Figure **7.10**, the project provides a number of facilities; 294 schools, 59 nurseries, a university for 5000 students, hotels, offices, 300-bed hospital, 12 healthcare centres, 27 youth centres, 23 sports arenas, a large mosque, seven shopping centres, three police stations, 2 civil defence centres and 32 fuel stations.
  - Customisation of the central project area as the central business district (CBD), occupying just over 7% of the total project area.
  - 59 children's play areas (one for each block), ranging from 2050- 5207 m^2 depending on number of residents.
  - All entrances to buildings have been supplied with ramps to facilitate access for the elderly and the disabled.
  - The provision of an adequate number of car parking spaces, according to the Iraqi urban development standards (MCH 2010), for residents and visitors; 150 cars per 1000 persons (Figure **7.11**). The streets and car parking system occupy 15% of the total project area.
  - The development is outside of Baghdad city, 10 km from Baghdad's borders and 25 km from its centre allowing for the possibility of development of the surrounding areas in the future.

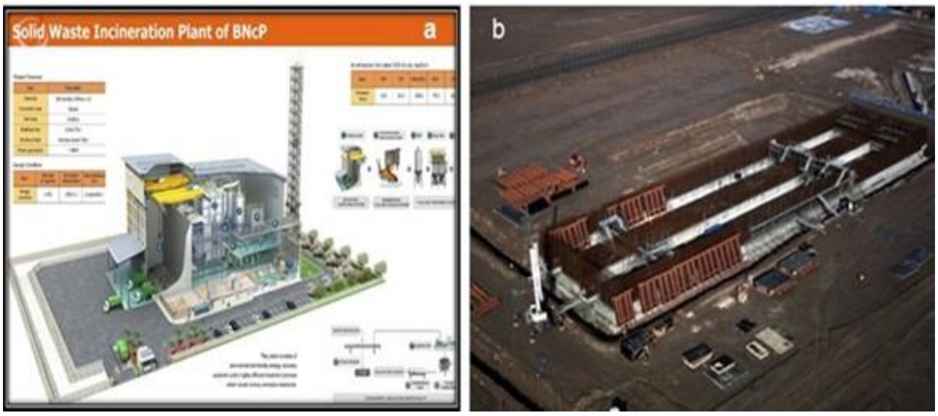

Figure 7.9: Solid waste incineration plant. (a) Planning phase. (b) Construction phase.

Figure 7.10: Land use plan for Bismaya city

Figure 7.11: Car parking for block A

- **Transportation & Infrastructure**
  - A public transport system has been adopted as the major means of transport making use of buses and providing two public transportation garages.
  - The provision of basic infrastructure systems; sewage, rainwater drainage, irrigation, communications, electricity distribution networks and a variety street networks.
  - Walking distances are between 200-800 m for most of the residential units and most daily activities such as schools, kindergartens, children's play areas, sports arenas, parks, daily shopping and car parking, as shown in Figure **7.12**.

Figure 7.12: Walking distances between residential units and most daily activities

- **Safety**
  - The project will be surrounded by a concrete fence after completion, with eight main secure gates for entry.
  - Eight checkpoints are at the main entrances.
  - Shaded pedestrian routes are provided in public zones to help inhabitants cope with high temperatures (Figure **7.13**).
- **Well-being**
  - Despite using precast concrete as the main construction material, walls and ceilings have been insulated providing thermal comfort for all buildings.
- **Management & Construction**
  - The investor company is responsible for the maintenance of all the project facilities for one year after occupancy.
  - The involvement of a few women in the labour force as part of the Resident Engineer Department.
- **Local culture**
  - The project includes some traditional designs features in residential units to emphasise the privacy of Iraqi families.
- **Urban space**
  - Figure 7.13 shows the green open space which occupies the centre of the project, surrounded by public activities such as commerce, offices, hotels, religious buildings and entertainment hubs.
- **Layout**
  - Vehicular access for residents and visitors and a central pedestrian area (Figure **7.14**).

Figure 7.13: Shades public zones

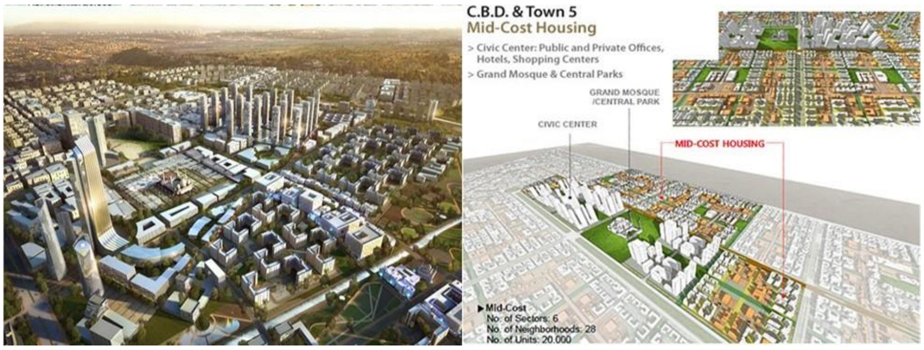

Figure 7.14: The central public zone

- **Housing**
  - This project focuses on resolving local housing problems offering 100.080 residential units in high-rise housing patterns. The new city will house 600,000 citizens.
  - Six different residential apartment types have been provided (Figure **7.15**).
  - The project promotes an affordable housing program through instalment sales of up to fifteen years, appropriate for many sectors of society, especially middle and low-income groups.
- **Jobs and business**
  - The project was designed by Hanwha E&C Corporation International Company, who have much experience in the urban development construction field.
  - A Training and Development Unit (TDU) has been created within the project for the development of a local capacity to design and construct urban development projects.

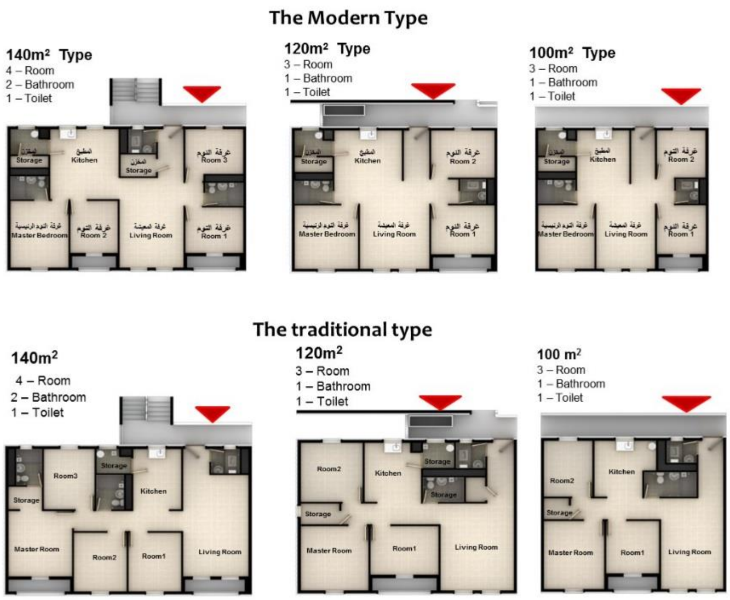

Figure 7.15: Types of residential units

7.7.2 Case study 2: Jannat Al Hussain residential project

The main sustainable characteristics that have been achieved in this project can be summarised as follows:

- **Ecology**
    - The project is a suburb of Karbala city near the green belt (0.15 km) that separates the city from the desert. This promotes a green lifestyle and contributes to the reduction of dust and environmental pollution.
    - Vegetation cover and green areas amount to 23.6% public green areas and 5.9% private green areas, a further 1.1% for outside play areas. This means that there is a higher than required green area ratio (29.5%), according to local Iraqi standards (MCH 2010).
    - Customise 0.7% of the project site for the development of public and private water bodies.
- **Energy**
    - Electricity cables and communication networks are underground.
    - Central gas pipelines service all residential units.
- **Water**
    - Water will be available in all areas by connecting with the national water network.
- **Land use**
    - The mixed-use development will include a range of residential units including villas, villa apartments, townhouses, apartments and luxury apartments located in towers. Service facilities include a shopping mall, nineteen individual shops, a mosque, three clinics, a recreational club, fuel station, police station, fire station and sports arenas.
    - The project comprises a variety of road networks, and provides an adequate number of public and private cars parking, according to Iraqi urban housing standards (MCH 2010), occupying approximately 25.8% of the project area.
    - The project site is on the edge of the administrative border of Karbala city. Being in a new mixed-use zone, it will attract investment and encourage further development in the future.
- **Transportation & Infrastructure**
    - A public transport system has been adopted in the project and neighbouring areas.
    - The project is designed to be integrated with basic commercial and infrastructure services including water networks, electricity, sewage, irrigation and liquid gas networks.

- **Safety**
    - Integrated security systems (surveillance cameras), will be used on both individual buildings and urban spaces.
    - Security checkpoints will be situated at main entrances.
- **Well-being**
    - Despite using concrete as the construction material, fully insulated walls and floors for heat and sound, and double-glazed windows have been incorporated to provide thermal comfort for all buildings.
- **Local culture**
    - The design of the central mosque shows the historical and cultural identity of the holy city of Karbala and Islamic patterns.
- **Urban space**
    - The project has a customised a pedestrian area in the central zone, the pedestrian and open spaces occupying 21.8% of the total site (Figure **7.16**).
- **Layout**
    - There is a hierarchy of building design in terms of their size and height. Two towers are located in the centre, followed by lower level buildings, ending with villas.
    - The colour of building facades is harmonised with desert and sand colours.
- **Housing**
    - The project focuses on resolving the housing problem offering 5166 residential units with low and high-rise housing patterns. The project will allow for more than 25,000 residents to find a house or flat.
    - Table **7.3** illustrates the diversity of the residential units provided; twenty-eight types in terms of diverse area and design as shown in Figure **7.17**. It aims to be homogeneous and responsive to the needs and wishes of Iraqi society as well as being available in different sizes and forms according to the needs and abilities of individuals and families in Iraq.
    - It promotes an affordable housing program through instalment sales over two years.
- **Jobs and business**
    - The project was designed as a cooperative venture between IRCCO Group and MARK & Partners, who are experienced in the urban development field across many countries.

Figure 7.16: The central pedestrian zone

Table 7.3: Main types of residential units

Unit type	Number of units
Studio apartments	5
2 Bedroom Apartments	717
3 Bedroom Apartments	3922
4 Bedroom Apartments	100
5 Bedroom Villas	176
Six bedroom Villas	246
Total Number of units	**5166**

Figure 7.17: Diverse designs of residential units for case study 2

7.7.3 Case study 3: Durrat Karbala residential project

The main sustainable characteristics that have been achieved in case study 3 can be summarised as follows:

- **Ecology**
    - 20.4% of the total project area is dedicated for vegetation cover.
    - 24.5% of private open areas (inside houses) are provided. This means that open areas have achieved higher than the required ratio (43.3%) of open spaces, in accordance with local Iraqi standards (MCH 2010).
    - External project boundaries are surrounded by a green belt of width 3 m, with medium height trees to reduce the impact of dust storms.
    - Figure **7.18** illustrates the hollow clay bricks that are used as the main construction material, these considered sustainable materials. Lightweight thermal blocks (Thurmaston) are also employed to provide high-quality thermal insulation.
- **Energy**
    - Electricity cables and communication networks are distributed safely under pavements.
    - The project was supplied with eight electricity generators (capacity 1024 KVA for each), which compensates for shortages of electricity due to frequent interruptions in the national grid. These also meet some of the electricity demands for project activities.

Figure 7.18: Clay bricks and thermal blocks as sustainable construction materials

- **Water**
  - The project houses a large underground water storage tank with a storage capacity of up to 3000 m^3. All houses are supplied with water tanks with a capacity of 5 m^3.
  - Water will be available to all parts of the project, through connection with the national water network supply.
- **Waste**
  - It was agreed with the investor company to collect all waste from the project and separate it in a specific location outside the project in order to take advantage of and reuse plastic waste and to bury solid waste.
- **Land use**
  - The project provides a number of facilities such as nursery, kindergarten, three primary schools, two secondary schools, youth centres, children play areas, a large shopping mall, two mosques, healthcare centre, communication centre, police station, civil defence, swimming pool and four sports fields.
  - All housing units have a private car park. The project also provides public parking at a rate of 192 places per 1000 residents. This is more than the required number of parking spaces, according to the Iraqi urban housing standards (MCH 2010). The streets and car parking system occupies 14.4% of the total project area.
  - This development is in the suburbs, 6.8 km from the Karbala city centre, which allows for the potential to develop surrounding areas in the future.
- **Transportation & Infrastructure**
  - The project provides many basic infrastructure systems such as sewage, rainwater drainage, irrigation, communications and electricity distribution networks.
  - Walking distances fall between 250-500 m for most of the residential units and daily activities such as kindergartens, schools, children play areas, sports areas, parks and car parking and central open space (Figure **7.19**).
- **Safety**
  - The project is surrounded by a concrete fence at height 3 m, with two main gates for entry (Figure **7.20**).
  - Tow checkpoints have been located on the two main entrances.

Figure 7.19: Walking distances between housing units and daily activities

Figure 7.20: The concert fence and the main gate of the project

- A camera surveillance system is in place covering several external areas for residents' protection.

- **Well-being**
  - The main construction material has thermal insulation properties for the walls.
- **Management & Construction**
  - It was agreed with the investor that all maintenance checks and processes would be in place for five years after the completion of construction.
- **Local culture**
  - The project uses traditional designs for the housing units emphasising the privacy of the Iraqi family.
  - A public hall accommodating more than 400 people for multi-events has been built.
- **Urban space**
  - The green open space occupies 6.8% of the total project area. It is located in the centre of the project and surrounded by several public activities such as sports areas, parks, religious and entertainments.

- **Housing**
  - The project offers 1266 individual housing units housing approximately 7500 citizens.
  - Four different housing types, in terms of area and design, have been provided (Figure **7.21**).
  - The project promotes an affordable housing program through instalment sales from one year and up to ten years.

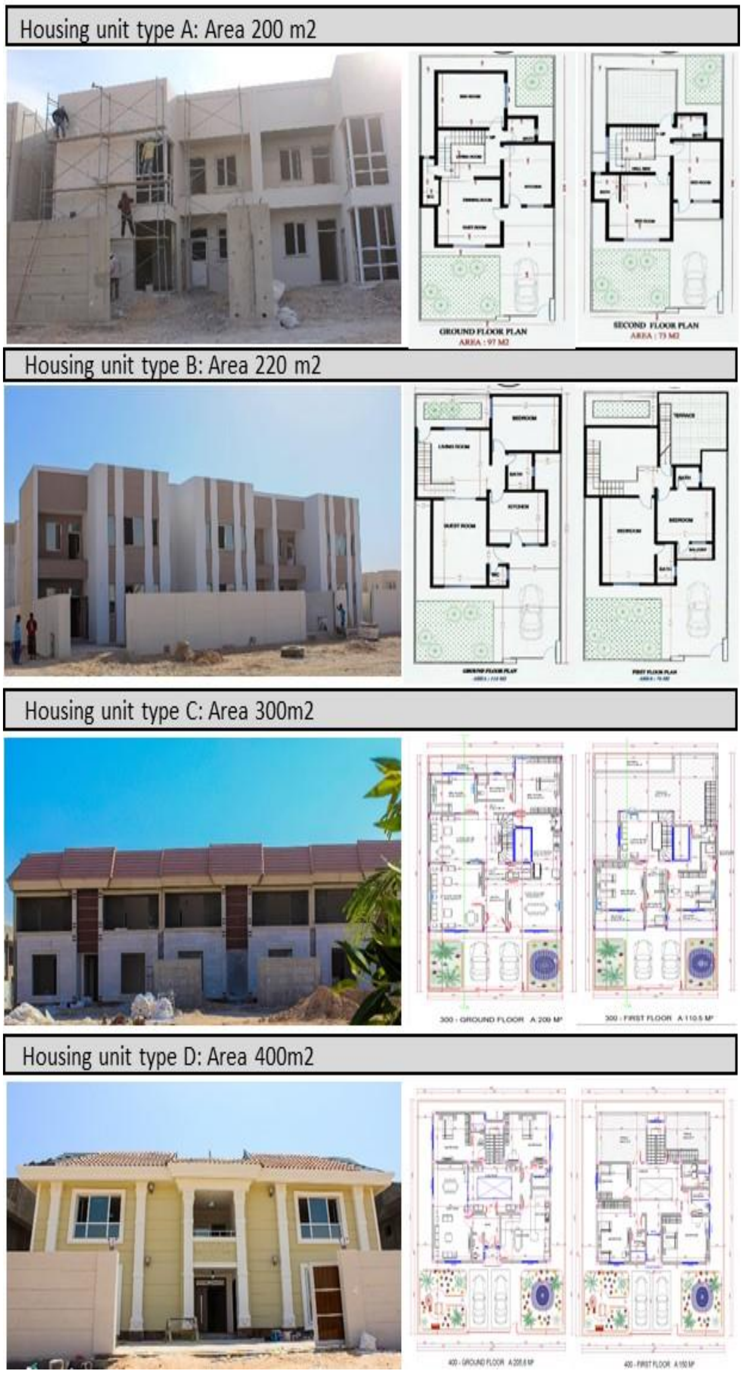

Figure 7.21: Types and areas of residential units

- **Local Economy**
    - Local construction materials have been used (more than 70% of the total materials) including cement, bricks, gravel, sand, tar and asphalt.
    - The project provides adaptable housing by using non-built-up areas in the house.
- **Jobs and business**
    - The project was designed by the KGGC Company and Marmara Construction Company from Turkey, who have proven experience in urban development construction.
    - The project employs more than 30% of the local work force.
    - The project provides an opportunity for local investment.

7.8 Data analysis

The assessment of IUSAF urban factors was carried out according to Iraqi urban development standards (MCH 2010), as shown in Figure **7.22**. Urban indicators analysis of the selected projects indicated a wide disparity in their sustainability. The result will be provided in descending order according to sustainability:

Housing factors represents one of the most important social factors. It was given high priority by all case studies, awarded ratings ranging from 3.4% to 4%. The most prominent factors were numbers of dwellings; diversity of patterns, types and areas, and adopting affordable housing programs.

Transportation and Infrastructure is also considered a necessity, achieving ratings between 1.6% and 2.9%. Public transport systems have been adopted as the major means of transport, specifically in CS1, on-site and neighbouring areas, providing a variety of street networks. Alternative means of transportation was not covered despite its importance. All the projects provided many basic infrastructure systems such as sewage, rainwater drainage, irrigation, communications and electricity distribution networks. Walking distances for all case studies are between 200-800 m for most of the residential units and most daily activities such as schools, kindergartens, sports arenas, parks and daily shopping trips.

Job and business reflecting interactive participation between local experiences and foreign expertise achieved ratings between1.5% and 2.8 %. Training and Development Units (TDU) have also been created to varying degrees, to develop local capacity.

Land use was included ranging from 1.2% to 2.5 %. CS1 and CS2 have included several public facilities such as schools, shopping mall and daily shops, mosques, healthcare centres, fuel stations, police and fire stations, sports arenas, children's play areas and youth centres. Car parking and disabled services were provided in varying proportions in terms of number, type and availability. The developments were located outside of cities, this allowing for the possibility of the development of the surrounding areas in the future.

