Developing a Measurement Scale for Sustainable High-Rise Building in City of Erbil

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment requirements of the degree of

Doctor of Philosophy
in
Architecture

Eastern Mediterranean University
April 2021
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

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ABSTRACT

High-rise buildings have been a point of interest and fascination ever since they started being constructed in ancient times. About 282 buildings with 200m or higher height were built between 1930 and 2001 at an average of four projects a year in the world. This figure has since increased drastically as 679 buildings were constructed between 2002 and 2015 at an average of 52 projects a year. Also, this difference in the average number of completed high-rise buildings yearly is mirrored in Erbil city, which has emerged as a centre for new high-rise buildings for both administrative and residential use, as have the region as a whole and Iraq in general.

The price of land, international symbols and global icons, sustainable development and climate change, population, and industrialization and urbanization are the clearest reasons to encourage high-scale building. The development of technology can also be evaluated as a significant factor in this development. This research aims to develop measurement scales of aspects of economic, socio-cultural and environmentally sustainable practice in the high-rise buildings of Erbil city, according to the local condition and priorities of the selected context, with the objective of providing a better quality of life inside the high-rise buildings.

To achieve this goal, more than one approach is employed: major and key methods used were literary analysis and the evaluation of textbooks to detect the significance scan, recognition and classification methodology that is proposed for developments related to the High-Rise Buildings (HRBs). discussion by means of semi-structured interviews with experts in the relevant field to localize the model; personal

observation; and questionnaires to understand the existing scenario in the high-rise buildings. This approach led to a primary database with a confidential bibliography with approximately 370 entries during this PhD project. The results of the measurement scale built could be used to assess and quantify the sustainability of the high-rise buildings in the city of Erbil, to define the problems of high-rise buildings and to recommend potential solutions with an emphasis on sustainability.

As a result, this PhD thesis proposes a Measurement Scale for Sustainable High-Rise Buildings (MSSHRB), specifically designed for new and existing buildings in Erbil city, with nine environmental, fourteen socio-cultural and four economic indicators for aspects with innovation issues. Five case studies are analyzed. According to the selected projects, none of them could be awarded a certificate. The results of this study are important for the metrics to enhance energy efficiency, safety and to reduce the cost for consumers in high-rise buildings by having some professional expertise on sustainability initiatives.

Keywords: High-rise buildings; sustainability; rating system; indicators; environmental protection; cost efficiency; design for human adaptation; Erbil city.

ÖZ

Yüksek binalar, eski zamanlarda inşa edilmeye başladıkları andan itibaren ilgi ve hayranlık uyandırmıştır. Dünyada 1930-2001 yılları arasında yılda ortalama dört proje ile yaklaşık 282 200 m2 bina inşa edilmiştir. Bu rakam 2002 ile 2015 yılları arasında, yılda ortalama 52 proje ile 679 bina inşa edilmesiyle önemli ölçüde artmıştır. Ayrıca, hem idari hem de konut amaçlı yeni yüksek katlı binalar için bir merkez olarak ortaya çıkan Erbil kentinde, bir bütün olarak bölge ve Irak'ta olduğu gibi, her yıl tamamlanan ortalama yüksek bina sayısındaki bu farklılık da yansıtılmaktadır.

Arazinin fiyatı, uluslararası semboller ve küresel simgeler, sürdürülebilir kalkınma ve iklim değişikliği, nüfus, ve sanayileşme ve kentleşme, çok katlı binaları teşvik etmenin en açık nedenleridir. Teknolojinin gelişimi de bu konuda önemli bir faktör olarak değerlendirilebilir. Bu araştırma, Erbil şehrinin çok katlı binalarında ekonomik, sosyo-kültürel ve çevresel açıdan sürdürülebilir uygulama yönlerinin ölçüm ölçeklerini, seçilen bağlamın yerel durumuna ve önceliklerine göre geliştirmeyi amaçlamaktadır.

Bu amaca ulaşmak için birden fazla yaklaşım kullanılmaktadır: HRE'lerle ilgili gelişmeler için önerilen önemi tarama, tanıma ve sınıflandırma metodolojisini tespit etmek için kullanılan temel ve anahtar yöntemler litaratür analiz ve ders kitaplarının değerlendirilmesidir ve modeli yerelleştirmek için ilgili alandaki uzmanlarla yarı-yapılandırılmış görüşmeler yoluyla tartışma; kişisel gözlem; ve yüksek binalardaki mevcut senaryoyu anlamak için anketler. Bu yaklaşım, bu doktora projesi sırasında yaklaşık 370 kayıt içeren gizli bir bibliyografya sahip birincil bir veri tabanına yol açtı.

Oluşturulan ölçüm ölçeğinin sonuçları, Erbil kentindeki yüksek binaların sürdürülebilirliğini değerlendirmek ve ölçmek, yüksek binaların sorunlarını tanımlamak ve sürdürülebilirlik vurgusu ile olası çözümler önermek için kullanılabilir.

Sonuç olarak, bu tez, özellikle Erbil kentindeki yeni ve mevcut binalar için tasarlanmış, sürdürülebilir yüksek katlı binalar (MSSHRB) için inovasyon konuları için dokuz çevresel, on dört sosyo-kültürel ve dört ekonomik gösterge içeren bir ölçüm ölçeği önermektedir. Beş örnek olay incelendi. Seçilen projelere göre hiçbirine sertifika verilemedi. Bu çalışmanın sonuçları önemlidir; başka bir deyişle, sürdürülebilirlik girişimleri konusunda bir takım profesyonel uzmanlığa sahip olarak, enerji verimliliğini, güvenliğini artıracak ve çok katlı binalardaki tüketiciler için maliyetleri azaltacak ölçümler için önemlidirler.

Anahtar Kelimeler: yüksek binalar; Sürdürülebilirlik; oylama sistemi (rating system); göstergeler; çevresel koruma; maliyet etkinliği; insan adaptasyonu için tasarım; Erbil şehri.

I would like to dedicate my thesis to:

- My Mom, the greatest amazing woman I've met, and my Dad the strangest man I've met who battle with the dark days.
- My lovely husband and children, inhabit my heart.
- A guide of my way, my dear supervisor.
- My sibling.
- My lovely Readers.

ACKNOWLEDGMENT

"In the Name of God, the Most Merciful and Most Compassionate"

First and foremost, I praise Allah, the Almighty, on whom ultimately, we depend on for sustenance and guidance. I would like to express heartfelt gratitude to my supervisor Assoc. Prof. Dr. Ercan Hoşkara for his constant support during my study at EMU. He inspired me greatly to work on this project. His willingness to motivate me contributed tremendously to our project. I would like to express my deepest gratitude to him for his guidance, encouragement, valuable advice and especially for his confidence in me throughout the process writing this thesis - I am indebted to him more than he knows.

I should express many thanks to the rest of the faculty members of the architecture department, especially my thesis committee members Prof. Dr. Sadiye Müjdem Vural and Assoc. Prof. Dr. Cemil Atakara for their encouragement, and insightful comments.

Finally, I would like to thank my beloved parents and sibling, they were always supporting me and encouraging me with their best wishes. Also, my lovely husband, I would never have been able to finish my thesis without the help and support from him. Thank you, Nabaz, for filling my heart with love and joy, and for being by my side regardless of what would happen

Furthermore, I acknowledge my friend, and every person that has provided me with any assistance, guiding me in the researching, thinking, working, and writing process of this dissertation. *Wezha Hawez Baiz*

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LIST OF ABBREVIATIONS

AE	Awareness and Education
AT	Accessibility and Traffic
BREEAM	Building Research Establishment Environmental Assessment Methodology
BSM	Building Services and Management
CAP	Culture and Privacy
CASBEE	Comprehensive Assessment System for Building Environmental
CB	Children Behavior
CP	Construction Practice
CS	Construction and Staff
CTBUH	Council on Tall Buildings and Urban Habitat
EA	Energy and Atmosphere
GBCA	Green Building Council of Australia
HK-BEAM	Hong Kong Building Environmental Assessment Method
HR	High-Rise
HRB	High-Rise Building
HRSBAF	High-Rise Sustainable Building Assessment Framework
HW	Healthand Wellbeing
IEQ	Indoor Environmental Quality

JO	Jobs Opportunity
KRG	Kurdistan Regional Government
KRI	Kurdistan Regional of Iraq
LO	Local Opportunity
LEED	Leadership in Energy and Environmental Design
LEG	Local Economic Growth
LRB	Low-Rise Building
MEP	Mechanical, Electric and Plumbing systems
MOCAH	Ministry of Construction and Housing
MU	Material Use
OIQ	Outdoor Impact Quality
RH	Relative Humidity
RII	Relative Important Index
S	Safety
SA	Semiotic Approach
SAC	Social and Community
SBAF	Sustainable Building Assessment Framework
SBAT	Sustainable Building Assessment Tool
SC	Security and Crimes
SD	Standard Deviation
SHRB	Sustainable High-Rise Building

SM	Site Management
SP	Shorter and more Predictable
SS	Scale and Size
Ss	Supply-side
UBC	Uniform Building Cod
UN	United Nations
USGBC	United States Green Building Council
VT	Vertical Transportation
WCED	World Commission on Environment and Development
WHO	World Health Organization
WP	Waste and Pollution
WU	Water Use

Chapter 1

INTRODUCTION

1.1 Introductory backgrounds

Through the history of building constructions, it can be clearly noted that there are some words as tallest and highest were used for describing the buildings around the world. Pyramids in Egypt are those types of construction that hold such kind of words as the tallest one among them that their construction date related to more than two thousand years before Christmas and can be measured as an obvious example in the history of architecture (Bunson, 2002). Nowadays, there are some words such as high-rise and tall buildings; towers and skyscrapers participate in describing and announcing these megastructures.

Words like skyscrapers, high-rise, and tall buildings have become increasingly common nowadays, especially among contemporary engineers and architects. In terms of their historical usage, little serves to differentiate between each of the three words. For example, the term “skyscraper” has been used to describe tall buildings since the 19th century, although its meaning has changed somewhat overtime: it was used as an adjective for tall buildings in 1884 and eventually began to be used as a noun by 1889. By the following year (1890), the term was used exclusively to describe “Multi-storey, office building types”. With its inclusion in different dictionaries, it continued to be used in different contexts and in 1933, one of the various meanings attributed to it by

the oxford dictionary included “tall man” (Biaz, 2012) But, according to Yeang (1996) and in World War 1, ’skyscraper’ used as a meaning of ’tall building’ for the first time.

A high-rise building is one characterized by a small roof area, footprint, and a very high façade. One difference between such buildings and other low- and medium-rise buildings is that their height necessitates the use of special engineering systems. Scott (1998) offers a useful, alternative definition “A high-rise is any structure where the height can have a significant impact on evacuation.”

Generally speaking, various acceptable definitions of high-rise and tall buildings abound with governments choosing to define them however they please. The UK’s Leicester City Council, for example, defines tall buildings as any structure with a minimum height of 20m/66ft, and/or a building with a height significantly more elevated than the average height of other buildings in the surrounding area, and/or a building that significantly impacts the city’s skyline (Leicester City Council, 2007). Alternatively, “tall buildings” are defined in German regulations as buildings with a minimum height of 22m/72ft capable of serving as a permanent residence for individuals (Ross, 2004). This height was determined based on the height of firefighters’ ladders. Cork City in Ireland defines tall buildings as those with a minimum of ten floors (Cork City Council, 2004), while the ASHRAE (American Society of Heating, Refrigerating, and Air-conditioning Engineers) Technical Committee for Tall Buildings defines them as buildings above 91m/300ft in height (Ellis and Torcellini, 2005). “According to today’s biggest online building database, a high-rise building’s architectural height is ranging between 35 and 100 meters. If the height is unknown, a building at least 12 floors or fewer than 40 floors is considered to be a high-rise” (Emporis, 2020). Correspondingly, there are many other definitions

about highrise buildings such as “A multistoried building equipped with elevators.”(Pickett 2006), “A high-rise building is a building with a minimal architectural height of 25 meters” (Bálint, 2013) (figure:1).

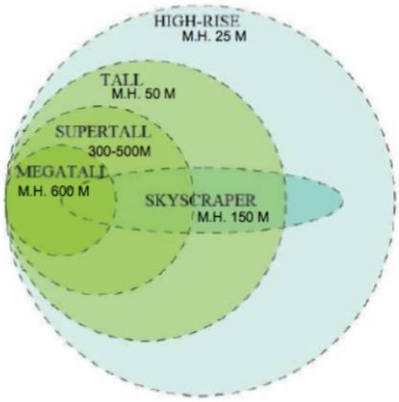


Figure 1: High-rise conditions suggested in the graphics. Source: (Bálint, 2013 editing by author).

There is no debate that, day by day ratio of high-rise buildings increase and despite this potential, the majority of tall buildings completed today continue to be designed with too little consideration of different strategies as sustainability. It is projected that by 2030, 5 billion people will live in urban areas throughout the world (Koop, and Leeuwen, 2017). Whereas 30 percent of the world population lived in urban areas in 1950, the proportion of urban dwellers climbed to 47 percent in 2000 and is projected to rise to 60 percent by 2030. Energy shortage, global warming, urban sprawl, air pollution, overflowing landfills, water shortage, disease, and global conflict will be the legacy of the twenty-first century unless we move quickly towards the notion and implementation of sustainability (Ali and Armstrong, 2008).

In general, people live inside buildings more than outside for various activities, such as working, spending leisure time and relaxing, this case tells that the environment inside buildings is vital and has a huge impact on human behavior and lives (Yiu, 2005;

Burnett, 2005). It is clear that the surrounding of humans is one of the factors should be organized and assessed if the controlling humans' products are required. According to Burnett (2005), the quality of individual production and overall income in economic situations depends on the quality of workplaces, especially in office high-rise buildings and property of residential units as healthy and comfortable effects on the value of residents' life.

The design high-rise buildings is not just about design the function and rising the tall. As known that global warming is a significant topic for the physic and environmental researcher. Architectures are among those researchers that worry about this issue. They have a number of specific strategies to go with it and other purposes. For example, passivhaus is one of them that is a standard which is used for reducing heat and cool requirement of buildings. It can be applied to hot, cool and moderate climates in many places in the world (URL1). Sustainability can be measured as one type of technology in high-rise buildings that has vast negotiations between scholars nowadays. In another word, sustainable buildings should offer a healthy environment for living inside the building with providing and improving the social conditions and economic situations in an ecological and well-organized manner (Ortiz et al., 2009). As clear, sustainability can specify those purposes on different sides.

Despite having a clear place of the word of sustainability in books and works of literature, there are many parts of it still absent and need to be studied (Burnett, 2005). Sustainability in different kinds of literature and sources are described in different ways, but the initial concepts and meanings are the same that considers about provident comfortable life in environmentally perspective, friendly to nature and not costly and providing the balance between all of the pillars, which environment, society, and

economy are very necessary requirements (Jin1 et al., 2013; Newman, 2001; Brundtland, 1987; Sassi, 2006) (figure: 2). These definitions of sustainability cover numerous aspects and they, sometimes, are not easy to create a construction that contains all of them in one way. In other words, there are many rules to go with some types of buildings but do not work in a suitable manner in another one. Also, it may not be working for the same building type in different sites and locations. Another matter of sustainability is important in the ability to apply all of them to the high-rise buildings in the city and how they will be improved on this agenda.

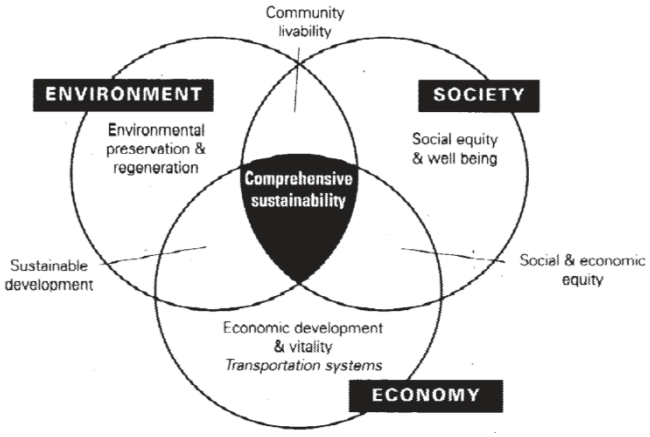


Figure 2: Comprehensive sustainability as production of overlapping all three principles of sustainability: Environment, society, and economy. Source: (Newman, 2001).

The figure shows that besides those three main pillars of sustainability that they are the environment, society and economy there are other four overlapping between them. Which they are social and economic equity as an overlapping of society-economic, community livability as an overlapping result area between society and environment aspects and the third one is sustainable economic development as an overlapping zone of environment and economy. Accordingly, comprehensive sustainability will be a product when a balance among all of the three and they're overlapped are achieved.

It is necessary to provide all of them while designing and constructing tall buildings for providing sustainability. In other words missing any one of them, the part of the pillar sustainability as an overall meaning will be lost. Each of them has a significant effect on a specific manner and could be on different projects and scales in various ways. To illustrate, in many cases, high-rise buildings were constructed as a solution for providing the residential unit with low cost (Holmes et al., 2008) and at the same time, it should provide and encourage social aspects also because social cohesion is very important for participation in creating the city more sustainable (Ijeh, 2015).

1.2 Why high-rise buildings in Erbil city and the reason for their boom

High rise buildings have been a point of interest and fascinations ever since they started being constructed in ancient times. About 282 200 m+ buildings were constructed between 1930 and 2001 at an average of four projects a year in the world. This figure has since increased drastically as 679 buildings were constructed between 2002 and 2015 at an average of 52 projects a year (Al-Kodmany, 2018). The difference in the average number of high-rise buildings completed overtime was also mirrored in Erbil City, which has emerged as a center for new high-rise buildings for both administrative and residential use – as have the Kurdistan region as a whole and Iraq in general. The spread of high-rise buildings was intended to meet the demand for hotels and other touristic purposes.

While the more specific reasons for constructing high-rise buildings differ, the following factors apply more directly to the construction of buildings with over 12 floors in Erbil City:

- Limited available land, which tends to be expensive in certain areas, such as those close to university campuses, the city center, and the airport. The use of tall buildings in such places helps mitigate both issues of availability and cost.
- As a product of need: The mass migration of people from rural to urban areas, coupled with rapid population growth and other social trends, such as a desire to live close to family even after marriage have necessitated the use of high-rise buildings as they help manage the high-density development prevalent in urban centers.
- Individuals and designers alike are also in a race to find a place for their services in the highly competitive marketplace by designing specific buildings for particular clients.
- Power, status, and prestige also play a role in the proliferation of high-rise buildings, as certain clients require such buildings for use as cooperate headquarters and the aesthetics, as opposed to reasons associated with efficient development.
- Because no strategies, plans, and designs are capable of perfectly limiting the potential height of a building, this allows for buildings to be easily constructed based on the desires of the engineer and/or client.
- Using high-rise buildings as an attractive construction in a big project. To illustrate, before starting any part of the project, they try to raise the tower for bringing the onlooker attentiveness to their project then they try to construct other sectors in the project.
- They try to come in different ways as in form, façade appearance, position and even the towers name and they serve different purposes, they try to optimize their buildings may enhance the global image of the city.

1.3 Research problem

Erbil City is one of the oldest cities in the world where life goes on and the capital of Iraq's autonomous Kurdistan region and is the country's fourth-largest city after Baghdad, Basra, and Mosul. Winner of the 2014 Arab Tourism Capital award, Erbil has experienced significant development ad expansion in the past few decades and is relatively more compact than other similar-sized cities in North America and Europe. Its unusually compact form is one of its distinguishing features (Akram et al., 2016). In regards to its development, one instrumental design policy requirement is that the projects are contextually situated in line with the various functional, social, visual and environmental factors.

The development of high-rise buildings since has seen little progress since the 1960s when it had remained environmentally conscious and energy-efficient. Even as efforts to bring about the much-required progress on the field were reinvigorated post-1973 oil crisis, very few architects have shown interest in reducing their energy consumption, even as energy efficiency is a paramount concern in the field.

Focusing on mega-structures in this development, as it has been mentioned above, design tall and high-rise buildings are not just design and solve the function inside the building and putting one over the other. Otherwise, there are many other sides that have to be carried the architect about it. And as known that mega-structure as tall buildings bring impacts around of them at strategic and local levels. In another word, the huge people load of a high building, particularly at peak times, may overload the cities infrastructure-its public transport, road, and utilities. Also, development of high-rise buildings has not progressed properly and efforts to reinvigorate progress resumed

following the energy crisis, the majority of architects have little interest in minimizing energy consumption even as energy efficiency remains an important issue. In many countries and universities especially in the north of Iraq, there are many problems can be seen clearly. Bellows are obvious problems in Erbil high-rise buildings:

There are no strong design guidelines, strategies or principles for constructing high-rise buildings in the city of Erbil from ministry and municipality such as survive in comfortable living environments answering human, social, culture and climate need. Unfortunately, planners and architects do not recognize or care about the potential benefits that could be realized and research into how various design strategies impact high-rise buildings has been minimal. Because of the absent regulations and non-welling recognize the potential benefits it can be seen that mega-structures lack an overall strategy for bettering the lives of the city's residents, their health, or the economy. This implies a lack of direct concern with sustainability issues and environmental-friendliness. There is no debated that, this case products many other problems and difficulty to themselves and their surrounding in the city such as dark caverns, overheating in summer, lack of rules regulation vision angle, very high of energy consumption level, the balance between green area and mass area, too expensive, environmental pollution.

Also, there are no measurement tools for evaluating and examining the scenario of the building and also those buildings are under construction to control or at least measuring the quality of the huge numbers of towers in Erbil city.

The sudden expansion of Erbil's construction sector, particularly in the areas of housing and building developments, has been a primary driver of economic growth.

However, this expansion has also been accompanied by a host of other economic, social, and environmental problems, which threaten the long-term sustainability of the city. These problems increase the necessity not just for social and political solutions, but economic ones as well, and the adoption of sustainability criteria by the construction sector is one method of achieving this.

These above cases are non-acceptable either in academic study or practice especially if focused on the very primary necessity of tall buildings. So, the scholars in the field of architecture, engineer and energy-saving have not adequately addressed the role of sustainable measurement tools to get the efficient building economic energy and material used, responsible to the environment and socio-culture that related to a lack of knowledge and study in Kurdistan region about the most building design strategies.

1.4 Detections from preliminary research study: need for further study

There has been a rapid proliferation of high-rise building construction for both residential and non-residential purposes, such as hotels, retailers, and offices. These buildings are subjected to external environmental elements, such as wind and sunlight, in all directions, thus causing them to suffer from a great degree of energy loss and increases the amount of energy required to maintain their internal comfort. This is even more costly in Erbil due to the price of new technologies in the area and its specific society.

In line with its general aim of providing a fresh perspective on the current issues related to sustainable measurement tool, this study does not aim to rely exclusively on previous research, although it will try to build on the insight gleaned from a review of

the existing literature on related topics. The following highlights the conclusions reached from a preliminary study into the issues of sustainability and the needs of humanity in Erbil's construction sector:

- It appears that no strong study deals exclusively with the role of sustainability in Erbil, neither was any compelling and demonstrable evidence of research into resource availability for the purpose of integrating the principles of sustainability at the earlier stages of the design process readily available.
- It was also found that there has been no very clear study that explored the proper use of natural resources and materials in relation to the future of building construction in Erbil.
- It was indicated that the required knowledge of building forms and shapes in line with their orientation, scale, and location to reduce the amount of energy they consumed and ensure that they were 'healthy' for occupation is lacking by designers in Erbil as a result.
- An overview of the preliminary study shows that certain variables for assessing the sustainability tools used in developed countries are not directly applicable to similar categories in developing countries. This is due to differences in their economic, socio-cultural, and environmental needs. Furthermore, even countries with similar economic performance levels can vary considerably in terms of their environmental, social, and even economic sustainability.
- In terms of evaluation and monitoring mechanisms, it was found that the majority of building professionals and architects still displayed an almost exclusive focus on financial and environmental factors in their project priorities, with little regard for their social aspects.

It is evident that scholars dealing with issues of sustainability in the field of architecture are yet to sufficiently address the measurement tools and its' strategies required by high-rise buildings and the role of these measurement tools for realizing efficient mega-structures in the city. The preliminary study reveals a wide knowledge gap in the literature, which answering this study's research questions hopes to fill to some extent.

1.5 Research aim and objectives and research questions

This research aims to develop the measurement tools for all of the sustainable aspects of socially, economic and environmentally sustainable practice in high-rise buildings of Erbil city for providing a better quality of life inside buildings. Whilst the research focuses on Erbil city, the research is expected to also contribute to other cities, which face similar problems as Erbil in terms of their demography and climographic constraints.

This research also tries to uncover the problems associated with high-rise buildings in Erbil city and suggests potential solutions with a focus on sustainability. Additionally, it has also aimed at uncovering ways to enhance comfort, adapting the buildings to societal and health requirements, and reduce their overall energy consumption.

The study also has objectives to assist planners and architects in attaining higher levels of sustainability in high-rise buildings by clarifying what "unsustainable aspects" are to be avoided. To this end, it proposes a check-list of issues and areas that impact high-rise building sustainability most directly, which serves to highlight critical and unexamined issues, as well as point out all practices and pitfalls. Using the pillars of

environmental, economic and social sustainability, it utilizes sustainability as a framework for consolidating the pitfalls of high-rise building development.

On a final note, this study also attempts investigations of which design principles are best applied to Erbil high-rise buildings and why these are to be preferred over others, depending on the specific decision factors. Additionally, it explored whether or not building users are satisfied with the strategies used in their buildings and subsequently provides some general frameworks and guidelines that are useful for improving any shortcomings in future projects. So, the main objective can be summarised as below:

Objective 1: proposing the principles of sustainability for high-rise buildings.

Objective 2: helping stockholder to construct the high-rise building in a sustainable way.

Objective 3: developing a sustainable measurement scale for high-rise building and concentrated by the selected context.

This study aims to answer both general and specific sub-questions. The motivating factor behind this is a desire to understand how sustainable strategies help influence and promote the construction of efficiency high-rise buildings in Erbil city. The study hopes to achieve this by answering the questions outlined below:

1. What are the parameters of economic, social and environmentally sustainable high-rise buildings globally, and how can apply high-rise buildings in a sustainable way and are they work with thinking of all pillars?
2. What would be the nature and form of a measurement tool, relevant to developing countries, particularly the high-rise building condition?
3. What, according to participants, are the main criteria for achieving all principles of sustainability for high-rise buildings according to the site study?

4. How can the high-rise buildings be evaluate according to sustainability and local conditions?

Accordingly, to support the main research questions the setup sub-questions are:

a) Can the high-rise buildings ever be sustainable and how?
b) What are the current conditions and problems of high-rise buildings in Erbil city?

1.6 Methodology of the research

The economic, environmental, and social sustainability rating systems for high-rise buildings are very broad and a "one-size-all fits" cannot be applied properly. Besides, the approach chosen must be adapted to the specific research objectives so that these aims can be accomplished and the study findings accurate (Fellows & Liu, 2015). Current work is therefore formulated as a qualitative and quantitative approach.

So, to accomplish the aim, there is more than one method, major methods used were literature review and textbook evaluation to find out the importance, personal observation, questioners, and discussion with an expert in the related field via semi-structured interviews (figure: 3).

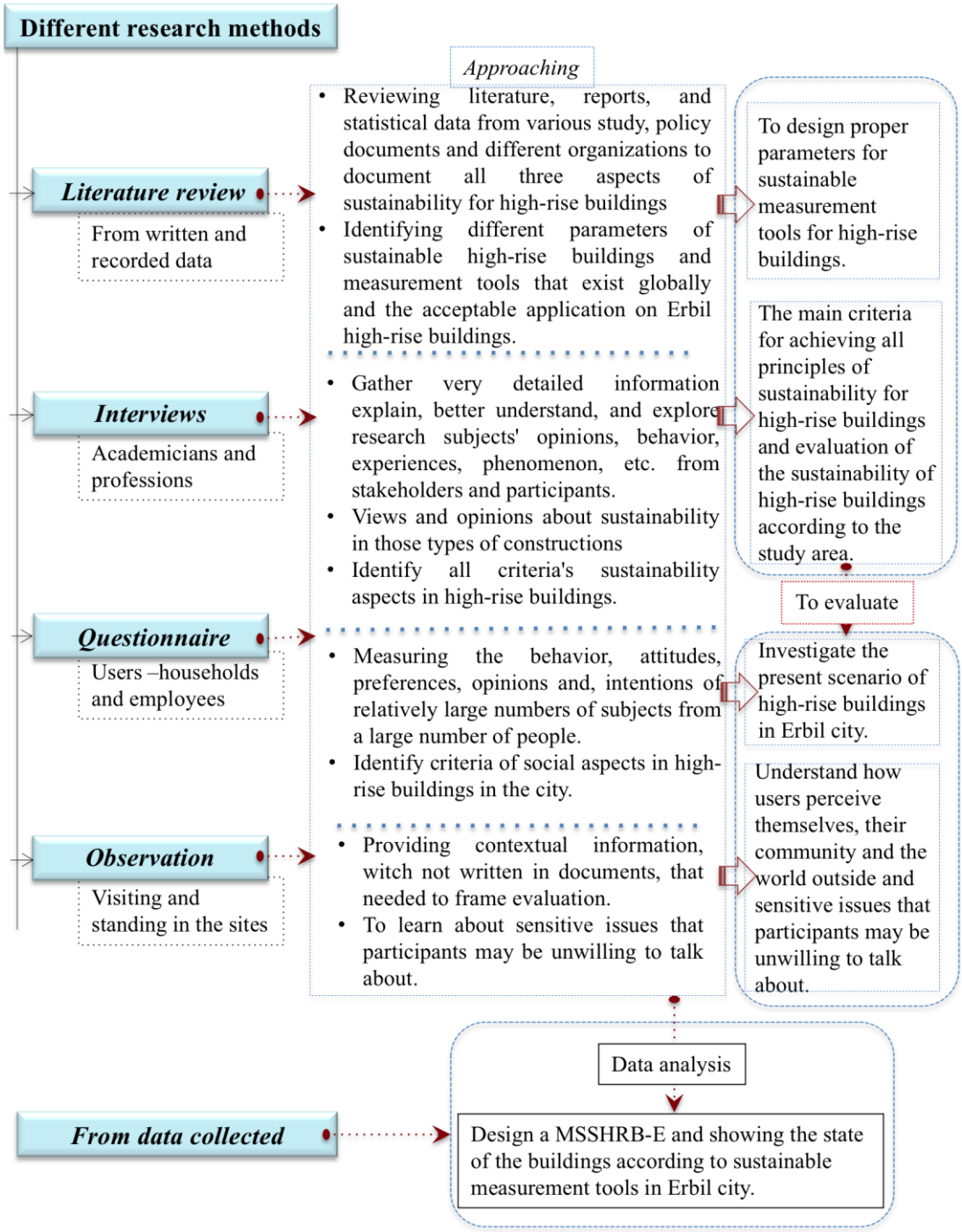


Figure 3: Different stages of the research methods.

One of the main methods that will be used in this study to achieve its objectives involves the use of documentation of the study, literature survey, include researches and different organizations about high-rise buildings, evidence-based on design architecture sustainable rating system, the architectural design of buildings, was used

to address the study object. Which was designed to provide the answers to the first and second research questions. Also, identifying different parameters of sustainable high-rise buildings that exist globally and the acceptable application on Erbil high-rise buildings. Also include an analysis of the current policy and regulation that are relevant to measurement and rating systems for sustainable high-rise buildings.

It can be done by looking back to the number of documents such as previews studies, researchers, and papers, systematic ’s reviews on this method for making the work richer. The literature survey will be conducted for data collection, to find the related documents about sustainability and sustainable measurement scale of high-rise buildings in previews study and literature. This was drawn from different subject fields, including architecture, engineering, socio-economic, socio-culture, strategies, methods, and sustainability.

Then, for the data collection source from, the literature search of this present study was purposely wide-ranging and interdisciplinary that include the aspect of architecture, climate condition, psychology and many and monthly income. Majority of the selects articles, indexed in electronic databases written and published in English. Furthermore, a wide range of terms used to find the data that the major terms and themes identified in this study include but not limited to: high-rise buildings; sustainability; sustainable approach; strategies, tall buildings; pillars of sustainability; sustainable strategies; sustainable high-rise buildings; socio-culture in sustainable aspects; semi-arid climate, architectural theory; design multi-story buildings, natural; energy sectors; environmental impact; policy development; the strategy of construction; regional development strategy; current situation; Erbil climography and

demographic of Erbil city and so on. The researcher carefully reviewed the transcript, reading word by word in some document, and highlighting the related case.

The interview is one of the key tools of this study as a qualitative method of data collection. Interviews are ideally adapted where little is understood or comprehensive feedback from individual participants about the study phenomenon is required. Through this interview, the views, perspectives, beliefs and/or motives on the sustainability aspects of high-rise buildings through Erbil and the conditions will be discussed for achieving the goal of localizing measurement scales to provide the answer to the third research question. Interviews are conducted among architects, engineers and experts of various ministers and administration, such as planing, municipalities and tourism, and information and data on sustainable and unsustainable strategies for high-rise buildings used at conventional high-rise buildings in Erbil are to be collected. Interviewees with several years of building construction experience in the area have been interviewed. The basis of this study is all this knowledge. The details can be obtained by e-mail, by telephone, by the faster process, more versatile so the interviewer can answer questions that the interviewee does not understand, and by personal interview.

For this study, a questionnaire is another tool used to address the main objective. More clearly, some questionnaires were distributed among Erbil's users, to better understand users' satisfaction with the living spaces and comfortable living and quality. In another term, the main goal to analyze the current high-rise construction scenario in Erbil using questionnaires and to provide answers to the fourth research question and the second sub-question of the study. As the state in the buildings is not easy to understand and no chance to test whether or not they are in some situation, whether or not the

questionnaire technology is disguised as open and close. These questionnaires ask whether or not you feel relaxed inside your home or your workplace. Also, the occupants are questioned whether they feel comfortable and satisfied with their units either for working in offices or living impartments and whether they want to understand the social phenomenon. Various statistical approaches were used to analyze the data in SPSS.

The observation in this study, for getting inside views, i.e. to understand how residents and workers perceive themselves, their community and the world outside, based on some sort of a category system in the light of theoretical literature on the subject. In another word, providing contextual information, witch not written in documents that needed to frame evaluation. Also, to learn about sensitive issues that participants may be unwilling to talk about. The data gotten from the observations of high-rise buildings in Erbil was analyzed by outlining building names, height, and floor number and orientation, etc. They have been surveyed and analyzed through personal observation, which is presented via photos and summarized tables.

Analyzed all the data collected to develop a measurement scale for socially, economic and environmentally sustainable practices to formulate the final model for socially and environmentally sustainable practices.

1.7 Reasons and motivation for the research study

The rapid increase in high-rise construction in Erbil city, as well as in some other areas of the world, has generally failed to take into account building typology and other aspects, such as sun exposure, energy crises, ambient air, exposure to the outdoor environment in all directions, culture, and social philosophy. All of these affect both

living conditions within the building and the surrounding environment. Losing energy so quickly and need extra energy for air conditioning to maintain the comfortable situation inside the building, creative air shadow in the surrounding, non-going with social style and so on. This study is motivated by a desire to understand the different strategies and measurement scales used in high-rise buildings and illuminate how such an understanding will prove useful in enhancing the design of multi-story buildings and thus, promoting well-being.

The use of sustainable design strategies and the measurement tool can help ensure human thermal comfort by utilizing principles such as minimizing cost and environmental harm, the heat index, and energy saving in buildings. The climate of Erbil combined with a general lack of know-how in regards to basic sustainability strategies to be used during construction has led to an inability of most high-rise buildings to capitalize on the plentiful solar energy during the summer to be efficiently distributed for heat during the winter. Meanwhile, construction of buildings regardless of solar energy elements such as appropriate shading devices windows, thermal insulation, natural ventilation strategies, thermal mass is considered as a big problem, efficiency cost and comfortable and healthy spaces that suitable for socio-cultures.