Safety is the most important domestic issue but the sustainability ratings achieved are not commensurate with the importance of the indicator ranging from 1-1.95%. Safety precautions were limited to surrounding projects by fences with secure gates for entry, with surveillance camera systems. CS1 provided shaded pedestrian routes in public zones help inhabitant cope with high temperatures.

Ecology was represented with vegetation cover and green areas, especially in CS2 and CS3, within the required standard ratio. The external boundaries of CS3 are surrounded by a green belt with high trees to reduce the impact of dust storms. Sustainable materials were used in CS3 for construction in terms of weight and thermal insulation. The indicator achieved a low sustainability rate compared to its importance in the local context, ranging from 0.8% to 1.3%.

Water was awarded low ratings ranging from 0.3% to 1.9% despite its significance. The case studies were limited to establishing a drinking water treatment system for CS1 and the provision of a large underground water storage tank for CS3. However, water is available to all projects through connection with the national water network supply. Water recycling and promoting the use of available alternative sources of water were not covered in any project.

Lay out was represented by building design in terms of size and height for CS1 and CS2. A traffic study was designed for the site allowing vehicular access for residents and visitors and provision of a central pedestrian areas of various size for all developments. Building facades in CS2 are painted to harmonise with the colours of the desert and sand. This indicator achieved a sustainability rate ranging from 0.2% to 1.7%.

Management and construction was limited to agreement on maintenance work after completion of the project for 1-5 years, as well the as the participation of a few women in the labour force as part of the Resident Engineer Department in CS1. This indicator achieved a low sustainability rate ranging from 0.5% to 1.25%.

Urban space was provided by customising the central zones for all project, surrounded with pedestrian open spaces and public activities such as sports areas, parks, religious and entertainments. The indicator achieved a sustainability rate ranging from 0.6% to 0.8%.

Local culture was awarded a low degree of urban sustainability ranging from 0.43% to 0.6%.

Figure 7.22: Sustainability scores for the case studies indicators

This indicator was limited to using traditional designs for housing units in CS2 and emphasising the privacy of the Iraqi family through the separation of public spaces from private family spaces. CS1 established a public hall for multi-events for more than 400 people. Some buildings such as the central mosques were designed to reflect the historical and local cultural identity.

Local economy was awarded a low degree of urban sustainability ranging from 1.6 % to 0.8. The developer of CS2 agreed to use local construction materials and provided adaptable housing by using non-built-up areas to allow for future expansion.

Energy, despite its importance and the global attention this receives, this was limited across the three case studies. CS1 established an electrical power distribution network and built concrete underground tunnels for services allowing safe energy distribution. CS3 was supplied with electricity generators to compensate for shortages of electricity. Electric cables and communication networks are distributed underground for all developments. The indicator was awarded a very low degree of urban sustainability ranging from 0.25% to 0.45%.

Waste also received very little attention, rated as ineffective in all projects, awarded a very low degree of urban sustainability ranging from 0% to 0.45%. This was limited to collecting all waste on site and separating it in a specific location to reuse plastic waste and bury solid waste.

Well-being was presented in the projects to address one single aspect of sustainability. Despite using precast concrete as the main material of the construction for CS1 and CS2, walls and ceilings have been insulated providing thermal comfort for all types of buildings. The indicator was awarded a very low degree of urban sustainability ranging from 0.08% to 0.17%.

Hazard, convergence and innovation have not been addressed.

7.9 Final rating

The final score for the case studies has been determined based on the total credits earned by the projects. As can be seen in Table **7.4**, all projects achieved a low overall IUSAF score; 21.139%, 16.832% and 16.535% out of 100%. Based on the rating benchmarks presented previously, this final score means that all the projects are rated as "Unclassified" as urban sustainable projects; the lowest result should be > 30% to consider the project as "Classified" in terms of urban sustainability. This result means that planners should give more attention or sustainability indicators to manage current and future sustainable growth.

Most of the indicators (energy, water, ecology, materials, waste, well-being and local economy) were treated superficially. There is also a disparity concerning several assessment indicators, between the existing situation (plans and reports information) and what is actually addressed by urban indicators, especially for some key sustainability assessment factors, as shown in Table **7.5**.

Table 7.4: IUSAF rating benchmarks for the case studies

Case studied	Available weighting score (%)	IUSAF rating achieved (%)	Achieved weighting score (%)	IUSAF rating benchmarks
CS1	100%	21.139%	MF + < 30 % score	**Unclassified**
CS2		16.832%	MF + < 30 % score	**Unclassified**
CS3		16.535%	MF + < 30 % score	**Unclassified**

Table 7.5: Disparity between the existing understanding and the assumed goals of several assessment indicators

Indicator	Sub-indicator	Existing and assumed goals of assessment factors	
		Existing information in the project	**Assumed information**
Ecology	Environmental impact of materials	Using natural, traditional and insulating construction materials	Using sustainable materials with least impact on the environment, regarding the manufacture, physical and chemical properties and ability to be recycled (UNEP 2010).
	Air pollution	Surrounding the project with a green belt and planting medium and high trees to reduce the impact of dust storms.	Compliance with acceptable concentrations of contaminants according to (AQI) such as fine particles (PM2.5), Carbon monoxide (10 mg/m3), and SO2 (350 µg/m3) (WorldBank 2017).
Energy	Energy efficiency	Establishing an electrical power distribution network, or providing electricity generators, to compensate for the lack of power supply.	Reducing energy consumption from HVAC, hot water and lighting by adopting an efficient technology, production process or application of methods (EU 2015).
Water	Water quality	Providing drinking water treatment system (litre/capita/day)	Providing adequate water with maximum acceptable concentrations for a number of potential contaminants (WorldBank 2017).
	Water conservation	Establishing water storage tank (over or underground) to store water in sufficient quantities for long periods.	Onsite water conservation strategies by sector: residential, industrial and commercial etc. (WorldBank 2017).
Waste	Recycle waste	Collecting waste on site and separating it outside the project, to take advantage of and reuse plastic waste and to bury solid waste.	Managing waste on-site by collecting, treating, recycling and disposing of solid wastes generated in urban projects (WorldBank 2017).
Land use	Inclusive design (ageing & disabled)	Providing ramps at the main entrances of buildings and lifts inside.	Providing to wide concepts of building and urban spaces that meet the needs of older and people with disabilities (CABE 2008).
Safety	Security by design	Supplying buildings with cameras surveillance system and fire alarms	Safety considerations in the buildings and site layout (PWC 2013).
	Safety of public places	Surrounding the projects by high fences with secure gates for entry.	Reducing and preventing the effects of hazards such as fires, explosions, car accidents, crimes and terrorist actions (PWC 2013).

7.10 Discussion

Many different urban changes have occurred in Iraqi cities as a result of rapid population growth and political instability, leading to the emergence of unique local challenges. These challenges coincide with the absence of the adoption of a comprehensive strategy for urban development by decision makers.

These three case studies have presented different aspects of how urban development processes have been implemented, revealing firstly a remarkable growth in the urban development domain. Sadly, this growth was not based on scientific or statistical studies about local requirements, the actual needs of the population not local principles of urban development planning but on a number of unsustainable plans and regulations that have been adopted randomly, based on foreign experience.

The results have confirmed that the three urban development projects are classified as unsustainable projects according to the IUSAF. The findings also reveal that the planning process of these projects was carried out with a minimum understanding and recognition of the three main dimensions of the IUSAF; environmental, social and economic issues. The low assessment ratings also reflect a lack of public awareness of urban sustainability aspects, especially by developers, governmental institutions and decision-makers. This is illustrated by the superficial attention paid to many indicators, as well as a zero response to some due to lack of knowledge of their objectives and benefits to the environment and society. NIC also has limited professional experience when it some to granting investment licenses depending on number of dwellings in a project, regardless of other requirements related to housing. This is exacerbated by administrative and financial corruption resulting in either the acceptance or rejection of some projects (Mohammed and Ali 2016).

Despite significant weaknesses, the selected projects have mainly emphasised the social dimension, covering 44% to 55% of the assessment. However, there is a clear lack of attention to safety and security factors to mitigate the threat to and reduce damage to individual buildings and urban areas. It is also important to ensure that the required level of protection is provided without compromising the capacity to create aesthetic and functional urban spaces (UN 2007).

Regarding environmental aspects, there was an emphasis on transportation and infrastructure which are considered an essential urban challenge, to compensate for that which has been destroyed as a result of successive wars, especially water distribution systems, sewage, roads, electrical plants and energy distribution networks across the country (Fulmer 2009). Despite attention to drinking water, there is a clear lack of in-depth interaction with many other factors concerning water, which is a critical local factor. Official reports indicate a significant reduction (by 35.2%) in per capita water availability in 2014 compared to 2012, due to population growth, climate change and pollution factors (Michel *et al.* 2012; CSO 2015). Therefore, water quality, recycling and promoting the use of available alternative sources of water should be viewed as a priority. There was also a substantial lack of attention to other environmental indicators such as ecology, energy, waste, hazard and alternative transportation modes. The environmental dimension rate for the case studies ranged from 30% to 40% of the assessment.

The results indicate a lack of information in official documentation and Iraqi urban development standards, with regard to key issues such as energy, ecology and waste. Many urban issues are referred to descriptively such as water bodies, green belts and conservation of agricultural land, without standards or regulations such as size, space or percentage required. There is the need to update local urban development standards, in line with global urban trends and innovations, to guide new urban development projects toward sustainability. The public perception of sustainable design, for example, is that it is expensive and complicated to achieve and that some decision makers are still not fully aware of the benefits of resource management, energy efficiency and consumption. Concerns are voiced about the initial cost of sustainable projects, considered high without acknowledgment of their economic benefits which can be remarkable in the long term (Martos *et al.* 2016).

Current economic issues ranged from 9% to 20% for the three projects. This suggests that economic issues need to be addressed and even emphasised by the relevant official authorities. Attention to alternative economic activities, e.g. local industry, life cycle costs, employability, qualification and skills and the use of sustainable products were limited across the selected projects.

Some urban standard issues have been overlooked when approving new development projects such as dwelling density, this representing one of the key issues to reduce the current housing deficit in Iraq. The dwelling density of urban development projects has been determined at between 40-80 residential units/hectare for low-rise and 60-120/hectare for high-rise. There is also a lack of attention to diversification of housing patterns by including at least 20% high-rise housing or more (MCH 2010).

Therefore, there is a critical need to change, modify or add several urban development standards, related to environmental, social and economic issues, in order to achieve sustainability. Based on this, the planner's role becomes one to propose appropriate urban solutions which are commensurate with the needs of the population at present, without prejudice to the requirements of residential environment and ancillary activities and which do not conflict with the individual and societal demands.

Finally, most of the results that have been obtained through the testing process have emphasised the urgent need to have an urban sustainable assessment framework such as the IUSAF. The results of the case study assessments show that these three case studies have been developed in an unsustainable manner. This chapter, therefore, argues that the presence of the IUSAF would create many substantial benefits, especially by directing awareness towards urban sustainability issues for developers, specialists and decision-makers, to create a plan of action for current and new urban development projects in Iraqi cities.

7.11 Summary

The chapter aimed to demonstrate the verification and testing process of the IUSAF. The procedures were conducted to assess the appropriateness of the proposed framework to the local Iraqi context. The testing process was based on the current urban development situation and applied this framework to three case studies which differed in terms of location, capacity, construction patterns and construction stage.

In brief, the results revealed that the three urban development projects suffer from problems caused by design and planning processes which are unsustainable. This will affect inhabitants, as well as the city, environmentally, socially and economically. The lack of attention to ecological issues, energy management, renewable energy, waste recycling, will cause rising resource consumption and increases in environmental pollution. These and other issues point to poor urban development planning resulting from the lack of adoption of local urban challenges and the search for appropriate and sustainable urban solutions. This research, therefore, would argue that the adoption and implementation of the IUSAF would help to design and develop the Iraqi cities and urban projects sustainably.

Chapter 8
Conclusion and Recommendation

This chapter reviews the motivation for the research and summarises the main findings which answer the research questions posed in Chapter 1. It provides general recommendations for sustainable urban development in Iraqi cities. The chapter also summarises the main limitations and outlines some recommendations for further research.

8.1 Motivation

The early 1990s witnessed serious attempts globally to implement sustainability as a strategy to develop cities, obligating the construction sector to comply with building laws and standards related to sustainability. Developed countries have put significant effort into the creation and development of urban sustainability assessment methods. These systems primarily focus on reducing the environmental impact on the built environment but without considering the demands of population growth.

However, the arbitrary use of existing global assessment tools can be hindered by environmental conditions, socio- cultural differences and local circumstances, specifically in developing countries, including war-torn countries such as Iraq. Here, urban development has suffered from the prolonged impact of political instability, resulting in acute environmental, social and economic difficulties impacting significantly on its public utilities and infrastructure.

Since 2003, Iraq has embarked on an ambitious urban development programme in different sectors, including the establishment of post-war projects and the rehabilitation of existing cities. A number of large urban development projects are currently underway, as a means of environmental, social and economic remediation.

Unfortunately, current urban development practice has shown that many urban projects are unsustainable. This means that there is a need for decision makers to adopt sustainable practices and innovative solutions to steer decision makers. Therefore, the aim of this study is to determine how to assess sustainability and investigate factors that effecting urban sustainability in Iraqi cities, leading to the development of a comprehensive urban sustainability assessment framework which embraces the challenges of the local context.

8.2 Answering the research questions

The overarching hypothesis of this research is that the leading global urban sustainability assessment models currently in use are not applicable to war-torn countries, due to their environmental, social and economic specificities. In their application, they fail to account for regional variations, including the constraints of available resources, local architecture, specific environmental conditions, and other economic and socio-cultural factors.

Due to the multi-disciplinary nature of the urban sustainability domain, a mixed methodology approach was utilised to investigate the research questions. The main research questions have been answered over the five theoretical and practical stages of this study.

The first stage comprised a literature review which established a comprehensive picture of the different urban sustainability assessment methods, as well as investigating the existing urban development challenges in Iraq. This addressed the first search question: *Are current global sustainability assessment tools fit for purpose/applicable in developing sustainable designs for Iraqi cities*? as presented in Chapter 2. An analytical comparison of a number of global assessment tools provided a definitive answer to the first research question. The results revealed that these systems primarily focused on reducing environmental impacts. Most of the existing urban assessment methods were designed for different local purposes and to suit specific regions, and are therefore not globally applicable across all countries, especially in Iraq, due to its unique urban challenges.

This led to the recognition of the need to develop a sustainability assessment tool for Iraqi development projects thus providing an introduction to the second research question: *What are the urban development factors needed to assess the sustainability of Iraqi cities*? An in-depth review of the previous literature was conducted to understand local urban challenges and factors and to ascertain the importance of these urban issues to stakeholders involved in the process of developing effective policies and solutions based on local priorities. It is important to acknowledge the differences in environmental and socio-economic trajectories in the context of local challenges as opposed to those found in developed countries. As a result, a nationwide questionnaire was conducted to engage stakeholders and assess their perceptions on local urban factors, their challenges, relevance and importance. Exploring stakeholders' views is a significant first step towards integrating their aspirations into the development of policies and activities for decision making. The findings of the questionnaire provided critical data about key urban factors which are essential to developing a local framework for current and new urban projects.

The third research question was related to local assessment factors: *How can identified urban factors be incorporated into a local sustainability assessment framework*? In order to answer this question, an empirical study was conducted using the Delphi technique to obtain contributions from a group of experts by use of a series of surveys with controlled opinion feedback. Three successive rounds of structured consultations were conducted; firstly, a brainstorming phase to identify potential factors applicable in the Iraqi context; secondly, a revision and narrowing down of the results of the previous round and thirdly, the final rating on the agreed urban sustainability assessment factors (indicators and sub-indicators). The results identified the key local urban sustainability factors, essential for the development of the IUSAF, which incorporates environmental, social and economic aspects.

The next stage sought to develop a customised weighting system for IUSAF factors through the use of AHP, an approach adopted to address the fourth research question: *What is most appropriate applicable weighting systems, rating formulas and benchmarks, to reflect an accurate assessment of the Iraqi urban context*? The AHP provides a multi-criteria decision-making process which allows decision makers to model a complicated problem in a hierarchical structure. In the context of this research, the use of AHP provided a crucial method convert the subjectivity of the research problem into a mathematical form.

Research questions 3 and 4 aimed to identify the major differences between IUSAF and other assessment tools, such as BREEAM Communities, LEED-ND and CASBEE-UD, in terms of urban factors (indicators and sub-indicators), priorities and weighting system. The results revealed that the indicator 'water' was the top priority, ‘safety and security’ indicators scored second. This was followed by ‘transportation and infrastructure’, ‘local economy’, ‘jobs and businesses’ and ‘housing’. The uniqueness of the IUSAF framework emanates from the fact that it focuses on providing several basic urban indicators and services, such as safety, transportation and infrastructure, economic factors and housing, which are considered vital and fundamental to the existing circumstances in Iraq, a war-torn country (CSO 2013).

The fifth stage was the testing process using a case study approach, this considered an essential part of the framework development, increasing confidence in its performance. The findings confirmed the appropriateness of the suggested IUSAF for the Iraqi urban development context.

8.3 The results

The results are summarised as follows:

- Global assessment tools are essential instruments for the successful implementation of the principles of urban sustainability, however, they tend to have disparities and differences in terms of urban factors and challenges, thereby restricting the potential to apply in all countries.
- The study presents, for the first time, an interactive experience between communities and the urban challenges facing their cities/regions, aiming to compensate for the severe shortage of comprehensive environmental, social and economic studies in the Iraqi context.
- A unique contribution of the research was achieved by adopting robust and comprehensive methodologies (consensus-built approach and AHP), to identify and prioritise the key quantitative and qualitative factors of urban challenges in the Iraqi context. These approaches

were used to identify and allocate credits and rating formulas to all factors. It can be concluded that this approach can provide substantial benefits in comparison to those achieved from the application of other global tools.

- The results revealed key differences between the Iraqi urban framework and a range of global tools in terms of urban factors (indicators, sub-indicators) and weighting systems.
- The applicability analysis reported the IUSAF as an appropriate to assess the urban sustainability.
- The testing process results have validated the need for IUSAF to assess existing urban design and development which has been planned and developed in an unsustainable manner.

8.4 Justification for adopting the IUSAF

As previously stated, the main motivation for creating and operating sustainability assessment methods is to promote energy efficiency and preserve the environment through reducing GHG emissions. These environmental issues have therefore been given top priority as the main urban challenges by most global assessment tools such as BREEAM, LEED, CASBEE, and SBTool.

The development of such assessment methods for specific contexts should include an investigation of local urban challenges from the stakeholders' view, as well as a consensus-based approach. As a result, these methodologies represent a key foundation for creating and developing a thorough and coherent assessment framework which can address these local challenges and offer solutions that promote sustainable development.

In the absence of clear guidance and reliable methodology for the development of new urban assessment schemes, views from many professionals, experts and related studies suggested that a consensus-based approach can offer an effective method (Cole 2005; Haapio and Viitaniemi 2007; Ali and Al Nsairat 2009; Alyami *et al.* 2013). As such, certain essential urban factors required customisation to suit the local Iraqi context, including: (a) the adaptation of urban sustainability assessment factors (indicators and sub-indicators) and (b) the development of a viable weighting system. To this end, stakeholder engagement forums were conducted to gather and investigate wider community perceptions towards key urban challenges via the multiple consultation rounds of the Delphi approach, which was critical in verifying the applicability of the selected urban assessment factors

According to the results, the study concludes that this powerful procedure was necessary as the complexities of this field cannot be consolidated by utilising a single method. Expert contributions were employed to synthesise different factors in the quest to develop the best method to underpin a thorough and coherent urban sustainability assessment scheme. Experts' judgements can also be transformed into a mathematical form, which can be used more accurately for the assessment of local circumstances using AHP. The IUSAF has utilised this technique to deliver an applicable weighting system for urban factors considered the core of the sustainability assessment method.

IUSAF stands to create many substantial benefits as it has the capacity to raise awareness about urban sustainability issues for developers, specialists and decision-makers and to constitute a plan of action for current and new urban development projects in Iraqi cities. In addition, the assessment and potential application of the IUSAF indicators to a different environment outside Iraq can assist in identifying the potential similarities and differences which could promote or hinder the smooth and successful application of the framework for sustainable urban development applied to Iraq. Careful consideration of the geographical and cultural differences within neighbouring countries, specifically urban factors and their weightings, could significantly contribute towards the establishment of a conceptual platform and a base for developing sustainability assessment frameworks tailored specifically for national urban development programmes.

8.5 Research limitations

The most significant limitations shaping the scope of the study, are as follows.

- Most official literature on urban sustainability assessment tools focuses on certification rather than the methods adopted for their development. Therefore, inter-tool comparison of methods could not be accomplished.
- Usable detailed data on existing and planned Iraqi urban development projects are not readily available or at best, are very difficult to obtain. This unavailability of data affected the number and the depth of case study assessments.
- The public perception survey had 31.6% female respondents, this figure is considered good given the prevailing social and cultural barriers regarding female participation and engagement in public issues. However, this also implies that there could be a gender bias in the results.
- Frequent interruptions in the national electricity supply in most Iraqi cities was one of the obstacles faced by respondents when filling out e-questionnaires, both during the public perception survey and the Delphi consultation. This has affected completion rates, specifically with reference to the public perception survey.
- Because of the current security and safety conditions in Iraq, it was challenging to obtain layout plans and relevant reports on existing and future urban development projects. The completion of lengthy formal procedures are often required to obtain official approvals, this having an impact on the selection process.

8.6 Recommendations

- Almost all global urban assessment methods are updated and revised every two to five years. It is therefore recommended that IUSAF should be subjected to regular revision to prioritise urban issues and to further develop and update the data.
- The suggested IUSAF scheme has specifically been developed to match urban development projects requirements. It is, therefore, possible that similar frameworks can be developed for other spheres such as healthcare, education, industry and buildings.
- Assessors should have a solid background in urban sustainable development and should engage in a comprehensive course in urban sustainability assessment. This will make the assessment process more effective and reliable, reflecting real performance.
- The testing and validation process of IUSAF has been limited to three case studies. It is recommended to test the framework further to assess the sustainability of other urban development projects of varying size and function.
- Most of the approved local urban development standards by the Iraqi Ministry of Planning date back to 1972, they should be updated to incorporate new urban factors such as utilisation of renewable energy, reduction of emissions, waste recycling and adaptation of sustainable infrastructure.

8.7 Future studies

The study highlights several suggested future areas for study, aiming to develop the framework and the sustainable urban development field in Iraq.

- Regarding the majority of Iraqi cities, further studies on sustainable infrastructure and transportation issues are highly recommended due to inefficient infrastructure and limited use of public transport and to provide sufficient infrastructures and transport systems that are more ecology friendly.
- Extend local studies about recycling waste and renewable energy as sustainable applications, capable of enhancing urban environment, as well as their role as efficient global solutions for some critical local challenges such as enhancing electricity production.
- Another substantial consideration arises from the assumption that green and environmentally friendly development projects are more expensive than conventional ones, which means that it is important to study and investigate any ecological and economic aspects that may hinder adoption of these types of urban projects.
- It is important to update the standards for Iraqi urban projects codes, as well as to include new urban factors that support urban sustainability. These new standards and codes should be

compatible with Iraqi urban requirements and circumstances. The comparison of international and local urban development standards is an important area for study and further investigation.

- Urban sustainability assessment is multi-dimensional and multi-disciplinary. Improvement in one objective or an indicator may have a detrimental effect on another. While sustainability assessment frameworks highlight performance in one dimension or for one indicator, further work is still needed on how to apply the outcomes in making complex design decisions, especially in cases where objectives conflict with each other. Engineering design disciplines have been considering multi-objective decision-making in the past decades (Mourshed *et al.* 2011) but its mainstreaming in urban design and development is yet to be seen.

8.8 Summary

This chapter presented the motivation for this study, namely the political, environmental, social and economic transformations of urban development in Iraq over the past four decades and the consequent pressures on the construction industry. The answers to research questions were included with main findings. Justification of the adoption of IUSAF, limitations, recommendations and future studies have also been discussed. The exceptional circumstances that faced the country, need to be carefully addressed with close monitoring, in order to tackle the major challenges facing cities and to achieve the sustainability in the urban development field.

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Appendix A: Examples of urban development projects in Iraq

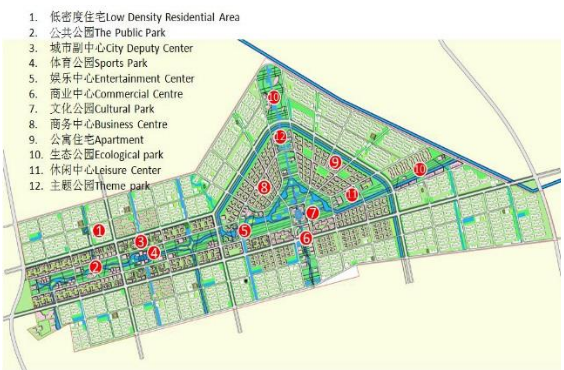
Name	**Iraq Gate**
Location	Baghdad (The capital in the middle of Iraq)
Area	285,000 m^2
Size (no. of units)	1824 flats
Stage	Construction stage
URL	http://www.iraqgate.com/

Name	**Saafat Al-Basrah Residential Project**
Location	Al-Bassra (in the south of Iraq) 450 km from Baghdad
Area	692,500 m^2
Size (no. of units)	1857 residential units (417 houses and 1468 flats)
Stage	Construction stage
URL	https://www.facebook.com/saafatalbasrah/

Name	Marmara Baghdad Dicle City
Location	Baghdad (The capital in the middle of Iraq)
Area	30,000 m2
Size (no. of units)	6500 residential units (flats)
Stage	Planning stage
URL	www.marmaraas.com/project/5/marmara-baghdad-dicle-city

Name	The Lebanese village
Location	Erbil (North of Iraq)
Area	240,000 m^2
Size (no. of units)	3400 residential units (houses and flats)
Stage	Construction stage
URL	www.lebanesevillage.net/zone_detail.php?pid=30

Name	Hillah New City Low-Cost Housing project
Location	Babylon (in the middle of Iraq) 100km from Baghdad
Area	36,000,000 m^2
Size (no. of units)	60,000 residential units (houses and flats)
Stage	Proposal
URL	www.plt.com.hk/images/01urban/2013_Hillah_New_City_low-cost_Housing_Project_Baghdad_Iraq/proj.html



Name	Al Rayan City
Location	Ninawa (in the north of Iraq) 465 km from Baghdad
Area	1,792,000 m^2
Size (no. of units)	3416 houses
Stage	Panning stage
URL	http://www.skyscrapercity.com/showthread.php?t=1633142

Appendix B: Invitation letters

1. Participation in the nationwide questionnaire

The Development of an Urban Sustainability Assessment Framework for Iraq

Perceptions on urban development challenges in Iraqi cities

Subject: Invitation letter

Dear Participant,

Iraqi cities suffered from destruction and degradation for more than four decades as a result of wars and international sanctions, affecting the economy and infrastructures. Sustainable rebuilding and rehabilitation are, therefore, essential, while establishing new urban areas and cities to meet the growing demand. With the
new oil boom and economic prosperity, there is also an emerging desire towards an improved standard of living.
The new urban movement in Iraq needs to identify urban development challenges to create a sustainable future for its citizen. Sustainable city plays a crucial role in improving the quality of life of the cities by enhancing the ecological, cultural, political, institutional, and socio- economic aspects and by reducing undesirable effects on future generations.
This questionnaire is a part of a doctoral research at Cardiff University, UK, which is aimed to developing a sustainability assessment framework for use in urban development projects in Iraq. Understanding the views of the stakeholders is an important first step in identifying the baseline and to prioritise urban development
challenges.
As an expert in the field, we are inviting your opinion on existing and future urban development challenges in Iraq by filling out this questionnaire. Collected data will be anonymised for reporting and will only be used for academic research purposes. For questions about this research and the questionnaire, please contact:

Raed Fawzi Mohammed Ameen
Doctoral researcher
School of Engineering, Cardiff University, Cardiff
United Kingdom, CF24 3AA
E-mail: MohammedAmeenRF@cadiff.ac.uk , raedf.ameen@yahoo.com
Mobil: 009647803776, 00447424832298

2. Participation in the Delphi technique

The Development of an Urban Sustainability Assessment Framework for Iraq

Subject: Invitation letter

Dear Expert,

I would like to invite you for joining the expert panel to carry out the Delphi technique. This questionnaire is a part of a doctoral research at Cardiff University, UK, which is designed to prioritize urban sustainability indicators, which are fundamental to the development of a national sustainability assessment framework for Iraq. In order to promote environmental, social and economic aspects to improve the quality of life in the Iraqi cities and establish sustainable cities and new urban projects. The proposed sustainability assessment framework is similar in nature to that of well- known tools such as (LEED- ND, BREEAM Community) that used in many developed countries.
A list of indicators sustainability indicators has been identified through:
a) An extensive review of the literature on urban sustainability and global assessment tools such as LEED-ND, BREEAM Communities, CASBEE-UD, SPTool^{PT}-UP, Pearl Community (PCRS), and GSAS / QSAS.
b) Conducted a nationwide survey in Iraq to investigate public perceptions of urban development challenges in Iraqi cities.
Your expertise is essential in translating the identified list of indicators into assessment items and rank them in order of priority so that relevant weightings can be developed. This study employs Delphi, a consensus building approach, as a methodology for the evaluation of urban sustainability indicators. In order to identify the final list of urban indicators of the proposed framework, which reflects the local urban challenges in the Iraqi context.
The contribution of this research is important to the success of this study. If you agree to participate in this study, you will be kindly required to reply to almost three rounds of questionnaires. Each round will take about less than 30 minutes to complete (the questionnaire will support detailed information about Delphi). All information provided by the participants will be handled as confidential and will be employed for research purposes only. The participant names and details of any person or organization will not be detected.
For any further questions, please contact me without any hesitation.
Readiness to participate in this study would be greatly appreciated.
Sincerely,

Raed Fawzi Mohammed Ameen
PhD Candidate
School of Engineering, Cardiff University, Cardiff
United Kingdom
E-mail: MohammedAmeenRF@cadiff.ac.uk, raedf.ameen@yahoo.com
Mobil: 009647803776, 00447424832298

3. Participation in the Analytical Hierarchy Process (AHP)

The Development of an Urban Sustainability Assessment Framework for Iraq

AHP survey: Pair-Wise comparisons

Subject: Invitation letter

Dear Expert,

I would like to express my appreciation for your time and efforts for completing the three rounds of the Delphi technique, and your extremely valuable comments.
The Delphi survey established the consensus on the urban sustainability assessment framework for Iraqi cities as shown in Fig. 1, which includes three main dimension, 18 urban indicators, and 71 factors (sub- indicators). I would like to conduct my consultation to assess the relative importance of the all urban items.
I would like to invite you to participate to this approach, where you are kindly requested to (a) compare pairs of dimensions, decide which of the two item is a very important, and (c) quantify the intensity of importance. This process is a very important and involve the use of Analytical Hierarchy Process (AHP) in order to elicit weighting and priorities of all items in the suggested framework.

For any other questions, please contact us without any hesitation.

Readiness to participate in this study would be greatly appreciated.

Sincerely,

Raed Fawzi Mohammed Ameen
PhD Candidate
School of Engineering, Cardiff University, Cardiff
United Kingdom
E-mail: MohammedAmeenRF@cadiff.ac.uk , raedf.ameen@yahoo.com
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Appendix C: The nationwide questionnaire of Iraqi cities

Perceptions on urban development challenges in Iraqi cities

1. Introduction
المقدمة

Perceptions on urban development challenges in Iraqi cities
تصورات حول المشاكل الحضرية للمدن العراقية

Iraqi cities suffered from destruction and degradation for more than four decades as a result of wars and international sanctions, affecting the economy and infrastructures. Sustainable rebuilding and rehabilitation are, therefore, essential, while establishing new urban areas and cities to meet the growing demand. With the new oil boom and economic prosperity, there is also an emerging desire towards an improved standard of living.
The new urban movement in Iraq needs to identify urban development challenges to create a sustainable future for its citizen. Sustainable city plays a crucial role in improving the quality of life of the cities by enhancing the ecological, cultural, political, institutional, and socio- economic aspects and by reducing undesirable effects on future generations.
This questionnaire is a part of a doctoral research at Cardiff University, UK, which is aimed to developing a sustainability assessment framework for use in urban development projects in Iraq. Understanding the views of the stakeholders is an important first step in identifying the baseline and to prioritise urban development challenges.
As an expert in the field, we are inviting your opinion on existing and future urban development challenges in Iraq by filling out this questionnaire.
Collected data will be anonymised for reporting and will only be used for academic research purposes. For questions about this research and the questionnaire, please contact:

عانت المدن العراقية من تدمير وتدهور لأكثر من أربعة عقود نتيجة الحروب والعقوبات الدولية، وبشكل أثرعلى الاقتصاد، والبنى التحتية للمدن . ان إعادة البناء وإعادة التأهيل للمدن بالطرق المستدامة يمثل احدى الضرورات لإنشاء المدن والمشاريع العمرانية الجديدة لتلبية الطلب المتزايد. ومع الطفرة النفطية الجديدة والازدهار الاقتصادي هناك رغبة نحو تحسين مستوى المعيشة للسكان.
ان الحركة العمرانية الجديدة في العراق تحتاج لتحديد مشاكل المدن وتحديات التنمية الحضرية لخلق مستقبل مستدام لمواطنيها. ان المدينة المستدامة تلعب اليوم دورا حاسما في تحسين نوعية حياة المدن من خلال تعزيز الجوانب الاقتصادية والبيئية والثقافية والسياسية والمؤسسية والاجتماعية وعن طريق الحد من الآثار الغير مرغوب فيها على الأجيال القادمة
ان هذا الاستبيان هو جزء من متطلبات بحث الدكتوراه في جامعة كارديف، المملكة المتحدة، يهدف إلى تطوير إطار لتقييم الاستدامة لاستخدامها في مشاريع المدن الجديدة و مشاريع التنمية الحضرية في العراق. ان فهم وجهات نظر شرائح المجتمع المختلفة هو الخطوة الأولى والمهمة في تحديد خط البدء والشروع وإعطاء الأولوية لمشاكل المدن . وكمتخصص في المجال, أود ان أدعوك لاعطاء رأيك حول مشاكل المدن وتحديات التنمية الحضرية الحالية والمستقبلية في العراق عن طريق ملء هذا الاستبيان
ان البيانات التي يتم جمعها لإعداد التقاريرستكون تحت السرية ولن تستخدم إلا لأغراض البحث العلمي. ولطرح الأسئلة حول هذا البحث والاستبيان، يرجى الاتصال ب

Mr Raed F Mohammed Ameen
Lecturer in University of Karbala
Doctoral researcher
School of Engineering/ Cardiff University/ UK
Cardiff, CF24 3AA
Email: MohammedAmeenRF@cardiff.ac.uk

رائد فوزي محمد امين - تدريسي في جامعة كربلاء
طالب دكتوراه
كلية الهندسة

جامعة كارديف

*** 1. Consent to proceed: please select your choice below. By clicking on the "Accept" button you confirm that you are at least 18 years of age.**

الموافقة على الأستمرار بالاستبيان: يرجى تحديد أختيارك أدناه. بالضغط على زر" قبول" فأنت تؤكد أن عمرك لا يقل عن 18سنة

○ Accept

قبول

○ Decline

رفض

Perceptions on urban development challenges in Iraqi cities

5. Demographic information
المعلومات الشخصية

Note: Please answer all questions to move to the next page

ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 7. In which of the following governorates do you live?**

في أي من المحافظات التالية تعيش؟

*** 8. Which of the following best describes the area you live in?**

ما هو افضل وصف للمنطقة التي تعيش فيها؟

○ Urban

تعيش في المدينة

○ Suburban

في الاقضية والنواحي

○ Rural areas

في القرى والارياف

Perceptions on urban development challenges in Iraqi cities

6. The goals of sustainable urban development
أهداف التنمية الحضرية المستدامة

Note: Please answer all questions to move to the next page
ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 9. Please rate how important the following urban development factors are for Iraq?**
رجاءاً ما تقييمك لأهمية عوامل التنمية الحضرية التالية للعراق؟

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Minimise energy consumption التقليل من استهلاك الطاقة	◯	◯	◯	◯	◯
Minimise greenhouse gas emissions التقليل من انبعاثات الغازات المسببة للاحتباس الحراري	◯	◯	◯	◯	◯
Minimise water consumption ترشيد استهلاك المياه	◯	◯	◯	◯	◯
Increase waste recycling زيادة إعادة تدوير النفايات	◯	◯	◯	◯	◯
Increase vegetation cover and green belts زيادة الغطاء النباتي والأحزمة الخضراء	◯	◯	◯	◯	◯
Reduce environmental pollution (air, water, dust etc.) تقليل التلوث البيئي (الهواء والماء والغبار الخ)	◯	◯	◯	◯	◯
Reduce traffic congestion تقليل الازدحام المروري	◯	◯	◯	◯	◯
Homogenous spatial grouping of activities (e.g. industries, residential, commercial, etc.) التجانس المكاني في توزيع الانشطة المتنوعة في المدينة (على سبيل المثال الصناعات، السكنية والتجاري)	◯	◯	◯	◯	◯
Improve infrastructure (roads) and utilities (water, sewage, etc.) تحسين البنية التحتية والخدمات العامة (الطرق، الصرف الصحي، الخ)	◯	◯	◯	◯	◯

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Promote new housing development تشجيع إنشاء المشاريع السكنية	◯	◯	◯	◯	◯
Provide job opportunities توفير فرص العمل	◯	◯	◯	◯	◯

Perceptions on urban development challenges in Iraqi cities

7. The environmental factors
العوامل البيئية

Note: Please answer all questions to move to the next page
ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 10. Please rate how important the following energy factors are?**
رجاءاً ما تقييمك لأهمية عوامل الطاقة التالية؟