The researcher's specific interest in sustainable architecture and high-rise buildings were instrumental in the choice of this study. It also highlighted the urgency of providing suitable decision-making tools to support designers in achieving sustainable high-rise developments and more health-conscious and environmentally-friendly buildings at a low cost. To this end, it is necessary for designers to have access to tools that are in line with design decisions at different stages of the process and are presented in an easily-understood format so that they can be interpreted by non-specialists with

an interest in using sustainability strategies. This is necessary as one primary reason for the lax adoption of these strategies amongst architects has been a disconnect between their methods of design decision-making and existing sustainability systems, in addition to a general lack of efficient planning schemes.

1.8 Significance of the study

The findings of this study will prove useful by adding to the existing body of knowledge on the sustainable measurement tools and design strategies used in high-rise buildings and their local application. Put differently, the findings of this study are significant to the extent that they provide some specialized knowledge of sustainable measurement scale to improve energy efficiency, health, and minimize cost for users of the high-rise buildings; the general goal is to simultaneously mitigate any adverse effects while enhancing the quality of life. The study will also serve to highlight recent relevant innovation in building technology and how these can be utilized in Erbil City. Additionally, the conclusions reached by this study will prove useful to urban planning students on the one hand, and engineers and architects on the other, as well as any others interested in the issues outlined herein. The study's findings will also prove useful to other beneficiaries like research institutions and government ministries, who might find its insights useful for future developments.

Summarily, the significance of this study is evident in the following ways:

1. Allowing for the concept and framework of design measurement tools to be identified in relation to the environment and socio-economic needs.
2. Supporting and expanding knowledgeable practices in high-rise buildings similar to the main points of the study space.

3. Providing useful information on the sustainability factors that could affect the successful product in the urban context.

1.9 Scopes and limitation of the study

Although many strategies and rating systems exist that can play a role in the efficient design of different types of buildings, like passive house strategies for use in green buildings, low-, or high-rise buildings, these are beyond the scope of the present study. The focus of this study is exclusively on the use of sustainable measurement tools for high-rise buildings in Erbil city. Covered by this umbrella is a variety of sustainable methods suitable for high-rise buildings, which are not necessarily suitable for low-rise buildings, super mega-structures, and skyscrapers in the same area. The focuses of the study include the conservation of resources, human adaptation, and cost efficiency, all of which play a role in providing sustainable buildings.

Put differently, this study focuses on the design strategies and tools relevant for use in Erbil city specifically and tailored to its particular society and socio-economic demands. As a result, the findings of this study may be limited by this narrow focus, as well as an insufficiently proposed conceptual framework. This research is limited by:

1. It focuses only on sustainable principles that could be applied on high-rise buildings
2. The research will focus on only high-rise buildings in Erbil city only
3. It concentrates on the most used available and local sources, socio-culture and environmental aspects in the study area with semi-arid climate condition BSh.

1.10 Organization of the research

This thesis consists of seven chapters, which are briefly introduced by an introduction, the principles and parameters, measurement tools, site study, analyzing the interviews to localized and specialize the model, Erbil high-rise building conditions, and a conclusion and discussion of the thesis. Below are brief descriptions of each chapter:

Chapter 1- introduction : The words history and meanings of "high-rise buildings" are clarified in this chapter in various backgrounds and contexts with figures. This chapter demonstrates why buildings in Erbil are high-rise buildings and why they boom, while the body chapter deals with research problems and their causes. The aims, the research questions and sub-questions concerning the subject and the methodology of the study are also described in the main body. Another element in this chapter is the organization of a thesis, together with a brief description of each chapter, which ends with the summer chapter.

Chapter 2- theoretical backgrounds of sustainable high-rise buildings: This chapter provides a theoretical basis for this research by reviewing the literature on the key aspects of the history of sustainability, sustainable construction, sustainable building, sustainable high-rise building and different dimensions of sustainability. To address the gap in the literature for sustainable high-rise buildings, this chapter also presents energy demand and uses in high-rise buildings.

Chapter 3- sustainability measurement and developing for high-rise buildings: This chapter provides the introduction and timeline of sustainable rating system development around the world with the rating system for a sustainable high-rise buildings. Also, there is a comparative analysis of five different measurements scale

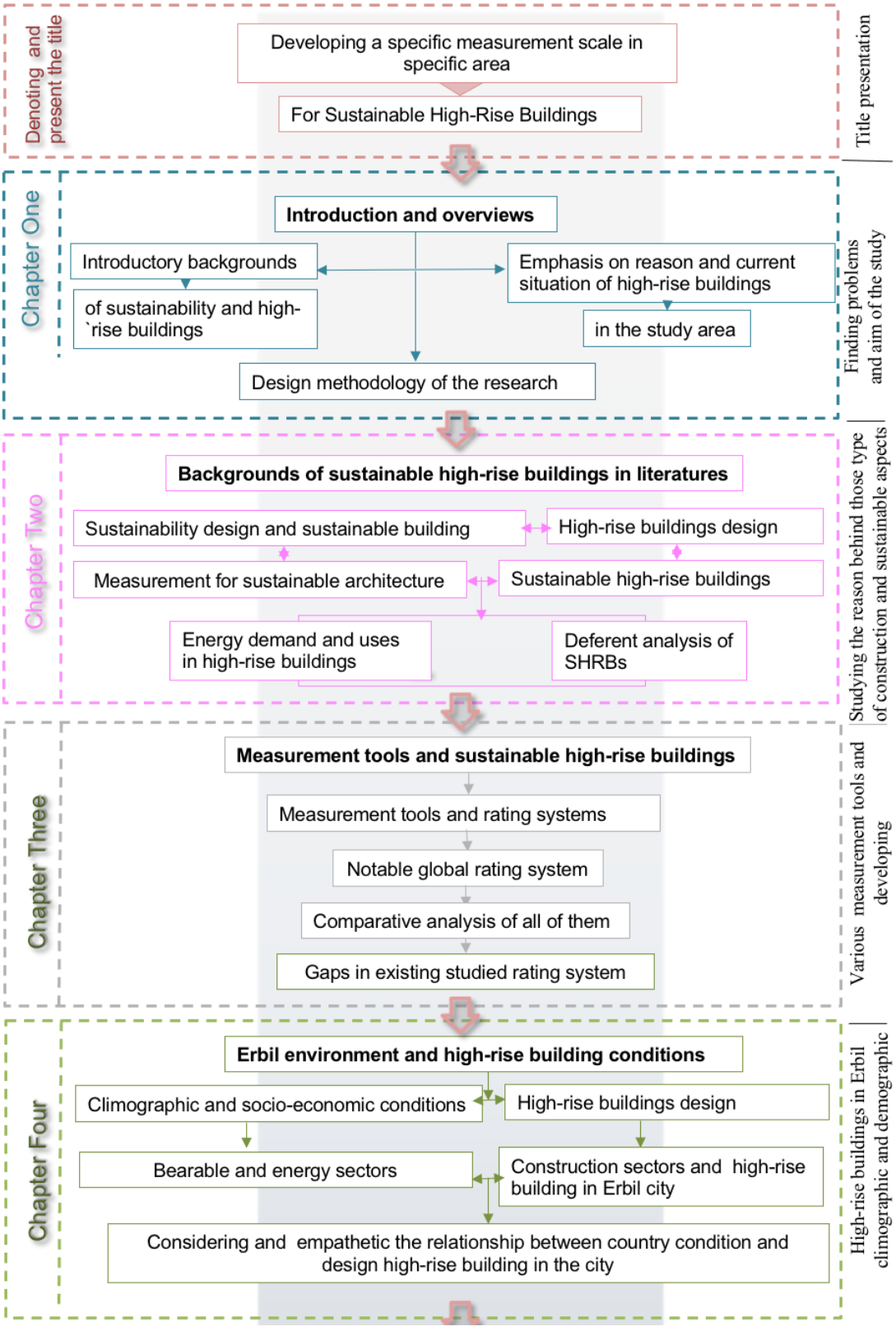
of sustainability and explain the gaps in the existing studied rating system. Then there is the development of a sustainable assessment tool for high-rise buildings.

Chapter 4- climographic and demographic condition and high-rise buildings in Erbil city: This chapter situates the research within the contextual situations of Erbil. It does this by providing information on the physical settings and growth of Erbil city, and by examining the economic, social and environmental problems of the city. The chapter highlights the state of governance for high-rise control and the infrastructure services in Erbil, with particular emphasis on the trend of high-rise apartment living, together with the constraints and priorities that outline the specific criteria that need to be investigated to develop the measurement scale for socially and environmentally sustainable practice in high-rise buildings.

Chapter 5- localization and specialization of the model of sustainable high-rise measurement tool: The research design, collection of data, and evaluation techniques used are described in this chapter. This chapter situates this research within the specified methodological approach and provides a rationale for that approach and offers justification and explains the methods of study, sampling, data collection and analysis used. Also, presents concerns of a high-rise buildings to design and developing the model especially for high-rise buildings for socially and environmentally aspects of sustainability. Explore qualitatively the awareness of sustainable high-rise buildings at different phases and the priorities and requirements for high-rise buildings in Erbil city which are sustainable from social, economic and environmental points of view. This was done through qualitative information analysis based on a semi-structured interview. In Erbil city with its scales, a measurement scale is built with its indicators for high-rise buildings.

Chapter 6- analyses, interpretation, and evaluation of the results of evaluation high-rise buildings in Erbil city: By using the proposed measurement scale model of sustainable high-rise buildings, the chapter assesses the status of five high-rise buildings by providing a detailed description of all the aspects of research design and procedures implemented. Explore in combination with high-rise living happiness and concerns the social, environmental and economic aspects in the context of living and working in high-speed buildings. It also explores the social and environmental dimensions of high-rise life in the occupants' behavioral aspects. This was achieved by evaluating quantitative data based on surveys by consumers. Site observation, often to learn about important topics that participants may not be prepared to address. The data from high-rise building observations in Erbil were analyzed by defining building names, floor numbers, and orientation, etc.

Chapter 7- decisions and conclusions: The last outcome of this study is provided in this chapter that the measurement scale, guideline, and recommendations for sustainable practices are based on the findings from the preliminary chapters: land use, material and natural sources, pollutions, indoor air quality, energy consumption, social quality, local economic aspects, etc. This chapter also summarizes the results of this research and outlines the findings based on an integration of the findings, analysis, interpretation, and synthesis of research. The work is minimal and the proposed measurement rating system is subject to conditional statements. Recommendations are also proposed for further study towards the end of this chapter (figure: 4).


Denoting and present the title
Developing a specific measurement scale in specific area
For Sustainable High-Rise Buildings
Title presentation
Chapter One
Introduction and overviews
Introductory backgrounds
of sustainability and high-`rise buildings
Emphasis on reason and current situation of high-rise buildings
in the study area
Design methodology of the research
Finding problems and aim of the study
Chapter Two
Backgrounds of sustainable high-rise buildings in literatures
Sustainability design and sustainable building
High-rise buildings design
Measurement for sustainable architecture
Sustainable high-rise buildings
Energy demand and uses in high-rise buildings
Deferent analysis of SHRBs
Studying the reason behind those type of construction and sustainable aspects
Chapter Three
Measurement tools and sustainable high-rise buildings
Measurement tools and rating systems
Notable global rating system
Comparative analysis of all of them
Gaps in existing studied rating system
Various measurement tools and developing
Chapter Four
Erbil environment and high-rise building conditions
Climographic and socio-economic conditions
High-rise buildings design
Bearable and energy sectors
Construction sectors and high-rise building in Erbil city
Considering and empathetic the relationship between country condition and design high-rise building in the city
High-rise buildings in Erbil climographic and demographic

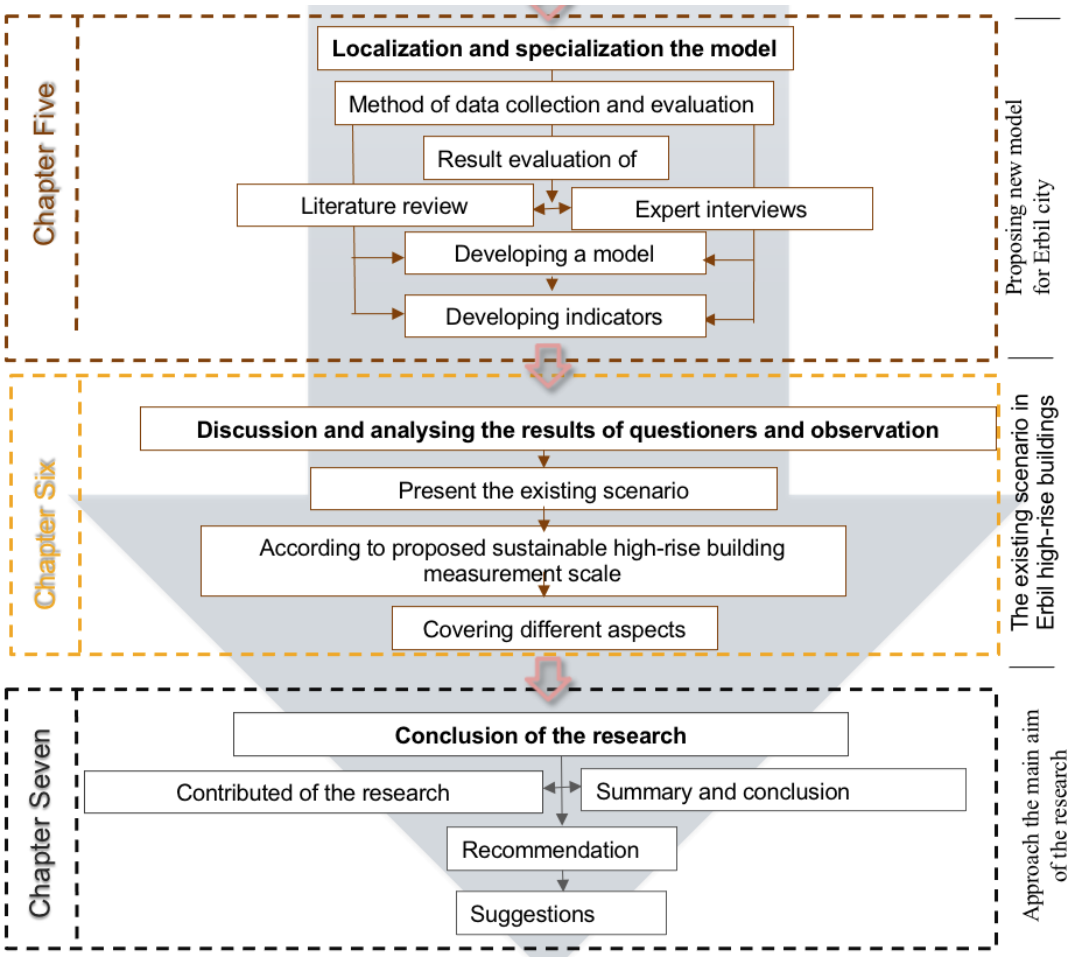


Figure 4: Organization of the research.

Chapter 2

THEORETICAL BACKGROUNDS OF SUSTAINABLE HIGH-RISE BUILDINGS

2.1 Introduction

Up to two billion people are currently without access to adequate food, urgently people require lots of resources to meet their basic needs (Sassi, 2006). Globally, there are 1.1 billion people without clean running water and about 2.4 billion people without proper sanitation (Worldwatch Institute, 2003). This situation is worsened by the increasing global population (Baranyai, 2020). Still, sustainability is one of the matters that is becoming increasingly common in various places around the world. There is a greater degree of complications when laws and regulations are considered (Sassi, 2006). This will have long-term implications for our society in the future because of the challenges that are being created. Future generations should be protected from undue environmental pressures that do not contribute to sustainability and development. Sustainable growth is a major factor in environmentally-sustainable decisions (Sassi, 2006).

2.2 History and definition of sustainability in architecture

As currently defined, both the roots and the beginnings of sustainable actions stems from the 1960's and the 1970's. This was fostered by the environmental movements, which grew from an understanding of the relationship between living creatures and their environment and dates back to the 1800's. Throughout the past sixty

years, a growing number of publications have asserted that human behaviour is influencing the climate change today (historically also). Environmental changes have an influence on all forms of life, including humans (Sassi, 2006). As such, sustainability has become much more detailed and expansive.

"Able to be maintained" in athor words capable of preservation is the meaning of "Sustainable". In scholarly literature, technical conferences and organizations, the term 'sustainability' also appears. In practice, including the American Planning Association (APA) and WUF (the United Nations World Urban Forum) many significant studies focused on sustainability, make use of the idea of 'sustainability' a key topic in their agenda to establish a robust sustainable framework (Al-Kodmany, 2018).

Many resources, academic studies, seminars and workshops are have talked about and discussed the sustainable aspects or sustainable building concepts and debated on how sustainable attributes can be implemented. Sustainability has grown over the last three decades, and is become much more complex and comprehensive. Almost all human actions, architects, activities, planners, and policymakers propose broad and diversified sustainability concepts. The exhaustiveness of a sustainability concept is made evident in one of the earliest and widely utilized meanings established by the United Nations Bruntland Commission in 1987. The argument raised by the committee is that sustainability can continue in a balanced manner, ensuring the interests of the present do not affect the needs of future generations (WCED, 1987). HEC Global Learning also acknowledges other principles of a prosperous future that concurrently pursues an economic development, balanced climate, and social inclusion.

It has three basic concepts, in general, which they include conservation of resources, cost effectiveness and human adaptation design. Furthermore, in addition to those three main piles there are three interconnected piles which are community life, social and economic justice and sustainable development (Newman, 2001) and '3Ps' of profit, planet, and people in which: 'people or population' supports social well-being , equality, and 'planet' represents environmental protection, and wealth; 'profit' reflects the vitality of financial (Al-Kodmany, 2014). The meaning and significants of inclusive sustainability will be absent if one of them is going to miss. Typically speaking, sustainable partnerships can be clarified more than loneliness or isolation patrs. In another word, the relationship between factors is sustainability.

2.3 Sustainable building aspect and principles

Constructive industries have also raised worries regarding production problems, electricity shortages and strong environmental impacts- ozone degradation, carbon dioxide pollution, global warming, and climate change- compared to other markets, the increasingly growing consumption of energy in the planet, as well as the usage of decreasing fossil fuel supplies (Ilha et al., 2009). Manufacturing of building material use electricity, building stage use energy, and construction use energy. The construction in each step should be managed so that it is performed in a right way without hurting anyone. Environmental, social and economic security are the drivers of sustainable growth (table: 1).

Table 1: Sustainable building issues. Source: (Akadiri et al., 2012).

Title	Key Theme	Principal Issues
Economic sustainability	**1.0 Maintenance of high and stable levels of local economic growth and employment** 1.1 Improved project delivery 1.2 Increased profitability & productivity	Improved productivity; Consistent profit growth; Employee satisfaction; Supplier satisfaction; Client satisfaction Minimizing defects; Shorter and more predictable completion time; Lower cost projects with increased cost predictability; Delivering services that provide best value to clients and focus on developing client business
Environmental sustainability	**2.0 Effective protection of the environment** 2.1 Avoiding pollution 2.2 Protecting and enhancing biodiversity 2.3 Transport planning	Minimizing polluting emissions; Preventing nuisance from noise and dust by good site and depot management; Waste minimization and elimination; Preventing pollution incidents and breaches of environmental requirements; Habitat creation and environmental improvement; Protection of sensitive ecosystems through good construction practices and supervision; Green transport plan for sites and business activities
	3.0 Prudent use of natural resources 3.1 Improved energy efficiency 3.2 Efficient use of resources	Energy efficient at depots and sites; Reduced energy consumption in business activities; Design for whole-life costs; Use of local supplies and materials with low embodied energy; Lean design and construction avoiding waste; Use of recycled/sustainability sourced products Water and Waste minimization and management
Social sustainability	**4.0 Social progress which recognizes the needs of everyone** 4.1 Respect for staff 4.2 Working with local communities and road users 4.3 Partnership working	Provision of effective training and appraisals; Equitable terms and conditions; Provision of equal opportunities; Health, safety and conducive working environment; Maintaining morale and employee satisfaction; Participation in decision-making; Minimizing local nuisance and disruption; Minimizing traffic disruptions and delays; Building effective channels of communication; Contributing to the local economy through local employment and procurement; Delivering services that enhance the local environment; Building long-term relationships with clients; Building long-term relationships with local suppliers; Corporate citizenship; Delivering services that provide best value to clients and focus on developing client business

2.4 Sustainable development

The sustainable approach to construction is seen as a way for the construction industry to move towards sustainable development taking environmental, socio-economic problems into account, as previously mentioned. EurActive (2009a) claimed that the "sustainability development has hundreds of definitions," but the World Commission on Environmental and Development (WCED) headed by Norwegian Prime Minister Gro Harlem Brundtland came out with a definition of sustainable development in 1987, " Sustainable development is development which meets the needs of the present

without compromising the ability of future generation to meet their own needs "(Brundtland, 1987).

Other concepts can also be seen through HEC Global Learning. Fundamentally, sustainable development encompasses five main principles: quality of life; justice and equity; engagement and partnership; caring for our climate and appreciation for environmental constraints - awareness of 'environmental limitations' - and thinking for the future and precautionary principle (Al-Kodmany, 2018).

Five essential social needs must be tackled by sustainable development: balancing stability and prosperity, meeting basic human needs, social justice, cultural integrity and the sustainability of ecological unity. Furthermore, sustainable development is a plan to create economic, human, physical and financial resources to enhance social prosperity, minimize poverty and provide long-term social comfort (Toulaee, 2007).

There have also been many other principles, some more general and some more specific in academic and science sources, concerning EurAC (2009b), which "based on consumption and production patterns that do not degrade natural resources that protect the environment, promote equitable sharing of well-being to all and alleviate poverty".

In relation to CIB's sustainable growth, it is just a continuous mechanism that maintains a dynamic equilibrium between the people's need for wealth, stability, and quality of life and what is “environmentally feasible" sustainable development is the kind of development we need to pursue in order to achieve the state of sustainability.

"Sustainable development does not constitute a fixed state of harmony but rather an evolving cycle" says Brudntland Research (1987).

The word development in this sense encompasses two important facets of the term: it cannot be limited to a number of fields or regions, but it now and in the future spreads across the whole universe and to everyone in it. Secondly, the target is not only set, but progress and further progress are the goal of success. The understanding concentrates on two principles: the theory of needs consisting of the needs to preserve a quality of life suitable for all and the definition of environmental capacities constraints; and the assessment of the state of the social and science association to address present and forthcoming needs (SABD, 2005). Three elements, fiscal, environmental and social dimensions, are of sustainable growth and sustainability (EurActive, 2009a).

Otherwise, natural elements of sustainable development would need to be sacrificed between the protection and utilization of the physical ecosystem and wealth in such a manner that the Planet can support human quality of life (CIB & UNEP-IETC, 2002). Furthermore, societies which ensure equitable opportunity and poverty alleviation for a healthy and rational quality of life need fair social development.

In addition to the sustainable development dimensions , it is also possible to speak about the other different scales that include: world as a global scale of sustainability, regions as regional scale of sustainability, countries and C. regions as a sustainability in national scale level, and local scale of the sustainability for the city, neighborhood and building scales (Hoskara, 2007) (figure: 5).

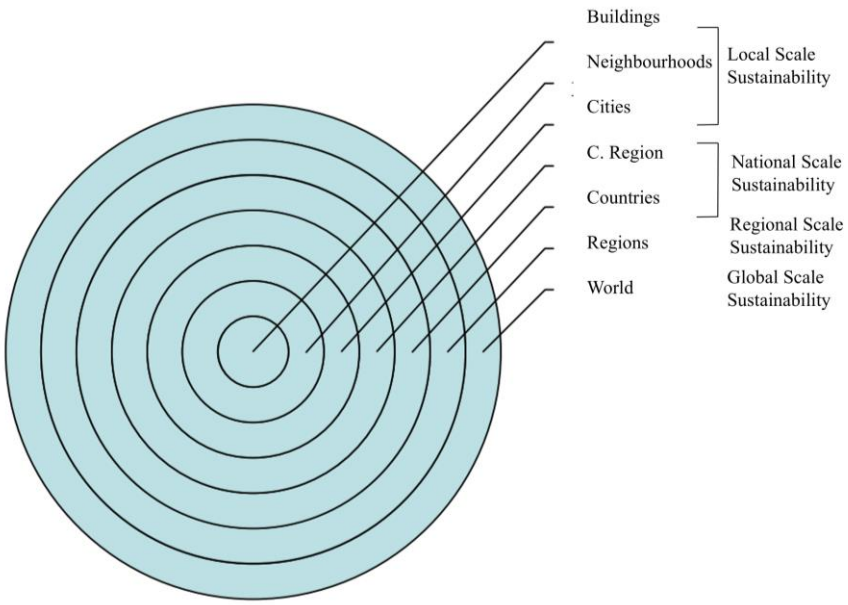


Figure 5: Seven scales of sustainable development. Source: (Hoskara, 2007).

2.5 High-rise building statuses in the equilibrium of sustainability

With respect to how well this fits in the balance of sustainability in the high-rise building environments, these concepts can be taken into account and integrated into the sustainability plan for high-rise buildings. Many scholars posed serious concerns. For example, Ken Yeang (2008), the pioneer in sustainable high-rise buildings, claimed that it should be clear from the beginning that skyscrapers are not an ecological buildings. It is in fact one of all kinds of non-environmental building. He illustrates that big and high-rise buildings need needless capital and sophisticated infrastructure, so they can cope with higher wind energy at high altitudes. This is a simple demonstration of 'un-ecological' and argues that more energy and money required to construct, manage and sustain it. Many of these difficulties emerge from the vertical orientation of this house. The question comes to this situation then is: (Can high-rise buildings ever be sustainable?). Bellow's comments are numerous critiques of sustainable high-rise buildings; his comments suggest they are not sustainable and are impossible to maintain (table: 2).

Table 2: Various critiques of sustainable high-rise buildings. Source: (by author).

Scholars	Opinion	Reasons
Ken Yeang (A leading figure on sustainable TB developments) (2008) in (Ecoskyscrapers and ecomimesis: New TB typologies)	• The skyscraper is not an ecological building type. • It is one of the most un-ecological of all building types.	• Require excessive materials and sophisticated structural systems • Demand greater energy to construct, operate, and maintain..
Christopher Alexander and colleagues (1977) In (A Pattern Language: Towns, Buildings, Construction;)	• Rejected the high-rise city altogether as a viable human habitat.	• There is abundant evidence to show that high buildings make people crazy.
Lé on Krier (A prominent proponent of the New Urbanism movement) (2009) in (The Architecture of Community)	• Buildings should have no more than five floors.	
James Howard Kunstler (1993) in (The Geography of Nowhere)	• Skyscrapers generate urban pathologies. They also demand lots of energy and are expensive to retrofit.	• When oil peak and climate change prevail, skyscrapers will become irreparable relics.
Jan Gehl (the Danish architect and urban designer) (1971 and 2010) in (Life Between Buildings Cities for People)	• Critiqued HR cities and praised low-rise ones in various parts of the world for they emphasize the value of human scale and provide abundant opportunities for healthy social interaction.	
Jane Jacobs (1963) In (The Death and Life of Great American Cities)	• Praised human scale environments that foster an active pedestrian life.	
Hans Blumenfeld (1971) In (The Modern Metropolis)	• Denounced tall buildings.	• They damage the historic fabric of cities.
H. Hayati, M.H. Sayadi (2012) In (Impact Of Tall Buildings In Environmental Pollution)	• With increasing the height, the density of the CO^2 will be increasing. • Making shadow surroundings area and avoiding getting sun solar directly from the sun (harmful to neighboured buildings and plants).	• Because of CO^2 properties. • Its Size.
Baiz, Khoshnaw and Byze (2016) In (High-Rise Buildings Aspects and Significant Impacts in Urban Areas)	• The CO^2 separate around and make the volume of the air pollution bigger. • Blocking the view and visuals from their surroundings.	• If the tower has a wind flow from above to down. • Because its physical mass.
Sleeper (1981) in (Architectural Graphic Standards) **A.A. Aldeberky** in (The Influence Of High-Rise Buildings On The Environment)	• Increasing the air shadow.	• Because of the air velocity and building height and their depth.
Ali & Al-Kodmany (2012 In (Tall Buildings And Urban Habitat Of The 21st Century: A Global Perspective)	• Society and culture play a key role in accepting or rejecting tall building development make inhabitants feel claustrophobic.	• Creating a rat-cage mentality
Adedoyin, (2013) In (Impact Of Skyscrapers In Urban Area: Case Study	• Crime and fear of crime are greater, and that they may independently account for	

Oflagos Island, Lagos State, Nigeria)	some suicides. Destroy some form of social, public life.	
Al-Kodmany (2018)	• Negatively affect the neighborhood character and the city skyline. • Reduce access to natural light, and prevent natural ventilation on nearby buildings.	
Ijeh, (2015)	• The traditional views of tall buildings are a largely unsustainable form of development. • The sustainability credentials of towers are not social or demographic but environmental.	

When high-rise structures are evaluated or compared to low-rise buildings, it might be accurate that they cannot be fully sustainable, but what about focusing them as themselves.

Shard's vicinity also provides a variety of facets of sustainability, allowing 30 percent less electricity than a typical, similar-height skyscraper to be used. Gensler in Shanghai with these outstanding features it claimed its Passivhaus status (three key measurements of RHW.2) enabling it to use 80 percent less energy for both heating and cooling than a similar tower. The double-skinned façade of the Gherkin and its swerved inner atrium "chimneys" helped to turn the building into a pioneer in high-rise atmosphere development at the time. Likewise, the 632 m Shanghai Tower with its 121-floor, which is claimed to be the world's first and highest eco-skyscrapers. For example, 1/3 of its interior for public gardens, has been accredited with prestigious LEED gold and has contributed an annual reduction of 34 thousand metric tons of carbon emissions compared to a building with same size. Elsewhere, architects are taking a very different approach to designing buildings that can be much more aesthetic with emphasis on sustainable conceptual frameworks.

The increase in wood-based high-rise construction could dramatically turn the carbon credential of high-rise buildings, according to Green in his report, The Case for Tall Wood Buildings. According to Ijeh (2015),

> " If we built a 20-storey building out of cement and concrete, the process would result in the manufacturing of that cement and 1,200 tons of carbon dioxide. If we did it in wood, we'd sequester about 3,100 tons, for a net difference of 4,300 tons. That's the equivalent of about 900 cars removed from the road in one year."

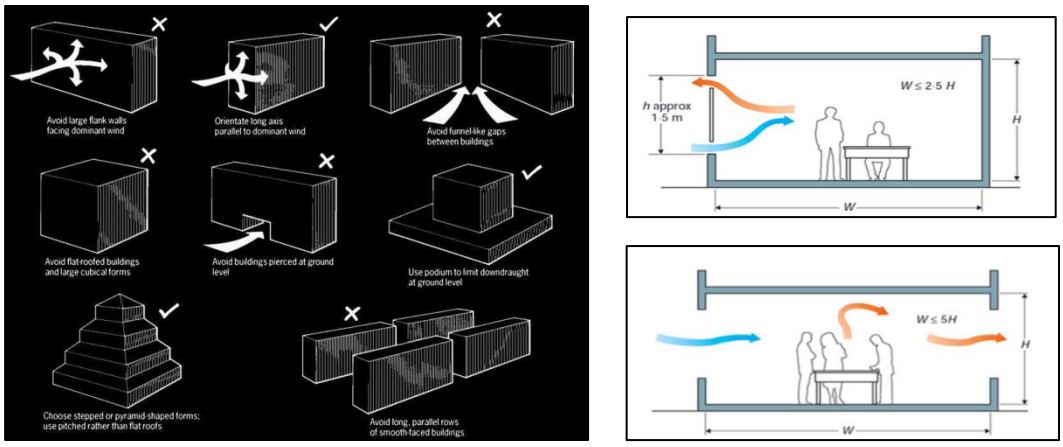
There are also some existing TB nad HRBs, that are assessed and grouped across the world as sustainable projects as both Hero Tower and Ropemaker Place in London, UK by BREEAM; Kansai Power Construction, Osaka and Dentsu Office in Tokyo, Japan by CASBEE; National Australia Bank Headquarters, Melbourne and Santos Place, Brisbane by Green Star; Peking Road, Hong Kong, China and the Chinese Bank, Hong Kong, China by HK-BEAM.

A useful study of high-rise buildings with sustainability problems has only been established over the last few decades, especially in terms of the climate and facilities. A significant issue worth considering is how to execute it in practice which is still very limited (Sassi, 2006). There are also some existing structures, that are assessed and grouped across the world as sustainable projects, but among the respondents there is a lack of awareness on the grounds of the core values of sustainable high-rise buildings (Sassi, 2006).

Similarly, Milana et al. (2014) recommended that for high-rises buildings, there are many aspects that must be addressed. This includes; use of sustainable materials, design and safety, excessive energy use and production, waste management, and not an emissions source, sites planning and services. Sustainability therefore, is not just

about construction itself, but also about the products that are utilized, looking at their immediate and future effect buildings themselves and their surroundings. In addition to these elements, there are also other examples and sustainability processes in building and design.

In the case of Gylling et al. (2011), the key concept and goal in sustainable buildings is that, they give humanity not less than the amount they receive, and in certain cases, offer more than they receive. High-rise buildings cannot be an entirely sustainable initiative without accountability for urban life as demonstrated by Zeiler (2017). In some cases, it may be possible to provide an environmental solution for individual buildings, including ventilation, orientation and energy from the sun. However, there is a simple community issue such as not having a shading field, which may become an undesirable air stream and blocking axis of views for others as shown in figure 6. Indeed, ventilation in a natural way of this type also plays a significant role in the cooling process, which minimizes energy usage with regards to electricity consumption (Eibakheit, 2012).



(a) High-rise buildings with Wind geometry (b) Natural ventilation and Rule of thumb

Figure 6: Airflow in buildings geometry and rule of thumb. Source: (Dyke, 2014).

In certain situations and regarding to the social dimension, large building divides society from each other, so that the good environment for contact and social community, and the urban group in the sky for social activities and a specific space for different activities can be seen as a way to provide a more sustainable urban perspective. High-rise development itself is struggling with costs because the low footprint of the land area and the availability of more units means that land rates and the usage of resources with expenses and length are a kind of sustainability.

2.6 Sustainable high-rise buildings

Sustainable high-rise buildings in term of sustainable architecture and high-rise district urban designs are primary growth patterns (Wood et al., 2008). Sustainable architecture will make sense once there is the existence of sustainability in the urban context (Gissen, 2003). Mega structures such as high-rise buildings, are no longer viewed as isolationist construction. These high-density developments appear to be connected to establish transportation centres in Europe. The most creative case of planning of urban in high-rise towers can be found in the case of London (Abel, 2003). For instance, Renzo Piano's mixed-use Shard of Glass or London Bridge Tower uses existing transport nodes to persuade Londoners to leave automobiles (Russell, 2004). In Asian mega cities, population densities have been high compared to other areas, so tall buildings for working and living are both a requirement and a pattern in Asian cities. By the 90s, recognition of tall buildings had evolved to some degree (Gissen, 2003).

Many researchers have investigated the concepts of high-rise sustainable buildings. Ken Yeang subsequently implemented the bioclimatic principles in high-rise buildings in the 1990s. He described them as low-energy, passive buildings and stronger design

strategies for more comfort with design elements such as sky gardens and water reclaim. According to Fazlic (2008), by separating bioclimatic and green (ecological) approaches, Yeang extended this concept of design to sustainable high-rise buildings.

Sustainable high-rise buildings are contemporarily becoming increasingly common, as urban authorities, officials of cities, planners or architects advocate low-rise urban compact cities to minimize energy use and pollution from climate change (Wood et al., 2008).

There are architectures that have certain design criteria in sustainability and environmentally friendly manner. These include; building material preferences, alignment of the construction for solar, passive ventilation and lighting systems, the greenery uses, water and waste management, promotion of environmentally friendly construction technologies and the development of an urban environment in terms of safety and viability (Gissen, 2003; Jin et al., 2013). Additional elements and components of design which donate to the sustainability of towers and high-rises are the recycling management, collection of rainwater, plant and co-generation facility storage systems, air distribution systems on the ground, energy sources with low carbon emotion such as the use of photovoltaic solar power and wind turbines on- site (Wood et al., 2009; Fazlic, 2008). Considering his concepts and designs on bioclimatic sky scrapers, Yeang (1999) brings additional elements to a sustainable high-rise buildings that involves recycled materials, passive and active façade systems that are environmentally friendly, involving the system for solar controlling, vertical green area and gardens, and multifunctional places of joint applications for high-rise buildings.