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Reduce energy demand from buildings تقليل الطلب على الطاقة من قبل المباني المتنوعة	○	○	○	○	○
Reduce energy demand from transport تقليل الطلب على الطاقة من قبل وسائل النقل المتنوعة	○	○	○	○	○
Maximize the use of renewable energy (solar, wind, etc.) التاكيد على اهمية استخدام الطاقة الطبيعية المتجددة (الطاقة الشمسية، وطاقة الرياح، وغيرها)	○	○	○	○	○
Effective and smart management of energy resources الادارة الفعالة والذكية لموارد الطاقة	○	○	○	○	○

Other (please specify)
غير ذلك (يرجى التحديد)

*** 11. Please rate how important the following water factors are for Iraqi cities?**
رجاءاً ما تقييمك لأهمية العوامل التالية الخاصة بالمياه للمدن العراقية؟

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Water conservation المحافظة على المياه	○	○	○	○	○
Water recycling إعادة تدوير المياه	○	○	○	○	○
Promotion of using available alternative sources of water (artesian wells, lakes, etc.) تشجيع ايجاد المصادر البديلة المتوفرة للمياه (الآبار الارتوازية، والبحيرات، وغيرها)	○	○	○	○	○
Rainwater harvesting تجميع مياه الأمطار	○	○	○	○	○
Use of recycled/ grey water in parks, irrigation, industry, etc. استخدام المياه المعاد تدويرها (المياه الرمادية) في الحدائق، والري، والصناعة، وغيرها	○	○	○	○	○

Other (please specify)
غير ذلك (يرجى التحديد)

*** 12. Please rate how the important the following waste factors are for Iraqi cities?**
رجاءاً ما تقييمك لأهمية العوامل التالية الخاصة بالنفايات للمدن العراقية؟

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Waste separation and recycling فصل وإعادة تدوير النفايات	○	○	○	○	○
Materials reuse إعادة استخدام المواد	○	○	○	○	○
Sewage treatment معالجة مياه الصرف الصحي	○	○	○	○	○

Other (please specify)
غير ذلك (يرجى التحديد)

*** 13. Please rate how important consideration of the following natural hazards are for your city/ region?**
رجاءاً ما تقييمك لأهمية الإجراءات التي ينبغي اتخاذها لمواجهة المخاطر الطبيعية التالية لمدينتك / منطقتك ؟

	Unimportant غير مهمة	Of little important قليلة الاهمية	Moderately important مهمة بشكل معتدل	Important مهمة	Very important مهمة جداً
Drought الجفاف	○	○	○	○	○
Earthquakes الزلازل (الهزات الأرضية)	○	○	○	○	○
Sandstorms العواصف الرملية	○	○	○	○	○
Desertification of lands التصحر في الأراضي	○	○	○	○	○

Other (please specify)
غير ذلك (يرجى التحديد)

*** 14. Please rate how influence the following natural hazards are in your city/ region?**
رجاءاً ما تقييمك لمقدار تأثير المخاطر الطبيعية التالية على مدينتك / منطقتك ؟

	Not at all influential غير مؤثرة اطلاقاً	Slightly influential مؤثرة قليلاً	Somewhat influential مؤثرة بشكل معتدل	Very influential مؤثرة جداً	Extremely influential مؤثرة للغاية
Drought الجفاف	○	○	○	○	○
Earthquakes الزلازل (الهزات الارضية)	○	○	○	○	○
Sandstorms العواصف الرملية	○	○	○	○	○
Desertification of lands التصحر في الاراضي	○	○	○	○	○

Other (please specify)
(غير ذلك (يرجى التحديد

*** 15. Please rate how important the following transport provisions are for Iraqi cities?**
رجاءاً ما تقييمك لأهمية توفير وسائل النقل التالية للمدن العراقية؟

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Offer a greater choice of transport modes (e.g., trains, buses, underground, etc.) تقديم خيارات أوسع من وسائط النقل (على سبيل المثال، والقطارات، الباصات, المترو وغيرها)	○	○	○	○	○
Promote and provide for the use of private car تشجيع وتوفير متطلبات استخدام السيارات الخاصة	○	○	○	○	○
Promote and provide for the use of public transport تشجيع وتوفير متطلبات استخدام وسائل النقل العام	○	○	○	○	○
P romote and provide for the use of bicycle (e.g., to go to work) تشجيع وتوفير متطلبات استخدام الدراجات الهوائية (على سبيل المثال، للذهاب الى العمل)	○	○	○	○	○
Encourage walking as a mean of mobility, particularly nearby distance تشجيع المشي كوسيلة للتنقل، لا سيما للمسافات القريبة	○	○	○	○	○

Other (please specify)
غير ذلك (يرجى التحديد)

Perceptions on urban development challenges in Iraqi cities

8. The social factors
العوامل الاجتماعية

Note: Please answer all questions to move to the next page
ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 16. Please rate how important the following security factors are for Iraqi cities?**
رجاءاً ما تقييمك لأهمية العوامل التالية الخاصة بالسلامة والامان للمدن العراقية؟

	Unimportant غير مهم	Of little important قليل الاهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Safety of public places السلامة والأمان للأماكن العامة	○	○	○	○	○
Securing in buildings (e.g., fire,vandalism, etc.) تأمين الحماية للابنية (على سبيل المثال، الحرائق، التخريب، وغيرها)	○	○	○	○	○
Promote and provide integrated urban security systems (e.g. monitoring cameras, sensors, etc.) تشجيع وتوفير استخدام انظمة الأمن الحضرية لإدارة الحوادث (على سبيل المثال كاميرات المراقبة، وأجهزة الاستشعار، وغيرها)	○	○	○	○	○

Other (please specify)
اخرى (يرجى التحديد)

*** 17. Please rate how important the following cultural factors are for Iraqi cities?**
رجاءا ما تقييمك لأهمية العوامل الخاصة بالثقافة المحلية للمدن العراقية؟

	Unimportant غير مهم	Of little important قليل الاهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Promote identity and local culture تعزيز الهوية والثقافة المحلية	○	○	○	○	○
Preservation of historical buildings الحفاظ على المباني التاريخية	○	○	○	○	○
Preservation of vernacular buildings الحفاظ على المباني التراثية المحلية	○	○	○	○	○
preservation of the hierarchy in public and private places الحفاظ على التدرج في الخصوصية للأماكن العامة والخاصة	○	○	○	○	○
Development of traditional methods of natural lighting and ventilation for buildings تطوير الطرق التقليدية في استخدام الإضاءة الطبيعية والتهوية للمباني	○	○	○	○	○
Using sustainable local (vernacular) materials in construction استخدام المواد التراثية المحلية المستدامة في البناء	○	○	○	○	○

Other (please specify)
أخرى (يرجى التحديد)

*** 18. Please, how would rate the importance of establishing housing development projects in the following zones?**
رجاءاً، كيف تقييم أهمية إنشاء مشروعات تطوير الإسكان في المناطق التالية؟

	Unimportant غير مهم	Of little important قليل الاهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
City centres مراكز المدن	○	○	○	○	○
Suburban regions مناطق الضواحي (قرب المدن)	○	○	○	○	○
Rural regions المناطق الريفية	○	○	○	○	○
Desert region المنطقة الصحراوية	○	○	○	○	○

Other (please specify)
اخرى (يرجى التحديد)

*** 19. Please rate how important the following housing development types are for Iraqi citizen?**
رجاءا ما تقييمك لأهمية أنواع التنمية الإسكانية التالية للمواطن العراقي؟

	Unimportant غير مهم	Of little important قليل الاهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Increasing housing projects زيادة مشاريع الإسكان الجديدة	○	○	○	○	○
Promote low-rise housing تشجيع المساكن الواطئة الارتفاع (البيوت المفردة))	○	○	○	○	○
Promote high-rise housing تشجيع السكن العمودي (الطوابق المتعددة)	○	○	○	○	○
Provide minimum standards (area, no. of bedrooms) based on household size توفير الحد الأدنى من المعايير (المساحة، عدد غرف النوم) على أساس حجم الأسرة	○	○	○	○	○
Minimise unplanned (random) housing التقليل من السكن غير المخطط له (العشوائي))	○	○	○	○	○

Other (please specify)
(أخرى (يرجى التحديد

Perceptions on urban development challenges in Iraqi cities

9. The economic factors
العوامل الاقتصادية

Note: Please answer all questions to move to the next page
ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 20. To what extent do you agree or disagree that there is unemployment in your city or region?**
إلى أي مدى توافق أو تعارض أن هناك بطالة في مدينتك أو منطقتك؟

Extremely disagree أعارض جداً	Disagree أعارض	Neither agree nor disagree لا اوافق ولا أعارض	Agree أوافق	Extremely agree أوافق جداً
○	○	○	○	○

*** 21. Please rate how important the following economic factors are for Iraq?**
رجاءا ما تقييمك لأهمية العوامل الاقتصادية التالية للعراق؟

	Unimportant غير مهم	Of little important قليل الأهمية	Moderately important مهم بشكل معتدل	Important مهم	Very important مهم جداً
Contribution of urban projects in the provision of employment opportunities مساهمة المشاريع الحضرية في توفير فرص العمل	○	○	○	○	○
Encourage investment in urban projects تشجيع الاستثمار في المشاريع الحضرية	○	○	○	○	○
Develop the tourism sector تطوير قطاع السياحة	○	○	○	○	○
Provision of affordable housing توفير السكن بأسعار معقولة	○	○	○	○	○

Other (please specify)
اخرى (يرجى التحديد)

Perceptions on urban development challenges in Iraqi cities

10. Self- assessment التقييم الشخصي

Self- assessment of the current urban development projects in your city or region
التقييم الشخصي لمشاريع التنمية الحضرية الحالية في مدينتك او منطقتك

Note: Please answer all questions to move to the next page
ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 22. How would you rate the quality of the following services and facilities in your city or region?**
كيف تقييم نوعية الخدمات والمنشآت العامة التالية في مدينتك أو منطقتك؟

	Not available غير متوفرة	Very bad سيئة جداً	Bad سيئة	Neither good nor bad ليست جيدة أو سيئة	Good جيدة	Very good جيدة جداً
Drinking water خدمات تجهيز المياه الصالحة للشرب	○	○	○	○	○	○
Electricity خدمات تجهيز الطاقة الكهربائية	○	○	○	○	○	○
Waste separation and recycling فرز وإعادة تدوير النفايات	○	○	○	○	○	○
Existing housing المشاريع السكنية الموجودة	○	○	○	○	○	○
Availability of housing توفر المشاريع السكنية	○	○	○	○	○	○
Educational facilities (e.g., schools and universities) المنشات التعليمية (على سبيل المثال، والمدارس والجامعات)	○	○	○	○	○	○
Health facilities (e.g., hospitals and medical centres) المنشات الصحية (على سبيل المثال، والمستشفيات والمراكز الطبية)	○	○	○	○	○	○
Public amenities (e.g., museums, public libraries, theaters, etc.) المنشات العامة (على سبيل المثال، المتاحف والمكتبات العامة والمسارح وغيرها)	○	○	○	○	○	○
Recreational facilities (e.g., public parks, theme park, zoo, etc.) الفعاليات الترفيهية (على سبيل المثال،الحدائق العامة, مدن الالعاب، حديقة الحيوان، وغيرها)	○	○	○	○	○	○

	Not available غير متوفرة	Very bad سيئة جداً	Bad سيئة	Neither good nor bad ليست جيدة أو سيئة	Good جيدة	Very good جيدة جداً
Homogenous spatial grouping of activities (e.g. industries, residential, commercial, etc.) التجانس في توزيع الانشطة والفعاليات المتنوعة في المدينة/ المنطقة (على سبيل المثال الصناعات، السكنية والتجارية, الخ)	○	○	○	○	○	○
Designated activities areas for the elderly and disabled توفير مناطق الأنشطة المخصصة لكبار السن والمعاقين	○	○	○	○	○	○
Designated activities areas for children's play areas توفير مناطق الأنشطة المخصصة للعب الأطفال	○	○	○	○	○	○
Infrastructure services (drinking, sewage, drainage, rainwater drainage, etc) مشاريع البنى التحتية (مياه الشرب, والصرف الصحي ـ وتصريف مياه الأمطار ـ الخ	○	○	○	○	○	○
Roads and streets مشاريع الطرق والشوارع	○	○	○	○	○	○
Conservation of green spaces and forest المحافظة على المساحات الخضراء والغابات	○	○	○	○	○	○
Reclamation of desertified and contaminated lands استصلاح الأراضي المتصحرة والملوثة	○	○	○	○	○	○
Using renewable energy (e.g., solar, wind, etc.) استخدام الطاقات الطبيعية والمتجددة (الطاقة الشمسية ـ وطاقة الرياح ـ وغيرها)	○	○	○	○	○	○
Shaded streets and protected open spaces الشوارع المظللة والمساحات المفتوحة المحمية	○	○	○	○	○	○

Perceptions on urban development challenges in Iraqi cities

11. Awareness of sustainable urban development
الوعي بالتنمية الحضرية المستدامة

Note: Please answer all questions to move to the next page
ملاحظة: يرجى الإجابة على جميع الأسئلة للانتقال للصفحة التالية

*** 23. How concerned are you about the sustainability of urban design for Iraqi cities?**
ما مدى اهتمامكم بشأن موضوع استدامة التصميم الحضري للمدن العراقية؟

Not at all concerned غير مهتم مطلقاً	Slightly concerned قليل الأهتمام	Moderately concerned مهتم بشكل معتدل	Very concerned مهتم جداً	Extremely concerned مهتم للغاية
○	○	○	○	○

*** 24. To what extent do you agree or disagree, that Iraqi cities are developed in unsustainable ways?**
إلى أي مدى توافق أو تعارض أن المدن العراقية يتم تطويرها بطرق غير المستدامة؟

Strongly disagree أعارض جداً	Slightly disagree أعارض قليلا	Neither agree nor disagree لا أوافق ولا أعارض	Slightly agree موافق قليلاً	Strongly agree موافق جداً
○	○	○	○	○

*** 25. Are you ready as a citizen to pay an additional cost to live in a sustainable city?**
هل أنت مستعد كمواطن لدفع تكلفة إضافية للعيش في مدينة المستدامة؟

No كلا	Yes نعم	I am not sure لست متأكداً
○	○	○

*** 26. How would you rate the potential of a community to influence to achieve a sustainable city?**
كيف تقييم إمكانية تأثير المجتمع في تحقيق المدينة المستدامة؟

Not at all influential غيرمؤثر اطلاقاً	Slightly influential مؤثر قليلا	Moderately influential مؤثربشكل معتدل	Very influential مؤثر جداً	Extremely influential مؤثر للغاية
○	○	○	○	○

Appendix D: The Delphi technique questionnaire (Round 1)

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

The scope of the study
مجال الدراسة

Dear Expert,

Iraqi cities suffered for more than four decades from destruction and degradation as a result of successive wars and international sanctions, affecting the economy and infrastructures. With the new oil boom and economic prosperity, there is an emerging desire towards an improved the quality life of the cities by enhancing environmental, social, and economic aspects. Identification of urban development challenges, therefore, are essential to establish new sustainable urban areas and cities to meet the growing demand to improve the standard of living of the population.

The questionnaire is designed to prioritise urban sustainability indicators, which are fundamental to the development of a national sustainability assessment framework for Iraq. The proposed sustainability assessment framework is similar in nature to that of well- known tools used in developed countries bet developed for Iraq.

A list of indicators sustainability indicators has been identified through:

(a) An extensive review of the literature on urban sustainability and global assessment tools such as BREEAM Communities, LEED-ND, CASBEE-UD, SBToolPT– UP, Pearl Community Rating System (PCRS), and GSAS/QSAS.

(b) Conducted a nationwide survey in Iraq to investigate the public perception of urban development challenges in Iraq.

An overview of the list of urban indicators is provided in Figure 1.

Your expertise is essential in translation the identified indicators list of assessment items and ranks them in order of priority so that relevant weightings can be developed. The study employs Delphi technique, a consensus-building approach, as a methodology for the evaluation of urban sustainability indicators.

Collected data will be anonymised for reporting and will only be used for academic research purposes.

For questions about this study and the questionnaire, please contect:

عزيزي الخبير

عانت المدن العراقية لأكثر من أربعة عقود من الدمار والتدهور نتيجة للحروب المتعاقبة والعقوبات الدولية، التي اثرت على الاقتصاد والبنى التحتية. ومع الطفرة النفطية الجديدة والازدهار الاقتصادي في العراق، تولدت الرغبة لتحسين نوعية الحياة في المدن من خلال تعزيز الجوانب البيئية والاجتماعية والاقتصادية. لذلك يمثل تحديد تحديات التنمية الحضرية ضرورة اساسية لإنشاء المدن والمشاريع الحضرية المستدامة الجديدة لتلبية الطلب المتزايد لتحسين مستوى معيشة السكا

ومن هنا, تم تصميم هذا الاستبيان لتحديد مؤشرات الاستدامة الحضرية وأولوياتها، التي تعتبر أساسية لتطوير إطار او اداة محلية لتقييم الاستدامة الحضرية في العراق. ان إطار تقييم الاستدامة المقترح مماثل في طبيعته الى الأدوات العالمية (LEED-ND، BREEAM Communities) المعروفة والمستخدمة في البلدان المتقدمة مثل

تم وضع قائمة مؤشرات الاستدامة الحضرية الاتية من خلال

أ)مراجعة شاملة للأدبيات حول الاستدامة الحضرية وأدوات التقييم العالمية مثل:

LEED-ND، BREEAM CO., CASBEE-UD، SBToolPT- UP، Pearl Co., GSAS/QSAS.