Therefore, in general, the parameters and factors according to environment and social can be classified into two groups belonging to environmental and social, which can also be separated into additional subcategories as shown in table 3.

Table 3: Design parameters of social and environmental sustainability. Source: (Öner and Pasin, 2015).

Environmental Sustainability			Social Sustainability	
Climatic Comfort	**Material Use**	**Site**	**Integration**	**Accessibility**
• Wind control indoors and outdoors Natural ventilation • Solar control • Use of solar energy • Photovoltaic cells • Passive and active thermal control systems • Under-floor air distribution systems	• Use of accessible materials in the local market • Use of recycled / recyclable materials • Long-term material firmness • Easy maintenance	• Use of carbon emitting greenery • Use of green public space • Vertical gardens and farms • Water and waste maintenance • Rainwater collection and recycling • Co-generation plant	• Social Interaction among various socio-economical and socio-cultural groups • Liveability and lively environment • Accessibility to all potential users	• Accessibility to shared public spaces and central districts • Accessibility to public transportation nodes

Ali and Armstrong (2010) suggested that, for high buildings to be sustainable, consideration of efficiency in energy use and functional flexibility that emphasizes mix use, by integrating living, working, commercial and leisure area into one building. Additionally, the link between high-rise buildings and their urban infrastructure and its effect on the physical sources of the urban city such as public transportation system, water source, waste management and energy consumption also needs consideration.

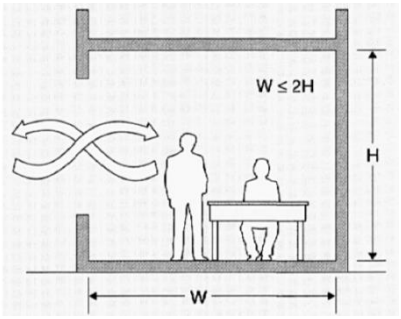
Al-Kodmany (2020) states that, design techniques, technology, construction materials sources and structural techniques, environmental protection, space program quality, safety and security, renewable energy in-sites, micro-climates around the buildings, quality of the building construction and space management and operations must be taken into account in the concepts of sustainable design for high-rise buildings.

Depending on certain other sources, the active system and the passive system can be described as the two main strategies. There is more than one technique for both strategies (Begec and Hamidabad, 2015). The active framework is represented by two major categories; renewable energy technologies and energy efficiency technologies (Begec and Hamidabad, 2015).

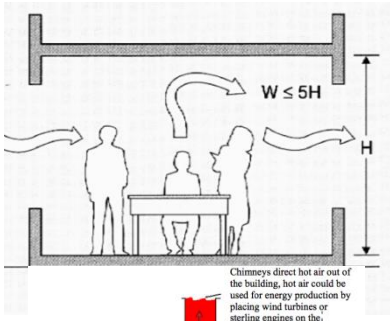
The Passive system is a technique that has a clear relation to the architect and engineers while the design process that covers the buildings orientation towards the sun and position form an organization and so on (Hamidabad and Begec, 2015). Natural ventilation can well serve as a passive technique for sustainable constructions and also provide the comfortable and healthy indoor environment with fresh air in buildings. Such high-rise construction approaches may be outlined by three kinds (Sev and Aslan, 2014):

Ventilation with single-sided: this form of technique relates directly to the ratio of width to room height as illustrated in figure 7 A. Cross and stack ventilation: two sides of the opening of the room may be carried out in this kind of ventilation as shown in figures 7B and 7C.

A: Ventilation by Single-sided



B: Ventilation in cross



C: Ventilation in stack

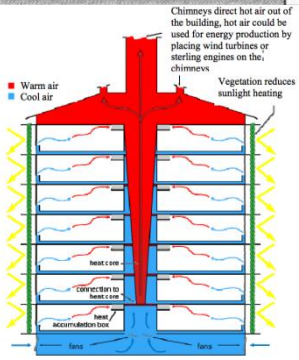


Figure 7: Different strategies of natural ventilation. Source: (Sev and Aslan, 2014).

Although the above investigators have argued and suggested concepts for sustainable high-rise buildings, they do not explicitly explain how such concepts and goals can be accomplished.

2.7 Different dimensions of economic, environmentally and social sustainable high-rise buildings

There is no debate that, urban area having high-rise buildings and skyscrapers will not be the same as those areas which have majority of buildings being low-rise buildings. Tall buildings are a phenomenon of the city now and do not going individually without affecting urban planning. Beside this, Eappen (2017) stated that, an odd thing is the fact that, no building more than two hundred meters in height was ever destroyed, apart from the World Trade Centre in 2001". Technological knowledge needs to be built, to allow deconstruction of high-rise buildings with limited environmental effect at the end of their life cycles.

2.7.1 Social dimensions

Today, the dominant type of high-rise buildings in major cities in the world has been proposed, and their rapid development has led the occupants of such buildings to have social and cultural concerns. Social capital is known as the cornerstone of every society's economic growth. The importance is evident in developed countries' economic growth.

Throughout the main cities and metropolitan areas around the world, high-rise buildings have now been introduced as a dominant type, and their rapid development has caused the inhabitants of these buildings to experience social, community and cultural issues. The capital of social and family wealth is remembered as the base for every society's economic growth. Its significance is evident in developing countries' economic growth. Social capital is the intangible wealth of a nation that includes social contact structures, community stalemates and norms.

In 1954, Minoru Yamasaki, a Japanese architect designed and constructed a high-rise residential complex called Pruitt-Igoe. It was inhabited by communities of blacks and whites and big families with many children. The number of units abandoned was incremental, this showed a lot of problem, and seventeen years after its completion, it had been agreed to be destroy. Aregger and Glaus (1967) also pointed out that, several experts have investigated the explanation for this phenomenon. One of such findings being that, high-rise buildings are usually appropriate for single persons, young people, young couples, and families with several children, except under certain conditions. An example is having a play area, playground, and green areas reasonably located on the roof in adequate quantities, particularly for children.

On the other hand, children living in high-rise buildings become less interactive and fun outside, even though children need to enjoy fresh air and social life. Nevertheless, the children's playground should be adjacent or bilateral agreements open to children, so that children have convenient access to home safety, as there is no direct contact between children and home in the upper floors of the large and high-rise buildings. The terraces and the patio could act as a playground for children if the building stories have communal terraces. Many examples of people with special status in high-rise houses include elderly people who are in need of care and socialization because they are more active in their homes and because of their presence in the society. The high elevations with adequate communal areas and adequate green spaces are therefore suitable for them (Conway, 1997). Consequently, providing the space for social activates and playgrounds for children are crucial in high-rise buildings in terms of social sustainability of towers.

Oldfield (2019), in the book of The Sustainable Tall Building: a design primer, asserts that, we must always focus on the styles of cultures that we construct for people in high-rise and tall buildings. Additionally, sustainability in socio-culture focuses on maintaining continuity with conventional culture, community values and the preservation of culture and linguistic identity (Keitumetse, 2009). The three concepts are also the least discussed by socio-cultural resilience due to the abstract existence of community and identity.

People live more in urban society and indoors than outdoors for different activities, such as working, hiking and recreation (Yiu, 2005; Burnett, 2005), where people spend more than 90 percent of their time on indoors – and more than 70 percent of their time inside at home (Sev, 2009; Adgate et al., 2002).“You cannot have a sustainable city

without social cohesion." (Ijeh, 2015). Architecture plays an important role in providing the wellbeing, physiological comfort, happiness and efficiency of the occupants..

Some academicians have argued that, high-rise buildings are a significant social interaction factor, proper treatment of outdoor spatial architecture with specifics and elements from high-rise constructions would create pleasant living environments (Huang, 2006). Therefore, well designed outdoor areas of high-rise complexes can become effective nodes of operation that encourage informal contacts among residents everyday. Moreover, the high-rise complex's rooftop architecture attracts people of various ages. All of them will integrate and share the same field that improves social contact. The activities are not confined to the rooftops, since they all stand chance of being used as a sitting area, they contribute to enhancing social contact among the residents of the block.

Family groups or household life is another dimension of HR resilience to society. However, this is lacking in high-rise environments that are autonomous and can lead to the reduction in the sense of competence in a child (Story and Saul, 2015).

Where there is no public outdoor and social area, the residents have to spend more time indoors, where they will be overwhelmed or "prisoned in the sky" (Prezza et al., 2001; Du, 2015). High-rise buildings are most sometimes disorganized with communities and neighbourhoods. These individualistic and introverted systems, make people feel like they are living mentally, socially and psychologically in "vertical silos" (Al Kodmany 2018). in the Architectural Science Review, Robert Gifford (2007) explains how a family member or a beloved child snaps out of a window, how

many "strangers" share in that house, a fire that may trap them in the building, a catastrophic earthquake that can trap a family in the apartment, an illness or transmissible diseases caused by crowds living nearby etc.

Additionally, bad design, whether in low or HRBs frequently creates less satisfaction for residents. In poorly built high-rise building areas, frustration may be increased due to the vertical position and orientation of the building, this often leads to the notion of restraint and isolation from community life on the streets (Prezza et al., 2001; Du, 2015). Income and racial segregation can be substantiated by the development of "vertical gated communities" (VGCs), which restrict societal contact and the fostering of cultural connections among socioeconomic classes (Al-Kodmany, 2014).

In addition, the disparity of physical and mental health in standards of living with regards to large buildings, may accommodate a wide variety of occupants, including the upper, medium, and lower classes.

Nevertheless, criticism has focused on high-rise buildings, catering for both the poor and the wealthy. Also, HRBs and towers have built private and spacious tall houses and can be said to be "mansions in the sky" for the rich man. These buildings have high security, restricted access, a 24-hour CCTV, and a wide range of other services just like hotels. The buildings are close to social infrastructure like movie theatres, supermarkets, shopping centers, cafés, restaurants, hospitals, public parks, and transport services. Temporarily, developers put up high-rise luxury flats in one location, in order to benefit from the best of both cities and suburbs worlds. These building apartments and units, however, also exclude people from poor backgrounds.

Indeed, the "Heavenly Mansion" symbolizes good reputation, acknowledgment, prosperity, rivalry, and social status. Steven H., (2015), a leading American architect has rebutted those patterns by constructing physical silos by isolating rich people from the rest of the population.

2.7.2 Environmental dimensions

Organizations dedicated to environmental performance goals are increasingly in agreement that effective policies and actions are required to improve the sustainability of building activities (Halliday, 2008). Due to its scale, the building consumes electricity, material resources, and water. Experts in the building sector have started to track and correct damages to the environment brought about because of their operations. The common goal is that buildings should aim at minimizing the negative effects on the environment (Akadiri et al., 2012). Technology is constantly being developed and revised to complement established practices in building sustainable structures.

With regards to energy and CO^2 productions, the process of building skyscrapers requires substantial energy, generating large quantities of CO^2 and this leads to the pollution of the air and in effect it leads to global warming. Far distant (sometimes worldwide) transport of building materials also uses energy and produces a lot of carbon dioxide (Du et al., 2016).

Architects have designed building with low-thermal building materials and deprived skyscrapers of natural air, so the residents of these buildings need to constantly be inside the warm and cool areas in the cold season and in the hot season respectively to make sure they have safe adequate temperature. The energy needed to cool and warm

these towers is therefore not just expensive but it also pollutes the atmosphere through the processing of large amounts of carbon dioxides (Heinonen et al., 2011).

In addition, towers and HRBs create a tunnel effect, which raises wind speed and affects the wellbeing of the peasants. Strong air currents that take place around big buildings create edges, pollution circles and air pollution, noisy and unpleasant street events. Wind acceleration happens in open spaces, such as parks, corridors, outlets and corners (Kawamoto, 2016).

Also, in cities where tall buildings are situation, more individuals, properties and facilities are situated in a particular place, this makes the likelihood of flooding high. The introduction of physical flood prevention measures in congested settlements, is a challenge and may destroy established infrastructures and weaken the firmness of pavement blocks on sidewalks and ground floors, creating unfriendly pedestrian environments (Lynch 2015).

Geological concerns are another component of environmental values, and the geological nature of one site has many impacts on the structure of large areas. For instance, if large buildings stand on a feeble soil, they will gradually sink. While anchoring the base of a skyscraper on a base (a geological layer of solid rock) is safest, it is not always easy to reach. In some cities, there is such a deep base that it is too costly to get there. Other urban areas have a mix of deep and swampy soil. Steady skyscrapers in these areas are expensive because they warrant an extraordinary feat of structural engineering. Tall buildings would otherwise collapse.

In addition, water treatment is another challenge in this regard, since large buildings are homes to large populations, large wastes are produced. On the average, a unit or flat of an apartment's disposal rate is around a ton annually. Although this quantity of waste and leftovers are not different from a single to six housing units, the management system of the waste is complicated as compared to low-rise buildings.

Also, since large buildings vary from building to building, types, shapes and structures for disposal and selection vary (Al-Kodmany, 2020), besides the above previous issues, there is a sustainable place, green area and construction envelopes which are also other concepts in this dimension.

2.7.3 Economy dimensions

The principle of sustainability used in building construction aims at encouraging optimum productivity and reducing financial and economic costs. Many organizations, both in the public and private sectors, take decisions on building investments based on estimates of the original costs of construction without considering the costs of operating and maintaining the building during its lifespan (Littlewood, 2020). There is sample evidence that design decisions include the option of building designs, building materials and building services, often combined with investment errors by insufficient economic decision-making (Giudice et al., 2005). Economic activities of buildings throughout the entire construction process and during their useful life should be considered as well as their preservation and conservation. The cost for life cycle is the original cost, the cost to be used, and the cost of recovery (Akadiri et al., 2012).

When a structure is taller, the concept of "premium for height" is applied as wind and gravity are increased laterally (Al Kodmany, 2018). In order to minimize vibrational

effects caused by wind, storms and earthquakes, structural engineers use dampers, which is used to move a building mass in a different direction from its forces.

Unexpansive vertical transport such as elevators and escalator are also required for skyscrapers to become affordable. In general, people do not want to climb a lot of stairs and people do not like waiting too long for elevators. In order not to for wait more than a few seconds for lifts, about thirty seconds to office units and forty-five seconds for residential apartments, engineers measure the required number of lifts (Al-Kodmany, 2014). If one of the lifts fails, it implies that, overcrowding in the lobby is developing rapidly. As a consequence, this issue must be considered early in the process of planning and it needs a number of lifts (for example, central, service, freight, firefighters) (Baiz, 2012).

As a result, lifts do not just add substantial expenses to the cost of the building but they take up a lot of space too. In addition, the shafts of lifts require exceptional building skills to make sure they achieve an impeccable vertical alignment and engineers that are very knowledgeable in power-driven and electrical networks, IT setups, software, and programing codes (Baiz,2012). Additional accessible spaces are often filled by vertical circulation structures including stairways and escalators.

In addition, towers need costly “Mechanical, Electric and Plumbing systems” (MEP) to make a cold atmosphere warm and a cold atmosphere hot and stronger force is needed to pump water to higher floors.

The Council on Tall Buildings and Urban Habita (CTBUH) has invented the expression “vanity height” to describe a space which has not been made good of in

the middle of a tower's uppermost available floor and its architectural top (CTBUH, 2013). Intrinsically, "vanity proportion" equals to "vanity height" divided by the building height. A CTBUH's report shows that towers gradually present a better vanity proportion. In the United Arab Emirates, normal vanity proportion is 19%, this makes it the country with the "vainest" towers.

As per tentative investment, high-rise building may be a dangerous investment, with investors banking on global financial growth and missing the economic crisis resulting in large openings in these towers. Tall buildings struggle with openings either as a result of the expense of maintaining the property or because of its obsolete appearance and features. In addition, population trends and behavioral changes could threaten the sustainability pledge of high towers (Al-Kodmany, 2018). To demonstrate, right after the foundation is built, one caisson swings due to some reason; time and cash or squeaking a component of the edifice like what happened in Boston, the activity will be obstructed by inaugurating the building after a long period.

Generally, it is possible to manage under the original, usage and restoration cost techniques where every one of them can be guided by their separate processes (Akadiri et al., 2012). For startup expenses: the architecture can maximize the usage of domestically produced resources, using of cost-effective building technology like diligent building structure should be done in order to provide the most efficient design of the foundation to guarantee that a small amount of material is unearthed. Pinpoint ways to reduce initial development expenses by using modular structures and uniform materials, using simple, easily accessible materials and the use of reused, recycled and recyclable material (Akadiri et al., 2012).

The costs in use therefore include the layout of the cleaning, maintenance and repair system, ensuring the availability of necessary expertise and work supply, choosing minimum maintenance equipment and materials and guaranteeing the service life needs of materials and components, shielding materials from disruptive elements such as heat, changes in temperature, wind, rain or moving moisture-loaded air through defects in the circumstance, simple to understand occupant access control (Akadiri et al., 2012).

All recovery expenses consist of all recycling possibilities and simplicity of dismantling, integrated reuse of an established venture, and reuse of construction products (Akadiri et al., 2012) that Couse produces less air emissions and water contamination, creates employment and saves precious money, decreases waste and preserves the electricity used for the production and building of materials.

2.8 Energy demand and uses in high-rise buildings

Latest research on energy preservation have found that management of energy is far more relevant and efficient in promoting energy preservation than energy-saving technology. Per the reports on energy consumed by households, energy consumed by households accounted for 11 percent of overall energy consumed by household in 2007, and 46,4 per cent of these family units were residences. The control of energy use in apartments is thus a significant problem (Ministry of Knowledge Economy, 2008).

In the early design process, the choices the contractor makes will have a direct effect on the energy efficiency of the building (Visa et al., 2020). The overall architecture of the building is of considerable significance for reducing energy burdens and allowing

adaptive construction approaches. A rising knowledge about the usage of building efficiency modeling techniques throughout the design phase is in existence. Per a research carried out by Athienitis and Attia (2010), approximately 60 percent of the energy models are planned for initial phase design. The structure of the building and positioning, plus the overall design of the structure, are the key focus regions for energy modelling throughout the initial design process.

Many research studies have revealed the relationship that is between the solidity of a building and the amount of energy it consumes (Pessenlehner and Mahdavi, 2003; Choi et al., 2012). A building's solidity is explained to be the proportion of the outer covering's area (A) to the volume (V). Research revealed that solid shapes can lead to a reduction in the amount of energy consumed, particularly when the weather is hot and cold (Susorova et al., 2013). As per Raji et al. (2017) the figure, distance downwards, a spin, windows to wall proportion are the elements which have a clear influence on the energy consumed in high-rise buildings.

Energy Institute discovered that the usage of electricity, in comparison with the square metre of a floor area, is almost 2.5 times higher in tall workplace buildings which have more than twenty floors than in low-rise buildings which have not more than 6 floors. Consumption of gas also rises with height, at approximately 40%. Due to this, the overall amount of carbon gas and electricity emit from high-rise buildings is two times more than that produced from low-rise buildings (University College London, 2017). Professor Philip Steadman (UCL Bartlett School of Energy, Environment and Resources) (2017) clarified, " using air conditioning performs an important role however, it does not entirely give a comprehensive description of these outcomes. Averagely, the amount of carbon emitted from offices that use air-conditioning

systems are discovered to be about 60% more than the amount emitted from offices which do not use air-conditioning systems.

Residential buildings in twelve districts in London were also analysed by the research team; they discovered that consumption of the gas rose significantly whereas power consumption increased. The study was carried out in the capital by taking census districts in the capital and comparing the overall consumption of gas and electricity in every district with the combined total heights of all dwellings and residences, as well as the volume, size and footprint and other aspects of buildings as population (Stationman, 2017). They believe the factors above are related to the meteorological and physical effects of tall buildings. Temperatures drop and the speed of wind increases due to height. All tall buildings are at risk due to strong winds and many hours of direct sunlight. This would increase the energy used for heating and cooling.

2.9 Chapter summary

This chapter presented the background, history and meaning of sustainability and the theoretical approaches' and interpretations in architecture. The concept of ‘meeting the needs of the present without compromising the ability of future generations to meet their own needs’ is the core factor for sustainable development in many scientific fields and ‘able to be maintained’ is a key to its meaning. There are several classifications and main characteristics with various names in accordance with the feature and concepts of sustainability. The common elements are economic sustainability, sustainability for the environment, and social sustainability. Three pillars (3P) or three E (Environment, Equity, and Economics) (3E) and three dimensions are often referred to. A description of the core principles is shown below.

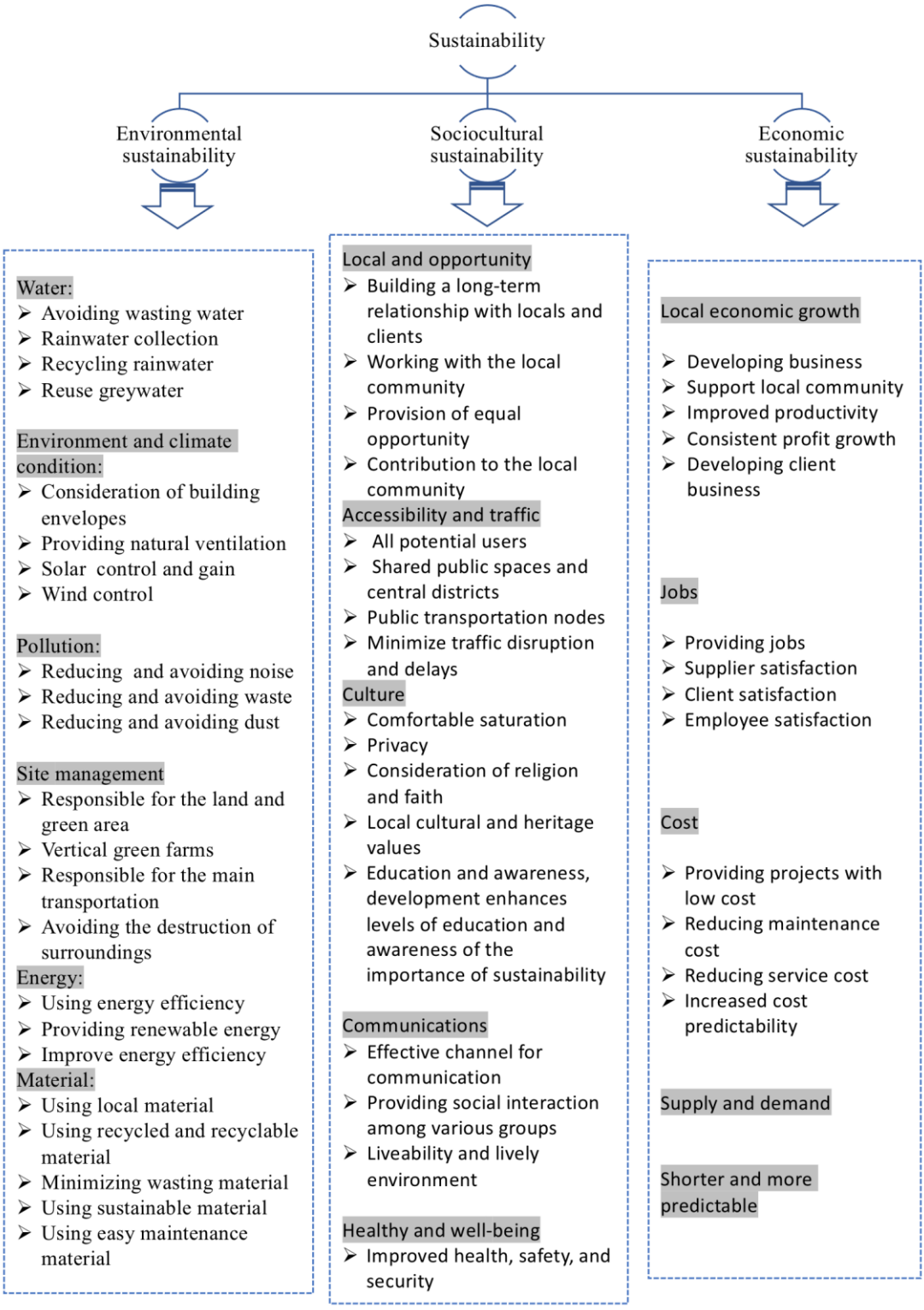


Figure 8: The main principles of sustainability. Source: (by author).

There was a table for different views in this chapter to address the issue of whether high-rise buildings can also be sustainable. The key reason for this being untenable due to their usual conditions, which cannot be readily accompanied by the main

concepts, is that many investigators disagree with high-rise buildings without considering a variety of issues. Many contrasted large and high-rise buildings to low-rise buildings to structure their views. The key topics of their opinions are the sustainability agencies of this type of structure: number of floors; human behaviours and energy demands; the promotion of an active pedestrian life; the shade of the surroundings; their height and size; vertical children's prisons; increased air pollution, blocking visibility; isolating society; the destruction of certain types of social and public life; increased crime.

However, if the continually living, optimistic and imaginative self, along with the favourable sense of the human ego are used to make people happy and proud, big buildings are a symbol of human development. When high-rise buildings are assessed or contrasted with low-rise buildings, it is true that they may not be completely sustainable, but they should be regarded in their own right. The central principle and purpose of sustainable buildings, according to the studied researchs, is that they can provide mankind with no less than the amount they earn and in certain cases more.

In this chapter, compact forms can also contribute to lower energy consumption and use in high-rise buildings, in particular in hot and cold climate conditions, as explained in this chapter. Factors that obviously affect energy consumption in high-rise buildings are also the form plan, orientation, windows-to-wall ratio:

- Energy consumption and electricity use is almost two and a half times higher per square foot in commercial towers with 20 or more floors than in multistorey buildings of six floors or less.
- The consumption of gas increases by almost 40 per cent of the total height.
- Consequently, gross carbon emissions from high-level buildings from gas and

electricity are double those of low-level buildings.

- On average, air-conditioned workplaces have 60% greater carbon emissions than naturally or mechanically ventilated office towers.
- Height reduces air temperature and average wind velocity increases. Higher constructions that stand up above their neighbours are more exposed to these sturdy winds, as well as to more hours of direct sun.

Chapter 3

SUSTAINABILITY MEASUREMENT TOOLS AND DEVELOPING FOR HIGH-RISE BUILDINGS

3.1 Introduction

This chapter addresses the process of evaluating sustainability and its method of rating- that is, its definition and content as well as the various sustainability appraisal methods. The five global measurement tool BREEAM (Building Research Establishment's Environmental Assessment Method) – UK and International; Leadership in Energy, Environmental Design (LEED) – U.S. and International; CASBEE (Comprehensive Assessment System for Building Environmental Efficiency – Japan; Green Star – Australia; are also defined and examined on the basis of the number of requirement specification. There is also a summary of correlations and discrepancies between them.

3.2 Sustainability measurement and rating system

Measurement of sustainability pertains to indicators used as the comparative basic principle for informed management of sustainability. Some measures that are still being developed for sustainable development include ecological, and socio-economic fields for both individual and different combinations. These measures encompass the measurement, evaluation and several other reporting structures, indices, standards, evaluations, indicators and accounts. A wide range of spatial and time scales are used to implement it (Hak, 2007; Bell and Morse, 2008).

Organizational sustainability reporting, three-pronged key point accounting, and sustainability management quality analysis for specific countries, using the environmental sustainable development index and environmental performance index (Hak, 2007; Bell and Morse, 2008). As regards methods to quantify sustainability, a building/project sustainability metric is specifically defined to explicitly describe building/project sustainability through quantifiable values (i.e. rankings, points, ratings). Sustainable development monitoring systems/indicators are required to support decision makers and/or policy makers at all level to concentrate more on sustainable development. However, other than the traditional economic well-being indicators, social, environmental and institutional indicators must also be taken into account in order to achieve a wider, more realistic evaluation of sustainable growth. Sustainability evaluation technologies can be used to achieve several objectives, for instance, to evaluate progress of pre-established targets or just to get an idea how events unfolded at a certain point in time.

3.3 Time line of sustainable rating system development

For decades, the concept of measuring and determining a project's feasibility has been around – with the exponential growth of sustainable and green architecture. But the measurement of sustainable buildings was not formally generalized or structured until the 1990's. In 1990, with the introduction of the BRE Environmental Evaluation Framework (BREEAM), the latest era of appraisal methods was commonly accepted (Reed et al., 2009) (Figure 9). Sustainability rating systems are a complex ancestral mechanism which is especially important as it defines the uniqueness of the rating system. The key explanation for aggregating the ranking methods is the variations between laws, environmental conditions and expectations of sustainable growth. This is the key reason why every nation must develop its own ranking system. Such

developing countries like the US, Canada, Japan, France, the UK and China have their own specialized standards and therefore their own ranking system.

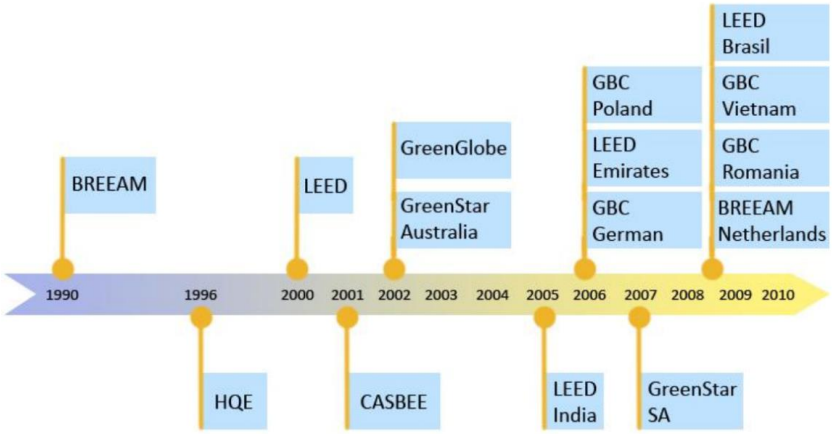


Figure 9: History of the production of ranking systems in different countries. Source: (Khanh, 2012).

3.4 Rating system for sustainable high-rise building

According to Khanh (2012), a noteworthy ranking framework for high-rise projects comprises 29 related tools/systems that can be used more than others across hundreds of sustainability evaluation tools/systems worldwide. These programs have been guided by a complex requirements method by an intensive assessment process. At the conclusion of the appraisal process, the following five structures were ranked the highest that they are BREEAM (Building Research Establishments Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), Green Star and HK-BEAM (Hong Kong Building Environmental Assessment Method).

3.4.1 BREEAM'S rating system (UK)

BREEAM (Building Research Establishments Environmental Assessment Method) is the prevalent and commonly used approach to environmental impact studies for

buildings. The BRE Lt (Building Research Establishment Limited) initiative in the United Kingdom has been involved since 1990. It is the only environmental assessment methodology with an outstanding and long record, according to AACSB (2010). BREEAM has since its inception been the primary measurement framework and development base for several ranking systems, including, Green Star, HK-BEAM and LEED. BREEAM contains a variety of types of architecture. With over 100,000 certified buildings and about 700,000 licensed buildings, it seems to be the most used (BREEAM, 2008; Reeder, 2010). Over the last 20 years, BRE, have built various BREEAM variants for different buildings like courts, environmentally safe houses, factories, health care, prisons, supermarkets and educational institutions.

Evaluation categories and weightings: Systems grant or meet a number of default criteria by awarding points or outcomes. The criteria are defined as 9 assessment classes known as the 'section' in BREEAM with innovation. The 9 assessment categories and their basic statistical weightings (BREEAM, 2008) are as a follow figure.

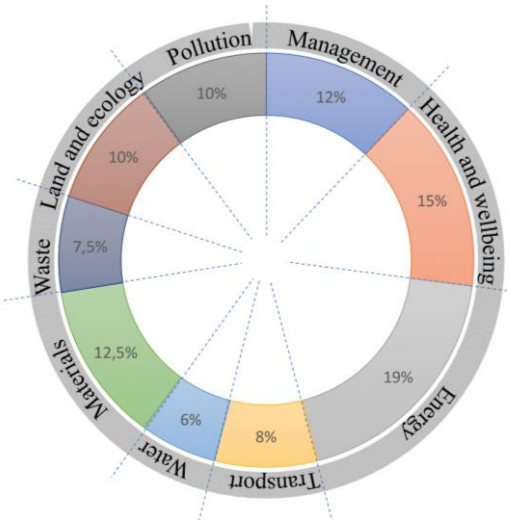


Figure 10: BREEAM categories and weightings. Source: (by author).

Score and evaluation technique: Every building is graded on the standard of Unclassified $(0 < \text{Unclassified} < 30)$, Pass $(30 \leq \text{Pass} < 45)$, Good $(45 \leq \text{Good} < 55)$, Very Good $(55 \leq \text{Very Good} < 70)$, Excellent $(70 \leq \text{Excellent} < 85)$ or Outstanding $(85 \leq \text{Outstanding})$. An additional 10 percent may be added to the overall BREEAM result for each Innovation credit obtained.

3.4.2 LEED's rating system (US)

The LEED (Leadership in Energy and Environmental Design- LEED) green building assessment framework has been developed in the United States of America. The United States Green Building Council (USGBC) provides a set of commercially effective, environmentally sustainable design strategies. Since its inception in 1998, energy and environmental architecture has continued to grow exponentially. It has expanded to about 14,000 initiatives in the United States and about 30 other countries all over the world (Fowler and Rauch, 2006).

Evaluation categories and weightings: A cumulative score of 100 is split into five LEED-NC v3 (LEED, 2009a) categories and innovation in design and regional priority (Figure: 11).

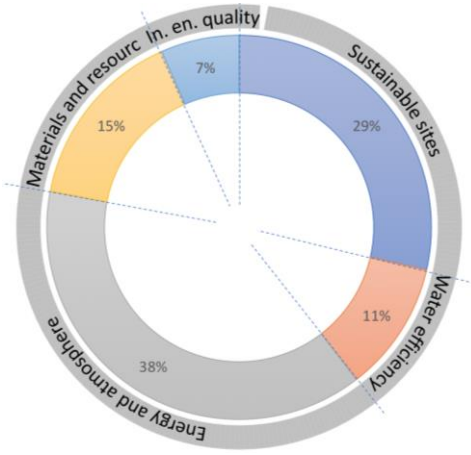


Figure 11: LEED categories and weightings. Source: (by author).

8 out of 100 points are qualifications (for certification) and 92 are core credits. An extra 10-point incentive will be awarded for concept excellence and geographic priority. The inventions in architecture category rewards up to 6 points for products not covered by LEED and for exceeding the credit criteria.

Score and evaluation technique: LEED uses a simple additive system, whereby the cumulative score is determined by applying one or more parameters or alternatives to each credit earned. The building shall be graded as Certified, Silver, Gold or Platinum based on a minimum score of 40, 50, 60 and 80, respectively.

3.4.3 CASBEE's rating system (Japan)

Some of the research done in Japan at the beginning of 2001 led to the discovery of the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) in the world. The CASBEE could be expanded and used for private and public buildings separated into residential and non-residential buildings and other styles of buildings. CASBEE has four basic versions, which are aligned with the various stages of the building life cycle: Pre-Design CASBEE (CASBEE-PD), New Construction CASBEE (CASBEE-NC), Existing Building (CASBEE-EB) and Restoration (CASBEE-RN).

CASBEE is based on three main principles. It is planned first to calculate and track buildings in relation to their life cycle. Secondly, the notion of environmental load (LR) and building efficiency (Q) are the main priorities in terms of results. Thirdly, on the basis of the principle of eco quality, a new BEE (Building Environmental Efficiency) indicator will be implemented (Reed et al., 2009).

Evaluation categories and weightings: The template is grouped into the following assessment groups. The Q (Built Environment Quality) consolidation is divided into three groups: Q1, Q2 and Q3. Data from various sources are combined. The Built-Environment Load (LR) will be further divided into LR1, LR2, and LR3 (table: 4). All test elements such as the Q1, Q2 and Q3 are measured to a maximal value of 1.0 in all calculation coefficients of Q classification. Per thing is compounded by the coefficient of measurement and summarized in SQ; the cumulative Q or LR scores; the cumulative LR scores respectively.

Table 4: CASBEE's indicators. Source: (JaGBC,, 2010a)

Q- Building Environmental Quality and Performance	**LR- Reduction of Building Environmental Loadings**
Q1: Indoor environment - Sonic Environment: Noise, Sound Insulation, Sound Absorption. - Thermal Comfort: Room Temperature Control, Humidity Control, Type of Air Conditioning System. - Lighting and Illumination: Day-lighting, Anti-glare Measures, Illuminance Level, Lighting Controllability. - Air Quality: Source Control, Ventilation, Operation Plan.	**L1: Energy** - Building Thermal Load. - Natural Energy Utilisation: Direct Use of Natural Energy, Converted Use of Renewable Energy. - Efficiency in Building Service System: HVAC System, Ventilation System, Lighting System, Hot Water Supply System, Elevators, Equipment for Improving Energy Efficiency. - Efficiency Operation: Monitoring, Operation and Management System.
Q2: Quality of Services - Service Ability: Functionality and Usability, Amenity, Maintenance Management. - Durability and Reliability: Earthquake Resistance, Service Life of Components, Reliability. - Flexibility and Adaptability: Spatial Margin, Floor Load Margin, Adaptability of Facilities.	**L2: Resources and materials** - Water Resources: Water Saving, Rainwater and Grey Water. - Reducing Usage of Non-renewable Resources: Reducing Usage of Materials, Continuing Use of Existing Structural Skeletons etc., Use of Recycled Materials as Structural Frame Materials, Use of Recycled Materials as Non-structural Materials, Timber from Sustainable Forestry, Efforts to Enhance the Reusability of Components and Materials. - Avoiding the Use of Materials with Pollutant Content: Use of Materials without Harmful Substances, Avoidance of CFCs and Halons.
Q3: Outdoor environment on site - Preservation and Creation of Biotope. - Townscape and Landscape. - Local Characteristics and Outdoor Amenity: Attention to Local Character and Improvement of Comfort, Improvement of the Thermal Environment on Site.	**L3: Off-site environment** - Consideration of Global Warming. - Consideration of Local Environment: Air Pollution, Heat Island Effect, Load on Local Infrastructure. - Consideration of Surrounding Environment: Noise, Vibration and Odour, Wind Damage and Sunlight Obstruction, Light Pollution.

Score and evaluation technique: each indicator is assessed from level 1 to level 5, level 1 is set to follow fundamental criteria, level 3 needs to be categorized to cover traditional socio-technical requirements and level 5 reflects a high level of efficiency. A technical manual contains detailed interpretations of every set of requirements and offers supporting documents and evaluation techniques, where applicable.

3.4.4 Green Star's rating system (Australia)

Green Star is an Australian non-compulsory construction environmental ranking scheme. The Green Building Council for Australian (GBCA), sponsored by BREEAM, launched it in 2003. Since the GBCA was introduced, assessment methods have also been amended to make the distribution process more compliant with the LEED methodology (Reeder, 2010). The Green Star rating criterion scheme consists of eight main categories with innovation.

Evaluation categories and weightings: After the ranking for each category has been determined, results are calculated by divided the amount of scores obtained by the qualifying numbers in each category that consists of eight main categories and multiplied by 100%. For a Green Star, the overall ranking is 100 for the weighted categories and five bonus creativity points.

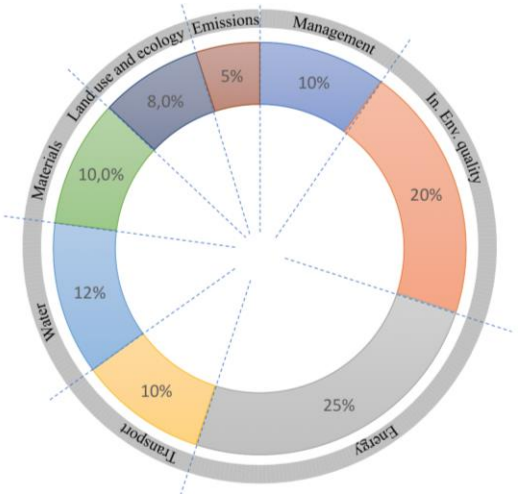


Figure 12: Green Star categories and weightings. Source: (by author).

Score and evaluation technique: A grade of 1 to 6 stars is determined for the overall minimum score of the score of 10, 20, 30, 45 (Best PR), 60 (Australian Excellence) and 75 (World Leader).

3.4.5 HK-BEAM's rating system

HK-BEAM has been initiated since 1996 in Hong Kong to support voluntary initiatives to measure, improve and label the environmental value of buildings with a view to environmental sustainability. It is owned by a non-profit and self-financing organization based in Hong Kong called the BEAM Society. The established HK-BEAM (BEAM Plus 1.1 for existing and new buildings) requirements cover all buildings: air-conditioned, naturally vented, or mixed mode (Smith, 2010).

Evaluation categories and weightings: A total of 100 points was assigned to HK-BEAM in five major categories with number of subcategories(figure: 13) and it has innovations and additions.

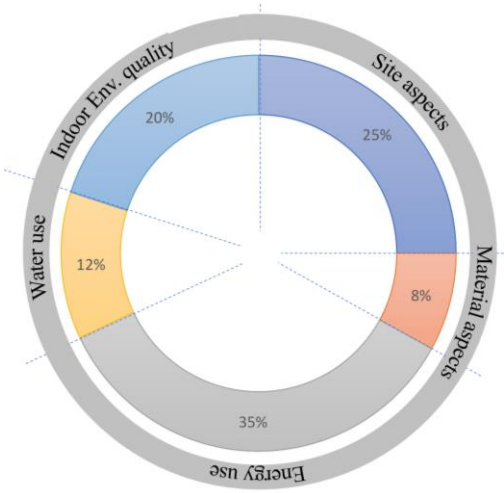


Figure 13: HK-BEAM categories and weightings. Source: (by author).

Score and evaluation technique: HK-rating BEAM's structure does not incorporate a very simple complement process. Based on a minimum score of 40%, 55%, 65% and 75%, the building is rated as bronze, silver, gold or platinum.

3.5 Comparative analysis of BREEAM, LEED, CASBEE, Green Star and HK-BEAM

Each of them has different value and weight for the aspects and different charachteristiees (table: 5 and table: 6).

Table 5: All five according to assessment categories. Prepared by author

Global Measur. tools	Management	Health and wellbeing (IAQ)	Energy	Transport	Materials	Water efficiency	Waste	Land use and ecology (Site Aspects)	Pollution	Innovation	Regional priority	Quality of services
BREAM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
LEED	-	✓	✓	-	✓	✓	-	✓	-	✓	✓	-
CASBEE	-	✓	✓	-	✓	✓	-	✓	✓	-	-	✓
Green Star	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	-
HK-BEAM's	-	✓	✓	-	✓	✓	-	✓	-	✓	-	-

Table 6: Weightings of assessment categories. Prepared by author

Global Measur. tools	Management	Health and wellbeing (IAQ)	Energy	Transport	Materials	Water efficiency	Waste	Land use and ecology (Site Aspects)	Pollution	Innovation	Regional priority	Quality of services
BREAM	12%	15%	19%	8%	12.5%	6%	7.5%	10%	10%	(+10)	-	-
LEED	-	15%	35%	-	15%	10%	-	26%	-	(+6)	(+4)	-
CASBEE	Complex weighting system applied at every level											
Green Star	10%	20%	25%	10%	12%	10%	-	8%	5%	✓	-	-
HK-BEAM's	-	20%	35%	-	8%	12%	-	25%	-	(+5)	-	-

Initiated and place each of them are different as explain all five measurements of sustainability in the table below with rating system and number of categories.

Table 7: Initiated, place and number of categories of all five measurements of sustainability. Source (by author).

Measurement of sustainability	Initiated	Place	Number of Categories
BREAM	1990	UK	10
LEED	1998	US	7
CASBEE	2001	Japan	6 minor under 2 major
Green Star	2003	Australia	9
HK-BEAM	1996	Hong Kong	6

3.6 Gaps in existing studied rating system

Concentration and specialization for high-rise structures: this difference can be easily seen among the measuring instruments that are commonly used to measure high buildings. None is designed for high-rise structures or for high-rise buildings. In other words, it has already been used for the study of big buildings in environmental matters, without taking note of their specialization, and lacking the needs of high-rise buildings. In many countries regardless of whether they are homes, commercial centers, schools or offices, the low and medium-sized buildings all have standardized architecture, operation, and restoration systems. High level structures, on the other hand, have absolutely specific methods, so specialized assessment criteria, especially in the fields of structural technology and technology, base construction and construction facilities, must be carefully assessed.

Many of these versions depend on environment and resource aspects and are ignored in socio-economic terms. They all take even more accountability, which is apparent in

their names; for environment appraisal (such as BREEAM and HK-BEAM), environmental architecture (such as LEED), and environmental efficiency construction (such as CASBEE). Otherwise all economic and socio-cultural factors will or will not be overlooked at the requisite precise stage.

These methods of assessment tend to shape "International Tools" for globalization. That is, they can also be used worldwide. This is a significant difference since existing rating schemes cannot be used in various parts of the world and temperature conditions are not included in the assessment criteria. For overall performance it is the importance of individual components that must be updated. The models can be modified according to ecosystems and climatic conditions and the accuracy of the assessment can therefore be enhanced. Furthermore, these tools also refer to common criteria of particular features that cannot be extended to the description of a requirement in different countries.

There is also a fairly large difference between emerging and developed countries. In order to support the interests of developed countries, it is important to consider and analyze how buildings can lead to social and economic development and environmental sustainability. In other words, because spatial, social and cultural distinctions are dynamic, the boundaries are difficult to establish; and given the variations in environmental circumstances, wages, methods of building and technology, it is impossible that a series of pre-conceived criteria will be formulated for worldwide usage without taking the context into consideration and without having additional ones.

In weightings, it is not clear that certain variables merit more credit than others. The weighting of the part is not clarified in compliance with the different factors, such as the design shape, while the assessment criteria of all building forms remain the same (Tabe: 8).

Table 8: Compare certificate levels of the rating systems. Source: (Khanh, 2012).

Rating systems	BREEAM	LEED	CASBEE	Green star	HK-BEAM
	C	Certified	C	One Star	Bronze
			B-	Two Star	
	Pass				Silver
		Silver	B+	Three Star	
		Gold		Four Star	Gold
	Good				
				Five Star	Platinum
			A		
				Six Star	
	V.Good	Platinum	S		
	Excellent				

3.7 Conclusion and chapter summary

In this chapter, the sustainable appraisal process and the different measures were further explained. Five well-known approaches were included in this chapter in evaluating the viability of high-rise buildings. of these approaches has specific strategies for different metrics, waiting scores and certificates.

Further specifics are intended for the comparison of sustainable building ranking methods in this portion. Many tools are accessible for incorporating environmental design principles into a building process. In examining the efficacy or projected efficiency of the entire system, sustainable approaches of design assessment are used

to turn performance evaluations into tools to evaluate the building output or performance levels of other buildings:

- BREEAM: the leading and commonest used form of building environmental assessment by it and is a crucial implementation basis for other assessment approaches, including LEED, HK-BEAM and Green Star. Nine appraisal criteria must be complied with; they include energy, land use and ecology, management, transport, pollution, health and wellbeing, water, waste, materials, and innovation. The building is assessed on the basis of the following criteria: non-classified, pass, fine, really good, remarkable or outstanding.
- LEED: Green Building Appraisal System was developed by USGBC. This basic approach is used to certify the design and development of profitable buildings. A total of 100 are grouped into five separate categories, namely: energy and atmosphere, sustainable sites, indoor environmental quality, water efficiency, materials and resources, and innovation in design and regional priority. The building is classified as approved (certified, silver, gold or platinum.
- CASBEE: was developed in Japan in 2001. For residential and neighbourhood facilities, CASBEE may either be used. It consists of two main groups namely Q for builsing environmental quality and performance and LR for reduction of building environmental loading and each of them has other three sub groups.
- On the other side, Green Star is a joint environmental management system for Australian constructions. GBCA was formed in 2003 and obtained funding from the BRE and the BREEAM in 2003. Green Star's appraisal criteria provide eight main classes: energy, land use and ecology, indoor environmental quality, management, transport, materials, emissions, water, and innovation. The overall

ranks of a minimum number of stars are 10, 20, 30, 45 (Best Method), 60 (Australian Brilliance) and 75 (Global Leader).

- HK-BEAM has been introduced in Hong Kong since 1996. The comprehensive assessment method includes excellent environmental design, architecture, development, execution, maintenance, repair and management practices. In particular, for HK-BEAM a composite index of 100 is allocated to five separate sections: energy use, site aspects, indoor environmental quality, materials aspects, water use, and innovations and additions. The construction of the building is divided into silver bronze, gold or platinum groups.

Form monitor evaluation, there are some gaps in existing studied Rating System that summarized in table below (table: 9):

Table 9: Different gaps in global rating system for sustainable high-rise buildings.

Various gaps	Features	Improving
Concentration and specialization for high-Rise buildings	Concerns of high-rise buildings totally ignored	Take a glance to considers about high-rise buildings
Specializations for aspects of sustainability	All of them are focusing on environmental and energy aspects and they are neglected social and economic aspects	Taking all three aspects of sustainability
Localization	There is no certain rating systems localized and specialized especially for Erbil city. The main explanation is that current rating systems cannot be implemented in various countries and the environment is not the criterion for the assessment itself.	Design a model that related to the specific area and not internationally
Weightings	It is not clear why certain issues receive more credit than others. It is not explained how the weighting factors can change with the different factors, such as building type, while the assessment criteria remain the same for all building types	Dividing points and weightings logically.

So, according to this chapter, and take a glance to the previews chapter, the measurement scale for high-rise buildings should be go throw different steps that summarized in the figure bellow:

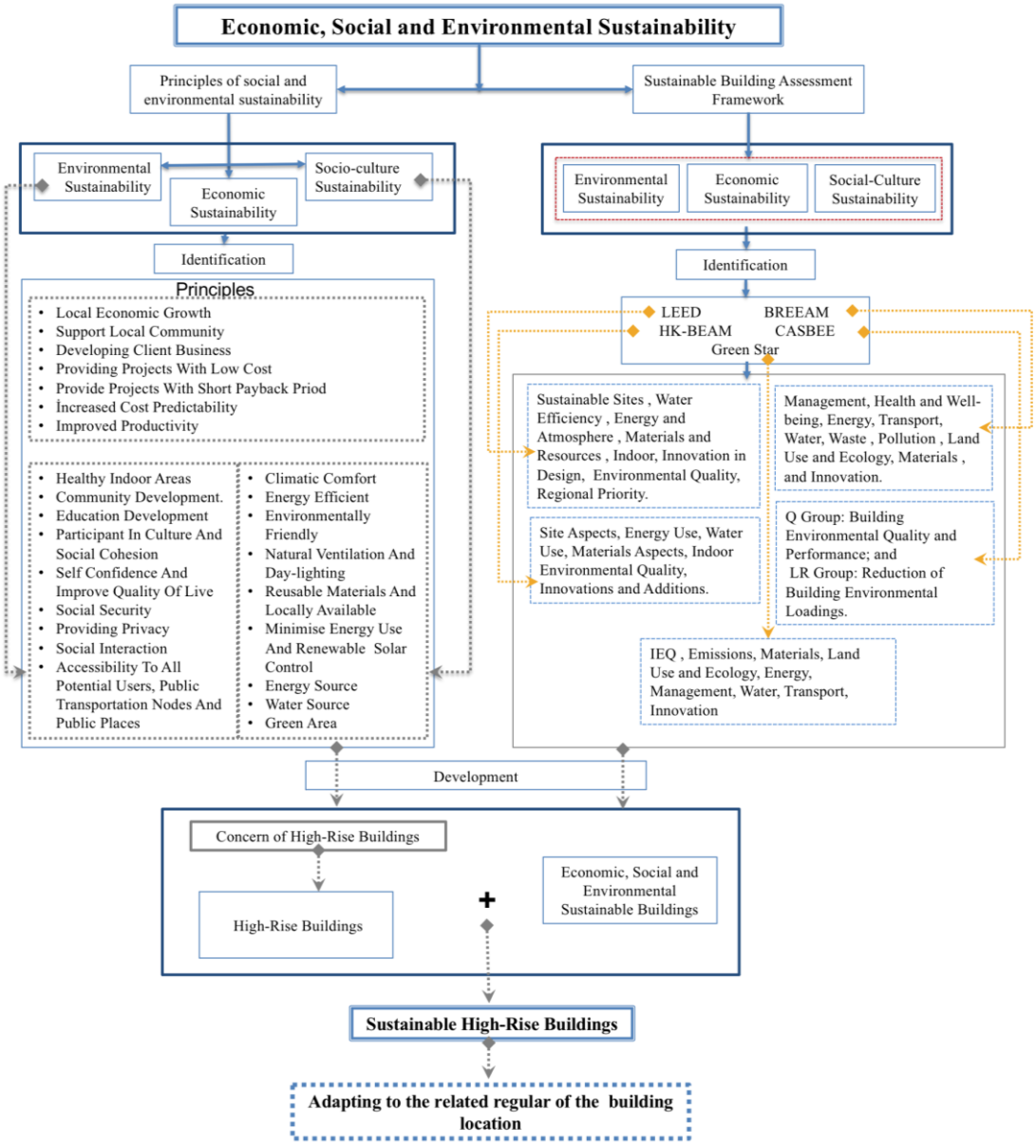


Figure 14: Conceptual model of sustainable high-rise buildings

Chapter 4

CLIMOGRAPHIC AND DEMOGRAPHIC CONDITION AND HIGH-RISE BUILDINGS IN ERBIL CITY

This section specifies an overview of the dominant both of the environmental -socio-economic conditions and background of high-rise buildings in Erbil city.

4.1 Location and geography of the Erbil city

Erbil became the main town of KRI and the city of KRI. Erbil's latitude is 36.2° North and the longitude is 44.02° in Greenwich's East Time zone, and the area is 453 m above sea level (Climate Consultant 6.0) (figure: 15) and lies on differing fertile lands of 15,870 square kilometres.

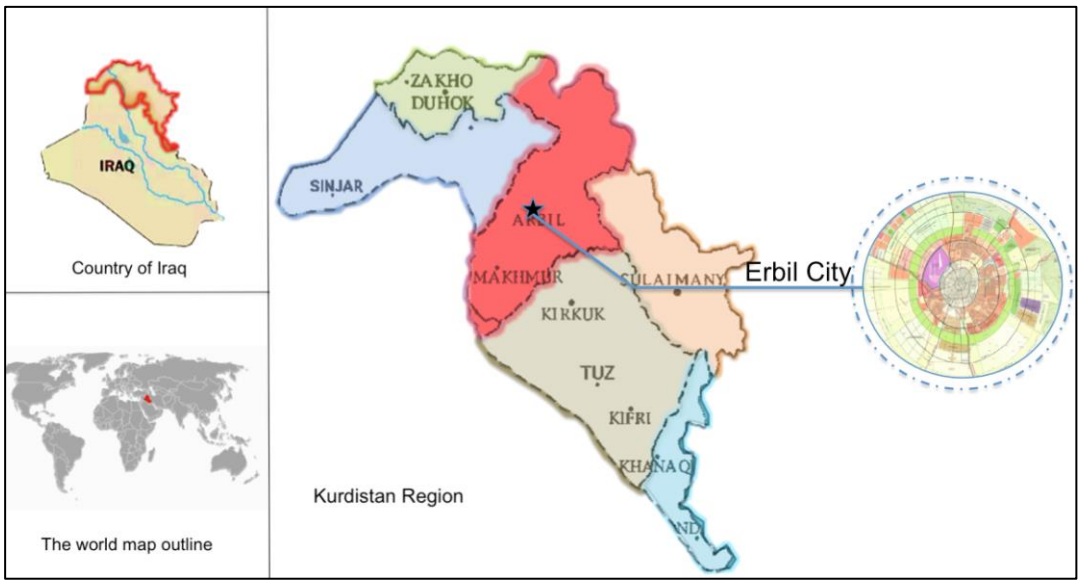


Figure 15: Study area, Erbil city. Source: (by author).

4.2 Topography of Erbil city

The topography of KRI splits into two topographical areas by heavy soil, air conditions and soil type (Ghafor, 2012). High mountain district: the region of this Kurdistan country occupies about 67000 square kilometres, covering 72.51 percent of the region's total area. In this field, most places are situated (Gardi, 2017). Low mountain area: there is a low mountain region in the northeast portion of Kurdistan. It is 27000Km2 in surface and covers 27.49 percent of the territory of KRI (Gardi, 2017) and Erbil happens to be situated in this area.

4.3 Climatic condition

The climate status is a simple feature of positive responses to the world. This research contained Koppen's climate categorization. According to Al-Mousawee and Madfoon (2011), the climatic grouping of Koppen appears to be amongst the most renowned and widely used types. Based on annual and monthly temperature and precipitation, five major climate categories are described. This environment has five forms of atmosphere (Kottek et al., 2006). Environment forms include (Moist Tropical) (A = Moist Tropical), (B = Humid Dry Climate), (C = Warm weather (Moist Middle Latitude)), (D = Cold (Snow)) and (E = Polar) as in figure: 16.

Many scholars have measured the atmosphere in Iraqi Kurdistan. Researchers will see that Kurdistan cannot be clustered into a single climate type. This dilemma is attributed to the large disparity between temperature and precipitation. It is evident that Kurdistan is grouped by classification of Koppen into two different climatic groups (Rasul et al., 2017), which are Mediterranean C and Steppe Climate B (figure: 20). Moreover, the Koppen system's semi-dry continental climate with a subtropical semi-dry (BSh) category is the Kurdistan climate (Rasul et al., 2017) (figure: 16). The study

Erbil based in Kurdistan under the Bsh zoon is the area of choice for this research. Capital letters are used for visualization and demonstration of temperature and rainfall, second and third phase are temperature markers.

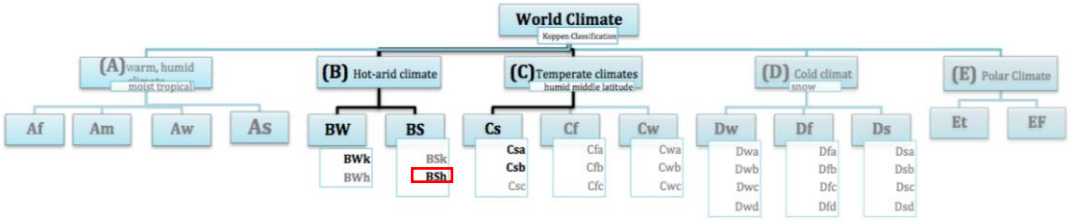


Figure 16: Climate classification of the KRG and Erbil city in particular among the world. Source: (by author from Chen, 2014).

4.3.1 Solar radiation

The reasons given regarding hotness in the summer and coldness in the winter were connected to the sun's angle in the atmosphere. The solar angle in July hits its highest and in January it sinks to its lowest. The solar angle, also defined as radiation of the atmosphere, passes through the summer a smaller region until it hits the earth's surface where it has the greatest sensitivity to the sun's radiation. The longer period of sunshine in summer and during daytime is another cause for warming. This is to suggest that the light sparkles during July and June for around 15 hours. In January, the sun rises in winter months for a short span of about 10 months (Figure: 17).

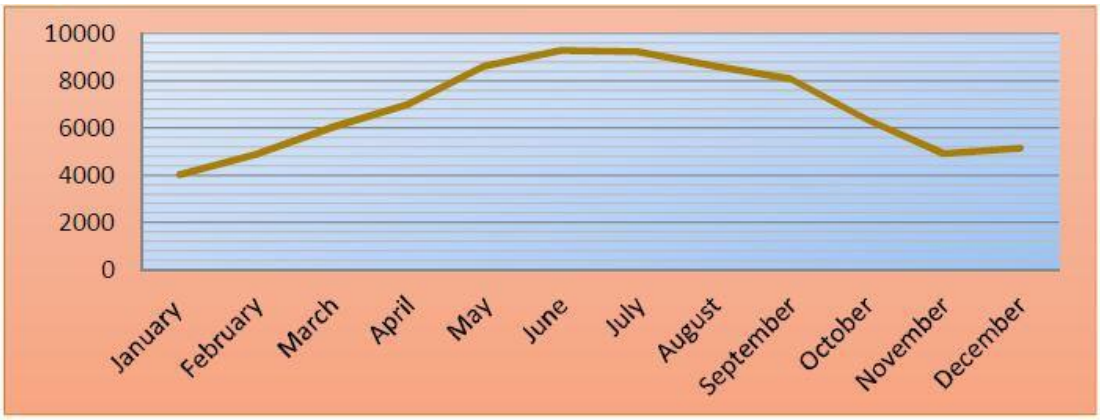


Figure 17: Solar radiation intensity in (Wh/m). Source: (Weather file of Erbil).

4.3.2 Air temperature

Erbil has two main environmental factors, as previously mentioned. Which is hot, dry, cold and wet. There is a big disparity between the average maximum temperature and the average lowest temperature per month of the year. The highest average temperature in three months goes above 40 degrees Celsius. The average lowest temperature in January and February dropped below zero degrees.

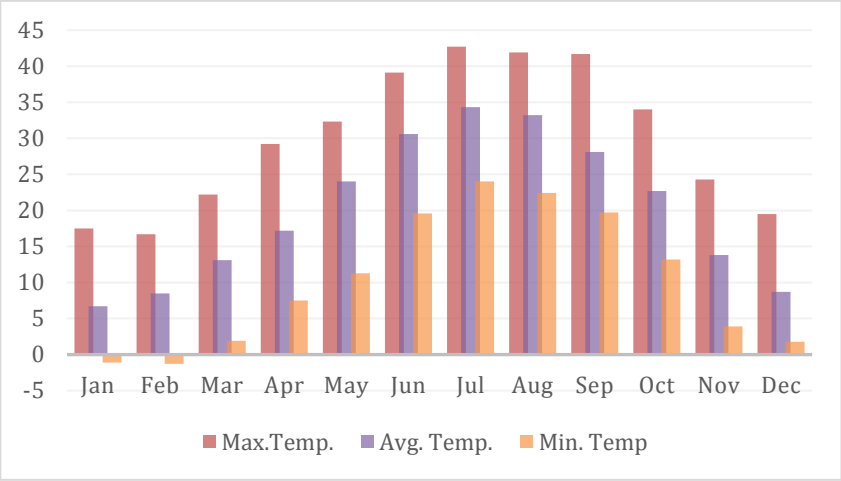


Figure 18: Maximum average, minimum average and average temperatures in Erbil city. Source: (Weather file of Erbil).

Based on the psychometric scheme and the comfort zone in relation to the average temperature and relative humidity, the Erbil weather conditions are defined as having less than or no comfortable weather conditions. The haven of the psychometric map was less than one quarter a year. The cycle of spring between May and October and autumn is more desirable than other months, respectively. This ensures that favorable times do not need an air-conditioning device and there is no sort of heating and cooling energy use (figure: 19).

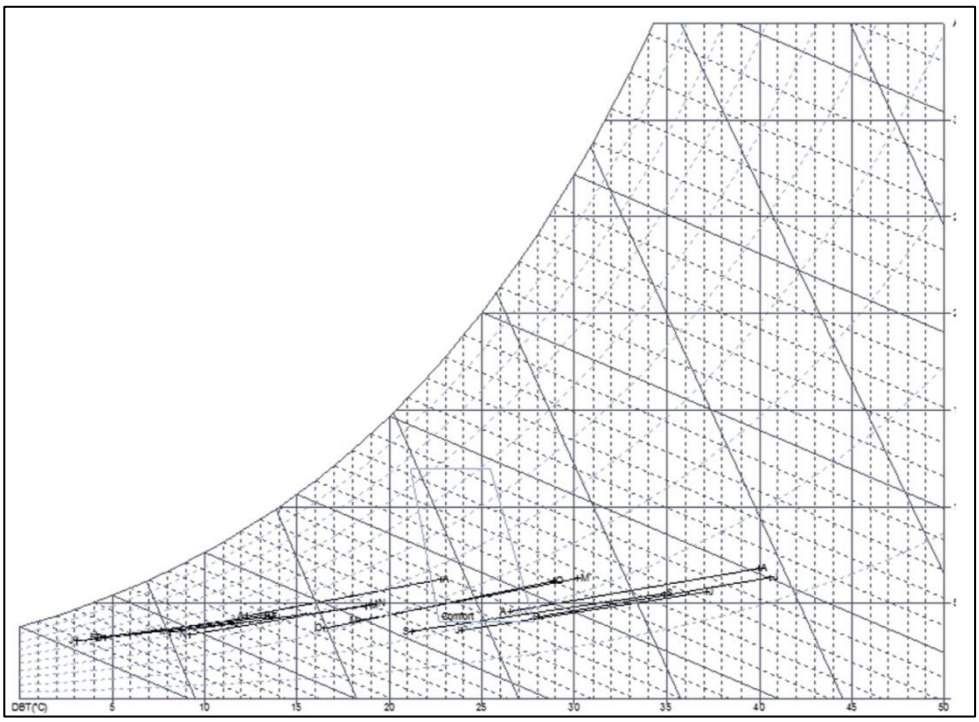


Figure 19: Psychometric chart and comfortable zone in Erbil city. Source: (weather file of Erbil).

4.3.3 Relative humidity

During the year, relative moisture differs from 66% to 26% in 9:00 in the morning. And from 51percent to 17percent RH at 3 in the afternoon. In July and August, relative humidity is poor. This applies to the air temperature and the water evaporation potential. In other terms, in the summer season, the lowest relative humidity is 17% at 3 in the afternoon in July. Relative humidity rises to 66 percent in December at 9 in the morning (figure: 20).

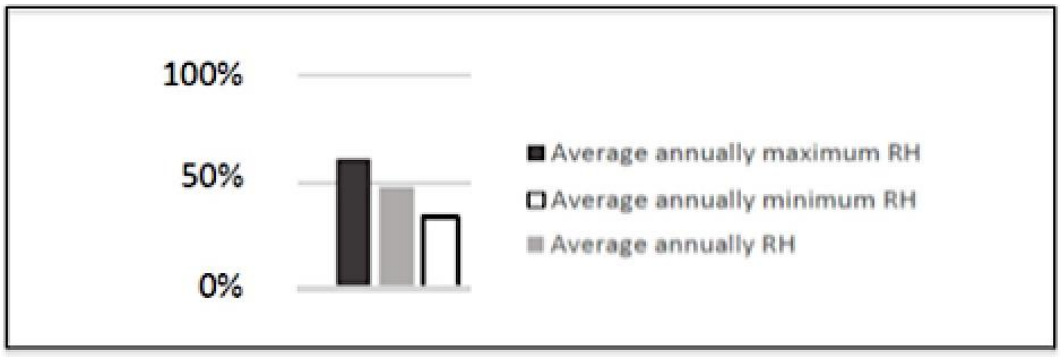


Figure 20: Average relative humidity of Erbil city. Source: (Husami, 2007).

4.3.4 Wind and moisture

Having experience in wind path and wind speed measurements and frequency allocation over the day, month and year is very relevant both spatially and temporally for wind analysis. Iraq's wind power grows as it moves from north to south due to the high air temperature. It has already been concluded that the Weibull model is an efficient instrument used in wind power assessment and can be used to provide energy to several areas of Iraq. A brief look in figure 21 shows the prevailing annual winds in the Erbil. Figure 22 demonstrates monthly wind speed details at 50 and 10 meters in height.

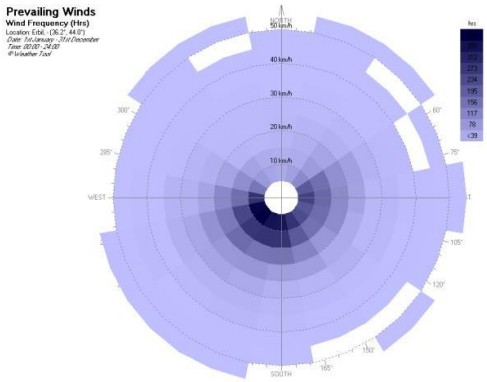


Figure 21: Annually prevailing winds in Erbil city. Source: (Erbil weather tool 2011).

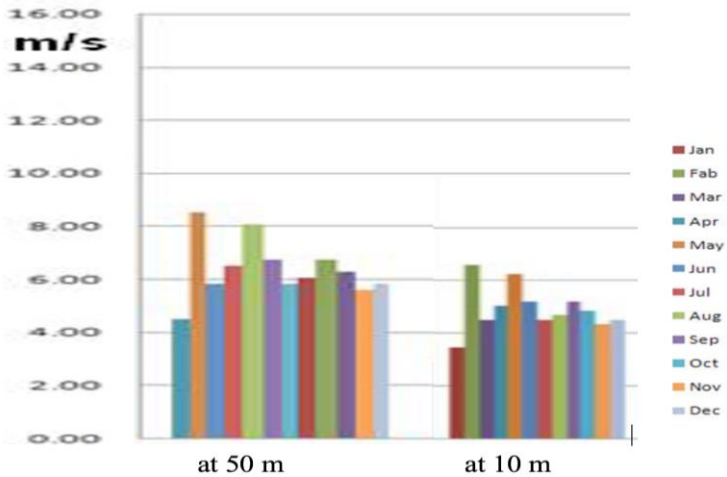


Figure 22: Monthly wind speed records at 50 m and 10m heights in Erbil city. Source: (Husami, 2007).

4.4 Demographic of Erbil city

4.4.1 Historical introduction of Erbil city

Scientists found Erbil a crib of the human race. Metropolitan existence in Erbil can date back to 6 000 BC and is one of the old cities of the world and the Governor's controls have become traces of the past thousands of years. In the center of the town former castle of Erbil can be seen (Erbil Chamber of Commerce and Industry; McDermid, 2010), which is estimated at around 6 000-8000 years of age (Morris, 1994) (figure: 23). Contemporary reports regarding past events in the area are related to Kurdish nationalism and a promotion of the creation of a Kurdish state that does not depend on the Baghdad governorate (NGO, 2015). Today, Erbil castle is not only situated in Erbil, but also in the Middle East and across the world. According to UNESCO World Heritage, the region was recently regarded as one of the world's oldest metropolitan areas. The construction and layout of the action plan, in particular the circulatory network of the community, are dramatically affected there are some charechterestice bellow:

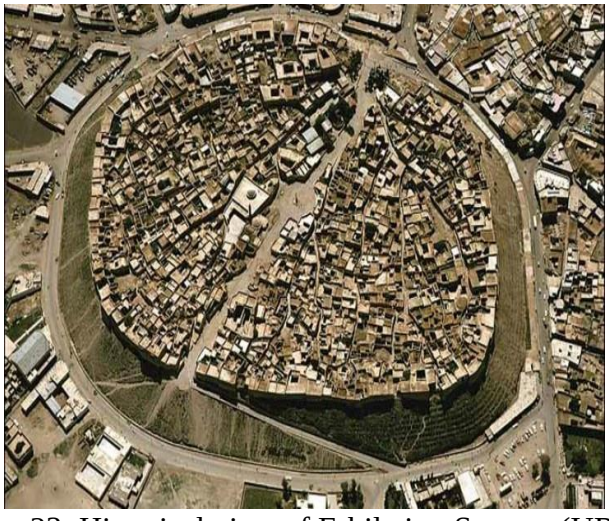


Figure 23: Historical view of Erbil city. Source: (URL 2).

- Urban Development:

In 1920, Erbil, considered a historic metropolitan city, experienced major advances in different periods after Iraq was established. It also culminated in economic growth since Erbil was autonomous and could control its own capital and finances. This gave the metropolis the opportunity to accelerate its reconstruction, development and stability and a harm-free atmosphere as opposed to other Iraqi metropolises (Yasin, 2011), particularly in 2003 when its growth was considerable. The form and height of the castle has provided the area surrounding it a certain urban touch as concentrated rings and a radial axis. Throughout its existence, the castle has become the center of Erbil's economic growth (Figure: 24).