ب)إجراء مسح وطني في العراق للتحقيق في تصورات العامة حول تحديات التنمية الحضرية في المدن العراقية)

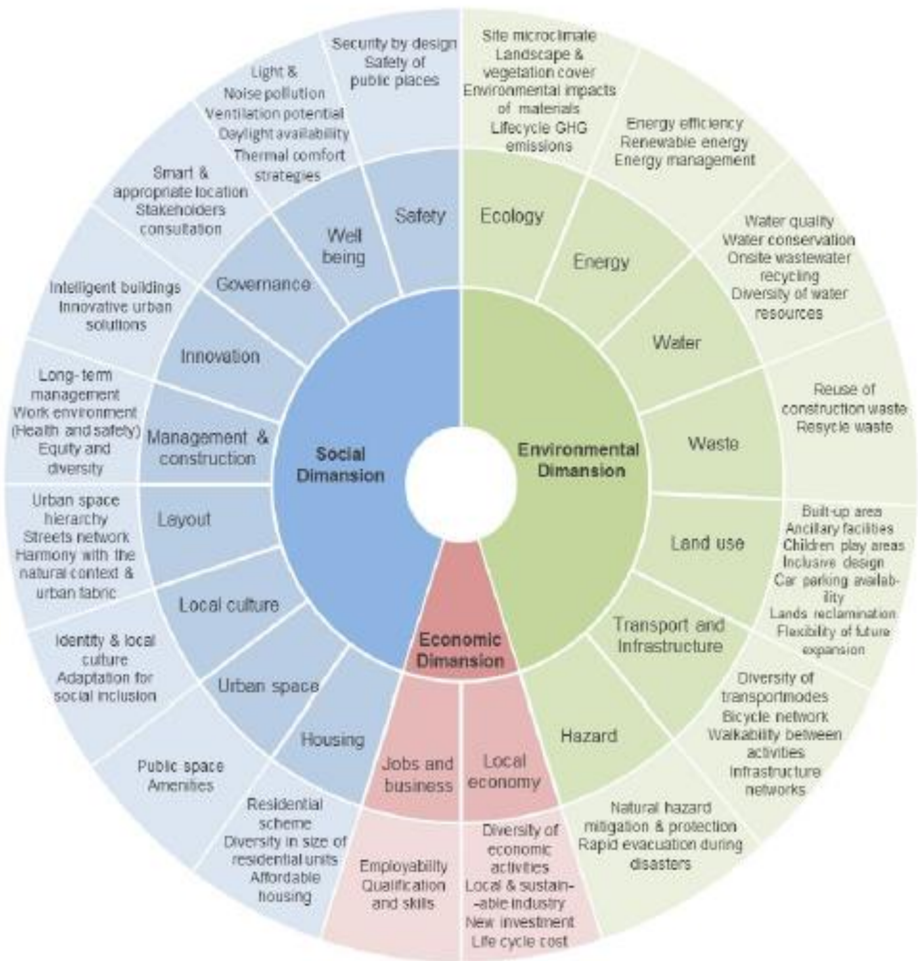
ولما تتمتعون به من خبرة ضرورية, نضع بين ايديكم قائمة المؤشرات المحددة في الشكل 1, لغرض تقييم المؤشرات وفق اولوياتها, مع امكانية اضافة ما ترونه ضروري من المؤشرات التي لم تشتمل عليه الدراسة. وبما يسمح لوضع الاوزان الترجيحية ذات الصلة لكل مؤشر مستقبلا. تم

استخدام تقنية دلفي، واتباع نهج بناء توافق الآراء بين الخبراء كمنهجية في هذه الدراسة لتقييم مؤشرات الاستدامة الحضرية. جميع البيانات التي تم جمعها ستكون سرية وسوف تستخدم لأغراض البحث العلمي حصرا. ان كان لديكم اي سؤال حول الدراسة والاستبيان، يرجى الاتصال ب

Mr Raed F Mohammed Ameen
Lecturer in Department of Architecture, College of Engineering, University of Karbala
Doctoral researcher
School of Engineering/ Cardiff University/ UK
Cardiff, CF24 3AA
Email: MohammedAmeenRF@cardiff.ac.uk, raedf.ameen@yahoo.com

Figure 1: The proposed framework for assessing the sustainability of urban development for Iraq.

الشكل 1: الإطار المقترح لتقييم الاستدامة للتنمية والمشاريع الحضرية في العراق



Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

The personal details

*** 1. Please provide down your personal details** الرجاء تسجيل البيانات الشخصية الخاصة بك

Name:
الاسم :

Organisation:
المؤسسة :

City/Town:
المدينة / المحافظة :

Country:
الدولة :

Email Address:
عنوان البريد الإلكتروني :

*** 2. Please provide the area of specialization** الرجاء تحديد مجال الاختصاص

Other specialization (please specify)
تخصصات أخرى (يرجى التحديد)

*** 3. Please rate how important the following ecology factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية العوامل البيئية التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Site micro-climate: Consideration of site; building configuration; air movement and direction; topographic characteristics; solar orientation; dust and pollution; and shading	○	○	○	○	○
Landscape and vegetation cover: Parks; gardens and green areas; landscaping; planting design and water bodies	○	○	○	○	○
Environmental impact of materials: Use sustainable construction materials with the least impacts on the environment, in terms of production, use, and recyclable	○	○	○	○	○
Lifecycle GHG emissions: Minimize the GHG emissions during the construction and operation stages	○	○	○	○	○

4. Please list further factors of ecology, which are not mentioned above.
يرجى ذكر عوامل الطاقة الأخرى التي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

1 ____

2 ____

3 ____

4 ____

*** 5. Please rate how important the following energy factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الطاقة التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Energy efficiency: Minimize energy consumption from HVAC systems (heating, ventilation, and air conditioning), hot water system, and lighting	◯	◯	◯	◯	◯
Renewable energy: Use renewable energy sources (e.g. solar, wind) onsite or near-site.	◯	◯	◯	◯	◯
Energy management: Use energy management system to monitor, control, and optimize the energy and environmental performance buildings	◯	◯	◯	◯	◯

6. Please list further factors of energy, which are not mentioned above.
يرجى ذكر عوامل الطاقة الأخرى التي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

1

2

3

4

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Environmental Dimension: 3. Water, 4. Waste
الابعاد البيئية: 3. المياه, 4. النفايات

*** 7. Please rate how important the following water factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل المياه التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Water quality: Provide safe water to the site	○	○	○	○	○
Water conservation: Onsite water conservation strategies by sector: residential, industrial, commercial, etc.	○	○	○	○	○
Onsite wastewater recycling: Recycling and treatment of wastewater and sewage in the site	○	○	○	○	○
Diversity of water resources: Use diverse water resources such as lakes, marshes, underground water, rainwater, etc.	○	○	○	○	○

8. Please list further factors of water, which are not mentioned above.
يرجى ذكر المزيد من عوامل المياه ، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

1 __________

2 __________

3 __________

4 __________

*** 9. Please rate how important the following waste factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل النفايات التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Reuse of construction waste: The construction and demolition waste such as concrete, bricks, gypsum, wood, glass, etc., which can be remanufactured	○	○	○	○	○
Recycle waste: Ensure efficient waste management by collecting, treating and disposing of solid wastes generated in urban projects	○	○	○	○	○

10. Please list further factors of waste, which are not mentioned above.
يرجى ذكر المزيد من عوامل النفايات التي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Environmental Dimension: 5. Hazard, 6. Land use
الابعاد البيئية: 5. المخاطر، 6: استعمالات الارض

* **11. Please rate how important the following hazard factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل المخاطر التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الاهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Natural hazard mitigation and protection: Protection against earthquakes, hurricanes, desertification, sandstorms, drought, etc., and Installation of sensors disasters	○	○	○	○	○
Evacuation during disasters: Prepare a hazards map for a rapid and secure evacuation when disasters occur, with providing the evacuation route network from the danger points	○	○	○	○	○

12. Please list further factors of hazard, which are not mentioned above.
يرجى ذكر المزيد من عوامل المخاطر، التي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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* **13. Please rate how important the following land use factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل استخدام الأراضي التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Green vs. built-up area: Compare ratio of green and open areas with built-up areas	◯	◯	◯	◯	◯
Ancillary facilities: Facilities such as social, health, educational and entertainment	◯	◯	◯	◯	◯
Children play areas: Comprises indoor and outdoor play area specifically designed for children	◯	◯	◯	◯	◯
Inclusive design (aging & disabled): Refer to broad concepts of designing buildings and the urban spaces that meet the needs of aging and people with disabilities	◯	◯	◯	◯	◯
Public car parking availability: Ensure balance in the car parking numbers for the project depending on Iraqi standards	◯	◯	◯	◯	◯
Land reclamation: Treatment of the contaminated and degraded lands via planting or other productive uses	◯	◯	◯	◯	◯
Flexibility of future expansion: Satisfy the growing and changing needs for activities, services, and the necessary infrastructure	◯	◯	◯	◯	◯

14. Please list further factors of land use, which are not mentioned above.

يرجى ذكر المزيد من عوامل استخدامات الأراض، التي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق للتنمية الحضرية المستدامة في المدن العراقية

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Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Environmental Dimension: 7. Transport and Infrastructure
الابعاد البيئية: 7. النقل و البنية التحتية

* **15. Please rate how important the following transport and infrastructure factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل النقل والبنية التحتية التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Diversity of transport modes: Promote public transport, taking into account users' needs and abilities	○	○	○	○	○
Bicycle network: The provision of safe cycling networks	○	○	○	○	○
Walkability: Encourage people to walk for getting the benefit health, environmental, and social. Distances are measured from the house to the diverse activities	○	○	○	○	○
Infrastructure networks: Ensure the performance of infrastructure systems such as roads, bridges, tunnels, water supply, sewers, electrical grids, telecommunications, etc.	○	○	○	○	○

16. Please list further factors of transport and infrastructure, which are not mentioned above.

يرجى ذكرالمزيد من عوامل النقل والبنية التحتية، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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*** 17. Please rate the following indicators according to their importance as amandatory item in the sustainability assessment framework. Note, if an item is classed as "mandatory", the relevant indicators have to be met regardless of the final outcome of the sustainability assessment process.**

يرجى تقييم المؤشرات التالية حسب أهميتها كمؤشر إلزامي في إطار تقييم الاستدامة. ملاحظة، إذا تم تصنيف البند بأنه "إلزامي"، هذا يعني ان المؤشرات الحضرية ذات الصلة يجب تحقيقها في المشروع الحضري بغض النظر عن النتيجة النهائية لعملية تقييم الاستدامة

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Ecology القضايا البيئية	○	○	○	○	○
Energy الطاقة	○	○	○	○	○
Water المياه	○	○	○	○	○
Waste النفايات	○	○	○	○	○
Hazard المخاطر	○	○	○	○	○
Land use استعمالات الارض	○	○	○	○	○
Transport and Infrastructure النقل والبنى التحتية	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Social Dimension: 1. Safety, 2. Well being
البعد الاجتماعي: 1. السلامة والامان ، 2. العيش برفاهية

*** 18. Please rate how important the following safety factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل السلامة التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Security by design: The safety considerations in the buildings and site layout	○	○	○	○	○
Safety of public places: Reduce and prevent the effects of hazards such as fires, explosions, car accidents and crimes	○	○	○	○	○

19. Please list further factors of safety, which not are mentioned above.
يرجى ذكر المزيد من عوامل السلامة، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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*** 20. Please rate how important the following well- being factors are for the sustainable urban development in Iraqi cities?**

يرجى تقييم مدى أهمية عوامل العيش برفاهية التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Light and Noise pollution: Eliminate external light pollution through efficient design to control or remove unnecessary exterior lighting, and control of the noise sources	○	○	○	○	○
Ventilation potential: Adopt effective design, allowing for the application of natural ventilation	○	○	○	○	○
Daylight availability: Use daylight to decrease the need for artificial lighting	○	○	○	○	○
Thermal comfort strategies: Maintain thermal comfort for occupants in the internal and external environment	○	○	○	○	○

21. Please list further factors of well- being, which are not mentioned above.

يرجى ذكر المزيد من عوامل العيش برفاهية، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Social Dimension: 3. Governance, 4. Innovation
البعد الاجتماعي:3.اتخاذ القرار, 4. الابتكار

*** 22. Please rate how important the following governance factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل نظام اتخاذ القرار التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Smart and appropriate location: Encourage development near existing communities, infrastructure, and public transport to improve and redevelopment of existing cities and suburban areas	○	○	○	○	○
Stakeholders consultation: Exchange ideas, needs and the knowledge with stakeholders to improve the quality and acceptability of the development during process design	○	○	○	○	○

23. Please list further factors of governance, which are not mentioned above.
يرجى ذكر المزيد من عوامل نظام اتخاذ القرار والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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*** 24. Please rate how important the following innovation factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الابتكار التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Intelligent buildings: Use technology in buildings to promote safety, productivity, and efficiency	○	○	○	○	○
Innovative urban solutions: New solutions to address urban challenges in integrated ways	○	○	○	○	○

25. Please list further factors of innovation, which are not mentioned above.
يرجى ذكر المزيد من عوامل الابتكار، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Social Dimension: 5. Management and construction, 6. Local culture
البعد الاجتماعي: 5. الادارة والانشاء، 6. الثقافة المحلية

*** 26. Please rate how important the following management and construction factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الادارة والانشاء التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Long- term management: Ensure long-term management and maintenance of all activities to maximize efficiency	○	○	○	○	○
Work environment (Health and safety): Ensure safe and healthy work environment during construction	○	○	○	○	○
Equality and diversity: Ensure a fair representation of gender and background	○	○	○	○	○

27. Please list further factors of management and construction, which are not mentioned above.
يرجى ذكر المزيد من عوامل الابتكار، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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* **28. Please rate how important the following local culture factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الثقافة المحلية التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Identity and local culture: Revive and enriching physical and cultural identity for the project components	○	○	○	○	○
Adaptation for social inclusion: Create various opportunities for people to participate in social, political, cultural and economic life	○	○	○	○	○

29. Please list further factors of local culture, which are not mentioned above.
يرجى ذكر المزيد من عوامل الثقافة المحلية، والتي لم يرد ذكرها أعلاه, والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Social Dimension: 7. Urban space, 8. Layout
البعد الاجتماعي: 7. الفضاء الحضري، 8. نظام التخطيط

* **30. Please rate how important the following urban space factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الفضاء الحضري التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Public space: Identify appropriate areas to set up significant social activities, as well as the meeting opportunities for all residents and visitors of the project	○	○	○	○	○
Amenities: Provide street furniture, benches, outdoor sports facilities, and toilets services that are designed according to the urban projects standards	○	○	○	○	○

31. Please list further factors of urban space, which are not mentioned above.
يرجى ذكر المزيد من عوامل و متطلبات الفضاء الحضري، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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*** 32. Please rate how important the following layout factors are for the sustainable urban development in Iraqi cities?**

يرجى تقييم مدى أهمية عوامل نظام التخطيط التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Urban space hierarchy: Focus on the privacy of the different activities besides the general uses of the urban space	○	○	○	○	○
Streets network: The hierarchy of street networks and connecting nodes, for example, major, minor, and cul-de-sac streets	○	○	○	○	○

33. Please list further factors of layout, which are not mentioned above.

يرجى ذكر المزيد من عوامل نظام التخطيط، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Social Dimension: 9. Housing
البعد الاجتماعي: 9. مشاريع الإسكان

* **34. Please rate how important the following housing factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الإسكان التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Residential scheme: Achieve the highest ratio of the housing sector in urban projects	○	○	○	○	○
Diversity in the residential units: Provide a range of residential units to meet the different housing needs of the community	○	○	○	○	○
Affordable housing: Provide mix of housing types for different income levels, by adopting housing policies such as repayment of long-term installments and promote non-profit housing process	○	○	○	○	○

35. Please list further factors of housing, which are not mentioned above.
يرجى ذكر المزيد من عوامل الإسكان، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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* 36. Please rate the following indicators according to their importance as amandatory item in the sustainability assessment framework. Note, if an item is classed as "mandatory", the relevant indicators have to be met regardless of the final outcome of the sustainability assessment process.

يرجى تقييم المؤشرات التالية حسب أهميتها كمؤشر إلزامي في إطار تقييم الاستدامة. ملاحظة إذا تم تصنيف البند بأنه "إلزامي"، هذا يعني ان المؤشرات الحضرية ذات الصلة يجب تحقيقها في المشروع الحضري بغض النظر عن النتيجة النهائية لعملية تقييم الاستدامة

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Safety عوامل السلامة	○	○	○	○	○
Well being العيش برفاهية	○	○	○	○	○
Governance نظم اتخاذ القرارات	○	○	○	○	○
Innovation الابتكار	○	○	○	○	○
Management & construction الادارة و الانشاء	○	○	○	○	○
Local culture الثقافة المحلية	○	○	○	○	○
Urban space الفضاء الحضري	○	○	○	○	○
Layout نظام التخطيط	○	○	○	○	○
Housing الاسكان	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 1
مؤشرات الاستدامة الحضرية للمدن العراقية

Economic Dimension: 1. The local economy, 2. Jobs and business
الاقتصاد 1. الاقتصاد المحلي، 2. وظائف وأعمال

*** 37. Please rate how important the following local economy factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية العوامل الاقتصادية المحلية التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الأهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Diversity of economic activities: Achieve integration with the commercial activities within the urban project	○	○	○	○	○
Local and sustainable industry: Involve local and sustainable industries in urban projects to promote local production	○	○	○	○	○
Encourage new investment: Provide small-medium investment opportunities to bridge investment gaps and overcome urban development challenges	○	○	○	○	○
Life cycle cost: Determine the most cost-effective option among different competing alternatives within the various stages of the project	○	○	○	○	○

38. Please list further factors of local economy, which are not mentioned above.
يرجى ذكر المزيد من عوامل الاقتصاد المحلي، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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* **39. Please rate how important the following jobs and business factors are for the sustainable urban development in Iraqi cities?**
يرجى تقييم مدى أهمية عوامل الوظائف والأعمال التالية لتحقيق التنمية الحضرية المستدامة في المدن العراقية؟

	Unimportant غير مهم	Of little importance قليل الاهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Employability: Contribute to local employment and job growth	○	○	○	○	○
Qualification and skills: Provide opportunities for local businesses and develop qualifications and skills	○	○	○	○	○

40. Please list further factors of jobs and businesses, which not are mentioned above.
يرجى ذكرالمزيد من عوامل الوظائف والأعمال، والتي لم يرد ذكرها أعلاه والتي تعتبرها مهمة لتحقيق التنمية الحضرية المستدامة في المدن العراقية

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* **41. Please rate the following indicators according to their importance as a mandatory item in the sustainability assessment framework. Note, if an item is classed as "mandatory", the relevant indicators have to be met regardless of the final outcome of the sustainability assessment process.**
يرجى تقييم المؤشرات التالية حسب أهميتها كمؤشر إلزامي في إطار تقييم الاستدامة. ملاحظة، إذا تم تصنيف البند بأنه "إلزامي"، هذا يعني ان المؤشرات الحضرية ذات الصلة يجب تحقيقها في المشروع الحضري بغض النظر عن النتيجة النهائية لعملية تقييم الاستدامة

	Unimportant غير مهم	Of little importance قليل الاهمية	Moderately important معتدل الاهمية	Important مهم	Very important مهم جدا
Local economy الاقتصاد المحلي	○	○	○	○	○
Jobs and business الوظائف والأعمال	○	○	○	○	○

Appendix E: The Delphi technique questionnaire (Round 2)

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Introduction

Dear Expert,

I would like to thank you very much for your efforts and time to completing the first round of Delphi questionnaire as well as your significant comments.
For your information, the results have been presented based on the experts responses to the questionnaire.
The urban indicators agreed by the experts will be included in the proposed framework, as well as the new indicators that have been suggested by the experts, which are essential for the development of urban sustainability assessment framework for Iraqi cities.
I would like to invite you to participate in the second round of the Delphi questionnaire, which requests you to re-evaluation the urban indicators that achieved consensus during the first round, also, to evaluate the new urban indicators that suggested from other experts.

Yours Sincerely.

* **Please provide down your personal details:** الرجاء تسجيل البيانات الشخصية الخاصة بك

Name:
الاسم :

Email Address:
عنوان البريد الإلكتروني :

*** 1. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following ecological factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الطاقة التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الأهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Site micro-climate: (4.16/5) Consideration of site; building configuration; air movement and direction; topographic characteristics; solar orientation; dust and pollution	○	○	○	○	○
Landscape and vegetation cover: (4.35/5) Parks; gardens and green areas; landscaping; planting design	○	○	○	○	○
Environmental impact of materials: (4.00/5) Use sustainable construction materials with the least impacts on the environment, in terms of production, use, and recyclable	○	○	○	○	○
Lifecycle GHG emissions:(3.98/5) Minimize the GHG emissions during the construction and operation stages	○	○	○	○	○

* **2. Further urban indicators:**

The experts recommended the following urban factors. Please rate the importance of the proposed ecological factors for the sustainable urban development in Iraqi cities.