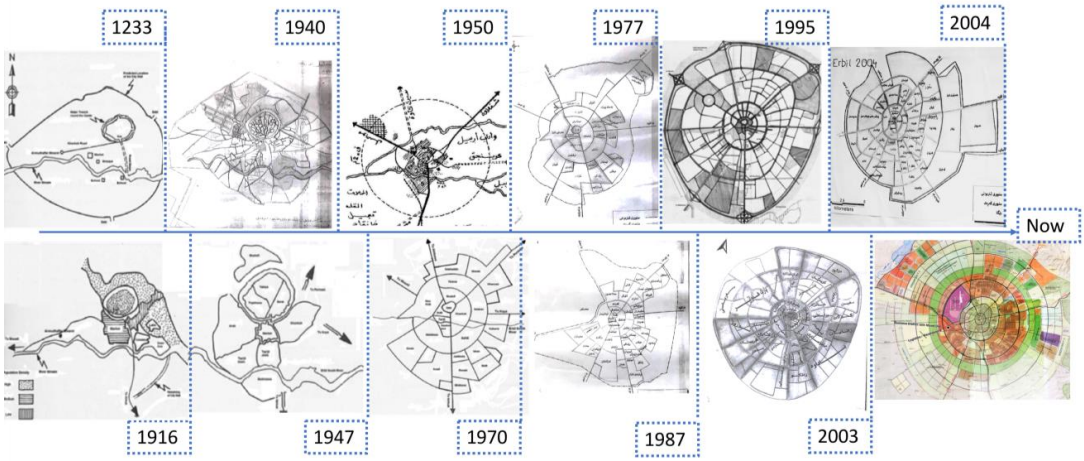


Figure 24: Advancement of the metropolis of Erbil. Source: (by author from Erbil municipality documents).

Almost the whole city was developed between 1920 and 2013 when Iraq was formed (Sabr, 2014). But once again the rise of private investment and in-depth planning tend to be detrimental in the region around this old city. The key unexpected progress was random, with no continuing plans but affected by the unpredictable effects of increasing population and economic capital (Rydin, 2010).

- Transportation:

Kurdistan's transport infrastructure system is obsolete and has not been developed domestically or globally. In relation to building structures, the metropolis is without a completely established and dependable management. In spite of the fact that the transportation system is shown as a credible nominee to be given the award as Arab's best Tourism Capital for 2014, there exists a traffic system which is stern, with no state of the art buses, no accessible road networks, no proper and enough bus stations and reliable bus timetable are absent, which leaves numerous people no other choice but to rely on cabs completely and private cars. This has resulted in a rise in the available taxis in Erbil (Ibrahim et al., 2015). As per latest Erbil traffic police department figures, over 69,000 taxis have been certified in Erbil. This has contributed to increased traffic jams. On the other hand, environmental and visual emissions has risen dramatically (Jassim et al., 2013). Furthermore, road networks are not up to standard, particularly rural road networks, which happens to be among the important priorities for rural community growth. In line with global standards, for every 100 inhabitants/km2 density requires 1 km/km2 of roads. The region's road density is approximately 0.2 km/km2, whereas this value must hit 0.4 km/km2, i.e. the distance of the road must be about 44,720 km (KRG, 2013).

4.4.2 Population of Erbil city

Kurdistan has 5.6 million residents. The area has a young and increasing population, 36 percent between 0 and 14 years of age and just 4 percent over 63 years of age. More than half of workers are under 20 (URL 3). In the past hundred years, the Erbil area has seen a tremendous growth in population and development programs. Per year, the population rises at 2.9% (Dizayee, 2014), while in 2015, the population of Erbil grew by 1.530.722 (Erbil Governorate Profile, 2015).

4.4.3 Social aspects

Belief structure and the ethnic community: Sunni Islam is the main faith of Erbil and Kurds are the major ethnic group. Christian sects live in Erbil, mainly in the Ainkawa region such as Chaldeans, Assyrians and Armenians. The Kaka'i (Ahl Al-Haq) and Yazidis are both housed in the governorate. Some Turkmen citizens live in Erbil, Sunni Islamic region. (UNHCR, 2007; NGO, 2015).

Social attitude regarding to the energy and electicity use, When electricity from the Kurdistan area is supplied from the national grid, customers try to make use of the services with all electric domestic devices particularly if they know that it is free. In other words, during the availability of national electricity in any area of the region the consumers are trying to enjoy electricity services as much as possible by operating all electrical appliances at home, especially if they know that they are not paying for it. But the situation is different for private power supplies as the volume of electrical equipment is limited and electrical appliances use tremendous quantities of electricity. This is not a free utility (Husami, 2007). Such acts will strengthen if the government could supply affordable electricity that is always available. As the present supply of power is irregular and ineffective, the authority is arguing that it should be charged by the consumer. Electricity is only usable in certain areas of Kurdistan at midnight. If the government continues to provide power constantly, people are able to pay (Husami, 2007).

4.4.4 Economic aspects

Erbil has been the center of commercial relations between the cities of Kurdistan such as Mosul and Baghdad since time immemorial. Despite that the city of Erbil, the summer capital of Iraq and is now the capital of Iraqi Kurdistan at the same time, the economic capital of Iraq, which is known starting point of the economy to Iraq (Erbil

chamber of commerce and Industry). Because of the security available in the city, it is a strong economic centre, with a large number of local factories and domestic and foreign companies in Iraq.

More than 15 international fairs are organized annually in Erbil, at which hundreds of international corporations participate. The area has an ideal field for cattle, wheat, and barley development throughout the years (Erbil Chamber of Commerce and Industry). Agriculture is hindered by the lack of modern agricultural technology and equipment in different regions of the governorate (Erbil Governorate Profile, 2015).

Moreover, the city of Erbil is the centre of business and imports from Iraq through the Chamber of Commerce and Industry of Erbil. The majority of the people function in agriculture, manufacture and transport, while some are government employees (Erbil Chamber of Commerce and Industry). Defense and overseas investment laws stimulated a great deal of overseas investment and encouraged cross-border trade with Turkey. In December 2003 an international airport was commissioned in Erbil.

This economic development caused a building upturn. The governorate holds several higher education schools. Despite these economic breakthroughs, unemployment, inflation and the governorate's poor government sector continue. The tremendous influx of IDPs and migrants from the US is also disadvantaging the local population (Erbil Governorate Profile, 2015).

4.5 Environment dimensions

Regarding to problems of environment, Erbil is faced with environmental concerns such as waste water treatment, water transport, soil conservation, air pollution, noise

pollution, carbon emissions attributable to a rapid growth of vehicle populations and the significant rise of generators in the entire sub-region.

4.5.1 Air pollution

The World Health Organisation (WHO) reports a disturbing report revealing that 92 percent of the world's population actually lives in areas deemed low environmental pollution quality, which indicates that 9 out of 10 citizens in the nation breathe poorly. According to the estimates of the Ministry of Environment of Iraq, 122 storms have been reported by dust and 283 dusty day storms and experts forecast that up to 300 times further dust storms will grow in the next ten years (Kobler, 2013). Transport from far away of organic and anthropogenic pollutants is unavoidable (Varga et al., 2013). The dust levels in Erbil is expected to decrease (97.6 gm/m2.year) on the basis of the analysis by Amin et al. (2017). The broad dust emission concentration due to accumulated particles from moveable vehicles, vehicle combustion and a fast-growing area with a high population in Erbil city is created in Erbil city (figure: 25).

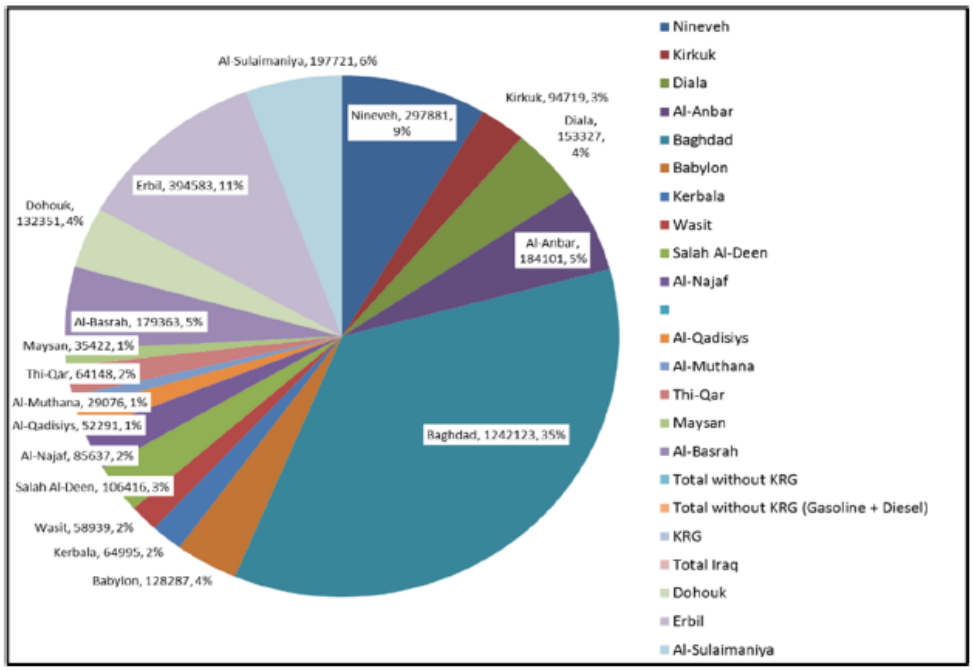


Figure 25: Distribution profile of automobile in Iraq in 2013. Source: (Jassim et al., 2014).

The source of dust storm of the Iraqi Kurdistan region originates from the middle and southern desert of Iraq. There are five major emissions from traffic delays triggered by multiple automobiles and industrial practices have a detrimental influence on the wellbeing of several people. The number of registered cars in Iraq has risen significantly (Republic of Iraq – Ministry of Planning 2013). This is apparent in the amount of CO^2 pollution.

4.5.2 Sound pollution

Noise Pollution is commonly recognized as contaminants arising from strange noises (Carera and Lee, 2000) is an ecological problem that people face before their birth and during existence. The problems of noise pollution were discussed both in Erbil and in other capitals. Some of the advantages Erbil enjoyed were fast growth and investment, population and vehicle growth, the renovation of Erbil International Airport and the large creation of homes, industries and industrial regions.

4.5.3 Water pollution

A greater section of the region area does not possess any or insufficient portable as well as secured water connecting systems. The prevailing systems having very low working processes, making their operability questionable. Barzinji et al. (2014), performed a full evaluation of Hawler groundwater areas, concluding that Hawler site has reasonably good reservoirs with good quality water mostly appropriate for human consumption and farming purposes. Barzinji et al. (2014) estimated that, approximately 97.15 % well water sampled was drinkable and 87.15 % recorded no rise. They detected comparatively high volume of nitrate (14-147 mgL-1) owing to water pollution across the city, as a consequence of the waste passage.

The reliability of water and the well-being of humans are in multiple respects intertwined (Brudtland, 2001). The recommendations of the World Health

Organization (WHO), stated that, the fraction of contaminants found in a sample of water under study is required not to exceed 0.05 to recognize it as clean and secure. They indicated that 11% of test samples (largely water wells) from Erbil metropolitan and its environs were polluted with bacteria, 20% and 40% of samples collected from quasi urban and rural parts of Erbil region were also polluted with bacteria respectively. Different issues like leaks visible in the municipal distribution channel are existent in the water structure in Erbil. Owing to this, employing it as drinkable water becomes a challenge. The pipelines are partially inefficient due their narrowness, this tends to increase pressure drops and minimizes stress and fluidity (Jassm et al., 2013).

4.5.4 Waste management

No independent urban sewage scheme and no sanitary deposit system, all municipal solid waste was gathered and drained into open fields or sinks (Shekha, 2011). Recently, the municipal administration of Erbil supervised the operations of the Janaen firm in the city, which was contracted to manage domestic waste disposal, and then sort out the waste to its different constituents (Shekha, 2011). Domestic waste in Erbil was primarily organic, the bulk of these being agricultural scraps 76%, with papers being 5% and yard peelings 3%, whereas inorganic content was expressed in 5% plastics and nylon, 4% glass and porcelain and 3% metals. A bulk of the domiciliary waste under research can be recycled or potentially recycled. In terms of percentages, 13.79% waste could undergo recycling, 85.87% could be potentially recycled and finally 0.34% not recyclable. The estimated waste generation for low, middle and high income households was 0.253, 0.424 and 0.447 kg/day respectively. The normal waste generation in day is estimated to amount to 400 tons in 2009, with a production anticipated to reach 12002 tons per month and 144028 tonnes per year (Shekha, 2011)

(figure: 26). The high values obtained, makes waste management in Erbil very necessary.

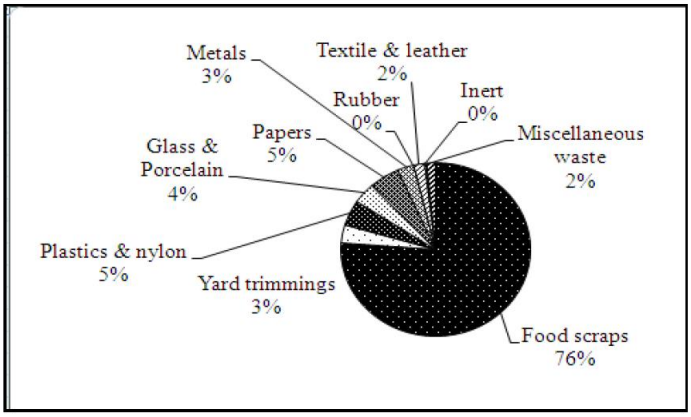


Figure 26: Percentage of different waste components in Erbil city. Source: (Shekha, 2011)

Issues associated with the waste management strategy in Erbil:

1. On a daily basis, Erbil produces considerable amount of waste; which amounts to 2000 tons per day.
2. The households and other producers of the waste do not sort out the disposed waste
3. The waste management approach employed by households and other producers is not effective
4. Owing to the lack of use of adequate models and reliable equipment the waste disposal by dump trucks is really not sustainable.
5. The transfer of the produced waste to the planned location is not effective due to additional costs and wastes.
6. The waste management method used is hardly sustainable nor medically safe.
7. Liquid waste is not properly treated or controlled by the authorities, this creates enormous challenges for sustainable practices and quality of life of the city of Erbil.

4.6 Energy constituencies and energy crisis in the region

In the 1970's, as oil prices were booming, many Middle Eastern countries used oil revenue to set up a new state and generate other financial resources than just oil. This was exactly what transpired in the United Arab Emirates, Kuwait and Qatar, when other nations preferred to utilize the massive oil proceeds for the procurement of weaponry and for the creation of a militarized nation, a typical example being Iraq. The current administration manning the region area as well as preceding authorities have rarely been interested in building commercial, industry oriented and agriculture. This has kept the area underdeveloped and entirely reliant on the national government for basic amenities (Husami, 2007).

The region was gradually deprived of fiscal, agricultural, and technological assets that led to prevalent hardship and starvation in an area that was formerly defined by the vast arable land and water supplies as Iraq's pot of gold (Husami, 2007). Furthermore, the Kurdish leadership has not built a significant number of evident facilities over the last therty years. One may claim that the region is very low in facilities. Despite the large assets of fossil energy, the region still struggles from the severe scarcity of energy supplies. The local authority is also unable to promise that the area can obtain continuous fuel and electricity.

4.6.1 Renewable energy in the region

The region is still in its pre-elementary phase of the idea of green energy and its planned major presence across the globe. The idea of renewable energies for citizens in all Kurdish societies would take extensive education and motivation. In Kurdistan, green energy is largely untapped and requires further research. Investigation of the major changes in the climate parameters were considered. In order to forecast

particular renewable energy types, rainfall intensity, wind velocity, sunlight, daily solar radiation serve as indicators. The position of the regions limits region's forms of renewables to include hydroelectric power, wind energy, solar energy, biomass and geothermal energy.

The findings indicated that the field of KRI has great prospects for hydroelectric power, wind, solar and biomass (Husami, 2007). Usually, private-sector solar plants have a limited capacity of about 50MW. While it is widely accepted that renewable sources are not sufficient to fulfill the Kurdistan region's energy requirement independently, renewables have an impact on achieving long-term power generation targets (World Bank Group, 2016).

4.6.2 Electricity

Power is supplied primarily from the national grid in Erbil and by two district hydroelectric power stations namely, Dokan and Darbandikhan. The facilities produce 500MW each day for Erbil and Sulaymaniyah Governorates (World Bank group, 2016). The National grid supply for the area, delivered 200MW of power until the end of June 2006; however, the national energy crises have since decreased this number to about half. District cities of about 125 in number and surrounding villages are generally served by the general electric grid while isolated communities are supplied primarily by local power generators (Husami, 2007). The Minister of Electricity in KRG, planned to generate adequate energy in the region in 2009, to help maintain the lights on for 24 hours each day but has not succeed.

Electric power resources in the Erbil region continue to be unreliable. The deliveries vary from period to period, and the region obtained 5 to 7hrs of electric power on average on daily basis at the end of August 2007. In 2006 and 2007, the shortage of

energy led to a series of mass remonstrations. In order to mitigate the crisis, 80% of the populace utilize independent generators to satisfy their demands in terms of power generation. In addition to 64,000 ID construction costs for both personal and local generators, the expense per ampère is approximately 8,500 ID. The rising cost of gasoline has resulted in estimates that households invest significant portion of their incomes on energy in certain places (World Bank group, 2016).

4.7 Hazards of humans and natural

4.7.1 Fire risks

Erbil has endured a number of fire incidents lately and in many instances the lack of appropriate safety precautions, administrative ineffectiveness, inadequate equipment and a lack of public knowledge worsen this issue. Erbil has seven fire branches, as seen in the figure bellow. Fire departments only protect 52% of the city's entire territory, which implies that 48% of the Erbil area struggles from the delays and challenges of supplying fire department facilities in compliance with international requirements (Wahab and Khayyat, 2014). In certain instances, the limited road network in the area which blocks fire service equipment accessing, traveling and working in an emergency and reduced accessibility on the road system raises the reaction duration of the authorities and in the end, severe fire failure.

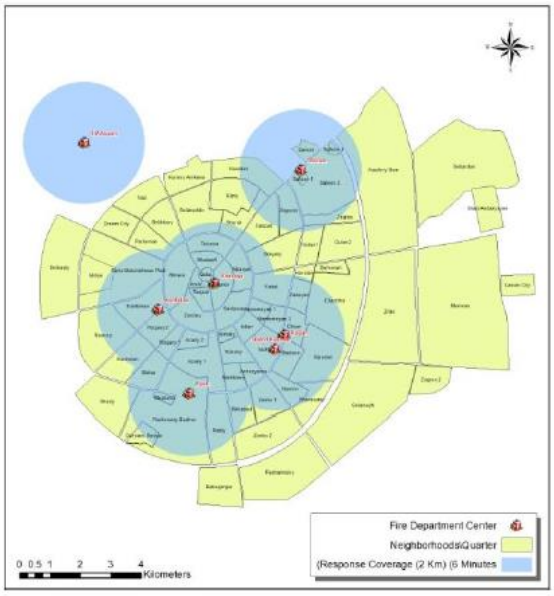


Figure 27: Geographic distribution of current fire stations in Erbil and coverage area. Source: (Wahab and Khayyat, 2014).

Civil defence services (Fire Department Services) is described by the Parliament of KRI as, a service that seeks to take preventive action and implement fire-resistant works and prevent their spread" (Iraq Official Gazette 1993).

The civil defence law goals in the Iraqi Kurdistan Region are as follows:

A. Ensure the protection and safety of citizens and their land and natural resources against fire hazards.
B. Firefighting and avoiding their propagation in residential areas.
C. Ensure the fire department facilities in the whole city are protected up to international guidelines.

4.7.2 Earthquakes

Thr region was struck by one of the most horrific and devastating events of the sort on 12 November 2017; a huge earthquake. This earthquake caused terrible destruction to lives and possessions. According to the American Geological Survey, the epicenter of the earthquake was confirmed to be 30 km south of Halabja, with a focal distance of

19 km. According to Professor Nazar Numan, a famous scholar of geology and Provost of the American University of Kurdistan, the last earthquake of this extent struck the area nearly a century ago. Though the disaster in Kurdistan was recorded to be 7.3 on a richter scale, the quakes experienced in the entire region were far less intense than those experienced in Kermanshah, Iranian Kurdistan.

A review of existing housing conditions in the region shows that an overwhelming number of accommodation facilities cannot resist seismic loads caused by an earthquake of this extent. The small buildings and apartments constructed in Kurdistan have historically no suitable correlation between the existing building and the foundation. The loads imposed on these buildings are then moved to the earth by supporting pillars that can just tolerate gravitational force. In addition, the panels are not completely attached to the supporting pillars and they require narrow friction zones to sustain the effect of the lateral forces. If the buildings and their foundations are hit by lateral forces, including an earthquake or major wind-related impacts, they will weaken the building significantly, almost to the brink of destruction. Any personal housing or villa owner depends on personal investment to construct their own homes employing earthquake-resistant systems. However, in the region, some high-rise buildings are built to withstand not just earthquakes but also serious winds.

4.7.3 Rainstorm

Global change in atmosphere has contributed to regular threats such as floods and water shortages; temporarily, it has also impacted geographical risks such as earthquakes (UNIRD, 2009; Crozier, 2010). The region is also confronted with natural dangers.

Erbil experienced severe downpours and consequently major flooding, which rendered

roads and dwellings with occupants stranded. The lack of proper water and sewage maintenance is a prevalent characteristic of the city of Erbil, especially in the rainy period. It also destroys transportation infrastructure and affects the tourism business. Often schooling in Erbil as elsewhere in the north of Iraq is suspended in a year as a protection measure, as more torrential rain and floods are expected.

4.8 High-rise building construction in Erbil city

Erbil city in north of Iraq also participate in the recording high rise buildings especially in the past few decade. For example, Mnaray Choly which is located in Erbil city, was considered the tallest mnara when it was initially constructed.

One of the main and essential departments in the Kurdistan Regional Government (KRG) is the Ministry of Construction and Housing (MOCAH). The area of north of Iraq situation was poorest in terms of facilities owing to the preceding Iraqi administrations' destruction and disruptive tactics. Therefore, in the early phases of its inception in 2004, MOCAH's mission was very challenging to address the considerable imperative demands. This resulted in unsatisfactory performance because of the lack of policy, a lack of sufficient budget and inadequate task reliability management. Following the fall of the Iraqi regime in 2003, MOCAH was charged with addressing the big pressing need to build and improve infrastructures. Relative to periods preceding 2003, MOCAH accomplished several important objectives in regard to building and transportation programs. MOCAH's internal operating system and policies do not address immediate and potential infrastructure requirements in the Kurdistan Region in the most effective way.

The key task of MOCAH is the construction of buildings and housing. Its vision is the provision of proper housing for the surging populace. Construction is a thriving market, particularly in the housing industry in the Kurdistan region. In Kurdistan, a large percentage reside in their private homes. In the whole region, 79% of residents reside in their own homes and have purchased them entirely. This is not entirely the case in the urban locations and remote locations where the percentages 77 and 89 respectively. Though there is significant acceleration in construction, private family abodes remain high, even with large families.

Owing to some recent research, economic and social studies, projections of the typical residential unit and evaluations of current housing standards, these estimates suggest the following details. All of these evaluations are dependent on the findings listed below (Ministry of Planning, 2012):

- There is no full data on the scale of dwellings and a huge deficit would occur if old population and housing surveys carried out many years back are used.
- Everything data suggests a housing crisis.
- There are significant differences in the degree of housing satisfaction among the numerous provinces.
- The challenges of infrastructure deficits, congestion and limited accommodation are far more severe in remote locations than in urban centers. This is because, earlier infrastructure programs have overlooked these areas and exempted them from all the advantages of living in urban areas. The housing deficiency study reveals that more than 37 % of the remote populace in this area suffer from a severe deficiency. (Essential activation code number seven of 2008 and to include low-income accommodation for citizens).

Urban planning and urban policy are decentralized, collaboration is poor and roles are conflicting. Furthermore, the chain of command for organizing, selection and permissions is not so clear. In addition, due to the poor local structure, the mechanism does not encourage citizen involvement or participation (KRG Ministry of Planning and UNDP, 2012). The city is designed on a circular structure of rings from its historical citadel. Ring five development densities are limited, spanning from 100 to 200 people per hectare. The current urban fabric up to ring five is capable of accounting for demographic rise till 2015. The town extends outside of ring five, amid this capability, as a result of various new construction and personal financing. The deployment of the facilities cannot however meet the distributed construction pace (KRG Ministry of Planning and UNDP, 2012).

For Industrial Buildings Permits, February 2000: A discussion was convened in the Ministry's office on 26 February 2000 under the coordination of the Director-General of Physical Planning and the Director of Physical Planning for the Province of Erbil and officials of the commission approving authorization for commercial structures built in compliance with the Ministry Order No. 4094 of 17-8-1998. Several concerns were raised during the discussion regarding the Criteria for authorizing approval for commercial structures. They agreed to revisit the guidelines (Ministry of Planning) following consultation and review of the subject and to promote the interests of people and enable them to establish and redevelop villages and towns, as shown by several points relating to high-rise structures below:

- *Space and corridors*

It can be seen in the tble bellow:

Table 10: The percentage of the open spaces for six different lot Area. Source: (Erbil municipality).

No.	Lot Area	The percentage of the Open Space
1	(30-99)m2	5%
2	(100-199)m2	8%
3	(200-299)m2	12%
4	(300-399)m2	15%
5	(400-499)m2	20%
6	More than 500	25%

- *Parking space for vehicles*

A lack of adequate automobile parking space is perhaps the major cause of transport issues in any major city. Considering offices, low ranking ones require one car park, medium requires two car parks and high requires three car parks with each car park approximately 50m^2. However, this usually is dependent on the number of guests utilizing the facility.

- *Structures*

They are built in compliance with the existing Uniform Building Code (UBC) and practice codes of British Standards.

- *For resilience to fire*

In order to alert the inhabitants when there is occurrence of fire, each structure shall be equipped with a fire warning device in accordance to (493) for the situation of fire. The warning system must be properly link through a wireless communicator to the department fire control center surveillance system:

- In order to avoid the transmission of flames, gases and smoke via the vertical entrance from one floor to the other, any exit stairway and other vertical space between the floors of a structure shall be sealed and secured, allowing ample period for people to access the route of escaping.
- All structures that are greater than five stories should have at least 15 m long spiral fire stairs as exit routes and needs to be more than just a single route.

– Each high rising structure must feature a red light.

- *Glazing*

Glass shall normally comply with BS 952. In all conditions, the glazing has to be wind and water-tight within BS 6375, with maximum gap for spontaneous displacements and other motions (Ministry of Planning).

- *Earthquakes and building guidelines in Kurdistan*

Kurdistan as an area has still not established any specifications or standards of conduct for its architects to use in their projects. The present difficulties in the architecture and the lack of architectural integrity mean that the large number of structures in the area will be completely destroyed if they are struck by a massive earthquake.

A vast number of designers utilize various internationally accepted standards of conduct in their operations owing to the challenges present in Kurdistan in terms of vivid lay down rules. These standards may not relate perfectly with the specific situations witnessed in Kurdistan environment. Also, it is clear that, it is very difficult to manage high-quality building construction without proper construction regulations (Issa, 2017).

4.9 Chapter summary

This chapter places the work within the situational scenarios of the city of Erbil and outlines the position of the leadership of Erbil's high-rise building regulation and construction systems, with specific focus on the high-rise residence living pattern. The climatic condition and the demographic of the city of Erbil can be summed up as follows (table:11 and table:12). Also, table 13 shows that the city of Erbil faces ecological challenges.

Table 11: Climatic conditions of the city of Erbil. Source: (by author).

Aspects	Properties
Location	• Situated 453 m above sea level at latitude 36.2 ° north and longitude 44.02 ° in the eastern hemisphere from greenwich.
Topography	• Erbil is situated in the low mountainous zone.
Climate condition	• Located under the Bsh zoon classification in the semi-Arid climate koppen system.
Air Temperature	• Warm to hot in the summer, over 42^{o} C and during the winter season below 0^{o}C.
Relative Humidity	• Ranges from 66% to 26% at 9 AM throughout the span of each year and at 3 PM, from 51% to 17% RH.
Wind and Moisture	• Monthly wind velocity levels faster than 8 m/s at 50 m and about 4 m/s at 10 m height.

Table 12: Demographic of Erbil city. Source: (by author).

Aspects	Properties
Historical construction of Erbil city	• It goes down to at least 6000 BC and is one of the worlds 's earliest consistently settled cities.
Urban development	• The outline and elevation of the castle influenced the urban architecture as concentric rings and radial axes in the surrounding city. • The absence of strategic direction has generated increasing frustration with latest construction ventures and new complexes in the old town.
Transportation system	• The transport network in the region is outmoded. • In addition, transport systems do not satisfy current requirement.
Population	• 2.9% pace of growth, the populace of Erbil in 2015 reached around 1.530,722.
Social considerations	• Religion and ethnic background: Kurds are the Sunni faction of Muslims and the prevailing ethnic community. • Christian groups exist, and also yazidis. A few other ethnic turkmen, who are affiliates of the sunni muslims, also reside in Erbil and the region.
Economic considerations	• Iraq's summer capital, which is now the capital of Iraqi Kurdistan and doubles as Iraq's commercial capital. • It is a powerful economic area due to the security that exist in the town. • The city's surroundings have been ideal for farming, industrial and popular assets over the years. • Even with such economic achievements, joblessness, inflation a weak civil service continues to threaten the city.

Table 13: Ecological issues of the city of Erbil. Source: (by author).

Aspects	Properties
Air pollution	• The dust drop level was reported in Erbil (97.6 gm/m2.year), with a high dust drop level in Erbil city. • Vehicle emissions and toxic contaminants have impacted many residents and have caused a lot of medical complications.
Sound Pollution	• Like most metropolitan areas, accelerated growth, increased quantity of cars, business and manufacturing zones, numerous activities etc, have contributed to the noise issues throughout this city being tackled.
Water pollution	• Hawler is adequately equipped with strong reservoirs possessing reliable water that is usually appropriate for consumption and farming purposes, but issues such as leakage in the public transmission networks are presently plaguing the water structure in the area, which guarantees that most of the water supplies are not secured.
Waste management	• Every municipal solid waste being generated is disposed in open fields with no segregated mechanism in the town and also no sanitary dump sites.

According to the region's energy representatives and crisis:

- Despite the enormous deposits of fossil fuels, the region continue to struggle from severe lack of power supplies.
- Since the position of areas of north of iraq limits the forms of renewable energy to comprise only hydroelectricity, otherwise, wind power, solar and geothermal energy, and renewable energy is indeed largely untapped and requires additional research and development.
- Energy supplies continue to be unstable from time to time.

Table 14: Compatibility with human and environmental hazards. Source: (by author).

Aspects	Properties
Fire risks	• Fire services just reaches 52% of the city's overall territory.
Earthquakes	• The massive number of buildings could not resist the seismic pressures that the massive earthquake released..
Rainstorm	• Area of north of Iraq has experienced environmental hazards of this nature. Owing to the heavy rainfall which leads to continue flow of water into water bodies, this makes the levels of the water bodies rise and later pose as natural risks and flood.

Regarding to the governance For High Rise Buildings in Erbil city, in high-rise housing complexes, Erbil identity and traditions are not expressed. The significance of the link between high structures and the climate has still not been investigated. Also, While there were complaints of loss of visual protection, children's playgrounds and public facilities, there has not enough study to offer ways to enhance these circumstances.

The city is designed on a circular structure of rings from its historical citadel. Ring five development densities are limited, spanning from 100 to 200 people per hectare. The current urban fabric up to ring five is capable of accounting for demographic rise till 2015. The town extends outside of Ring Five, amid this capability, as a result of various new construction and personal financing. The deployment of the facilities cannot however meet the distributed construction pace

For permits for industrial structures, these considerations apply to the construction of high-rise complexes:

- High-rise structures not permitted in the buffer range (municipality 1 zone).
- Car parks: considering offices, low ranking ones require one car park, medium requires two car parks and high requires three car parks.
- For fire resistance: all structures are greater than five stories should have at least 15 m long spiral fire stairs as exit routes .
- Glazing: glazing must be able to withstand or prevent the entrance of wind and water.
- Earthquakes: there are really no structural laws mandating compliance with minimum specifications during building planning and building processes.

Chapter 5

LOCALIZATION AND SPECIALIZATION OF THE MODEL OF SUSTAINABLE HIGH-RISE MEASUREMENT TOOL

5.1 Introduction

This chapter focuses on the methodology applied in this study. Adopting a mixed method, the study uses both qualitative and quantitative methods to collect and explain data. The main aim of using literature review to identifying different parameters of sustainablity and sustainable high-rise buildings. Also, the purpose of interviewing different participants is so as to involve them in drawing up a model and measurement tool for sustainable high-rise buildings in the city of Erbil in efforts to arrive at a general agreement between the different stakeholders involved in the building.

5.2 Research design

According to Creswell (2005), research design is the procedure involved in conducting a research; data collection, analysis of data collected, and report writing. Specifically, research design allows us to answer our research questions. A study design is therefore important in determining whether one's findings are scientifically sound. Consequently, this study is designed in such a way as to effectively address the research objectives of this study.

5.3 Data collection and obtaining information methods

There are two different methods for obtaining data; qualitative and quantitative methods. For the purposes of this study, that is, the designing and development of a measurement scale for the high-rise building in the city of Erbil, a number of different will be adopted, some of which have been previously explained.

Some of the methods adopted in this study in order to achieve the objectives involve; documentation analysis, review of literature on high-rise buildings, evidence based architectural designs on sustainable architectural strategies, and architectural design of buildings. Furthermore, the study will identify the different parameters for sustainable high rise building accepted globally, investigate the local conditions and constraints in the construction sector in the city of Erbil, as well as an analysis of the current policy and regulation relevant to the measurement and ratings for sustainable high-rise buildings.

Data collection for this study was intentionally designed to be wide-ranging and interdisciplinary, bringing together techniques from architecture, psychology, environmental studies as well as income analysis. The majority of selected articles reviewed in this work are published in English and indexed in electronic databases. The researcher carefully reviewed transcript and highlights those cases related to the drawing up of the evaluation model.

Besides the literature review, there is global rating system for assessing the buildings as a first step towards developing a measurement scale. As a second step, analysing different high-rise buildings will also go a long way to answering some of the questions which the existing measurement rating systems are unable to answer. The

specificities of the conditions in the particular country condition which have been explained in the previews chapter as well as interviews with experts regarding the model combined together will constitute step three in the diagram for getting the final step to design and develop the measurement scale which is the main focus of this chapter (figure: 28).