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية العوامل البيئية المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Agricultural land conservation Preserve irreplaceable agricultural lands, forests, soils and ecological diversity	◯	◯	◯	◯	◯
Water bodies creation and conservation Create water bodies and conserve the existing to support ecosystem and biodiversity	◯	◯	◯	◯	◯

Other comments
ملاحظات اخرى

*** 3. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following energy factors for the sustainable urban development in Iraqi cities.

هنـاك توافق واجماع واسع على اهميـة المؤشـرات الحضـرية التاليـة بين الخبراء في الجولـة الأولى من المسح. لـذا، يرجى تقييم مستوى أهمية عوامل الطاقة التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant **(1) غير مهم**	Of little importance **(2) قليل الأهمية**	Moderately important **(3) معتدل الاهمية**	Important **(4) مهم**	Very important **(5) مهم جدا**
Energy efficiency: (4.13/5) Minimize energy consumption from HVAC systems (heating, ventilation, and air conditioning), hot water system, and lighting	○	○	○	○	○
Renewable energy: (3.89/5) Use renewable energy sources (e.g. solar, wind) onsite or near-site	○	○	○	○	○
Energy management: (3.69/5) Use energy management system to monitor, control, and optimize the energy and environmental performance buildings	○	○	○	○	○

* **4. Further urban indicators:**

The experts recommended the following urban factors. Please rate the importance of the proposed energy factors for the sustainable urban development in Iraqi cities.

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل الطاقة المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
On-site, Energy delivery performance: Use efficient systems for energy transmission, such as underground cables, gas pipelines, and optical cables	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Environmental Dimension: 3. Water, 4. Waste
الأبعاد البيئية: 3. المياه, 4. النفايات

*** 5. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following water factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل المياه التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Water quality: (4.26/5) Provide safe water to the site	○	○	○	○	○
Water conservation: (4.09/5) Onsite water conservation strategies by sector: residential, industrial, commercial, etc.	○	○	○	○	○
Onsite wastewater recycling: (3.67/5) Recycling and treatment of wastewater and sewage in the site	○	○	○	○	○
Diversity of water resources: (3.76/5) Use diverse water resources such as lakes, marshes, underground water, etc.	○	○	○	○	○

* **6. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed water factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل المياه المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Rainwater harvesting system: A temporary source of water by collecting rainwater and storing for later use	○	○	○	○	○

Other comments
ملاحظات اخرى

* **7. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following waste factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا،
يرجى تقييم مستوى أهمية عوامل النفايات التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Reuse of construction waste: (3.45/5) The construction and demolition waste such as concrete, bricks, gypsum, wood, glass, etc., which can be remanufactured	○	○	○	○	○
Recycle waste: (4.05/5) Ensure efficient waste management by collecting, treating and disposing of solid wastes generated in urban projects	○	○	○	○	○

*** 8. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed waste factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل النفايات المقترحة

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Waste separation and treatment: Separation of different elements found in waste is enabling the recovery of useful materials, minimizing the amount of material sent to a sanitary landfill that cannot recycle.	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Environmental Dimension: 5. Hazard, 6. Land use
الابعاد البيئية: 5. المخاطر، 6. استعمالات الارض

*** 9. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following hazard factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل المخاطر التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Natural hazard mitigation and protection: (3.60/5) Protection against earthquakes, hurricanes, desertification, sandstorms, drought, etc., and Installation of sensors disasters	◯	◯	◯	◯	◯
Evacuation during disasters: (3.84/5) Prepare a hazards map for a rapid and secure evacuation when disasters occur, with providing the evacuation route network from the danger points	◯	◯	◯	◯	◯

*** 10. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed hazard factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل المخاطر المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Shelters for disaster protection: Provide security, safety, and protection and enable affected populations to recover from the impact of disasters.	○	○	○	○	○

Other comments
ملاحظات اخرى

*** 11. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following land use factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل استخدامات الارض التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Green vs. built-up area: (4.42/5) Compare ratio of green and open areas with built-up areas	○	○	○	○	○
Ancillary facilities: (3.95/5) Facilities such as social, health, educational and entertainment	○	○	○	○	○
Children play areas: (4.09/5) Comprises indoor and outdoor play area specifically designed for children	○	○	○	○	○

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Inclusive design (aging & disabled): (3.95/5) Refer to broad concepts of designing buildings and the urban spaces that meet the needs of aging and people with disabilities	○	○	○	○	○
Public car parking availability: (4.31/5) Ensure balance in the car parking numbers for the project depending on Iraqi standard	○	○	○	○	○
Reclamation of lands: (4.20/5) Treatment of the contaminated and degraded lands via planting or other productive uses	○	○	○	○	○
Flexibility of future expansion: (4.20/5) Satisfy the growing and changing needs for activities, services, and the necessary infrastructure	○	○	○	○	○

*** 12. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed land use factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل استخدامات الارض المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Buffer zones: Protect the residential and commercial areas from industrial accidents and environmental pollution.	○	○	○	○	○
Development outside the cities : Establishment of urban projects outside the cities in the suburbs and rural areas	○	○	○	○	○

Other comments
ملاحظات اخرى

*** 13. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following transport and infrastructure factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل النقل والبنية التحتية التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Diversity of transport modes: (4.46/5) Promote public transport, taking into account users' needs and abilities	○	○	○	○	○
Bicycle network: (3.81/5) The provision of safe cycling networks	○	○	○	○	○
Walkability: (3.94/5) Encourage people to walk for getting the benefits health, environmental, and social. Distances are measured from the house to the diverse activities	○	○	○	○	○
Infrastructure networks: (4.44/5) Ensure the performance of infrastructure systems such as roads, bridges, tunnels, water supply, sewers, electrical grids, telecommunications, etc.	○	○	○	○	○

* **14. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed transport and infrastructure factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.

الرجاء تقييم أهمية عوامل النقل والبنية التحتية المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Complete streets: Design and operate the roads to enable safe access for all users, including pedestrians, private and public transport, motorcyclists, crossings, pavements, and other features to improve safety	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Social Dimension: 1. Safety, 2. Well being
البعد الاجتماعي: 1. السلامة والامان ، 2. العيش برفاهية

*** 15. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following safety factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل السلامة والامان التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Security by design: (4.20/5) The safety considerations in the buildings and site layout	○	○	○	○	○
Safety of public places: (4.35/5) Reduce and prevent the effects of hazards such as fires, explosions, car accidents and crimes	○	○	○	○	○

* **16. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed safety factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل السلامة والامان المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Protection from high temperatures and sunlight: Provide external protection means from high temperatures and sunlight in urban areas	○	○	○	○	○

Other comments
ملاحظات اخرى

*** 17. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following well-being factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل العيش برفاهية التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Light and Noise pollution: (3.94/5) Eliminate external light pollution through efficient design to control or remove unnecessary exterior lighting, and control of the noise sources	○	○	○	○	○
Ventilation potential: (4.04/5) Adopt effective design, allowing for the application of natural ventilation	○	○	○	○	○
Daylight availability: (4.15/5) Use daylight to decrease the need for artificial lighting	○	○	○	○	○
Thermal comfort strategies: (4.07/5) Maintain thermal comfort for occupants in the internal and external environment	○	○	○	○	○

* 18. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed well-being factors for the sustainable urban development in Iraqi cities.

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل العيش برفاهية المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Housing and activities proximity: Reduce the time and consuming energy	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Social Dimension: 3. Governance, 4. Innovation
البعد الاجتماعي:3.اتخاذ القرار, 4. الابتكار

* **19. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following governance factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل نظام اتخاذ القرار التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Smart and appropriate location: (3.81/5) Encourage development near existing communities, infrastructure, and public transport to improve and redevelopment of existing cities and suburban areas	○	○	○	○	○
Stakeholders consultation: (4.44/5) Exchange ideas, needs and the knowledge with stakeholders to improve the quality and acceptability of the development during process design	○	○	○	○	○

20. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed governance factors for the sustainable urban development in Iraqi cities.

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل نظام اتخاذ القرار المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
The review of design: Intensive review of the designs after consulting specialists and stakeholders	○	○	○	○	○

Other comments
ملاحظات اخرى

* **21. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following innovation factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا،
يرجى تقييم مستوى أهمية عوامل الابتكار التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Intelligent buildings: (4.09/5) Use technology in buildings to promote safety, productivity, and efficiency	○	○	○	○	○
Innovative urban solutions: (4.09/5) New solutions to address urban challenges in integrated ways	○	○	○	○	○

*** 22. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed innovation factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل الابتكار المقترحة

	Unimportant **(1) غير مهم**	Of little importance **(2) قليل الاهمية**	Moderately important **(3) معتدل الاهمية**	Important **(4) مهم**	Very important **(5) مهم جدا**
ICT management: Establish an integrated information management systems for urban projects	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Social Dimension: 5. Management & construction, 6. Local culture

*** 23. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following management and construction factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الادارة والانشاء التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Long- term management: (4.37/5) Ensure long-term management and maintenance of all activities to maximize efficiency	○	○	○	○	○
Work environment (Health and safety): (4.11/5) Ensure safe and healthy work environment during construction	○	○	○	○	○
Equality and diversity: (3.43/5) Ensure a fair representation of gender and background	○	○	○	○	○

*** 24. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed management and construction factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل الادارة والانشاء المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Planning Policies and legislations: Compliance and develop the local laws and legislation for urban construction	○	○	○	○	○

Other comments
ملاحظات اخرى

*** 25. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following local culture factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الثقافة المحلية التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Identity and local culture: (4.06/5) Revive and enriching physical and cultural identity for the project components	○	○	○	○	○
Adaptation for social inclusion: (4.09/5) Create various opportunities for people to participate in social, political, cultural and economic life	○	○	○	○	○

*** 26. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed local culture factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل الثقافة المحلية المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Conservation and urban renewal: Preserve the traditional and cultural heritage buildings	◯	◯	◯	◯	◯

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Social Dimension: 7. Urban space, 8. Layout
البعد الاجتماعي: 7. الفضاء الحضري، 8. نظام التخطيط

* **27. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following urban space factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الفضاء الحضري التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Public space: (3.89/5) Identify appropriate areas to set up significant social activities, as well as the meeting opportunities for all residents and visitors of the project	○	○	○	○	○
Amenities: (4.22/5) Provide street furniture, benches, outdoor sports facilities, and toilets services that are designed according to the urban projects standards	○	○	○	○	○

*** 28. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed urban space factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل الفضاء الحضري المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Proximity to urban space: Determine the proximity and distance between the various activities and urban space	○	○	○	○	○

Other comments
ملاحظات اخرى

*** 29. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following layout factors for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا،
يرجى تقييم مستوى أهمية عوامل نظام التخطيط التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Urban space hierarchy: (3.96/5) Focus on the privacy of the different activities besides the general uses of the urban space	○	○	○	○	○
Streets network: (4.20/5) The hierarchy of street networks and connecting nodes, for example, major, minor, and cul-de-sac streets	○	○	○	○	○

* 30. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed layout factors for the sustainable urban development in Iraqi cities.

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل نظام التخطيط المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Harmony with surrounding: Project harmony with the surrounding neighbourhoods, whether with nature, heritage, historical and other	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Social Dimension: 9. Housing
البعد الاجتماعي: 9. مشاريع الإسكان

*** 31. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following housing factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الإسكان التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Residential scheme: (3.89/5) Achieve the highest ratio of the housing sector in urban projects	○	○	○	○	○
Diversity in the residential units: (4.11/5) Provide a range of residential units to meet the different housing needs of the community	○	○	○	○	○
Affordable housing: (4.43/5) Provide mix of housing types for different income levels, by adopting housing policies such as repayment of long-term instalments and promote non-profit housing process	○	○	○	○	○

* 32. **Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed housing factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل الإسكان المقترحة

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
The quality of housing units: Provide adequate housing to meet the basic needs of the dwellers	○	○	○	○	○

Other comments
ملاحظات اخرى

Urban sustainability indicators for Iraqi cities/ Delphi technique- Round 2
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة 2

Economic Dimension: 1. The local economy, 2. Jobs and business
الاقتصاد 1.الاقتصاد المحلي، 2. الوظائف

* **33. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following local economy factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الإقتصاد المحلي التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Diversity of economic activities: (4.06/5) Achieve integration with the commercial activities within the urban project	◯	◯	◯	◯	◯
Local and sustainable industry: (4.22/5) Involve local and sustainable industries in urban projects to promote local production	◯	◯	◯	◯	◯
Encourage new investment: (4.11/5) Provide small-medium investment opportunities to bridge investment gaps and overcome urban development challenges	◯	◯	◯	◯	◯

*** 30. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed layout factors for the sustainable urban development in Iraqi cities.**

المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية.
الرجاء تقييم أهمية عوامل نظام التخطيط المقترحة

	Unimportant **غير مهم (1)**	Of little importance **قليل الاهمية (2)**	Moderately important **معتدل الاهمية (3)**	Important **مهم (4)**	Very important **مهم جدا (5)**
Harmony with surrounding: Project harmony with the surrounding neighbourhoods, whether with nature, heritage, historical and other	○	○	○	○	○

Other comments
ملاحظات اخرى

35. The feedback and re-evaluation:
There is a highly consensus on the following urban indicators according to the level of importance in the first round of the survey. Thus, please rate the level of importance of the following jobs and business factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الأولى من المسح. لذا، يرجى تقييم مستوى أهمية عوامل الوظائف والاعمال التالية لتحقيق التنمية الحضرية المستدامة للمدن العراقية

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Employability: (4.15/5) Contribute to local employment and job growth	○	○	○	○	○
Qualification and skills: (4.17/5) Provide opportunities for local businesses and develop qualifications and skills	○	○	○	○	○

*** 36. Further urban indicators: The experts recommended the following urban factors. Please rate the importance of the proposed jobs and business factors for the sustainable urban development in Iraqi cities.**
المؤشرات الحضرية الاضافية : العوامل الحضرية التالية اقترحها الخبراء في الجولة الاولى لتطوير التنمية الحضرية المستدامة للمدن العراقية. الرجاء تقييم أهمية عوامل الوظائف والاعمال المقترحة

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Participate regional expertise: Develop local expertise in the establishment of urban projects	○	○	○	○	○

Other comments
ملاحظات اخرى

*** 37. Please rate how important the following sustainability dimension are for the urban development in Iraqi cities?**
يرجى تقييم مدى أهمية أبعاد الاستدامة التالية للتنمية الحضرية في المدن العراقية؟

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Environmental dimension البعد البيئي	○	○	○	○	○
Social dimension البعد الاجتماعي	○	○	○	○	○
Economy dimension البعد الاقتصادي	○	○	○	○	○

Appendix F: The Delphi technique questionnaire (Round 3)

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Introduction
المقدمة

Dear Expert,

I would like to thank you very much for your efforts and time to completing the second round of Delphi questionnaire and your significant comments.
For your information, the urban indicators agreed by the experts the first and second round will be included in the proposed framework, as well as the new indicators that have been suggested by the experts, which are essential for the development of urban sustainability assessment framework for Iraqi cities.
I would like to invite you to participate in The third and final round of the Delphi questionnaire, which requests you to evaluation the new urban indicators that suggest from the panel experts.

Yours Sincerely

Raed F. M. Ameen
College of Engineering- Cardiff University

السيدات والسادة الخبراءالمحترمون

أود أن اتقدم بأشكر الجزيل لجهودكم ووقتكم لاستكمال الجولة الثانية من استبيان دلفي ورفدنا بالمقترحات وبالتعليقات الهامة
وبعد عملية تحليل النتائج, حصل توافق عالي في ارائكم على المؤشرات الحضرية المقترحة في الجولة الأولى والثانية ...وسيتم تضمين المؤشرات الحضرية في الإطار المقترح، فضلا عن المؤشرات الجديدة التي تم اقتراحها من قبلكم ، والتي تعتبر أساسية لتطوير إطار لتقييم الاستدامة للمشاريع الحضرية للمدن العراقية
وأود أن أدعوكم للمشاركة في الجولة الثالثة والاخيرة من استبيان دلفي (وهي جولة قصيرة جدا تحتاج من 5-10 دقائق فقط)، والتي تتطلب منكم اعادة تقييم للمؤشرات الحضرية الاضافية فقط والتي تم اقتراحها من قبل فريق الخبراء

تفضلوا بقبول فائق الاحترام والتقدير

رائد فوزي محمد امين
جامعة كارديف _ بريطانيا

*** Please provide down your personal details: الرجاء تسجيل البيانات الشخصية الخاصة بك**

Name:
الاسم :

Email Address:
عنوان البريد الإلكتروني :

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Environmental Dimension: 1. Ecology, 2. Energy
الأبعاد البيئية: 1. علم البيئة، 2. الطاقة

Note 1: Please answer all questions to move to the next page
ملاحظة 1: يرجى الإجابة على جميع الأسئلة للانتقال إلى الصفحة التالية

* **1. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following ecological factors for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية العوامل البيئية التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Conservation of agricultural lands: (4.43/5) الحفاظ على الأراضي الزراعية الحفاظ على الأراضي الزراعية التي لا يمكن الاستغناء عنها والغابات والتربة الصالحة للزراعة والتنوع البيئي	○	○	○	○	○
Development and conservation of urban water bodies: (4.38/5) التشجيع و الحفاظ على المسطحات المائية استحداث المسطحات المائية والحفاظ على الموجودة منها لدعم النظام البيئي والتنوع البيولوجي	○	○	○	○	○

* 2. The feedback and re-evaluation:

There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following energy factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق وإجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الطاقة التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Safe energy distribution network: (4.28/5) التوزيع الامن والكفوء للطاقة استخدام شبكات توزيع الطاقة الأمنة ولفعالة، مثل الكابلات تحت الأرض، شبكات أنابيب توزيع الغاز، الخ	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Environmental Dimension: 3. Water, 4. Waste
الابعاد البيئية: 3. المياه، 4. النفايات

* **3. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following water factors that recommended by experts for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل المياه التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Rainwater harvesting system: (4.20/5) منظومة تجميع مياه الامطار جمع وتخزين مياه الأمطار لاستخدامها لاحقا	○	○	○	○	○

* **4. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following waste factors that recommended by experts for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل النفايات التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Waste separation and treatment: (4.33/5) فصل ومعالجة النفايات فصل النفايات لاستعادة المواد المفيدة، تقليل كمية المواد المرسلة إلى المكبات والمدافن الصحية للنفايات والتي لايمكن تدويرها	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Environmental Dimension: 5. Hazard, 6. Land use
الابعاد البيئية: 5. المخاطر، 6. استعمالات الارض