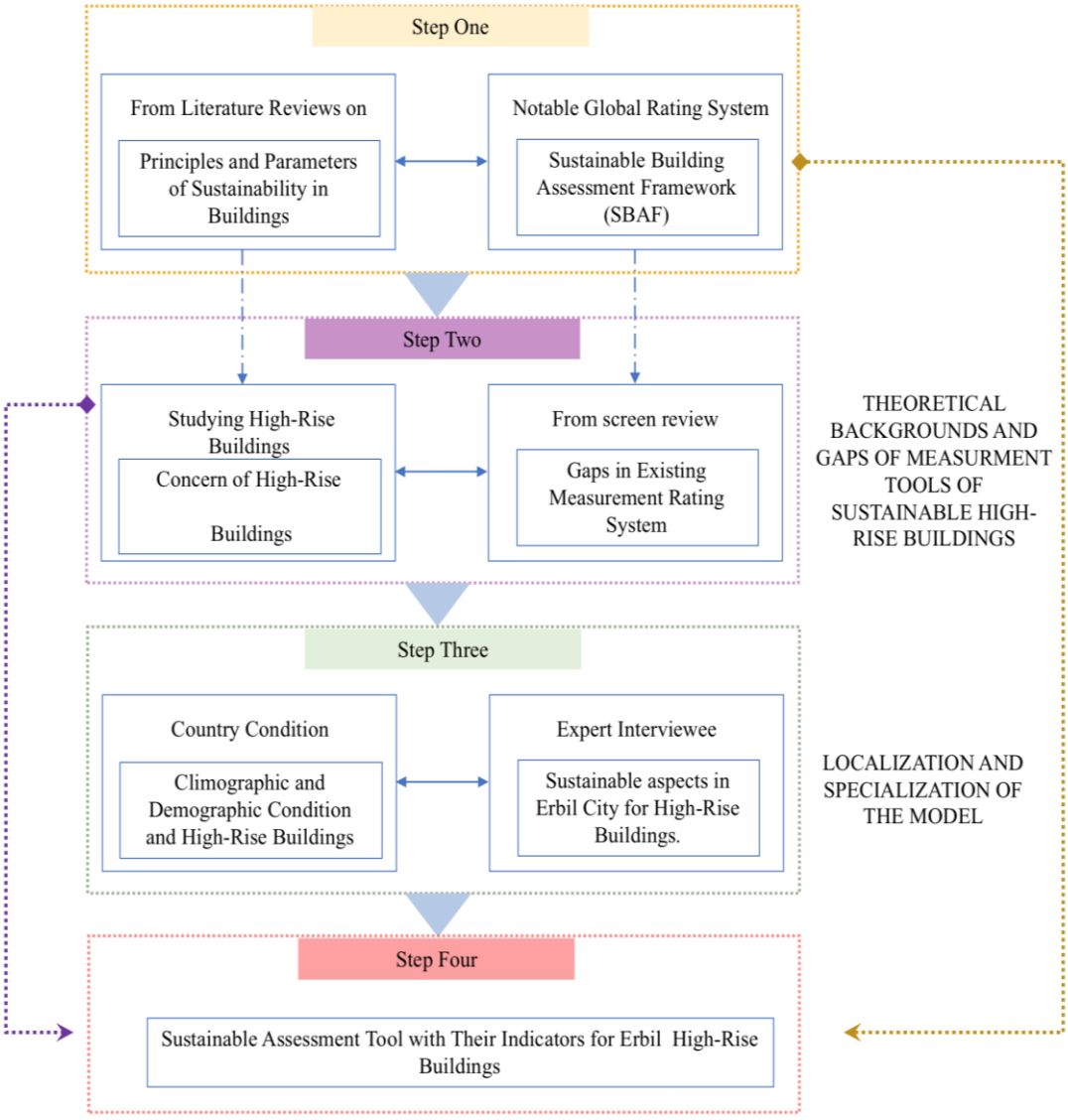


Figure 28: Steps of developing a measurement scale for sustainable high-rise buildings.

5.4 Concerns of high-rise building

To fill the gap of concentration and specialisation for high-rise buildings, there is a concern of high-rise buildings. The architecture of HR construction contains several characteristics and qualities that make them unique and exceptional in contrast to other buildings. The pattern of successful evolution is high-rise structures. It requires sophisticated technologies and main components. Whatever the positive dedication to high living standards, a range of problems remain in ather words, the optimistic approach to high living standards was successful, it is related to a range of issues (Yuen 2011). However it is important to identify issues that contribute to major concerns, as they need to be remedied in order to foster healthy fiscal, social and environmental activities. Many major problems with large buildings can be listed as follows:

- Fire prevention and fire incidence: over the years, tall buildings have achieved substantial worldwide prominence in terms of fire safety. Several floors in the large building allow many people to travel long vertical distances in an emergency down the stairs. While the fire codes are improved, many big buildings appear badly designed. All buildings have few to no fire protection, fire control and emergency management protocols, in particular in the underdeveloped world. The explosion of fire in high-rise buildings jeopardizes the lives of residents and firefighters. For example, high-height shafts provide lift shafts, smoke shafts, wire and plumbing shafts, and parcels, mail and waste drops. Railings, gypsum block walls, automatic doors and trap doors typically prohibit occupants from going through such vertical components. Glass, asphalt and metal pieces from tall buildings will injure passers-by during the process on the ground (Wu, 2020).

- Vertical transport: lifts are accessible in most of the tall buildings. The huge buildings, the more lifts needed to service different banks at different locations. For vertical transport, elevators are an integral parameter. They also act as useful tools in emergencies. The operational performance is calculated by measuring the nature and delivery of lifts well before the operation is over. The failure of the lift is seen as a significant problem and must thus be stopped at all costs. It should also be accepted that elevator travel time is another problem.
- The neighbour effect is that tenants and associates have a much greater effect on each other in tall buildings than in low-rise buildings. Anxiety over this is also highly necessary.
- Crimes in elevators and hallways: violence and abuses like rape and theft are reputed to be the primary thrust of crimes nationwide, rather than low-rise and high-rise structures. The architectural layout of a big building facilitates illegal behaviour and thus poses safety issues. However the real result of design can be modest.
- Accidental falls from the high-rise: stumbling in big buildings and sliding down from high floor is one of the biggest risks to the inhabitants of HRBs. Drops from heights often pose a serious risk to building workers.
- Equipment failures: facilities in massive buildings may be affected if not properly shut down in the event of power outage and subsequent recovery. Measures to mitigate damage are important. Water pumps and heating systems often need to be shut down manually in a large building, especially after a power outage.

- Structural protection: rigid structural stability requirements are not compulsory in high-rise buildings because the construction plays a vital role in the preservation of life and against earthquakes or other causes such as burning.
- Building height: most people experience a degree of disparity while they are at height. The visual system offers details that contrasts with somatosensory and vestibule structures that contribute to an imbalance in height where there is a distance of more than 20 meters from the eye to the object. If a person has a chance of falling, feel a sebce of dangers (Salassa and Zapala, 2009; Yuen, 2011).
- Behavioural problem in children: children living in big buildings reported to have twice the number of behavioral problems such as bed-wetting and temperament issues (Salassa and Zapala, 2009). These issues will be counterbalanced if access to open space is given to children; that is, the correlation of problems of big buildings with behaviour. The lack of adequate room for children may therefore be seen as another difficulty of living in big buildings. In a study of children in relation to gender and financial wellbeing, it has been found that children in big buildings more prone to have major behavioral difficulties relative to children in other forms of housing. Therefore, high-rise or tall structures have a strong function and effect on the development of children. Possible challenges vary from simple growth challenges to routine daily tasks such as playing.
- Fewer social interaction: social relations can be split into two sections: those of the individuals in the same household, and those of the neighbours in a certain household. The Salassa and Zapala (2009) and Auclair and Hertzog (2015) claim

that people in big buildings have very low social skills between themselves and others.

- Lack of privacy: HR apartments sometimes offer less privacy than LR apartments such as visual privacy in acoustic, visual and olfactory privacy. It may also be stated that it is not simple to get any self-style or less privacy in towers.
- Suicide: some studies suggests that several residents of HR buildings exhibit depressive problems more frequently than in other dwellings. This makes them feel suicidal, that is to say, want to spring down from the house. A research conducted in Singapore between 1960 and 1976 showed that the number of people living in high buildings rose (from 9% to 51%). During the same time, the suicide rate increased four-fold in high buildings, while suicides declined in different ways (Turner and Wigfield 2017)
- Family and community living: autonomy that gives children a sense of security is missing from the environment of the big building (Story and Saul, 2015). Overall residential satisfaction is affected more by the lack of entertainment and/or social open space at large buildings than at low buildings (Prezza et al., 2001). Where the outdoors and other social spaces are small, people are "forced" to spend more time indoors where they can be overcrowded (Prezza et al., 2001 and Du, 2015). They are tailored systems that make people believe that they exist "vertically," mentally, socially and emotionally" (Al-Kodmany 2018). The longitudinal tendency of frustration in poorly designed high-rise settings can be complemented with a broader sense of constraint and exclusion (Prezza et al., 2001 and Du, 2015). The construction of "Vertical Gated Communities" (VGCs), which limit social contacts and foster socioeconomic class formation,

has been explained by income and racial disparity (Al-Kodmany, 2018). In addition, the TB, containing high, middle and low classes, could accommodate a vast number of people in many divisions and incomes. However, blame concentrated on massive buildings that mainly care for the poor or wealthy.

- Human scale: humanity is the standard of all things, as described by the Greek pre-Socratic philosopher Protagoras, (Al-Kodmani and Ali, 2013). Human level observation is important to the comfort of people in environmental sustainability. In addition, skyscrapers sometimes disturb the urban scale by breaking neighboring houses and public areas. The house is more than 20 stories, and it is much more than 44 times the height of a human being, at which stage one urns his or her head back to look at the skyline across the street (Kendig and Keast, 2010).
- Placelessness and the public realm: because of their wide capacity and elevated heights, the topic of placelessness has also been applied to high increases. High buildings also encourage an intimidating, hard-working enterprise atmosphere in central business districts. In comparison, they share the concept of living in tight apartments in residential neighborhoods that are more like cellars than living areas. By dwarfing nearby public spaces and houses of historical significance, incredibly large buildings also disturb the human dimension (Gehl, 2010). Conversely, civilians are also not able to see architectural art and customized features, such as flowerpools through the various new windows that give a touch of nature to these types of residential buildings (Al-Kodmany and Ali, 2013). Freedman (2014) argues that vernacular brick, wood, and stone low-rise neighborhoods are more humane than glittering, steel-and-glass high-rise neighborhoods. Moshe Safdie said that high-rise buildings disrupt the public

domain often. He has illustrated that big, blank façades have replaced small mother-and-pop shops in traditional communities (Al-Kodmany, 2018).

- Preservation and blocking views: tall buildings, not like low buildings, shield their height from the other side of the city. There are regulations to prohibit block views in certain towns such as London. Safe sights are of vital significance in urban development, especially if there is an iconic building or historic landmark in the city of global importance.
- Window cleaning, repair, and maintenance: workers' lives are jeopardized by constant work to repair and clean their walls. People sometimes take the issue of window cleaning for skyscrapers lightly, but it remains a common cause of the deaths of employees. Architects continue to work to build and not save lives with modern ways and products. The last question to answer should not be the matter of window washing. Furthermore, breaking and shattering glass are persistent issues.
- Construction workers: the construction of tall buildings, in particular extremely high structures, can lead to workers being killed or injured. Sadly, building depends on physical work done by workers. For eg, the mounting and external covering of the facade depend on the workers, meaning that the panels are manually gathered from the cranes and assembled in some areas. Building workers repeat the same process until the facade is done on each panel. It is slow because hundreds of panels exist in Burj Khalifa, especially the 26,000 glass windows (Al-Kodma 2015). Montage work at the upper floor, where the wind is high, is more dangerous as a minor error committed by an employee may lead to the collapse and death of the employee.

- Health and well-being: several reports indicate that residents in tall and HR buildings are recovering from a range of emotional trauma and other adverse psychological conditions. Studies have shown that unfavorable social interaction among residents tends to produce tension and conflict between them because the floors and other services are shared (Prezza et al., 2001). Nonetheless, the more the size and assets existed, the more the tension amounted. The congestion of homes, insufficient planning and construction, accelerated arrival and disappearance of inhabitants, the shortage of outdoor recreation and the possibility of social spaces are declining. Specifically, high-rise buildings in poor areas have to cope with overcrowding, a restricted outdoor and leisure room. Also the probability of exchanging money and space is strong. By contrast, inhabitants of costly lifestyles will encounter alienation (Prezza et al., 2001).
- Semiotic method: incorporating architectural type as a language that contains messages allows it easier for architecture to read signs. In encounters of what the building comprises, which ideas are contained in it and how these theories will usually help the society or other buildings, the audience is told. Many scholars claim that the attractiveness of an urban town relies on the style of building in that town. (Sani et al., 2015). It is obvious that high-rise buildings play a vital part in the representation of an area, whether it be for landmark purposes that have a symbolic purpose or just for the neighborhood. Many people assume that elevated buildings are associated with a huge bad ego (Roaf et al., 2009). The selfish, selfish character that outlines the neighbors and other activities on the street (Balint et al., 2013).

- Bird crash: crashing with bird-glass is one of the detrimental consequences of high-level constructions or skyscrapers around the globe. In reality, millions of birds die every year from glass collisions, which renders them the second biggest danger faced by human beings after their environment is lost. The US is primarily responsible for about a billion birds per year (American bird conservancy, 2014). Clear and opaque glasses injure birds during the day, since the birds don't realize the clear lenses are blocked passages and so they want to fly accidentally. In comparison, reflective glass represents clouds, atmosphere, and the terrain that replicates an environment that is thought familiar and attractive to birds. Owing to the reality that most modern high-rise buildings are glass enclosed. We may then conclude that skyscrapers appear to be the ideal executioner.
- Space and venue: unforgettably, the position and costs of constructing high-rise towers is always directly associated, however these locations are not taken into account in terms of environment but in terms of financing. In a survey, five different venues were measured in relation to how much it was sold and key building price range. This lead to the unexpected outcome that the cost of skyscrapers in Shanghai was about four times smaller than those designed in London (Watts and Langdon, 2010).

Similarly, problems that lead to the existence and function of skyscrapers should be recognized as they need to be alleviated to promote sustainable financial, social and environmental activists, as stated above and re-examined. As defined in this part, the scale for measuring skyscrapers must therefore be followed step by step. Table: 15 shows the summary of concerns of high-rise buildings.

Table 15: Summarized of concerns of high-rise buildings. Source: (by author).

Concerns	Key themes
Safety	Fire safety and fire incidence
	Accidental falls from the height
	Structure safety
	Safety while maintenance and cleaning
	Safety of construction workers
Vertical transportation	Elevator breakdown
	Travel time in elevator
Crimes and security	Crime in corridors
	Crime in elevators as rape and robbery
Scale and size	Human scale
	Building height
Children behavior	Behavior problem in children
	Children development
	Lack of adequate playing space for children
Social and community	Family and community
	Social interaction
	Isolating from others and ground
	Disparity in quality of life
	Who the neighbors are
	Lack of neighbor facility
	The public realm of the livability of street
Environmental aspects	Bird collision
	Prevent natural ventilation on nearby buildings
	Loss direct contact with nature
	Negative affect on surrounding
Semiotic approach	Sign and symbolic
	Placelessness and public realm
Privacy	Lack of privacy
Health and well being	Psychological feeling - suicide
	Stress and other negative psychological conditions
Cost	Speculates investment
	Mistakes while construction
	Space and location
Heritage	Respect to heritage and historical buildings
	Preservation and blocking views
Services	Power failure

5.5 Expert interviewer

From a social scientific perspective, interviews are a method of data collection that involves two or more people exchanging information through a series of questions and answers.

Interviews as a method of data collection in a qualitative manner is one of the main methods of inquiry adopted in this research to fill the third gap. Interviews are most appropriate when there is some knowledge about the phenomenon being studied or where detailed insights are required from individual participants. They are also particularly appropriate for exploring sensitive topics (Gill et al., 2008). The purpose of the interviews is to explore the views, experiences, beliefs and/or motivations of the architects, planners and engineers on the social and environmentally sustainable aspects in the city of Erbil for high-rise buildings.

Interviews as part of the qualitative methods used in this study are thought to provide a 'deeper' understanding of social phenomena than would be gotten from purely quantitative methods, such as questionnaires (Silverman, 2000).

- *Interviews in depth*

There are a variety of methods of data collection in qualitative research, including observations, textual or visual analysis (for instance, from books or videos) and interviews (individual or group) (Silverman, 2000). Gill (2008) purports that there are three fundamental types of research interviews: structured, semi-structured, and unstructured.

Structured interviews are basically, verbally controlled surveys, in which a rundown of predetermined questions are posed, with next to zero variety and with no scope for

follow-up questions to responses that warrant further elaboration. Consequently, they are simple and easy to oversee and might be of specific use if the explanation of specific inquiries is required or if there is a likelihood of literacy or numeracy issues with the respondents. Be that as it may, by their very nature, they only allow for limited participant responses and are, thus, of little use if 'depth' is required.

Then again, unstructured interviews don't mirror any biased speculations or thoughts and are performed with almost no organization (May,1991 and Gill, 2008). Unstructured interviews are generally very tedious (frequently enduring a few hours) and can be hard to oversee, and to partake in, as the absence of predetermined questions gives little direction on what to discuss (which numerous participants may find confounding and pointless).

Semi-structured interviews comprise of a few key inquiries that help to characterize the areas to be investigated, but also gives room for the interviewer or interviewee digress in order to be able to provide more details if necessary (Gill, 2008) which is used in this study.

- *Population and sample size*

Salant and Dillman (1994) contend that there are standard sample sizes which are recommended for statistical procedures which vary, however, there is no single method or e sample size that is applicable for every statistical procedure and research method. Nonetheless, (Mason, 2010) contends that a lot of scholars posit that the concept of saturation is an important factor to always keep in mind when considering the size of samples in qualitative research. Salant and Dillman (1994) and De Vaus (2002) on the other hand, argue there are two important factors which determine the required sample size; the degree of diversity in the population which is intended to be

studied and the level of toleration extended in case of sampling error. Consequently, the level of saturation relies upon numerous elements and not every one of them are under the analyst's control. A portion of these include: studying of homogenous or heterogeneous in the populace, amount of money in the budget to carry out the study, selection criteria, the experience of the researcher, critical key rang for an in-depth understanding of the topic (Charmaz, 2006), hypothetical sampling concerns with ensuring depth on relevant concepts and examining a range of concepts and characteristics (Strauss and Corbin, 2007).

Qualitative researchers need tools which they will use to analyse the sample size while preparing for a study as well as during the research process to be able to continuously assess the sample size, and finally to be able to ascertain if the sample size chosen is requisite for the intended analysis and publication (Guest et al., 2006 and Morse, 2000). Guest, Bunce, and Johnson (2006) with regards to the minimum Sample Size, that often saturation usually occurs when there are 12 participants in a homogeneous group. As such, taking steps to ensure that no new major concepts emerge in subsequent interviews or observations is always necessary. As such, a minimum of 15 participants for most qualitative interview studies works well when the participants are homogeneous. However, if the participants being interviewed are of different types, then it is possible that 12 to 15 of each type is needed in order to reach saturation (Latham, 2013). Some academic journals are quite specific with regards to the designs for their sampling sizes. For instance, the policy adopted by the Archives of Sexual Behaviour for their publications is a sample size of between 25 to 30 participants as a minimum before saturation is reached and redundancy in grounded theory studies that use in-depth interviews (Dworkin, 2012). Table 16 shows the summary of sample size in interviews.

Table 16: The summary of sample size in interviews. Source: (Namey, 2017).

Study authors	Saturation definition	Findings
Individual interviews		
Morgan and colleagues (2002)	Not defined	5-6 interviews for most concepts In all four sets of interviews, approximately 80-92% of concepts identified within 10 interviews (extrapolated from reported data)
Guest, et al. 2006	The proportion of identified themes at a given point in analysis divided by the total number of themes identified in that analysis	6 interviews to reach 70% saturation 12 interviews to reach 92% saturation
Francis, et al. (2010)(gated)	The point, after conducting 10 interviews, when three additional interviews yield no new themes	Most themes in both studies identified within 5-6 interviews Saturation reached within 17 interviews in one study, and not reached in 14 interviews in a second study
Coenen, et al. (2012)(gated)	The point at which linking concepts from two consecutive focus groups or individual interviews reveals no additional second-level categories	Inductive approach: 13 interviews to reach saturation Deductive approach: 8 interviews to reach saturation
Hagaman and Wutich (2016)(gated)	The number of interviews required to identify the most common themes in a total of three interviews	Less than 16 interviews at site level 20-40 interviews to identify cross-cultural meta-themes
Namey, et al. (2016)	The proportion of identified themes at a given point in analysis divided by the total number of themes identified in that analysis	At the median: 8 interviews to reach 80% saturation (range 5-11) 16 interviews to reach 90% saturation (range 11-26)

For this study there are 12 interviewees amongst which we have an architect, engineers as well as experts from different ministries and administrations such as municipalities and tourism. The plan is to gather data about the strategies they usually implement and whether these are either sustainable or unsustainable for the high-rise buildings in the city of Erbil. The interviewees who have been interviewed have many years of experience in the construction sector in the region. The target group for this survey is comprised of stakeholders in the construction industry in Erbil city, categorized into

four professional classes; architects, planners, civil engineers, and other engineers. The following table is the samples categorized with their description criteria.

Table 17: Sample categorized and their description criteria.

Categorizing	Number	Criteria
Architects	5	Two architects in Policymakers in the Ministry of Municipalities and Tourism in Erbil city. Two architects from the Ministry of Higher Education that they already studied the sustainability and high- rise buildings for their master degree. One architect from the private sectors that has experience in the high-rise construction in Erbil city
Planners	3	Two planners in Policymakers in the ministry of planers One planner from the private sector that he/she already has experience and studied the sustainability and city planning
Civil engineers	2	One civil engineer form the Minister for Housing and reconstruction One civil engineer from the private sector that he/she already has experience and studied the sustainability and city planning
Other engineers	2	Different branch in engineering in the building construction. Mechanical and environmental engineer are selected because their experience the high-rise construction

- *Interviews sample structure*

Section one: Personal background information of the participant

Questions 1 to 5 in section one were questions intended to collect general information about the respondents' characteristics that is personal background, including name, contact information, gender, age group, occupation and highest level of education awarded, career's experience, place of work, and job title.

Section two: General issues

Questions 6 to 10 in section two were questions to identify, in general, the understanding of the awareness level of the respondents about the sustainability and

sustainable high-rise buildings through their experience and their plan for the future; also, it was designed to identify the main driving forces of high-rise buildings in this city and their opinion to the federal government in these kinds of issues.

Section three: Certain response - possible techniques

Question 11 questioned to identify and describe the stakeholders' preferences on environmental, economic and socio-culture issues criteria for sustainable high-rise buildings respectively. These questions were designed to establish what was considered desirable. The main purpose of this section is to identify the main problems of Erbil's high-rise buildings and show the expert's and stakeholders' opinions on both the good and bad sides of those buildings according to all sustainable piles.

Section four: Concern of high-rise buildings

Questions 12 is a question to define and specified the main aspects of concerns of high-rise buildings that related to social, economic and environmentally sustainable while all process of building from design and construction to uses period. In another word, it was established to recognize the concern of high-rise buildings should be considered in different stages that are important to develop the measurement scales.

Section five: Extra questions as time permits

Questions 13 and 14 were questions to define and their estimate both the requesting and supporting of the current market related to sustainable concept practice and sharing any other idea that they want to add. It means, it was designed to identify the various local priorities that have a clear effect and roles on designed high-rise building sustainable rating system from the point of experts and authorities views and any other ideas that they want to share.

5.6 Method of analysing and evaluation of interviews' results

As has been mentioned previously, interview questions prepared range from areas covering design, interviewee questionnaires, pilot study and sample size, and data collection which includes locating respondents, conducting interviews and carefully recording the data before analysing.

The data obtained through the interviews was analyzed by looking at how each individual responded to each question to find out differences, common points and comments provided by the interviewees. Then, common points and comments as well as different responses (as additional comments) were categorized and the percentages were calculated. In other words, for analysing and evaluating the interview results there are number of steps that include; coding the data gotten from answers of interviewees additional questions, phrases, sentences or sections, which will be done through the relevant meanings and areas. Thereafter, sorting to create different categories to conceptualize the data do not have the same objects or process will be done. The third step will involve the labelling of the categories. The results obtained and the analysis and evaluation of the interviews and discussions of results in similar studies will be the final step (figure: 29).

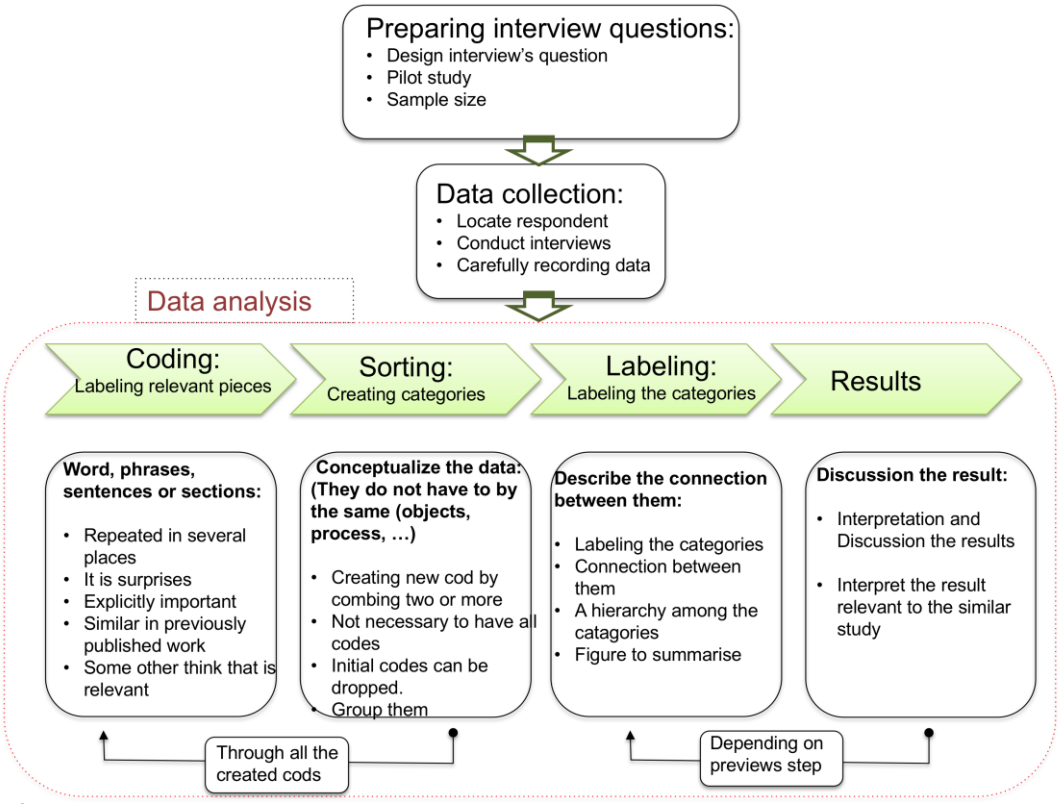


Figure 29: Evaluation of interviews' results. Source: (by author).

5.7 Results and discussions of interviews

5.7.1 Personal background information of the participant

Regarding the distribution of respondents according to their professions, the target population for this interview included experts and authorities in the construction industry in Erbil city and are subdivided into four professional categories; architects, planners, civil engineers, and other engineers. 41% of this sample size are architects from different sectors such as policymakers at the Ministry of Tourism, the ministry of Higher Education, the municipality of Erbil as well as from the private sector. The planners who participated in this study (25%) include policy makers from the ministry of Housing and Reconstruction and the private sector. Civil engineers (17%) consisted of experts from the Ministry of Housing and Reconstruction and the private sector who have experience and have studied sustainability and city planning. The final group

which is made up of other types engineers involved in the construction industry (figure: 30).

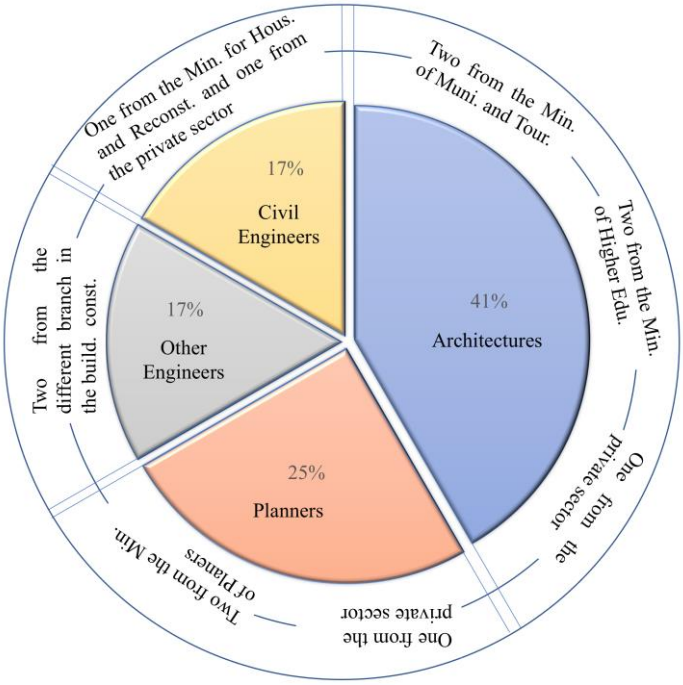


Figure 30: Dissemination of professional information.

The levels of education of the participants range from; B. Sc. to M.Sc. to the PHD, and other forms of diplomas. The chart shows that 17% have a B.Sc., 8% are PhD holders, 8% have other forms of diplomas and a vast majority 67% are M.Sc. holders (figure: 31).

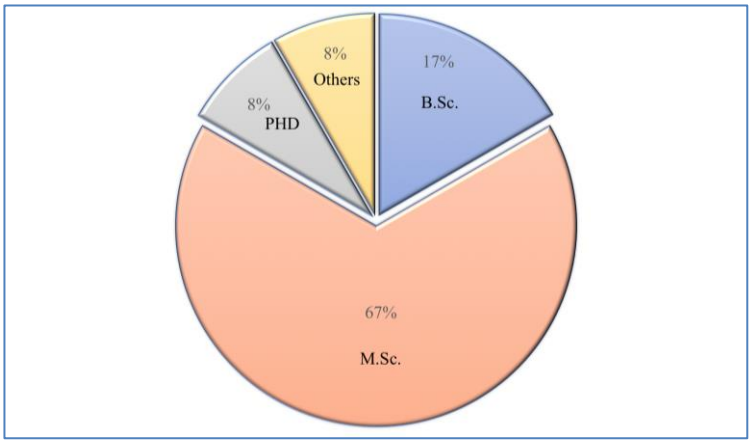


Figure 31: Different current level of education of participants.

According to apportionment of experience year as shown in the figure: the result in this part gotten depends on working experience of experts in the building construction with a minimum of 1-4 years, a mean experience of 10-15 years, and maximum more than 25 years. There is about 25% of the participants had a working experience between 5-9 years, and about 33% had a working experience between 10-15years, also there is 25% for 16-25 years working experience. For those participants had a working experience more than 25 years include 17% and for the ratio of the participant with less than 5 years is zero (figure: 32).

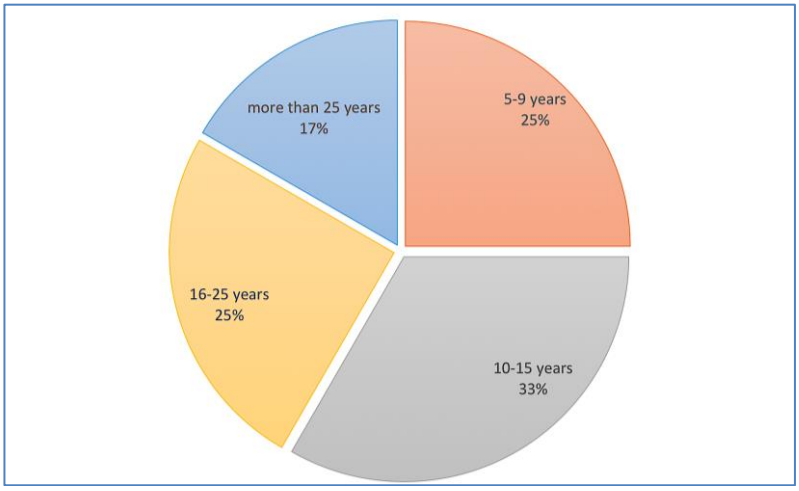


Figure 32: Apportionment of experience year

5.7.2 General issues

Regarding the awareness level of the respondents with regards to sustainability and sustainable high-rise buildings as a result of their experience and their plan for the future, the interviews revealed that all the participants had to a varying degree some knowledge on these. They also identified it as a degree of the influence of the human impact on the environment with low cost and providing a healthy and wealthy environment for living. The majority of them they feel that, today, sustainability has become a necessity in all facets of human life, especially in the field of architecture

and construction. Buildings are responsible for polluting the environment and expenditure of huge sums of money for heating, cooling and transportation.

With regards to the sustainability of high-rise buildings, 10 of the 12 participants (83%), focused on energy conservation and environmental concerns when designing and implementing their projects (figure: 33).

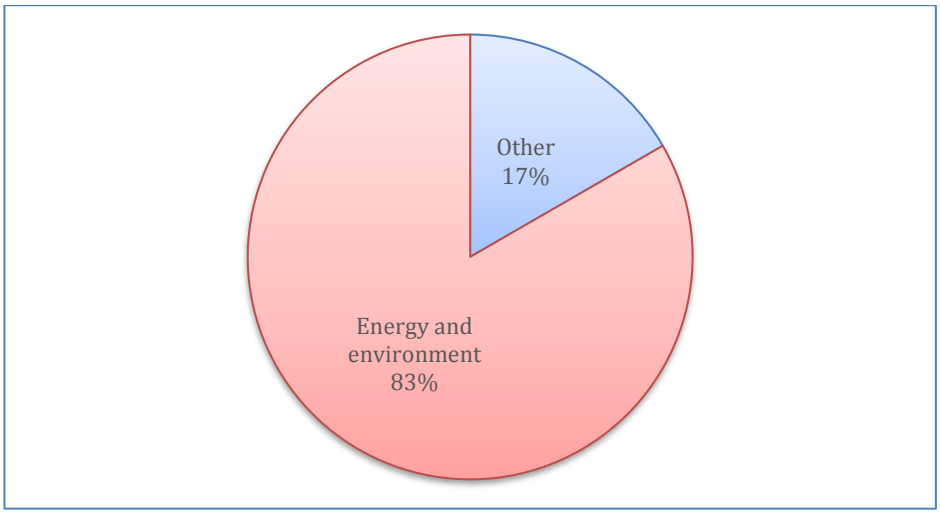


Figure 33: Different focusing of stakeholders as a required for sustainable high-rise buildings.

Sustainable high-rise buildings require said buildings to be eco-friendly as well as energy consumption-friendly. Consequently, sustainable high- rise buildings can be environmentally friendly in many aspects, including but not limited to; the manner in which advanced material is used in efforts to count the building as a ‘green’ building.

The sustainability of high-rise buildings is more crucial than most other buildings because they are usually large and consume a lot of energy as well as need a lot more materials for their construction. As such, the intention is for high-rise buildings to be more eco-frindly and sustainable through the encouragement of designers and engineers to use less resources during the process of construct but also to make sure

that during its lifecycle, it has very little impact on the environment. Such as, trying to benefit from free and renewable energy sources like the sun and wind as well as using material that has less or no impact on the environment.

On the other hand,17% of participants think that from a logical standpoint, while the construction of high-rise buildings requires the usage of more resources than lower buildings, because these high-rise buildings are stand-alone and as a result do not need the construction of many roads and utilities unlike lower buildings, they end up being eco-friendlier and sustainable. In their opinion, lower buildings particularly in suburban areas require the construction of roads to facilitate transportation and as a result, chop up more space and need more energy resources for the construction of these facilities, hence, they are less eco-friendly than high-rise buildings – which from this point of view, are definitely the more sustainable option.

Regarding of the question; what is your institution/ company's experience with the sustainable high-rise building and its assessment tool? The majority of the interviewees asserted that the increase in the demand for high-rise buildings is having a spill over effect as a result of economic, physical and social needs. Due to their extended size, large impact and area of influence on the urban pattern, these buildings potentially can improve the quality for living for many through detailed design and urban integration. Nonetheless, planning considerations with regards to sustainable integration of high-rises need to be considered even more seriously with more detail and care than with other small-scale structures. Unfortunately, not enough consideration is given towards sustainability because most designs are based on the needs of investors as well as the fact that there is not sufficient widespread knowledge about the importance of high-rise buildings. There are not enough measurement tools

in Erbil city about sustainability and sustainable high-rise buildings. Only a few architects who work for the Ministry of High Education try to educate their students about the importance of sustainability in high-rise building projects focusing on issues such as the principles and drivers for high-rise buildings as well as the opportunities these buildings offer today's global world in terms of climate change, high-rise farming, façade designing and sky courts. However, the concern here is that these teachings are principally in theory and not in practice. Moreover, despite the increasing number of graduation projects focusing on sustainable high-rise buildings, there still seems to be not sufficient knowledge and information on this subject. As such, there is a need for concerted government effort in raising awareness and increasing access to information on this subject. It is also possible that with time, knowledge in the field of sustainable high-rise buildings will only increase.

With regards to government regulation of the quality of high-rise buildings, there seems to be a seemingly lack of enough awareness being raised by officials regarding the importance of environmental friendly buildings. This has resulted to the less awareness within the building industry; architects and clients included on the importance of sustainability when designing and constructing these edifices. With the global call for sustainable high-rise buildings on the rise, this study asked the participants what their opinion vis-à-vis the role the federal government could play. That is, how can the federal government better implement sustainable building measurement scales into their management plans? There are some points have been mentioned by them that can be summarised in number of cods:

Code (1) Building polices and regulations-governments

Code (2) Academies

Code (3) International company

Code (4) Sustainability

Table 18: Sorting methods for general issues

Inter.	Code (1)	Code (2)	Code (3)	Code (4)
Particip. 1	• Improving	-	• Contracts with international companies	• Introduce sustainability • Awareness about climate
Particip. 2	-	• Working with them	-	• Introduce sustainability
Particip. 3	• Apply norms and legislations	-	• Group work	-
Particip. 4		• Getting support	-	• Introduce sustainability • Awareness about social
Particip. 5	• Improving	-	-	• Awareness about climate
Particip. 6	-	• Getting support for start point	• Contracts with international companies	• Awareness about economic
Particip. 7	• Apply norms and legislations	-	-	• Awareness about climate
Particip. 8	• Improving	-	• Group work	-
Particip. 9	-	• Getting support	-	• Introduce sustainability
Particip. 10	• Control by Goverment • Apply norms and legislations	-	• Contracts with international companies • Group work	• Awareness about all aspects
Particip. 11	• Improving	-	-	• Awareness about climate and social
Particip. 12	• Improving • Apply norms and legislations	-	-	• Awareness about climate

Their responses could be surmised as follows:

- By improving knowledge on sustainability in all sectors particularly the educational sector as well by introducing sustainable building policies as guidelines for all actors.
- By adding eco-friendlier regulations during planning and better monitoring

during the process of construction.

- By hiring professionals and experienced staff.
- Governments introduction of regulations and norms in favour of sustainability.
- Increase awareness about the environment, economy and social life of the local populations where such high-rise buildings are commissioned.
- Enter into contracts with international companies who have experience in sustainable high-rise building constructions in the region to share their know-how expertise in this field.

On the issue for the boom in high-rise buildings in the city of Erbil, the participants responded as follows:

- The price of land is very expensive in Erbil.
- For prestigious reasons that is powerful businesses in competition for social status.
- Increase in tourism and desire by tourists to live in luxury hotels and residential towers.
- The increase in the population of Erbil city which is as a result of influx of new habitants, people in search for work, and entertainment. Consequently, there is more pressure than before to provide accommodation for this growing population. Investing in vertical buildings is less costly than in horizontal buildings which require more land.
- Economic growth makes Erbil more attractive than the other cities in the Kurdistan region.

5.7.3 Certain response - possible techniques

The respondent emphasised on a key number of issues which they considered as

essential in terms of sustainable high rise buildings. Principally among this is that fact that for a building to be considered sustainable, it needs to be able to manage its resources, waste, energy efficiently, be highly performant, needs to be occupied and its tenants are supposed to be able to use the building efficiently in all aspects. Thus, the building should not negatively impact the climate, the way of life and work for the local population. In this regard, the respondents raised some concerns:

- Erbil is a city suffering from the global problems of energy and increase in pollution, as well as the inefficient use of energy. As such, the energy consumption in buildings is higher than traditional low-rise construction. Thus, while high-rise buildings as stand-alone solutions usually consume more energy resources, in this instance because low-rise buildings in themselves are costly, high-rise buildings can be part of an overall more sustainable solution when considered in a wider context.
- Due to economic stagnation and political crises, a number of high-rise buildings stand uncompleted after several years, some as long as ten years.
- Building management also depends on the project manager, however in general, project management in Erbil is not very scientific.
- According to site context, Erbil city mostly consists of low-rise buildings, which meaning that high rise buildings contradict with the Erbil city fabric. A tall building can be uncomfortable for a normal citizen who lives next to HRB.
- There is not enough regulation limiting the planning and construction in certain locations.
- Erbil high-rise buildings appear benefit only a few.

The sustainability criteria must be applied in all phases of buildings from inception to

completion is one area which the participants agree on. Generally, the responses provided are relevant for solving the problems of sustainability and can be added as the new indicators for the measurement scales. There are some points have been mentioned by them that can be summarised in number of cods:

Code (1) Socio culture Indicators

Code (2) Economic Indicators

Code (3) Environmental Indicators

Table 19: New indicators for sustainable measurement scales

Interview	Code (1)	Code (2)	Code (3)
Particip. 1	• Participant in decision making. • Visual privacy for others.	-	• Construction period • Vertical farms
Particip. 2	• Context architectural identity • Consideration with religion and faith	-	• Construction period • Easy maintenance material
Particip. 3	• Working with the local community • Consideration with religion and faith	• Provide multiple benefits of financincy to communities • Projects with short payback period	• Reduced peak energy requirements
Particip. 4	• Consideration with religion and faith • To prevent be a copy from other region.	-	• Reduced peak energy requirements
Particip. 5	• Working with the local community • Providing equal opportunity	Projects with short payback period	• Time Management • Reducing dusty
Particip. 6	• Providing equal opportunity • Visual privacy for others.	• Provide multiple benefits of financincy to communities • Projects with short payback period	• Project Time Management
Particip.	• Visual privacy for	• Employee local people	• Vertical farms

7	others.		• Easy maintenance material
Particip. 8	• Working with the local community • Participant in Decision making.	• Projects with short payback period	• Stormwater management strategies
Particip. 9	• Context architectural identity • Visual privacy for others.	-	• Stormwater management strategies
Particip. 10	• Participant in decision making • Providing equal opportunity	-	• Project Time Management • Easy maintenance
Particip. 11		• Projects with short payback period	- Easy maintenance
Particip. 12	• Working with the local community • Consideration with religion and faith	• Employee local people • Provide multiple benefits of financincy to communities • Projects with short payback period	• Reduced peak energy requirements • Vertical farms

Those people working in private sectors are more careful about time management, working with the local community and having a chance to the people of Erbil city in decision making.

5.7.4 Concern of high-rise buildings

Generally speaking, this section intends to summarize the responses provided by participants with regards to the issue of developing measurement scales, the process of design, and construction (table: 20).

Table 20: Concern of Erbil high-rise buildings

Sustainable Dim.	Concern of HRBs	Reason
Socio culture aspects	Respect to view line of Erbil citadel	Erbil citadel important more than just a heritage for all humanity not just for Erbil city
	People choices and decision	Many times, there is no reason for choosing, when they choose,

	it is chosen
Terrorists attack	It is surrounded by many places are faced to the terrorist actions
Context architectural identity	To prevent be a copy from another region.

The table illustrate that:

- High-rise buildings should not be allowed around the Erbil city citadel as well as the buffer zone.
- In Erbil city, function and people choices are very important, not just in the building and construction sector, but also in everyday life, such as choosing different transportation and cars, favourite zones and buildings for working or living, and level of education.
- Even if Erbil city is safe to live and work in, there is still always a fear of terrorists attacks or war.
- Majority of participants feel that the big company that construct the big projects should respect the Erbil infrastructure. Unfortunately, this is not the case today.

5.7.5 Extra questions

The various local priorities that have a clear effect on designing sustainable high-rise building rating system from the view point of the experts and authorities is reflected thus:

- In some places, local materials and local facades.
- The microclimate of Erbil city and the social life of its people.
- The investors and clients have a major role in the outcomes and oftentimes simply reject any efforts by the architects to provide more sustainable options as they care only about their benefits.

5.8 Development of sustainable assessment tool with their indicators for HRB

As highlighted earlier, there is a need to develop a rating system and measurement scale for Ebil's high-rise buildings. In fact, this is essential in terms of fulfilling the requirement of one of the important aspects that an emerging/developing country should learn from. As such, it is important to develop a measurement scale for high-rise buildings in the city of Erbil. Regarding the literature study, a synthesis of all outcomes and findings so far, the number of requirements such as embracing the holistic sustainable idea and concept of and addressing their priorities should guide in the MSSHRB-E design and development. International organizations for standardization, note that "all aspects of sustainable development are inter-related; hence, certain issues should be given attention when analysing the sustainability of a building as a whole" (ISO/TS 21929-1 (2006), as well as acknowledging the local context. Additionally, learning from the strengths and weaknesses of existing measurement rating systems and their criteria should reflect the local conditions and constraints. Also, care should be taken to ensure that the criteria set does not focus solely on the buildings and site impacts, but also on the global effects and out site as well. Moreover, addressing all life cycles of building and anticipating the prospect unavailability of specific data in the specific country are important considerations. Also, involving the participation of local building stakeholders through cooperation, communication and dialogue is vital

As regional, social and cultural differences are complicated, the limits are hard to identify; and as there are various in techniques, conditions of climatic, level of income, and materials of buildings (Kohl, 2019), it is not possible for a worldwide pre-designed

criterion without taking into consideration the local context and making additional amendments. So, depending on previous study and interviews the model for measurement sustainability with their indicators and aims can be summarized as in the bellow table.

Table 21: Indicators and their aims of measurement scale for sustainable high-rise building - Erbil MSSHRB-E

Environmental Indicatour	
Indoor Environmental Quality (IEQ)	Aims
➢ Environmental tobacco smoke control	to prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems
➢ Providing natural ventilation	to provide low humidity, moderate temperature wind currents and air circulation throughout.
➢ Solar control and thermal comfort design	to reduce space heating demand in the winter and to minimize cooling requirements in summer. In another word to provide the thermal comfort zone
➢ Natural lighting	to provide general and task lighting, a health and wellbeing benefit, and to reduce electric lighting and saving energy
➢ Considering of building envelopes	to control physical environmental factors such as heat, light and sound
➢ View quality	to provide psychologically and physiologically beneficial
➢ Acoustic control	to balance sounds appropriately rather than to produce a completely quiet environment
Outdoor Empact Quality (OEQ)	Aims
➢ Natural ventilation on nearby buildings	to provide healthy air for breathing by both diluting the pollutants originating in the surrounding and removing the pollutants from it
➢ Avoiding negative effect on surrounding	to avoid engaging in repeated negative impact reflection
➢ Bird savers	to prevent birds from colliding with windows of buildings
➢ Consideration of global worming	to preventing catastrophic climate change
➢ Direct contact with nature	to have a positive impact on self-esteem and mental-well-being
Waste and Pollution (WP)	Aims
➢ Recycling waste	to reduce create air and water pollution and recycling saves energy also
➢ Land pollution	to control and prevent solid or water pollution
➢ Reducing and avoiding wastes	to achieve waste minimization and therefore reduce the amount of waste entering the waste stream
➢ Air pollution	to minimize air pollution from site workers' accommodation and other building surrounding
➢ Noises pollution	to reduce noise pollution or to reduce the impact of that noise, whether outdoors or indoors and to acceptable levels by action on the work environment.

➢Reducing and avoiding dusty	to reach the breathing zones of the users and to minimize the impacts of contaminants on the environment as a whole.
Site Management (SM)	Aims
➢Responsible to the land and green area	to redevelopment of used/brownfield site rather than green field.
➢Selecting site	within urban areas with existing infrastructure, and have low ecological value or in non-sensitive areas
➢Open spaces and vertical green farms	to save water and energy, enhance the economy, reduce pollution, provide new employment opportunities, restore ecosystems, and provide access to healthy food.
➢Avoiding the destroy of surrounding	to avoid negative effect on surrounding aether while construction or whole lifetime
Energy and Atmosphere (EA)	Aims
➢Using energy efficiency	to reduce the amount of energy required to provide products and services
➢Minimum and optimise energy performance	to reduces energy requirement and costs and financial cost saving to consumers. Also, for a solution to the problem of reducing greenhouse gas emissions
➢Providing onsite renewable energy	providing energy to society to permit everybody to use electricity. Also, replacing energy sources that submit emissions (Co2, other pollutants)
➢CO2 emissions	for Minimizing Pollution
➢Reduced peak energy requirements	to reduce cutoff
➢Improve energy efficiency use	to maximize the ratio of reduce the amount of energy required
Material Use (MU)	Aims
➢Using local material	for reducing the significant environmental impacts of transporting materials long distances and encouraging vernacular building styles, supporting the local economy, and connecting users directly with the impacts of their choices.
➢Using recycled and recyclable material	recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution (from incineration), and water pollution (from landfilling).
➢Minimizing wasting material	to reduce environmental pollution by minimizing the generation of waste. It is also often an economically viable option because it requires an efficient use of raw materials.
➢Building reuse	to optimize the operational and commercial performance of built assets.

➢ Using sustainable material	to construct a building that lasts and means lower maintenance costs and less upkeep and a cost reduction and extended life-span.
➢ Easy maintenance material	minimizing the loss of productive time and cost required.
Water Use (WU)	**Aims**
➢ Water quality	to reduce water-borne diseases and foster healthy living and ensure that all human beings within a country have access to safe drinking water.
➢ Avoiding wasting water	to extract pollutants, remove toxicants, neutralise coarse particles, kill pathogens so that the quality of discharged water is improved to reach the permissible level of water to be discharged into water bodies or for agricultural land.
➢ Rainwater collection	to increase available water during dry season
➢ Recycling rain water	to increase crop production and reduces the use of groundwater thus increasing its levels.
➢ Stormwater management strategies	to control the quantity and quality of stormwater runoff, hence preventing flood and soil erosion
➢ Reuse grey water	to provide substantial benefits for both the water supply subsystem by reducing the demand for fresh clean water as well as the wastewater subsystems by reducing the amount of wastewater required to be conveyed and treated.
Building Services and Management (BSM)	**Aims**
➢ Metering and monitoring	to provide building owners and operators with the crucial information they need to improve building energy performance
➢ Time management	to successfully and efficiently meeting budget and program targets, as well as achieving profitability.
➢ Communication and IT management and services	to provide acceptable conection between users and service units
➢ Electric equipment	to protects against the risk of electrical shock
➢ Plumbing and drainage	to supply safe drinking- water in adequate quantities, to remove liquid wastes efficiently, and to minimize the risk of failure through vigilance and quality assurance
➢ HVAC systems	to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort

➢ Impact of city infrastructure	to reduce the negative effect on city infrastructure and avoiding creating a problem on public and private physical improvements such as roads, railways, bridges, tunnels, water supply, sewers, electrical grids, and telecommunications
➢ Regular maintenance	to provide a safe and better working and living environment and to maintain the aesthetic value of the building
Construction Practice (CP)	Aims
➢ Efficiency in construction standerds and management	to find money and time-saving opportunities and provide clear lines of accountability
➢ Construction safety	to decrease the risk of injuries to the public and reduces the risk of work-related injuries and accidents
➢ Construction prosess	to provide essential for a successful outcome in the construction project
➢ Durability and reliability	to prevent collapse during natural disaster
Socio-cultural Indicators	
Local Opportunity (LA)	Aims
➢ Building long-term relationship with local and client	to provide loyalty, reduced marketing effort, brand advocates, successful outcome, competitive advantage, network opportunities, and testimonials.
➢ Working with local community	people feel more secure when they know that they have others around them who share their goals and care about their progress. A simple relationship between people is enough to increase feelings of warmth and motivation
➢ Provision of equal opportunity	to promote everyone's right to equal opportunities
➢ Participation in decision making	to abolish the differences among individuals, develop a spirit of common interest and sacrifice and also participate collectively in community programs. To organize the people for the promotion and progress of the community
Construction and Staff (CS)	Aims
➢ Respect for staff	to understand the reasons behind the poor performance, create an engaged workplace culture, encourage good health and happiness at work and provide opportunities for lifelong learning.
➢ Partnership working	to clarity, openness, trust, shared goals and values, and regular communication between partners. Also, Support for interdisciplinary work between architects, engineers, costing specialists, operation people and other relevant actors right from the beginning of the design process

Accessibility and Traffic (AT)	Aims
➢ Shared public spaces and central districts	to help them in growing up, social interaction and the development of social identity, for exercise and as a retreat.
➢ Responsible to the main transportation.	to reduce greenhouse gas emissions, improve road safety and increase the efficiency of transport systems. Others can incentivize people to switch from cars to more sustainable modes such as walking, cycling, and public transport. Also, prioritizing public transport has proven to reduce traffic deaths.
➢ Public transportation nodes	to easy access and get benefets into public transportation
➢ Minimize traffic disruption and delays	to prevent loading on traffic condition especially while peak times
➢ Pedestrian and cyclist	to increase the use of bicycles and encourage walking by creating a safe and robust bicycle and pedestrian network of paths to serve all the citizens
➢ Acces with the disability	to provide accessible services, goods and facilities to persons with disabilities in a manner that promotes dignity, independence, integration and equal opportunity
➢ Car park capacity	to provide enough space for users
➢ Cleaning the façade	easy to clean the building facades and other elements or design (or consider self-cleaning facades)
Culture and Privacy (CP)	Aims
➢ Visual privacy	to provide comfortable atmospher for users
➢ Private open space	to provide an important key of quality of life
➢ The building culturally acceptable	to demonstrate respect and appreciation for the culture of the people in the place
➢ Visual privacy for orhers	to provide comfortable atmospher for the others live nearby
➢ Consideration with religion and faith	as mental structures, they influence the way we perceive the world around us and the values we accept or reject. As social structures, they provide a supportive network and a sense of belonging.
Health and Well Being (HWB)	Aims
➢ Psychological feeling	to prevent negative psychological conditions and to create happiness and life satisfaction and to prevent suicide
Safety (S)	Aims
➢ Fire safety	to minimize the risk on users
➢ Accidental falls from the height	avoiding accidental falls of the users from above

➢ Safety while maintenance and cleaning	providing safe atmosphere for those persons that do cleaning and maintenance the building
➢ Safity for construction workers	avoiding accidental falls of the worker from above and structure failer and falling building materials on the workers.
Vertical Transportation (VT)	Aims
➢ Elevators	avoiding breakdown or maintenance as soon as possible
➢ Travel time in elevator	try to reduce travel time.
Security and Crimes (SC)	Aims
➢ Crime in corridors	to minimize and control the corridors against the crime
➢ Crime in elevators as rape and robbery	to minimize and control the puplic area and facility agenst the crime
➢ Monitoring and controlling	to reduce crime and not become a target for terrorist attacks
Scale and Size (SS)	Aims
➢ Human scale	for providing comfort to users and working and considering with human scale and size. Also, providing a comfortable environment for pedestrians
➢ Building height	avoiding of increasing congestion population, environmental pollution, reduce citizen access to fresh air and sunlight not effect on previews work in front of users. glance
Children Behavior (CB)	Aims
➢ Behavior problem in children	having a positive impact on children behaviors and not become as a person for children and isolated from the community
➢ Children development	encourage the development in level as physical and mental, also all different stages as the child's ability to learn and solve problems, social and emotional development, and speech and language development
➢ Playing space for children	to prevent lack of adequate of children ground play facility
Social and Community (SC)	Aims
➢ Social interaction	have a positive influence on human beings' physical and mental health
➢ Effective channel for communication	product efficient businesses, productive relationships and satisfaction between. people.

➢Family and community	to assess local family support needs and promote change in response to need and to ensure equality of access to the centre and its services for the whole community and to maintain a professional, viable and sustainable organisation and to contribute to the social and economic regeneration of the area.
➢Who the neighbors are	to achieve sustainable neighborhoods.
➢ Neighbor facility	for changes and improvements such as neighborhood safety, beautification and social activities.
➢The public realm of the livability of street	to avoiding from disconecting and missing the connection between streets and high-rise building's users
Heritage Respect (HR)	Aims
➢Respect to heritage and historical buildings	to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic documents.
➢Respect to whole of the Erbil citadel	to preserve and reveal the aesthetic and historic value of as an urban settlement of importance for the region and all humanity.
Awareness and Education (AE)	Aims
➢Knowledge skills of users	to improve knowledge on sustainable issues of users as conserving energy and water as well as reducing waste
➢ Staffs knowledge	to improve knowledge on sustainable issues among design team members, maintenance and operation staff
➢ Spaces for education	to incease the education levels of users to creat beet world by library spaces, reading spaces, etc…
Semiotic Approach (SA)	Aims
➢Sign and symbolic	to learn and interpret the message that can be interpreted at two levels. First, the outside level and the second is the original level.
➢Context architectural identit	to express a region's architectural cultural identity in their work.
➢Placelessness and public realm	to maximize shared value
Economic Indicatores	
Local Economic Growth (LEG)	Aims
➢Support local community	to care about the community that you live in

➢ Improved productivity	increased productivity helps businesses compete with other companies, innovate and keep operational costs low
➢ Consistent profit growth	to profit maximisation
➢ Developing client business	to utilize partners in selling to the right customers. Creating opportunities for value to be ongoing in the long-term is very important
Jobs Opportunity (JO)	**Aims**
➢ Employment local people	to provide financial freedom and decision making power
➢ Providing job	to find work and support individuals
➢ Supplier satisfaction	provides the basis for cooperative relationships and product improvement
➢ Client satisfaction	and economic support
➢ Employee satisfaction	to maintain, attract, and develop skilled employees.
Shorter and more Predictable (SP)	**Aims**
➢ Providing projects with low cost	to provides the basis for project cost control and suitable for every level of society
➢ Provide multiple benefits of financincy to communities	to create multiple income streams that allow a person to diversify the various cash flow sources that are coming in
➢ Provide projects with short payback period	to get benefits as soon as possible from the building unit iether for rent or buy
➢ Reducing maintenance cost	to provide nonexpensive maintenance for the users
➢ Reducing service cost	to provide nonexpensive services for the users
➢ Increased cost predictability	providing the best value to construction clients
➢ Ongoing costs	to creating multiple income streams that allow a person to diversify the various cash flow sources that are coming in.
➢ Vanity height	to avoid the wasted space between a skyscraper’s highest occupiable floor and its architectural top
Supply-side (Ss)	**Aims**
➢ Supply and demand	to determine the price for consumers as well as the supply business owners need to supply to be profitable.
➢ Reliability and reduction	to have lower general conditions cost, and they are less disruptive to owners' businesses

Innovation (I)	Aims
➢ Innovation in design	to higher productivity, meaning that the same input generates a greater output and improve business performance and help growth.
➢ Innovation in techniques and technologies	to provide better production
➢ Innovation in benchmarks	to determine where it falls short against top performers and where it is a leader
➢ Exemplary and enhancement level of performance	to develop the capacity of individuals to meet the expectations of the organization.

5.9 Indicators' weighted for different categories

Although, still disputed, weighting is now recognised as an essential part of building assessment methods. In other words, as Cole (1997) contends, when establishing a building performance assessment system, weighting has emerged as an important issue. Furthermore, there is an impressive interest inside the global frame board on the record and protocols for inferring them and consideration in building performance appraisal systems. There are of course those who disagree, claiming that using weightings for assessing is not valid.

In the early stages of developing tools for sustainability rating, Papamichael and Protzen (1993) purported that weightings systems work only under those circumstances wherein the relative importance of the different components can be stated confidently, which almost is never.

It is clear that the number of issues in the sustainability of the building are more problematic than others, such as; changing priorities and preference through time between regions and changes in building types. Consequently, in efforts to consider the differences in terms of significance in particular regions as well as to account for the impact of issues regarding sustainability, different weighting systems are usually assigned to the criteria for assessment (Papamichael, 2000). Weighting is inherent in the building rating system, and all parameters are assigned equal weights, or the criteria are implicitly weighted by points distributed, if not specific (Todd, et al., 2001). Weighting is the core of building rating systems, according to Lee et al. (2002), because it will take control of the total performance, execution, and outcome of the structure being evaluated. These concerns focus on the inability of many performance

metrics, particularly those that are more qualitative by design, to extract relative weightings with any precision and interdependence. However, tracing back to the root of it, scoring a building's sustainability is a first-place relative calculation. There is no negotiation that each pile of sustainability has its meaning and without any one of them, sustainability could not be complete. In all three dimensions of sustainability, the selected region has also suffered, but in some indicators it suffers more than others, in aspects of energy, local economy and some socio-culture indicators. As such, it can be concluded that each of the piles has similar weights of credits which is divided equally according to their indicators. Additionally, with those indicators that support more than one pile, the region clearly suffered because they got credits from more than one side especially those indicators which have an obvious role in sustainability (Figure: 34).

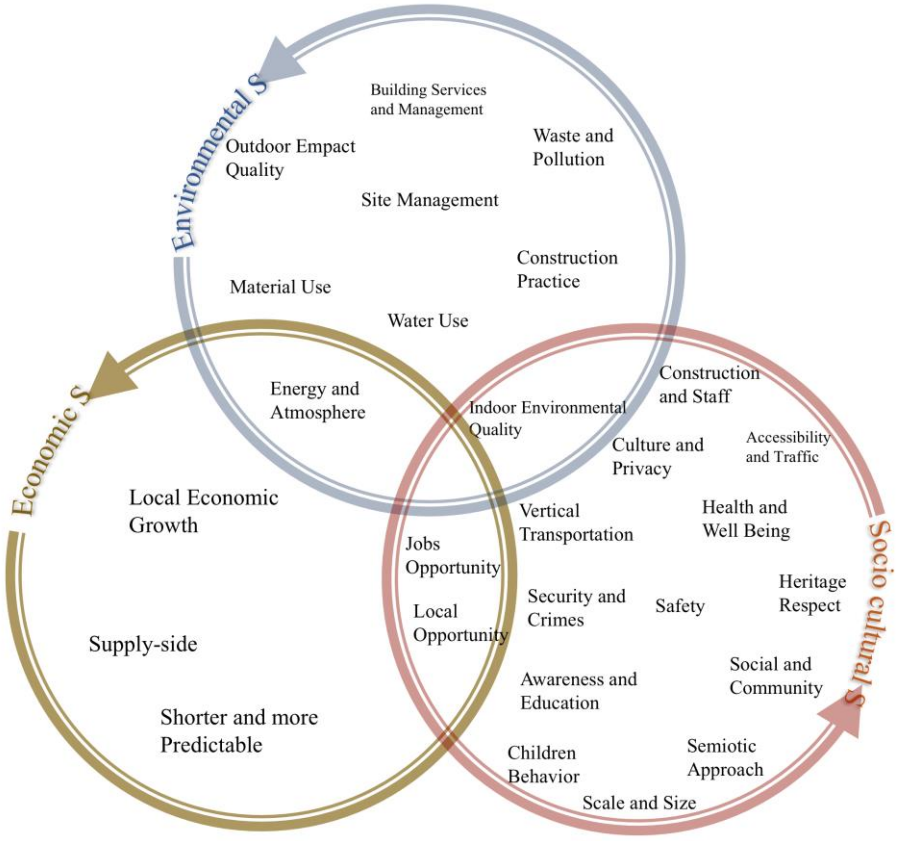


Figure 34: Sustainability with its indicators for HRBs. Source: (by author).

Users of the mode must calculate the number of credits achieved in accordance with the evaluation criteria for each question, in order to achieve the total score for any high-rise projects then calculate the percentage for each indicator. Finally, the Innovation score must be added to give the Total Score. Assessments are divided into six categories/grades (A+, A, B, C, D, and no certificates), as well as demonstrations of graphs, charts and other kinds of data. Table 22 shows the checklist of Measurement Scale For Sustainable High-Rise Building - Erbil (MASHRAB-E) with their weighting.

Table 22: Checklist of Measurement Scale for Sustainable High-Rise Building - Erbil MSSHRB-E

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

High-Rise building Checklist

Name of High-rise building:

			Environmental Indicatour	%
0	0	0	Indoor Environmental Quality (IEQ)	5,8
		Prereq 1	➢Environmental tobacco smoke control	Required
		Credit	➢Providing natural ventilation	0,97
		Credit	➢Solar control and thermal comfort design	0,97
		Credit	➢Natural lighting	0,97
		Credit	➢Considering of building envelopes	0,97
		Credit	➢View quality	0,97
		Credit	➢Acoustic control	0,95
0	0	0	Outdoor Impact Quality (OIQ)	3,7
		Credit	➢Natural ventilation on nearby buildings	0,74
		Credit	➢Avoiding negative effect on surrounding	0,74
		Credit	➢Bird savers	0,74
		Credit	➢Consideration of global worming	0,74
		Credit	➢Direct contact with nature	0,74
0	0	0	Waste and Pollution (WP)	3,7
		Prereq 1	➢Recycling waste	Required
		Credit	➢Land pollution	0,74
		Credit	➢Reducing and avoiding wastes	0,74
		Credit	➢Air pollution	0,74
		Credit	➢Noises pollution	0,74
		Credit	➢Reducing and avoiding dusty	0,74
0	0	0	Site Management (SM)	3,7
		Credit	➢Responsible to the land and green area	1
		Credit	➢Selecting site	0,9
		Credit	➢Open spaces and vertical green farms	0,9
		Credit	➢Avoiding the destroy of surrounding	0,9
0	0	0	Energy and Atmosphere (EA)	9,3
		Prereq 1	➢Using energy efficiency	Required
		Credit	➢Minimum and optimise energy performance	1,86
		Credit	➢Providing onsite renewable energy	1,86
		Credit	➢CO2 emissions	1,86
		Credit	➢Reduced peak energy requirements	1,86
		Credit	➢Improve energy efficiency use	1,86
0	0	0	Material Use (MU)	3,7
		Prereq 1	➢Using local material	Required
		Credit	➢Using recycled and recyclable material	0,74
		Credit	➢Minimizing wasting material	0,74
		Credit	➢Building reuse	0,74
		Credit	➢Using sustainable material	0,74
		Credit	➢Easy maintenance material	0,74
0	0	0	Water Use (WU)	3,7
		Prereq 1	➢Water quality	Required
		Credit	➢Avoiding wasting water	0,74
		Credit	➢Rainwater collection	0,74
		Credit	➢Recycling rainwater	0,74
		Credit	➢Stormwater management strategies	0,74
		Credit	➢Reuse grey water	0,74
0	0	0	Building Services and Management (BSM)	3,7
		Prereq 1	➢Metering and monitoring	Required
		Prereq 2	➢Time management	Required
		Prereq 3	➢Communication and IT management and services	Required
		Credit	➢Electric equipment	0,74
		Credit	➢Plumbing and drainage	0,74
		Credit	➢HVAC systems	0,74
		Credit	➢Impact of city infrastructure	0,74
		Credit	➢Regular maintenance	0,74
0	0	0	Construction Practice (CP)	3,7
		Credit	➢Efficiency in construction standerds and managemer	1
		Credit	➢Construction safty	0,9
		Credit	➢Construction prosess	0,9
		Credit	➢Durability and reliability	0,9

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building:

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

				Socio-cultural Indicators	%
0	0	0		Local Opportunity (LO)	7,6
			Credit	➢Building long-term relationship with local and client	1,9
			Credit	➢Supplier satisfaction	1,9
			Credit	➢Client satisfaction	1,9
			Credit	➢Employee satisfaction	1,9
0	0	0		Construction and Staff (CS)	2,1
			Credit	➢Respect for staff	1,05
			Credit	➢Partnership working	1,05
0	0	0		Accessibility and Traffic (AT)	2,1
			Prereq1	➢Shared public spaces and central districts	Required
			Credit	➢Responsible to the main transportation.	0,3
			Credit	➢Public transportation nodes	0,3
			Credit	➢Minimize traffic disruption and delays	0,3
			Credit	➢Pedestrian and cyclist	0,3
			Credit	➢Acces with the disability	0,3
			Credit	➢Car park capacity	0,3
			Credit	➢Cleaning the façade	0,3
0	0	0		Culture and Privacy (CAP)	2,1
			Prereq1	➢Visual privacy	Required
			Prereq2	➢Private open space	Required
			Credit	➢The building culturally acceptable	0,7
			Credit	➢Visual privacy for others	0,7
			Credit	➢Consideration with religion and faith	0,7
0	0	0		Health and Wellbeing (HW)	2,1
			Credit	➢Psychological feeling	2,1
0	0	0		Safety (S)	2,1
			Credit	➢Fire safety	0,6
			Credit	➢Accidental falls from the height	0,5
			Credit	➢Safety while maintenance and cleaning	0,5
			Credit	➢Safity for construction workers	0,5
0	0	0		Vertical Transportation (VT)	2,1
			Credit	➢Elevators	1,05
			Credit	➢Travel time in elevator	1,05
0	0	0		Security and Crimes (SC)	2,1
			Credit	➢Crime in corridors	0,7
			Credit	➢Crime in elevators as rape and robbery	0,7
			Credit	➢Monitoring and controlling	0,7
0	0	0		Scale and Size (SS)	2,1
			Credit	➢Human scale	1,05
			Credit	➢Building height	1,05
0	0	0		Children Behaviour (CB)	2,1
			Prereq1	➢Behavior problem in children	Required
			Credit	➢Children development	1,05
			Credit	➢Playing space for children	1,05
0	0	0		Social and Community (SAC)	2,1
			Prereq1	➢Social interaction	Required
			Credit	➢Effective channel for communication	0,42
			Credit	➢Family and community	0,42
			Credit	➢Who the neighbors are	0,42
			Credit	➢Neighbor facility	0,42
			Credit	➢The public realm of the livability of street	0,42
0	0	0		Heritage Respect (HR)	2,1
			Credit	➢Respect to heritage and historical buildings	1,05
			Credit	➢Respect to whole of the Erbil citadel	1,05
0	0	0		Awareness and Education (AE)	2,1
			Credit	➢Knowledge skills of users	0,7
			Credit	➢Staffs knowledge	0,7
			Credit	➢Spaces for education	0,7

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building:

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

0	0	0		Semiotic Approach (SA)	2,1
			Credit	➢Sign and symbolic	0,7
			Credit	➢Context architectural identit	0,7
			Credit	➢Placelessness and public realm	0,7

				Economic Indicatores	%
0	0	0		Local Economic Growth (LEG)	5,5
			Prereq 1	➢Support local community	Required
			Credit	➢Improved productivity	1,83
			Credit	➢Consistent profit growth	1,83
			Credit	➢Developing client business	1,84

0	0	0		Jobs Opportunity (JO)	7,6
			Prereq 1	➢Employment local people	Required
			Credit	➢Providing job	1,9
			Credit	➢Working with local community	1,9
			Credit	➢Provision of equal opportunity	1,9
			Credit	➢Participation in decision making	1,9

0	0	0		Shorter and more Predictable (SP)	5,5
			Credit	➢Providing projects with low cost	0,7
			Credit	➢Provide multiple benefits of financincy to communities	0,7
			Credit	➢Provide projects with short lifecycle cost	0,7
			Credit	➢Reducing maintenance cost	0,7
			Credit	➢Reducing service cost	0,7
			Credit	➢Increased cost predictability	0,7
			Credit	➢Ongoing costs	0,7
			Credit	➢Vanity height	0,6

0	0	0		Supply-side (Ss)	5,5
			Credit	➢Supply and demand	2,75
			Credit	➢Reliability and reduction	2,75

0	0	0	+	Innovations (I)	10
			Credit	➢Innovation in design	2,5
			Credit	➢Innovation in techniques and technologies	2,5
			Credit	➢Innovation in benchmarks	2,5
			Credit	➢Exemplary and enhancement level of performance	2,5

0	0	0	Totals	0

Certificate	Percentage
No certified	< 40
D	40 - 49
C	50 - 59
B	60- 69
A	70-80
A+	>80

5.10 Some characteristics of the model

The main characteristics of the model can be summerised as:

- The definition: it is a method for the evaluation and ranking of high-rise buildings with regard to their social, economic and environmental performance, in other words, in sustainability implementation. It provides detailed evaluations of the efficiency of high-rise buildings, addressing aspects of sustainability. Assessments are divided into six categories/grades (A+, A, B, C, D, and no certificates), as well as demonstrations of graphs, charts and other kinds of data.
- The structure of the measurement scale: basically, it consists of three elements and nine environmental indicators, 14 socio-cultural indicators and four economic-aspect indicators with innovation issues. That includes 119 issues, with four additional innovation issues.
- The purpose of MSSHRB-E: is to increase the quality of high-rise buildings in the city of Erbil and stimulate demand for more sustainable high-rise buildings, acknowledging enhanced efficiency and minimizing false claims, as well as including a detailed set of performance criteria for high-rise developments.
- Type of the high-rise building: it may be used in all future high-rise buildings to evaluate and measure sustainability; redesign and renovation of existing high-rise buildings; new additions to current high-rise buildings; current high-rise buildings.
- Various stages: at the design stage and post-construction stage, it is most fitting to be used.
- Different function: it could be used for all high-rise buildings used for residential, commercial and mixed used.