* **5. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following hazard factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل المخاطر التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Shelters for disaster mitigation: (3.85/5) توفير الملاجئ للتخفيف من حدة الكوارث لتوفير الأمن والسلامة وحماية السكان المتضررين من آثار الكوارث. والملاجئ أيضا يمكن ان تتعدد استخداماتها كاستخدامها كمدارس, ابنية خدمية او رياضية في الاوقات العادية	○	○	○	○	○

*** 6. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following land use factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل استعمالات الارض التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Buffer zones:(4.38/5) **المناطق العازلة** العزل والحماية للمناطق السكنية والتجارية من الحوادث الصناعية والتلوث البيئي	○	○	○	○	○
Development outside cities : (4.53/5) **تطوير المناطق خارج المدن** إنشاء المشاريع الحضرية في الضواحي والمناطق الريفية، خارج نطاق المدن ومراكزها المكتظة بالسكان.	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Environmental Dimension: 7. Transport and Infrastructure
الأبعاد البيئية: 7. النقل والبنية التحتية

*** 7. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following transport and Infrastructure factors that recommended by experts for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل النقل والبنية التحتية التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Safe streets:(4.55/5) الشوارع الآمنة تصميم وتشغيل الشوارع والطرق لتمكين الوصول الآمن لجميع المستخدمين، بما في ذلك تحديد ممرات المشاة النقل الخاص والعام، الدراجات النارية، مناطق العبور، والأرصفة، وغيرها من الميزات لتحسين السلامة	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Social Dimension: 1. Safety, 2. Innovation
البعد الاجتماعي: 1. السلامة والامان ، 2. الابتكار

*** 8. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following safety factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل السلامة والامان التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Protection from high temperatures and sunlight: (4.15/5) اساليب الحماية من الحرارة العالية واشعة الشمس في المناطق الحضرية توفير الحماية في المناطق الخارجية المفتوحة من ارتفاع درجات الحرارة وأشعة الشمس في المناطق الحضرية	○	○	○	○	○

*** 9. The feedback and re-evaluation:**

There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following innovation factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الابتكار التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Information modelling (BIM level 2): (4.22/5) إدارة تكنولوجيا المعلومات إنشاء نظام متكامل لتبادل البيانات والمعلومات المتعلقة بكافة تفاصيل اعداد التصاميم والانشاء وإدارة المشاريع الحضرية والمعروف ببناء نماذج (BIM) المعلومات	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Social Dimension: 3. Management & construction, 4. Local culture

*** 10. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following management and construction factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الادارة والانشاء التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Planning Policies and legislations: (4.43/5) سياسات التخطيط والتشريعات الامتثال للقوانين المحلية والتشريعات البنائية في المناطق الحضرية	○	○	○	○	○

*** 11. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following local culture factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الثقافة المحلية التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Conservation of buildings: (4.28/5) الحفاظ والتجديد الحضري الحفاظ على التراث الثقافي والتقليدي، والمباني التاريخية اضافة الى المباني ذات الأهمية الاقتصادية.	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Social Dimension: 5. Layout, 6. Housing
البعد الاجتماعي : 7. نظام التخطيط، 8. الاسكان

* **12. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following layout factors that recommended by experts for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل نظام التخطيط التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant **(1) غير مهم**	Of little importance **(2) قليل الاهمية**	Moderately important **(3) معتدل الاهمية**	Important **(4) مهم**	Very important **(5) مهم جدا**
Harmony with surrounding:(4.08/5) **الانسجام مع المجاورات** **انسجام المشروع مع طبيعة المشهد الحضري القائم والمجاورات, سواء الطبيعية التراثية, التاريخية وغيرها**	○	○	○	○	○

* **13. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following housing factors that recommended by experts for the sustainable urban development in Iraqi cities.
أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الاسكان التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant **(1) غير مهم**	Of little importance **(2) قليل الاهمية**	Moderately important **(3) معتدل الاهمية**	Important **(4) مهم**	Very important **(5) مهم جدا**
The quality of housing units: (4.33/5) **نوعية الوحدات السكنية** **توفير المنازل الملائمة لتلبية احتياجات الساكنين الأساسية**	○	○	○	○	○

Urban sustainability indicators for Iraqi cities/ Delphi technique- round 3
مؤشرات الاستدامة الحضرية للمدن العراقية/ الجولة الثالثة

Economic Dimension: 1. The local economy, 2. Jobs and business
الاقتصاد 1.الاقتصاد المحلي، 2. الوظائف

* **14. The feedback and re-evaluation:**
There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following local economy factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الاقتصاد المحلي التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant غير مهم (1)	Of little importance قليل الاهمية (2)	Moderately important معتدل الاهمية (3)	Important مهم (4)	Very important مهم جدا (5)
Adaptable housing: (4.28/5) المنزل القابل للتكيف السكن الذي يستوعب تغيير نمط الحياة وزيادة حجم الأسرة من دون الحاجة إلى هدم أو تحويلها تحويلا جوهريا في البنية الاساسية والخدمات القائمة	○	○	○	○	○

* 15. The feedback and re-evaluation:

There is a highly consensus on the following urban indicators according to the level of importance in the second round of the survey. Thus, please re-evaluate the level of importance of the following jobs and business factors that recommended by experts for the sustainable urban development in Iraqi cities.

أجابات الخبراء وإعادة التقييم: هناك توافق واجماع واسع على اهمية المؤشرات الحضرية التالية بين الخبراء في الجولة الثانية من المسح (الرقم بين القوسين / من خمس درجات) والمثبت امام العنصر. لذا، يرجى اعادة تقييم مستوى أهمية عوامل الوظائف و الاعمال التالية والتي اوصى بها الخبراء لتحقيق التنمية الحضرية المستدامة للمدن العراقية مستقبلا

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Demonstrable experience in similar projects: (4.75/5) الاستفادة من التجارب والخبرات العالمية في المشاريع المماثلة مشاركة الخبرات العالمية الرائدة لتطوير الخبرات المحلية في إنشاء المشاريع الحضرية	○	○	○	○	○

* 16. Please rate how important the following sustainability dimension are for the urban development in Iraqi cities?

يرجى تقييم مدى أهمية أبعاد الاستدامة التالية للتنمية الحضرية في المدن العراقية؟

	Unimportant (1) غير مهم	Of little importance (2) قليل الاهمية	Moderately important (3) معتدل الاهمية	Important (4) مهم	Very important (5) مهم جدا
Environmental dimension: (4.20/5) البعد البيئي	○	○	○	○	○
Social dimension: (4.13/5) البعد الاجتماعي	○	○	○	○	○
Economy dimension: (4.45/5) البعد الاقتصادي	○	○	○	○	○

Appendix G: Pair-wise comparison: AHP

AHP survey: Pair- wise comparison

The Development of Urban Sustainability Assessment Framework for Iraq

AHP survey: Pair-Wise comparisons

Subject: Invitation letter

Dear Expert,

I would like to express my appreciation for your time and efforts for completing the three rounds of the Delphi technique, and your extremely valuable comments.
The Delphi survey established the consensus on the urban sustainability assessment framework for Iraqi cities as shown in **Fig. 1**, which includes three main dimension, 18 urban indicators, and 71 factors (sub- indicators). I would like to conduct my consultation to assess the relative importance of the all urban items.
I would like to invite you to participate to this approach, where you are kindly requested to (a) compare pairs of dimensions, decide which of the two item is a very important, and (c) quantify the intensity of importance. This process is a very important and involve the use of Analytical Hierarchy Process (AHP) in order to elicit weighting and priorities of all items in the suggested framework.

For any other questions, please contact us without any hesitation.

Readiness to participate in this study would be greatly appreciated.

Sincerely,

Raed Fawzi Mohammed Ameen
PhD Candidate
School of Engineering, Cardiff University, Cardiff
United Kingdom
E-mail: MohammedAmeenRF@cadiff.ac.uk , raedf.ameen@yahoo.com
Mobil: 009647803776, 00447424832298

AHP survey: Pair- wise comparison

Figure 1: The suggested factors (indicators and sub-indicators) of urban sustainability assessment framework for Iraqi cities

Urban Development Dimensions, Indicators, and sub-indicators

Environmental

Indicator	Sub- indicator
Ecology	Site micro-climate
	Landscape and vegetation cover
	Environmental impact of materials
	Lifecycle GHG emissions
	Conservation of agricultural lands
	Development and conservation of water bodies
Energy	Energy efficiency
	Renewable energy
	Energy management
	Safe energy distribution network
Water	Water quality
	Water conservation
	Onsite wastewater recycling
	Diversity of water resources
	Rainwater harvesting system
Waste	Reuse of construction waste
	Recycle waste
	Waste separation and treatment
Hazard	Natural hazard mitigation and protection
	Evacuation during disasters
	Shelters for disaster mitigation
Land use	Green vs. built-up area
	Ancillary facilities
	Children play areas
	Inclusive design (aging & disabled)
	Public car parking availability
	Land reclamation
	Flexibility of future expansion
	Buffer zones
	Development outside cities
Transport and Infrastructure	Diversity of transport modes
	Bicycle network
	Walkability
	Infrastructure networks
	Safe streets

Social

Indicator	Sub- indicator
Safety	Security by design
	Safety of public places
	Protection from high temperatures and sunlight
Well being	Light and Noise pollution
	Ventilation potential
	Daylight availability
	Thermal comfort strategies
Governance	Smart and appropriate location
	Stakeholders consultation
Innovation	Intelligent buildings
	Innovative urban solutions
	Information modelling (BIM 2)
Management and construction	Long- term management
	Work environment (Health and safety)
	Equality and diversity
	Planning Policies and legislations
Local culture	Identity and local culture
	Adaptation for social inclusion
	Conservation of buildings
Urban space	Public space
	Amenities
Layout	Urban space hierarchy
	Streets network
	Harmony with the surroundings
Housing	Residential scheme
	Open space in residential units
	Affordable housing
	The quality of housing units

Economic

Indicator	Sub- indicator
Local economy	Diversity in economic activities
	Local and sustainable industry
	Encourage new investments
	Life cycle cost
	Adaptable housing
Jobs and business	Employability
	Qualification and skills
	Demonstrable experience in similar projects

Personal information

Please provide down your personal details الرجاء تسجيل البيانات الشخصية الخاصة بك

Name: الاسم

Organisation: المؤسسة

Specialisation: الاختصاص

Email: عنوان البريد الإلكتروني

AHP survey: Pair- wise comparison

In this survey, you will be asked to preform relative comparison of importance of the applicable urban indicators of sustainable development of Iraqi cities. Each row in the relative comparison table include two indicators and their rating boxes at the middle. Therefore, please select the appropriate number using a pair- wise comparison scale (1- 9 scale) as shown in table below.

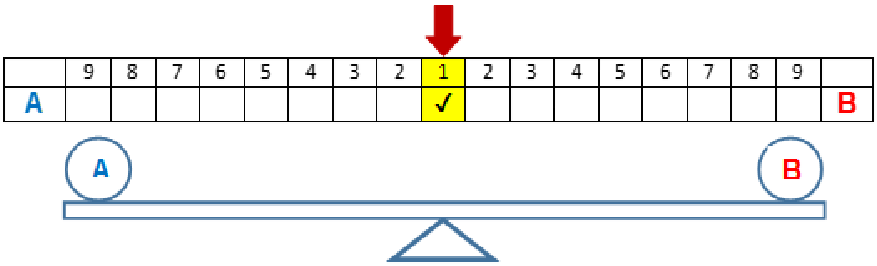
First: Explanation

Intensity of the importance	Definition and clarification
1	Equally Important
2	Equally to moderate more important
3	Moderately important
4	Moderate to strong more important
5	Strongly important
6	Strong to very strong more important
7	Very strongly important
8	Very to extremely strong more important
9	Extremely more important

Examples:

The aim to determine the weighting for each conducting pair- wise comparison.

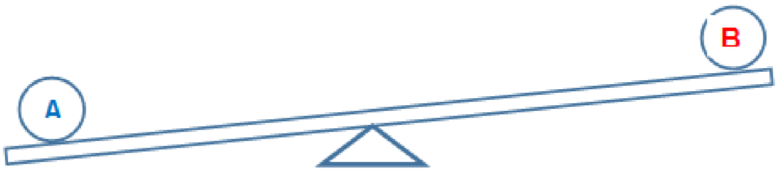
- **If** your decision is that the weight of **'A'** and **'B'** are ***Equally Important***, then your response will be as the following example:



AHP survey: Pair- wise comparison

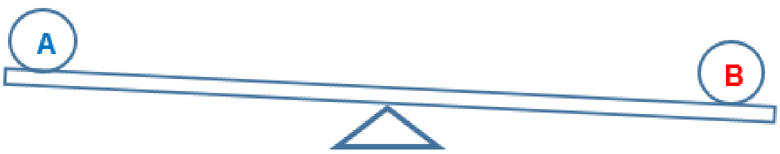
- **If** your decision is that the weight of **'A'** is *Strongly important*, then **'B'**, then your response will be as the following example:

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
A					✓													B



- **If** your decision is that the weight of **'B'** is *Moderately important*, then **'A'**, then your response will be as the following example:

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
A											✓							B



AHP survey: Pair- wise comparison

Second: Pair- wise comparison the sustainability assessment framework:

Could you please preform the following pair-wise comparison, to determine the applicable weighting system for Iraqi context?

1. Please conform pair-wise comparison of the **'Ecology'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate **1= Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Ecology																		Energy
Ecology																		Water
Ecology																		Waste
Ecology																		Hazard
Ecology																		Land use
Ecology																		Transport & Infrastructure
Ecology																		Safety
Ecology																		Well being
Ecology																		Governance
Ecology																		Innovation
Ecology																		Management & construction
Ecology																		Local culture
Ecology																		Urban space
Ecology																		Layout
Ecology																		Housing
Ecology																		Local economy
Ecology																		Jobs and business

2. Please conform pair-wise comparison of the **'Energy'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate **1= Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Energy																		Water
Energy																		Waste
Energy																		Hazard
Energy																		Land use
Energy																		Transport & Infrastructure
Energy																		Safety
Energy																		Well being
Energy																		Governance
Energy																		Innovation
Energy																		Management & construction
Energy																		Local culture
Energy																		Urban space

AHP survey: Pair- wise comparison

Energy																		Layout
Energy																		Housing
Energy																		Local economy
Energy																		Jobs and business

3. Please conform pair-wise comparison of the **'Water'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate **1= Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Water																		Waste
Water																		Hazard
Water																		Land use
Water																		Transport & Infrastructure
Water																		Safety
Water																		Well being
Water																		Governance
Water																		Innovation
Water																		Management & construction
Water																		Local culture
Water																		Urban space
Water																		Layout
Water																		Housing
Water																		Local economy
Water																		Jobs and business

4. Please conform pair-wise comparison of the **'Waste'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate **1= Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Waste																		Hazard
Waste																		Land use
Waste																		Transport & Infrastructure
Waste																		Safety
Waste																		Well being
Waste																		Governance
Waste																		Innovation
Waste																		Management & construction
Waste																		Local culture
Waste																		Urban space
Waste																		Layout
Waste																		Housing
Waste																		Local economy
Waste																		Jobs and business

AHP survey: Pair- wise comparison

5. Please conform pair-wise comparison of the **'Hazard'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Hazard																		Land use
Hazard																		Transport & Infrastructure
Hazard																		Safety
Hazard																		Well being
Hazard																		Governance
Hazard																		Innovation
Hazard																		Management & construction
Hazard																		Local culture
Hazard																		Urban space
Hazard																		Layout
Hazard																		Housing
Hazard																		Local economy
Hazard																		Jobs and business

6. Please conform pair-wise comparison of the **'Land use'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Land use																		Transport & Infrastructure
Land use																		Safety
Land use																		Well being
Land use																		Governance
Land use																		Innovation
Land use																		Management & construction
Land use																		Local culture
Land use																		Urban space
Land use																		Layout
Land use																		Housing
Land use																		Local economy
Land use																		Jobs and business

7. Please conform pair-wise comparison of the **'Transport and Infrastructure'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Transport & Infrastructure																		Safety
Transport & Infrastructure																		Well being

AHP survey: Pair- wise comparison

Transport & Infrastructure																		Governance
Transport & Infrastructure																		Innovation
Transport & Infrastructure																		Management & construction
Transport & Infrastructure																		Local culture
Transport & Infrastructure																		Urban space
Transport & Infrastructure																		Layout
Transport & Infrastructure																		Housing
Transport & Infrastructure																		Local economy
Transport & Infrastructure																		Jobs and business

8. Please conform pair-wise comparison of the **'Safety'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Safety																		Well being
Safety																		Governance
Safety																		Innovation
Safety																		Management & construction
Safety																		Local culture
Safety																		Urban space
Safety																		Layout
Safety																		Housing
Safety																		Local economy
Safety																		Jobs and business

9. Please conform pair-wise comparison of the **'Well- being'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Well being																		Governance
Well being																		Innovation
Well being																		Management & construction
Well being																		Local culture
Well being																		Urban space
Well being																		Layout
Well being																		Housing
Well being																		Local economy
Well being																		Jobs and business

AHP survey: Pair- wise comparison

10. Please conform pair-wise comparison of the **'Governance'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Governance																		Innovation
Governance																		Management & construction
Governance																		Local culture
Governance																		Urban space
Governance																		Layout
Governance																		Housing
Governance																		Local economy
Governance																		Jobs and business

11. Please conform pair-wise comparison of the **'Innovation'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Innovation																		Management & construction
Innovation																		Local culture
Innovation																		Urban space
Innovation																		Layout
Innovation																		Housing
Innovation																		Local economy
Innovation																		Jobs and business

12. Please conform pair-wise comparison of the **'Management & construction'** indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= **Equal** 3= Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Management & construction																		Local culture
Management & construction																		Urban space
Management & construction																		Layout
Management & construction																		Housing
Management & construction																		Local economy
Management & construction																		Jobs and business

13. Please conform pair-wise comparison of the **'Local culture'** indicator to other urban indicators.

AHP survey: Pair- wise comparison

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= Equal 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Local culture																		Urban space
Local culture																		Layout
Local culture																		Housing
Local culture																		Local economy
Local culture																		Jobs and business

14. Please conform pair-wise comparison of the '**Urban space**' indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= Equal 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Urban space																		Layout
Urban space																		Housing
Urban space																		Local economy
Urban space																		Jobs and business

15. Please conform pair-wise comparison of the '**Layout**' indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= Equal 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Layout																		Housing
Layout																		Local economy
Layout																		Jobs and business

16. Please conform pair-wise comparison of the '**Housing**' indicator to other urban indicators

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= Equal 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Housing																		Local economy
Housing																		Jobs and business

17. Please conform pair-wise comparison of the '**Local economy**' indicator to other urban indicators.

9= Extreme 7= Very strong 5= Strong 3= Moderate 1= Equal 3=Moderate 5= Strong 7= Very strong 9= Extreme

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Local economy																		Jobs and business

Appendix H: Sustainability assessment results

Final assessment of urban sustainability indicators of Bismaya city project

Urban Indicators	Sub-indicators	Weight (%)	Credits Achieved (CA)							Maximum Credits	Credit value (CV) %	Indicator Score (%) (CA) X (CV)
Ecology		**4.9**	**0.00**	**0.25**	**0.50**	**0.75**	**1**	**2**	**3**	**14**		
	Landscape and vegetation cover	Required	Achieved							-	-	
	Conservation of agricultural lands	Required								-	-	
	Site micro-climate	0.4	✓							2	0.2	**0.0**
	Landscape and vegetation cover	0.8		✓			✓			3	0.266	**0.332**
	Environmental impact of materials	0.6		✓						2	0.3	**0.084**
	Lifecycle GHG emissions	0.6	✓							2	0.3	**0.0**
	Conservation of agricultural lands	1.2		✓						3	0.4	**0.4**
	Development and conservation of water bodies	1.3	✓							2	0.65	**0.0**
Energy		**4.3**								**8**		
	Energy efficiency	0.9	✓							2	0.45	0.0
	Renewable energy	1.6	✓							2	0.8	**0.0**
	Energy management	0.9	✓							2	0.45	**0.0**
	Safe energy distribution network	0.9					✓			2	0.45	**0.45**
Water		**8.5**								**11**		
	Water quality	Required								-		
	Water quality	1.5						✓		3	0.5	**1.0**
	Water conservation	1.6	✓							2	0.8	**0.0**
	Onsite wastewater recycling	1.7					✓			2	0.85	**0.85**
	Diversity of water resources	2.1	✓							2	1.05	**0.0**
	Rainwater harvesting system	1.6	✓							2	0.8	**0.0**
Waste		**5.3**								**6**		
	Recycle waste	Required								-		
	Reuse of construction waste	1	✓							1	1	**0.0**
	Recycle waste	2.1		✓						3	0.7	**0.175**
	Waste separation and treatment	2.2		✓						2	1.1	**0.275**
Hazard		**5.2**								**4**		
	Natural hazard mitigation and protection	1.7	✓							1	1.7	**0.0**
	Evacuation during disasters	2	✓							2	1	**0.0**
	Shelters for disaster mitigation	1.5	✓							1	0.75	**0.0**
Land use		**5**								**19**		
	Green vs. built-up area	Required								-		

	Green vs. built-up area	0.3					✓			3	0.1	**0.1**
	Ancillary facilities	0.3					✓			2	0.15	**0.15**
	Children play areas	0.6						✓		2	0.3	**0.6**
	Inclusive design (aging & disabled)	0.6		✓						2	0.3	**0.075**
	Public car parking availability	0.8						✓		2	0.4	**0.8**
	Land reclamation	0.6	✓							2	0.3	**0.0**
	Flexibility of future expansion	0.6	✓							2	0.3	**0.0**
	Buffer zones	0.5			✓					2	0.25	**0.125**
	Development outside cities	0.7						✓		2	0.35	**0.7**
Transportation & Infrastructure		**7.8**								**12**		
	Diversity of transport modes	Required								-		
	Infrastructure networks	Required								-		
	Safe streets	Required								-		
	Diversity of transport modes	1.8					✓			3	0.6	**0.6**
	Bicycle network	1	✓							1	1	**0.0**
	Walkability	1.1					✓			2	0.55	**0.55**
	Infrastructure networks	2.1						✓		3	0.7	**1.4**
	Safe streets	1.8			✓					3	0.6	**0.3**
Safety		**7.9**	**0.00**	**0.25**	**0.50**	**0.75**	**1**	**2**	**3**	**6**		
	Security by design	2.5			✓					2	1.25	**0.625**
	Safety of public places	2.6				✓				2	1.3	**0.975**
	Protection from high temperatures and sunlight	2.8		✓						2	1.4	**0.35**
Well-being		**3**								**8**		
	Light and noise pollution	0.7	✓							2	0.35	**0.0**
	Ventilation potential	1	✓							2	0.5	**0.0**
	Daylight availability	0.6	✓							2	0.3	**0.0**
	Thermal comfort strategies	0.7		✓						2	0.35	**0.087**
Governance		**4.3**								**4**		
	Smart and appropriate location	1.7	✓							2	0.85	**0.0**
	Stakeholders consultation	2.6	✓							2	1.3	**0.0**
Innovation		**4.4**								**6**		
	Intelligent buildings	1	✓							2	0.5	**0.0**
	Innovative urban solutions	1.5	✓							2	0.75	**0.0**
	Information modelling (BIM 2)	1.9	✓							2	0.95	**0.0**
Management & Construction		**4.5**								**8**		
	Long- term management	1		✓						2	0.5	**0.125**
	Work environment (Health and safety)	1					✓			2	0.5	**0.5**

	Equality and diversity	1		✓						1	0.5	**0.125**
	Planning Policies and legislations	1.5					✓			3	0.5	**0.5**
Local culture		**5**								**6**		
	Identity and local culture	2		✓						2	1	**0.25**
	Adaptation for social inclusion	1.4		✓						2	0.7	**0.175**
	Conservation of buildings	1.6	✓							2	0.8	**0.0**
Urban Space		**3.7**								**4**		
	Public space	1.6			✓					2	0.8	**0.4**
	Amenities	2.1		✓						2	1.05	**0.262**
Layout		**5.3**								**6**		
	Urban space hierarchy	1.5				✓				2	0.75	**0.6**
	Streets network	1.6					✓			2	0.8	**0.8**
	Harmony with the surroundings	2.2	✓							2	1.1	**0.0**
Housing		**6.3**								**9**		
	Affordable housing	Required								-		
	Residential scheme	1.1			✓		✓			2	0.55	**0.825**
	Diversity of the residential units	1.2			✓					2	0.6	**0.3**
	Affordable housing	2.1						✓		3	0.7	**1.4**
	The quality of housing units	1.9					✓			2	0.95	**0.95**
Local Economy		**7.6**	**0.00**	**0.25**	**0.50**	**0.75**	**1**	**2**	**3**	**10**		
	Diversity in economic activities	1.3		✓						2	0.65	**0.162**
	Local and sustainable industry	1.8	✓							2	0.9	**0.0**
	Encourage new investments	2.1	✓							2	1.05	**0.0**
	Life cycle cost	1.1	✓							2	0.55	**0.0**
	Adaptable housing	1.3	✓							2	0.65	**0.0**
Jobs and business		**7**								**9**		
	Demonstrable experience in similar projects	Required								-		
	Employability	1.9		✓						2	0.95	**0.237**
	Qualification and skills	2.1			✓					2	1.05	**0.525**
	Demonstrable experience in similar projects	3						✓		3	1	**2.0**
The total		**100%**								**150**		**21.139%**

Final assessment of urban sustainability indicators for the Jannat Al-Hussain residential project

Urban Indicators	Sub-indicators	Weight (%)	Credits Achieved (CA)							Maximum Credits	Credit value (CV) %	Indicator Score (%) (CA) X (CV)
Ecology		**4.9**	**0.00**	**0.25**	**0.50**	**0.75**	**1**	**2**	**3**	**14**		
	Landscape and vegetation cover	Required	Achieved							-	-	
	Conservation of agricultural lands	Required								-	-	
	Site micro-climate	0.4	✓							2	0.2	**0.0**
	Landscape and vegetation cover	0.8							✓	3	0.266	**0.8**
	Environmental impact of materials	0.6	✓							2	0.3	**0.0**
	Lifecycle GHG emissions	0.6	✓							2	0.3	**0.0**
	Conservation of agricultural lands	1.2		✓						3	0.4	**0.1**
	Development and conservation of water bodies	1.3					✓			2	0.65	**0.65**
Energy		**4.3**								**8**		
	Energy efficiency	0.9	✓							2	0.45	**0.0**
	Renewable energy	1.6	✓							2	0.8	**0.0**
	Energy management	0.9	✓							2	0.45	**0.0**
	Safe energy distribution network	0.9			✓					2	0.45	**0.225**
Water		**8.5**								**11**		
	Water quality	Required								-		
	Water quality	1.5			✓					3	0.5	**0.25**
	Water conservation	1.6	✓							2	0.8	**0.0**
	Onsite wastewater recycling	1.7	✓							2	0.85	**0.0**
	Diversity of water resources	2.1	✓							2	1.05	**0.0**
	Rainwater harvesting system	1.6	✓							2	0.8	**0.0**
Waste		**5.3**								**6**		
	Recycle waste	Required								-		
	Reuse of construction waste	1	✓							1	1	**0.0**
	Recycle waste	2.1	✓							3	0.7	**0.0**
	Waste separation and treatment	2.2	✓							2	1.1	**0.0**
Hazard		**5.2**								**4**		
	Natural hazard mitigation and protection	1.7	✓							1	1.7	**0.0**
	Evacuation during disasters	2	✓							2	1	**0.0**
	Shelters for disaster mitigation	1.5	✓							1	0.75	**0.0**
Land use		**5**								**19**		
	Green vs. built-up area	Required								-		
	Green vs. built-up area	0.3			✓			✓		3	0.1	**0.25**
	Ancillary facilities	0.3				✓				2	0.15	**0.12**

	Children play areas	0.6					✓			2	0.3	**0.3**
	Inclusive design (aging & disabled)	0.6		✓						2	0.3	**0.075**
	Public car parking availability	0.8						✓		2	0.4	**0.8**
	Land reclamation	0.6	✓							2	0.3	**0.0**
	Flexibility of future expansion	0.6	✓							2	0.3	**0.0**
	Buffer zones	0.5	✓							2	0.25	**0.0**
	Development outside cities	0.7					✓			2	0.35	**0.7**
Transportation & Infrastructure		**7.8**								**12**		
	Diversity of transport modes	Required								-		
	Infrastructure networks	Required								-		
	Safe streets	Required								-		
	Diversity of transport modes	1.8		✓						3	0.6	**0.3**
	Bicycle network	1	✓							1	1	**0.0**
	Walkability	1.1	✓							2	0.55	**0.0**
	Infrastructure networks	2.1						✓		3	0.7	**1.4**
	Safe streets	1.8		✓						3	0.6	**0.15**
Safety		**7.9**	**0.00**	**0.25**	**0.50**	**0.75**	**1**	**2**	**3**	**6**		
	Security by design	2.5	✓							2	1.25	**0.0**
	Safety of public places	2.6			✓					2	1.3	**0.65**
	Protection from high temperatures and sunlight	2.8		✓						2	1.4	**0.35**
Well-being		**3**								**8**		
	Light and noise pollution	0.7	✓							2	0.35	**0.0**
	Ventilation potential	1	✓							2	0.5	**0.0**
	Daylight availability	0.6	✓							2	0.3	**0.0**
	Thermal comfort strategies	0.7			✓					2	0.35	**0.175**
Governance		**4.3**								**4**		
	Smart and appropriate location	1.7			✓					2	0.85	**0.425**
	Stakeholders consultation	2.6	✓							2	1.3	**0.0**
Innovation		**4.4**								**6**		
	Intelligent buildings	1	✓							2	0.5	**0.0**
	Innovative urban solutions	1.5	✓							2	0.75	**0.0**
	Information modelling (BIM 2)	1.9	✓							2	0.95	**0.0**
Management & Construction		**4.5**								**8**		
	Long- term management	1	✓							2	0.5	**0.0**
	Work environment (Health and safety)	1	✓							2	0.5	**0.0**
	Equality and diversity	1	✓							1	0.5	**0.0**
	Planning Policies and legislations	1.5					✓			3	0.5	**0.5**

Local culture		**5**								**6**		
	Identity and local culture	2		✓						2	1	**0.25**
	Adaptation for social inclusion	1.4		✓						2	0.7	**0.175**
	Conservation of buildings	1.6	✓							2	0.8	**0.0**
Urban Space		**3.7**								**4**		
	Public space	1.6					✓			2	0.8	**0.8**
	Amenities	2.1	✓							2	1.05	**0.0**
Layout		**5.3**								**6**		
	Urban space hierarchy	1.5					✓			2	0.75	**0.75**
	Streets network	1.6		✓						2	0.8	**0.4**
	Harmony with the surroundings	2.2			✓					2	1.1	**0.55**
Housing		**6.3**								**9**		
	Affordable housing	Required								-		
	Residential scheme	1.1					✓			2	0.55	**0.55**
	Diversity of the residential units	1.2						✓		2	0.6	**1.2**
	Affordable housing	2.1		✓						3	0.7	**0.35**
	The quality of housing units	1.9						✓		2	0.95	**1.9**
Local Economy		**7.6**	**0.00**	**0.25**	**0.50**	**0.75**	**1**	**2**	**3**	**10**		
	Diversity in economic activities	1.3	✓							2	0.65	**0.0**
	Local and sustainable industry	1.8	✓							2	0.9	**0.0**
	Encourage new investments	2.1	✓							2	1.05	**0.0**
	Life cycle cost	1.1	✓							2	0.55	**0.0**
	Adaptable housing	1.3		✓						2	0.65	**0.162**
Jobs and business		**7**								**9**		
	Demonstrable experience in similar projects	Required								-		
	Employability	1.9	✓							2	0.95	**0.0**
	Qualification and skills	2.1			✓					2	1.05	**0.525**
	Demonstrable experience in similar projects	3					✓			3	1	**1.0**
The total		**100%**								**150**		**16.832%**

Final assessment of urban sustainability indicators for the Durrat Karbala residential project

Urban Indicators	Sub-indicators	Weight (%)	Credits Achieved (CA)							Maximum Credits	Credit value (CV) %	Indicator Score (%) (CA) X (CV)
Ecology		4.9	0.00	0.25	0.50	0.75	1	2	3	14		
	Landscape and vegetation cover	Required	Achieved							-	-	
	Conservation of agricultural lands	Required								-	-	
	Site micro-climate	0.4	✓							2	0.2	**0.0**
	Landscape and vegetation cover	0.8							✓	3	0.266	**0.8**
	Environmental impact of materials	0.6			✓					2	0.3	**0.3**
	Lifecycle GHG emissions	0.6	✓							2	0.3	**0.0**
	Conservation of agricultural lands	1.2	✓							3	0.4	**0.0**
	Development and conservation of water bodies	1.3		✓						2	0.65	**0.162**
Energy		4.3								8		
	Energy efficiency	0.9	✓							2	0.45	**0.0**
	Renewable energy	1.6	✓							2	0.8	**0.0**
	Energy management	0.9	✓							2	0.45	**0.0**
	Safe energy distribution network	0.9			✓					2	0.45	**0.225**
Water		8.5								11		
	Water quality	Required								-		
	Water quality	1.5					✓			3	0.5	**0.5**
	Water conservation	1.6	✓							2	0.8	**0.0**
	Onsite wastewater recycling	1.7	✓							2	0.85	**0.0**
	Diversity of water resources	2.1	✓							2	1.05	**0.0**
	Rainwater harvesting system	1.6	✓							2	0.8	**0.0**
Waste		5.3								6		
	Recycle waste	Required								-		
	Reuse of construction waste	1	✓							1	1	**0.0**
	Recycle waste	2.1		✓						3	0.7	**0.175**
	Waste separation and treatment	2.2		✓						2	1.1	**0.275**
Hazard		5.2								4		
	Natural hazard mitigation and protection	1.7	✓							1	1.7	**0.0**
	Evacuation during disasters	2	✓							2	1	**0.0**
	Shelters for disaster mitigation	1.5	✓							1	0.75	**0.0**
Land use		5								19		
	Green vs. built-up area	Required								-		

	Green vs. built-up area	0.3							✓	3	0.1	**0.3**
	Ancillary facilities	0.3					✓			2	0.15	**0.15**
	Children play areas	0.6				✓				2	0.2	**0.15**
	Inclusive design (aging & disabled)	0.6	✓							2	0.3	**0.0**
	Public car parking availability	0.8					✓			2	0.4	**0.4**
	Land reclamation	0.6	✓							2	0.3	**0.0**
	Flexibility of future expansion	0.6	✓							2	0.3	**0.0**
	Buffer zones	0.5		✓						2	0.25	**0.062**
	Development outside cities	0.7			✓					2	0.35	**0.175**
Transportation & Infrastructure		7.8								12		
	Diversity of transport modes	Required								-		
	Infrastructure networks	Required								-		
	Safe streets	Required								-		
	Diversity of transport modes	1.8		✓						3	0.6	**0.15**
	Bicycle Network	1	✓							1	1	**0.0**
	Walkability	1.1					✓			2	0.55	**0.55**
	Infrastructure networks	2.1					✓			3	0.7	**0.7**
	Safe streets	1.8		✓						3	0.6	**0.15**
Safety		7.9	0.00	0.25	0.50	0.75	1	2	3	6		
	Security by design	2.5			✓					2	1.25	**0.625**
	Safety of public places	2.6			✓					2	1.3	**0.65**
	Protection from high temperatures and sunlight	2.8	✓							2	1.4	**0.0**
Well-being		3								8		
	Light and noise pollution	0.7	✓							2	0.35	**0.0**
	Ventilation potential	1	✓							2	0.5	**0.0**
	Daylight availability	0.6	✓							2	0.3	**0.0**
	Thermal comfort strategies	0.7			✓					2	0.35	**0.175**
Governance		4.3								4		
	Smart and appropriate location	1.7	✓							2	0.85	**0.0**
	Stakeholders consultation	2.6	✓							2	1.3	**0.0**
Innovation		4.4								6		
	Intelligent buildings	1	✓							2	0.5	**0.0**
	Innovative urban solutions	1.5	✓							2	0.75	**0.0**
	Information modelling (BIM 2)	1.9	✓							2	0.95	**0.0**
Management & Construction		4.5								8		
	Long- term management	1					✓			2	0.5	**0.5**
	Work environment (Health and safety)	1			✓					2	0.5	**0.25**

	Equality and diversity	1	✓							1	0.5	**0.0**
	Planning Policies and legislations	1.5					✓			3	0.5	**0.5**
Local culture		5								6		
	Identity and local culture	2		✓						2	1	**0.25**
	Adaptation for social inclusion	1.4			✓					2	0.7	**0.35**
	Conservation of buildings	1.6	✓							2	0.8	**0.0**
Urban Space		3.7								4		
	Public space	1.6				✓				2	0.8	**0.6**
	Amenities	2.1	✓							2	1.05	**0.0**
Layout		5.3								6		
	Urban space hierarchy	1.5	✓							2	0.75	**0.0**
	Streets network	1.6		✓						2	0.8	**0.2**
	Harmony with the surroundings	2.2	✓							2	1.1	**0.0**
Housing		6.3								9		
	Affordable housing	Required								-		
	Residential scheme	1.1					✓			2	0.55	**0.55**
	Diversity of the residential units	1.2		✓						2	0.6	**0.15**
	Affordable housing	2.1						✓		3	0.7	**1.4**
	The quality of housing units	1.9						✓		2	0.95	**1.9**
Local Economy		7.6	0.00	0.25	0.50	0.75	1	2	3	10		
	Diversity in economic activities	1.3				✓				2	0.65	**0.487**
	Local and sustainable industry	1.8	✓							2	0.9	**0.0**
	Encourage new investments	2.1	✓							2	1.05	**0.0**
	Life cycle cost	1.1	✓							2	0.55	**0.0**
	Adaptable housing	1.3				✓				2	0.65	**0.487**
Jobs and business		7								9		
	Demonstrable experience in similar projects	Required								-		
	Employability	1.9				✓				2	0.95	**0.712**
	Qualification and skills	2.1			✓					2	1.05	**0.525**
	Demonstrable experience in similar projects	3					✓			3	1	**1.0**
The total		**100%**								**150**		**16.535%**