- Location: it should be used for the city of Erbil and other places which have similar features in terms of socio-cultural, economic and environmental aspects.
- The construction project itself and the project's surroundings operate on two separate levels.

5.11 Chapter summary

The procedure of defining the utmost critical requirements to be integrated into the measurement scale and assigning their acceptable level of weighting has been presented in this chapter. It was based on the use of documentation, literature survey, the opinions of limited stakeholders via interviews. Data collection, results, and analysis have guided the processes. This section also proposed a development pattern for a sustainable assessment tool based on the indicators proposed by respondents. In other words, the interviewees and literature survey added some indicators to the localization and specialization of the model.

Sustainability is a new technology used in building and different structure systems that can also be built into large and high-rise buildings that can make life indoors comfortable, energy-efficient and healthier in the local environment. Within the key features of the buildings' sustainability the aim is to combine many principles that some of them are specified to HRBs, which are: premium for height, vertical transportation, vanity height, speculative investment, building construction under the economic dimension, family and community living, disparity in quality of life, human scale, placelessness and the public realm, fire incidences, preservation and blocking views, window cleaning, repair, and maintenance, construction workers, health and well-being, semiotic approach, and energy and carbon emission, wind, sea-level rise, geological considerations, bird collision, waste management, space and location etc.

As a result, the categories and their subcategories changed have altered based on some of the categories gotten from literature and screen review and some of them proposed by the interviewees which added the number of categories to the study area from previous and this chapter (table: 23).

Table 23: Summary of MSHRBE categories and sub-categories

MRS	Indicators with sub-indicators	Refrences
	Environmental Indicatour	
Indoor Environmental Quality (IEQ)		
✪	➢ Environmental tobacco smoke control	From literature reviews
✪	➢ Providing natural ventilation	From literature reviews
✪	➢ Solar control and thermal comfort design	From literature reviews
✪	➢ Natural lighting	From literature reviews
	➢ Considering of building envelopes	Concern of HRBs
	➢ View quality	From literature reviews
✪	➢ Acoustic control	From literature reviews
Outdoor Impact Quality (OIQ)		
	➢ Natural ventilation on nearby buildings	Concern of HRBs
✪	➢ Avoiding negative effect on surrounding	Concern of HRBs
	➢ Bird savers	Concern of HRBs
✪	➢ Consideration of global worming	From literature reviews
	➢ Direct contact with nature	Concern of HRBs
Waste and Pollution (WP)		
✪	➢ Recyvling waste	From literature reviews
✪	➢ Land pollution	From literature reviews
✪	➢ Reducing and avoiding wastes	From literature reviews
✪	➢ Air pollution	From literature reviews
✪	➢ Noises pollution	From literature reviews
	➢ Reducing and avoiding dusty	Added by interviewers
Site Management (SM)		
✪	➢ Responsible to the land and green area	From literature reviews
✪	➢ Selecting site	From literature reviews
	➢ Open spaces and vertical green farms	Added by interviewers
✪	➢ Avoiding the destroy of surrounding	From literature reviews
Energy and Atmosphere (EA)		
✪	➢ Using energy efficiency	From literature reviews
✪	➢ Minimum and optimise energy performance	From literature reviews
✪	➢ Providing onsite renewable energy	From literature reviews
✪	➢ CO2 emissions	From literature reviews
✪	➢ Reduced peak energy requirements	Added by interviewers
	➢ Improve energy efficiency use	From literature reviews
Material Use (MU)		
✪	➢ Using local material	From literature reviews
✪	➢ Using recycled and recyclable material	From literature reviews

✪	➢ Minimizing wasting material	From literature reviews
✪	➢ Building reuse	From literature reviews
✪	➢ Using sustainable material	From literature reviews
	➢ Easy maintenance material	Added by interviewers
Water Use (WU)		
✪	➢ Water quality	From literature reviews
✪	➢ Avoiding wasting water	From literature reviews
✪	➢ Rainwater collection	From literature reviews
✪	➢ Recycling rainwater	From literature reviews
✪	➢ Stormwater management strategies	Added by interviewers
✪	➢ Reuse grey water	From literature reviews
Building Services and Management (BSM)		
✪	➢ Metering and monitoring	From literature reviews
	➢ Time management	Added by interviewers
✪	➢ Communication and IT management and services	From literature reviews
	➢ Electric equipment	From literature reviews
	➢ Plumbing and drainage	From literature reviews
✪	➢ HVAC systems	From literature reviews
✪	➢ Impact of city infrastructure	From literature reviews
	➢ Regular maintenance	From literature reviews
Construction Practice (CP)		
	➢ Efficiency in construction standerds and management	From literature reviews
	➢ Construction safty	From literature reviews
	➢ Construction prosess	From literature reviews
✪	➢ Durability and reliability	From literature reviews
Sociocultural Indicators		
Local Opportunity (LA)		
	➢ Building long-term relationship with local and client	From literature reviews
	➢ Working with local community	Added by interviewers
	➢ Provision of equal opportunity	Added by interviewers
	➢ Participation in decision making	Added by interviewers
Construction and Staff (CS)		
	➢ Respect for staff	From literature reviews
	➢ Partnership working	From literature reviews
Accessibility and Traffic (AT)		
	➢ Shared public spaces and central districts	From literature reviews
	➢ Responsible to the main transportation.	From literature reviews
✪	➢ Public transportation nodes	From literature reviews
	➢ Minimize traffic disruption and delays	Added by interviewers
✪	➢ Pedestrian and cyclist	From literature reviews
✪	➢ Acces with the disability	From literature reviews
✪	➢ Car park capacity	From literature reviews
	➢ Cleaning the façade	Concern of HRBs
Culture and Privacy (CP)		
	➢ Visual privacy	From literature reviews
	➢ Private open space	From literature reviews
	➢ The building culturally acceptable	Added by interviewers
	➢ Visual privacy for others	Added by interviewers
	➢ Consideration with religion and faith	Added by interviewers
Healthand Well Being (HWB)		

	➢ Psychological feeling	Concern of HRBs
Safety (S)		
✪	➢ Fire safety	From literature reviews
	➢ Accidental falls from the height	Concern of HRBs
	➢ Safety while maintenance and cleaning	Concern of HRBs
	➢ Safity for construction workers	From literature reviews
Vertical Transportation (VT)		
	➢ Elevators	Concern of HRBs
	➢ Travel time in elevator	Concern of HRBs
Security and Crimes (SC)		
	➢ Crime in corridors	Concern of HRBs
	➢ Crime in elevators as rape and robbery	Concern of HRBs
	➢ Monitoring and controlling	From literature reviews
Scale and Size (SS)		
	➢ Human scale	Concern of HRBs
	➢ Building height	Concern of HRBs
Children Behavior (CB)		
	➢ Behavior problem in children	Concern of HRBs
	➢ Children development	Concern of HRBs
	➢ Playing space for children	Concern of HRBs
Social and Community (SAC)		
	➢ Social interaction	Concern of HRBs
	➢ Effective channel for communication	From literature reviews
	➢ Family and community	Concern of HRBs
	➢ Who the neighbors are	Concern of HRBs
	➢ Neighbor facility	Concern of HRBs
	➢ The public realm of the livability of street	Concern of HRBs
Heritage Respect (HR)		
	➢ Respect to heritage and historical buildings	Concern of HRBs
	➢ Respect to whole of the Erbil citadel	Added by interview
Awareness and Education (AE)		
	➢ Knowledge skills of users	From literature reviews
	➢ Staffs knowledge	From literature reviews
	➢ Spaces for education	From literature reviews
Semiotic Approach (SA)		
	➢ Sign and symbolic	Concern of HRBs
	➢ Context architectural identity	Added by interviewers
	➢ Placelessness and public realm	Concern of HRBs
Economic Indicatores		
Local Economic Growth (LEG)		
	➢ Support local community	From literature reviews
	➢ Improved productivity	From literature reviews
	➢ Consistent profit growth	From literature reviews
	➢ Developing client business	From literature reviews
Jobs Opportunity (JO)		
	➢ Employment local people	Added by interviewers
	➢ Providing job	From literature reviews
	➢ Supplier satisfaction	From literature reviews
	➢ Client satisfaction	From literature reviews
	➢ Employee satisfaction	From literature reviews

Shorter and more Predictable (SP)		
	➢Providing projects with low cost	From literature reviews
	➢Provide multiple benefits of financincy to communities	Added by interviewers
	➢Provide projects with short payback period	From literature reviews
	➢Reducing maintenance cost	From literature reviews
	➢Reducing service cost	From literature reviews
	➢Increased cost predictability	From literature reviews
	➢Ongoing costs	From literature reviews
	➢Vanity height	Concern of HRBs
Supply-side (Ss)		
	➢Supply and demand	From literature reviews
	➢Reliability and reduction	Concern of HRBs
Innovation (I)		
✪	➢Innovation in design	From literature reviews
✪	➢Innovation in techniques and technologies	From literature reviews
✪	➢Innovation in benchmarks	From literature reviews
	➢Exemplary and enhancement level of performance	From literature reviews

Interviewers	: Interview with the groups
Literature reviews	: Literature reviews on sustainability and its indicatores
Concern of HRBs	: Concerns of high-rise buildings from the previous study
✪	: Exist in the studied rating systems

Chapter 6

ERBIL HIGH-RISE BUILDING CONDITIONS IN TERMS OF SUSTAINABILITY

6.1 Introduction

In order to better understand the socio-cultural, economic and environmental dimensions of using either to live or to work in such buildings here, chapter six introduces and explores the scenario that occurs in Erbil high-rise buildings and their condition through user experience and observation. With its pilot analysis, population and sample size, and questionnaire content and structure, the chapter first addresses the questionnaire survey. There is also a description of observation and photographic registration with the method of review of the outcome for each of them. In general, it discusses the environmental issues of high-rise buildings in Erbil, followed by discussions on the socio-cultural aspects, after that there is level of affordability on the economic features. Later, concerns of high-rise living together with the behavioural aspects of the respondents regarding the all three sides will be discussed for all five case studies with short description for all of them.

There is also a building assessment, which relies on the results of questionnaires and observations, and the use of a checklist of sustainable measuring instruments to explain their degree in sustainable terms.

6.2 Questionnaire survey

Distribution of questionnaires is another approach that will be used in this study to

approach the primary target. More clearly, some questions were spread among the users of Erbil's high-rise buildings to understand the degree of satisfaction of users about the work/living areas, living standards and quality. In other words, the main aim of using questionnaires was to investigate the present scenario of high-rise building in Erbil and provide the answers to the question; what are the current conditions and problems of high-rise buildings in Erbil city? Since inside the buildings there is no easy to understand and no possibility of assessing conditions, of verifying the situations they live in, and whether they are relaxed or not, it has been decided to use both open and close-ended questionnaires. In these questionnaires, while visiting multi times in November and December of 2019 and the summer of 2010, they will be asked to state whether or not they feel secure in their homes or workplaces. In addition, occupants are asked whether or not they feel relaxed and happy with their units and to provide awareness of social phenomena.

- *Population and sample size*

It is a very important to decide sample size because samples that are too big can waste time, energy and money, whereas samples that are too small can result in inaccurate results. The sample size is influenced by many factors, including population size, uncertainty, error margin, and degree of significance. The sample size for any analysis usually depends on:

- Appropriate degree of importance.
- Power of the survey
- Expected effect size
- Underlying event rate in the population
- Standard population deviation.

The predicted drop-out rate, an unequal distribution ratio, and the purpose and nature of the study are some more considerations that can be considered when determining the final sample size. The sample size have been determined after explaining main information of the case studies.

- *Content and structure of questionnaire*

Section one: Personal information of the participant

Question one in section one, were questions attribute questions to collect information about the occupants' personal characteristics, including education, occupation, contact information-number/ email - age group and gender. Questions two in the same section is about building specifications as name of tower, floor number of flat or unit and their area.

Section two: Environmental aspects

The questions in this section are to find out the user's satisfaction for either living or working on the environmental issues of their buildings and unit/flat. Questions three was questions to investigate the level of satisfaction for environmental aspects of the high-rise building and apartment/ office unit as building location, land management, various pollution, sound insulation, thermal insulation, materials, waste management. Etc.

Question four in the second section was question to investigate existing or absent of different environmental issue that shown by yes, no, or no opinion such as the materials from local, the water system as greywater or rainwater harvesting, and having have a renewable energy system.

Section three: Socio-cultural aspects

The question five in the section was to investigate the user's satisfaction, for either living or working, on the Socio-cultural issues of their buildings and unit/flat as privacy, views plan arrangement...etc

Also, by question six, it is to discover about either existing or absenting of some other socio-cultural issues in the buildings. The question seven to ten were about the attractive points of high-rise buildings and some other opinion.

Section four: Economical aspects

The questions in this section to examine the level of affordability, according to the users, on the economic issues as rent and sell prices and services' prices as water, gas, electricity power, cleaning, waste collection, and etc....etc Also, it is to discover about payback period, supporting the local economy and local people employees.

Section five: Concern of high-rise buildings

Question 14 was designed to investigate the respondents' concerns about various issues of high-rise buildings and their units such as human scale, travel waiting, clime in different parts...etc. Additionally, to identify and describe the participants' preferences on evaluating the safety of above floor for children, water plumbing, gas services,

Section six: open end question

Questions 15, 16 and 17 in section six that open end question were questions to indicate some other aspects such as the response opinions about the benefits and drawbacks of living in high-rise buildings in general, the way for improving the office unit/ apartment, and sharing any other things or aspects if they want.

6.3 Cases study

Within the scope of this research, there are five high-rise projects in Erbil as sample cases to questionnaire as explain below:

1. Office tower:

- Roj empire tower (The central business tower): it has been constructed by Empire World company. It consists of 27 floors high and covers a construction area of 24,000m^2 with glass facade material. It has the basement and ground floors, reserved offices and information services. The first floor is mezzanine floor and second floor includes a conference hall, business centre and meeting rooms. Ther are 9 floors that each with 4 offices and an average area of 215m^2, 8 floors each with 2 offices and an average area of 520m2 and 6 floors with just 1 office and an average area of 1,045m2.
- Office tower of World trade centre –Gulan Park: it has been constructed by Rönesans company with the modern architecture style. consists of 21 floors and 91 metre height. It is located on Gullan street and in group of towers.

2. Mix used tower:

- Justice tower (Erbil business & trade centre): it is a largest tower in Erbil city and its area is approximately 240.000m2 that progressing and executed by Nasri group of companies. It is Comprising 37 floors, 3 underground floors and a 120m high suspended bridge. The front part contains a 5-star hotel and 336 luxury hotel rooms, as well as a host of other services and facilities. The back part consists of office spaces with a modern design. These offices are in different size variants between 55m2 and 140m2 on the building's second to twenty- second floors. From the twenty-fourth floor and above, large commercial spaces are provided for use by big companies, such as banks, to provide upscale services.

3. Residential tower:

- Escan towers: they have been constructed by Shaxa barza and 99 companies that are two towers together in a group of towers in a mix used project on Escan street in Erbil city and comprising 27 floor, 1 underground floors, and 90 m height.
- Quattor towers: they have been constructed by MRF company that are four towers together on Gullan stree in Erbil and comprising 31 floors, 3 underground floors and a 103m height. Each of the tower contains 350 apartments, all of them together became (4*350) apartments.

Basic information on each high-rise study is shown in the table below: number of floors above the ground floor, current functions, views, and location by municipality. Therefore, almost all high-rise buildings have office, residential, and retail functions, though some also provide exhibition and sports facilities. They are built either as one tower or more, as seen from the table.

Table 24: Summery of five cases studies.

HRBs name	No. of stories	Height	Functions	Location	Tower Properties
Roj Empire tower	27		Commercial	Muni.	In group of towers.
World trade centre	21	91	Commercial	Muni. 2	In group of towers.
Justice tower	37	120	Mix-used	Muni. 6	One tower
Escan towers	27	90	Residential	Muni. 4	Two towers
Quattor tower	31	103	Residential	Muni. 2	Four towers
Muni. : Municipality					

Sample size, method of sample size and sample type determination for questionnaire. Sample size is the number of completed responses the survey receives, depending on population and sample size. It's called a survey because it only represents part of the

community of people whose views or behaviour you care about or target population. One way of sampling, for example, is to use a' random sample,' where respondents are selected from the general population entirely by chance. There are suggested sample sizes for different statistical proces, according to Salant and Dillman (1994), but no particular sample size formula or method is applicable for every research method and statistical procedure. Many researchers argue that the idea of saturation in qualitative research is the most important element to consider when making sample size decisions (Mason,2010). Nevertheless, the sample size needed depends on two important factors; the size of the sampling error that can be tolerated and the degree of population variety with regard to the sample characteristics (Salant and Dillman, 1994; De Vaus, 2002). Saturation is therefore based on several variables and not all of them are under the control of the researcher. Some of these include: the study of the population is homogeneous or heterogeneous, selection criteria, the amount of money in the study budget, a crucial key range for an in-depth understanding of the subject, the researcher's knowledge (Charmaz, 2006), theoretical sampling and ensuring depth of relevant concepts and analyzing a range of concepts and characteristics (Strauss & Corbin, 2007). The table below shows the sample size for various population sizes and precision levels.

Table 25: Sample size for various population size and of precision levels. Source: (Dillman, 2007)

	Sample size for the 95% confidence level					
	±10% Sampling Error		±5% Sampling Error		±3% Sampling Error	
Population Size	50/50 split	80/20 split	50/50 split	80/20 split	50/50 split	80/20 split
100	49	38	80	71	92	87
200	65	47	132	111	169	155
400	78	53	196	153	291	253
600	83	56	234	175	384	320
800	86	57	260	188	458	369
1,000	88	58	278	198	517	406
2,000	92	60	322	219	696	509
4,000	94	61	351	232	843	584
6,000	95	61	361	236	906	613
8,000	95	61	367	239	942	629
10,000	95	61	370	240	965	640
20,000	96	61	377	243	1,013	661
40,000	96	61	381	244	1,040	672
100,000	96	61	383	245	1,056	679
1,000,000	96	61	384	246	1,066	683
1,000,000,000	96	61	384	246	1,067	683

Two measures to determine the sample size:

1. Calculate the sample size for populations from infinity
2. Adapt the sample size to the population needed.

Then, the calculation that should be used to calculate the sample size for infinity populations.

S=Z2 *P*(1-p)/ M2
Where:
S=sample Size for infinite population
Z=Z score (is determined based on confidence level)
Confidence Level: the probability that the value of a parameter falls within a specified rang of values
P=population proportion (Assumed to be 50% =0.5)
M=Margin of error

If we consider 95% confidence level, then Z-Score equal to 1.96

Then Margin Error is a small amount that is allowed for in caws of miscalculation or change of circumstance.

Generally, the taken margin of error is 5% , then M=0.05, Z-Value=1.96 for 95% of confidence level.

In this case Sample Size becomes:

$S= (1.96)^2*0.5*(1-0.5)/(0.05)^2$
$S= 3.8416*0.25/0.0025$
$S=384.16$, for Margin error (10%), S=96.02

Then for adjust the sample size to the required population

The following formula for adjusted sample size

Adjusted sample size = (S)/ [1+ (S-1)/population]

So, there are five case studies as it has mentioned above (figure: 35).

Figure 35: Five cases studies location.

For Escan towers: Adjusted sample size = (384.16)/ [1+ (384.16-1)/192]

Adjusted sample size = (96.02)/ [1+ (96.02-1)/192]

For World trade centre towers: Adjusted sample size = (384.16)/ [1+ (384.16-1)/ 73]

Adjusted sample size = (96.02)/ [1+ (96.02-1)/73]

For Quattor tower: Adjusted sample size = (384.16)/ [1+ (384.16-1)/350]

Adjusted sample size = (96.02)/ [1+ (96.02-1)/350]

For Roj Empire tower: Adjusted sample size = (384.16)/ [1+ (384.16-1)/58]

Adjusted sample size = (96.02)/ [1+ (96.02-1)/58]

For Justice tower: Adjusted sample size = (384.16)/ [1+ (384.16-1)/1012]

Adjusted sample size = (96.02)/ [1+ (96.02-1)/1012]

Table 26: Sample sizes of case studies with different confidence level and sample error

Building names	*Unit Number*	*Confidence Level 95%, and Sample error 5%*	*Confidence Level 95% and Sample error 10%*
Roj Empire tower	58	51	36
World trade centre	73	61	42
Justice tower	1012	279	88
Escan towers	192	128	64
Quattor tower	4*350	183	76

The participant selection will be random, and the rate will also be determined by the answer. The average survey answer rate is 36% ±13%, (i.e. 23-49%), according to Baruch (1999), or it can be around 60%± 20% (i.e. 40-80). In other words, to get the actual and the necessary number of responses, it needs to submit at least more than three times the goal of the study population.

6.4 Observation and photographic registration

The observation in this research based on some kind of a category structure in the light of the theoretical literature on the subject, to get inside views, i.e. to understand

how residents and employees interpret themselves, their society and the world outside. In other words, providing contextual information, which is not written in documents needed to frame evaluation. Also, to learn about sensitive concerns that participants may not be able to address. By outlining building names, height and floor number and orientation, etc. the data obtained from the observations of high-rise buildings in Erbil was analyzed. Via personal observation, while visiting multi times in November and December of 2019 and the summer of 2020, which is presented through images and summarized tables, they have been surveyed and analyzed.

- *Content and structure of observation*

Section one: General issues

This section was designed to understand and evaluating the general issues of the building, it was designed to identify the main subject of high-rise buildings within this city urban spaces.

Section two: Environmental aspects

This section is to find out the state of some environmental issues of the buildings. In another word, it is to discover about either existing or absenting of some environmental issues in the buildings.

Section three: Socio-cultural aspects

The purpose of the section three is to investigate score, for either living or working, on the Socio- cultural issues of the buildings and unit/flat as communication integration, being as a landmark, and the heritage value. Also, it is to observe some other socio-cultural issues in the buildings and the attractive points of high-rise buildings.

Section four: Economical aspects

This section is to examine and discover the score of different issues, according to the users, on the economic issues as distance from public transportation, supporting the local economy and local people employees.

6.5 Method of analysing and evaluation the result

6.5.1 Evaluation of results of questionnaire in local people and user

All questionnaire data were analyzed using different SPSS statistical methods. As the findings are presented, data interpretation specifics are given later. $P<0.05$ is available, indicating a confidence level of 95 percent (figure: 36).

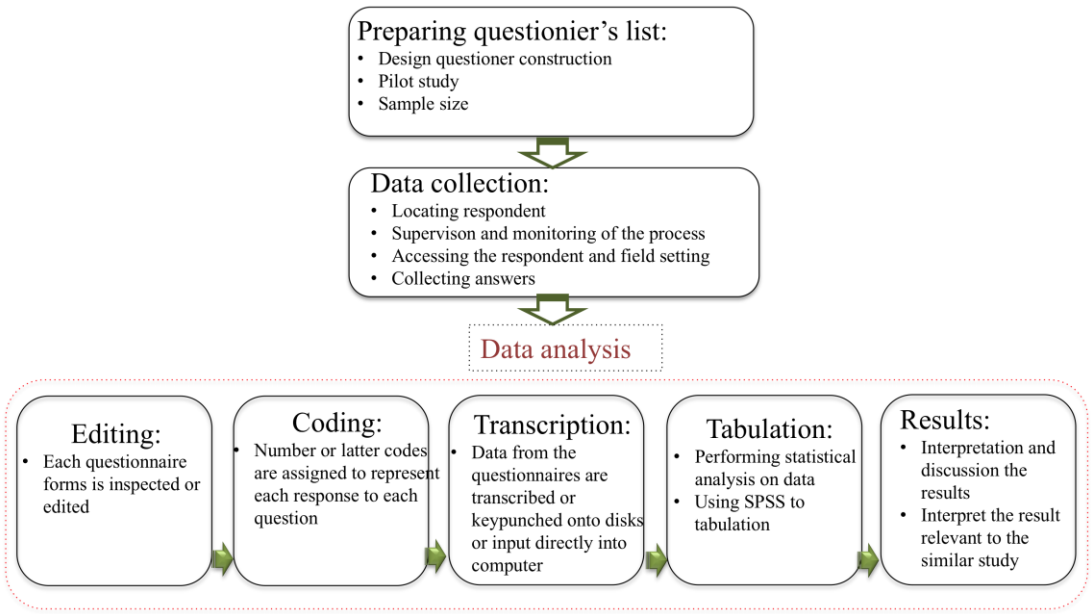


Figure 36: Steps of evaluation of results of questionnaire in local people and users. Source: (by author).

6.5.2 Evaluation of observations

All data from the form were analyzed. As the findings are presented, data interpretation specifics are given later.

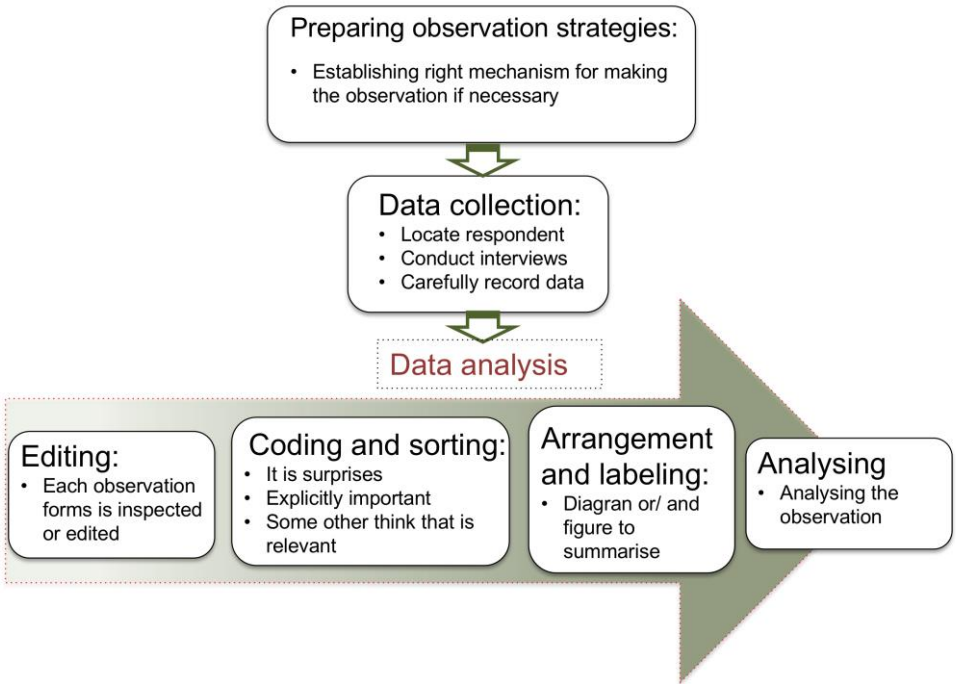


Figure 37: Method of observation evaluation. Source: (by author).

6.6 Results and discussions of survey- users of high-rise buildings questionnaire

The various analytical approaches used here are descriptive statistics, one-way variance analysis and linear regression analysis using SPSS (Version 25). Descriptive statistics were used to summarize data by finding mean and standard deviation on different social, environmental and economic dimensions of high-rise buildings, participant satisfaction, complaints and behaviours.

6.6.1 Roj empire tower (The central business tower)

6.6.1.1 Descriptive statistics and frequencies of Roj empire tower

- *Personal Information of the participant*

A significant majority of respondents (75%) were professionals, while a few were graduates (11.1%) and post-graduate graduates (13.9%). The engineers were almost 28% of the participants. The majority of users (almost 64%) were between 20 to 30 years and a further significant group (19.4%) was between 31 to 40 years. The majority

(nearly 64%) were female and 2.8% were other, as shown in table 27, compared with 33.3% male. This means that most users are male, young and graduates.

Table 27: Descriptive statistics frequencies of the demography of participants in Empire tower.

Demo-Variables	Sub Variables	Frequency	Percentage
Education	Un -gradu.	4	11.1
	Gradu.	27	75
	Post-gradu.	5	13.9
Occupation	Engineer	10	27.8
	Other	26	72.2
Age	20-30	23	63.9
	31-40	7	19.4
	41-50	3	8.3
	51-63	3	8.3
Gender	Male	23	63.9
	Female	12	33.3
	Other	1	2.8

- *Satisfaction for the environmental and socio-culture aspects of high-rise building and apartment/ office unit*

Users were asked about their overall satisfaction with working/living in a high-rise. The respondents' answers were based on a Likert scale of five points, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied"

Table 28: Descriptive statistics of satisfaction for the environmental and socio-cultural aspects in Roj Empire tower.

Descriptive Statistics

		Minimum	Maximum	Mean	Std. Deviation
Environmental aspects	Building location	1	4	3.03	.941
	Land management	2	5	3.19	.822
	Over shadowing	2	4	2.71	.572
	Natural light	2	5	3.31	1.078
	Natural ventilation	1	3	2.53	.654
	Water quality	1	4	2.92	.770
	Noise from nature	1	5	2.97	1.082
	Noise by human pro.	1	5	2.94	1.372
	Sound insulation	1	5	3.11	1.190

	Pollution	2	5	3.19	.951
	Thermal insulation	1	5	2.97	1.124
	Material and monitoring	1	4	2.88	.880
	Material use	2	4	2.94	.754
	Construction quality	1	5	3.03	.941
	Structure safety	1	5	2.92	1.131
	Metric system	1	5	3.03	1.114
	Finishing material	2	4	3.22	.760
	Water management	1	3	2.59	.657
	Orientations	1	5	2.83	1.183
Socio-cultural aspects	Entrance	1	4	2.67	.894
	Plan	1	4	2.78	.989
	Size	2	5	3.31	.920
	Interior design	1	5	2.86	1.089
	View	1	4	2.69	1.117
	Privacy level	1	5	2.91	1.138
	Interaction with neigh	2	5	3.31	1.037
	Community space	1	5	2.81	1.009
	Green area	1	4	2.28	1.003
	Children playground	1	4	2.47	1.047
	Safety for children	2	3	2.48	.508
	Entertainment facility	1	5	2.71	1.088
	Futures for disability	1	4	2.70	.918
	Announcements	2	5	2.94	.864
	Sewage system	1	5	2.97	1.087
	Car park capacity	1	5	3.66	.968

It is clear from Table 28 that there is a lack of natural ventilation, water quality and control, thermal insulation, monitoring, material, structural protection, and an appropriate environmental orientation for their offices. It is also important to note that respondents working on this tower only report on socio-cultural benefits in terms of office size, community engagement, and parking capacity.

- *Exist and absent different socio-culture issues*

For these five questions, the respondents' responses were "Yes", "No" and "No Idea".

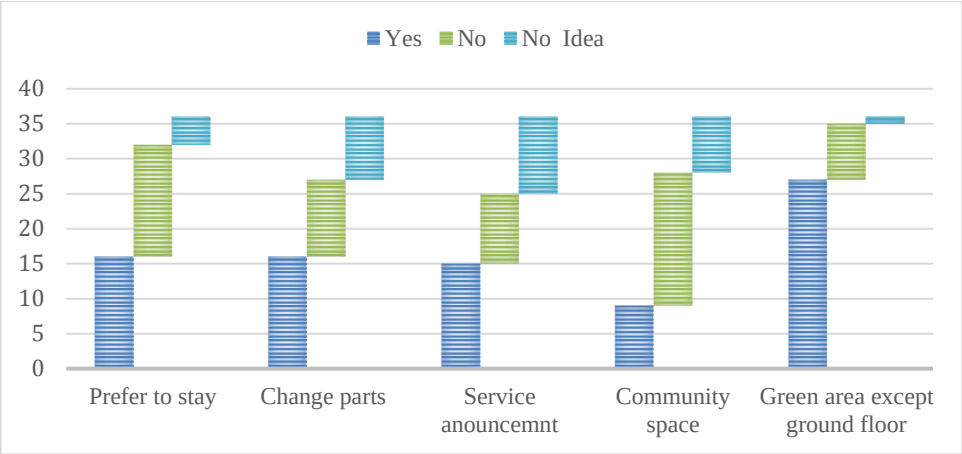


Figure 38: Exist and absent of the number of socio-culture side in Roj empire tower.

Statistics of the outcomes in figure 38 indicate that fewer than half of them choose to remain, have altered parts, and when they receive service notification choose to comply with the community spaces.

- *Level of affordability for the different economic issues*

The users were asked about their general satisfaction with high-rise jobs. The respondents' answers were based on a Likert scale of five points, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied".

Table 29: Level of affordability of participant in Roj empire tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. D.
For rent	1	3	1.88	.820
For sell	1	4	2.18	1.074
Water	1	4	2.52	1.064
Gas	2	5	2.91	.963
Electricity	1	5	2.67	1.242
Cleaning	1	5	2.94	1.298
Waste collection	2	4	3.06	.864
Other service	1	5	2.67	1.407
Life cycle cost	1	4	2.33	1.080

The above table indicates that descriptive figures of most of the outcomes of the

participant's degree of affordability are not acceptable and have a mean of less than three.

- *Payback period, supported of the local economy, and employees*

A "Yes", "No and No Idea" were the responses of the respondents to these three Payback period questions, supported by the local economy, and employees.

Figure 39: The situation of payback period, supported of the local economy, and employees from local in Empire tower.

For all three, the responses to the questionnaire indicate that the tower does not have a short payback period and does not help local workers as well as local staff.

Private cars or taxis are the travel services used by users, and there is no public transit used by users. And some problems can be explained from the observation that there is no recycled material used, 80% of the material is not local, there is no reuse of the water system as greywater or rainwater harvesting; the waste system is isolated quite initially; there is no good fire design system; and very little consideration of

passivestrategies as a solution for openings as shading devices, not enough efficiency in the use of lifts, and the energy system is not renewable.

- *Concern of High-rise buildings in roj empire tower*

The general concerns about high-rise living were defined by a number of points based on the literature review, such as the height of the building, growth of children and their behaviours, human scale, insufficient neighbourhood facilities, not enough playing space for kids, symbolic attraction, lack of social interaction, lack of visual privacy, emotional stress or mental health concerns, and so on and so forth. These problems were asked to the participants for purposes of rating. All responses to these concerns were based on a Likert scale of five points where "1" was not concerned" and "5" was "highly concerned".

Table 30: Concern level of high-rise buildings in Roj empire tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. De
Human scale	1	4	2.42	.937
Children growth and beh.	1	5	2.31	1.142
Travel time	1	4	2.69	1.037
Corridor waiting	1	5	2.78	1.072
Building height	1	5	3.25	1.079
Isolated from ground	1	4	2.29	.957
Neighboured	1	4	2.29	1.045
Accidental falls	1	5	2.56	1.182
Fire safety	1	5	3.40	.914
Crime in lift	1	5	2.81	.980
Car park	1	5	3.00	1.057
Elevator breakdown	1	5	2.61	1.153
Suicide	1	4	2.18	.999
Children play ground	1	5	2.03	1.000
Privacy	2	5	2.92	.806
Symbolic attraction	2	5	3.94	.955
Social relation	1	4	2.60	.847

Strain stress mental health	2	3	2.44	.504
Failure of electricity	2	4	3.08	.770
Water cut	1	4	3.29	.825

The absence of three quarters of the sub-indicators of concern for high-rise buildings is evident from the above table. With regards to the idea of sustainability, it was observed that the majority of the components are ignored or not considered.

6.6.1.2 Scoring system and its result of the Roj Empire tower

It is suggested that a project's score should be calculated by taking the various steps to measure every score of sub-issue; applying the net weighting to every sub-indicator; adding all weighted sub-issue scores together within each issue; and adding any points of innovation that might have been achieved. By using the equation (Tam 2000), giving the weight or not giving it depends on the mean, standard deviation and Relative Important Index (RII):

Relative Important Index (RII) = $\sum W/(AN)$

where W was the respondent's weighting for every aspect.
A is the highest weight (A= 5).
N is the sample size; and the is presented by RII.
which $0 \leq$ Relative Important Index ≤ 1.

And if ($0 \leq RII \leq 0.6$) is low. So in this analysis, which is equivalent to the mean: 3,00, it becomes appropriate above. The following table is the Roj Empire Tower scoring estimate and its final performance ranking.

Table 31: Scoring result of Roj Empire tower according to MSSHRB-E

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

High-Rise building Checklist

Name of High-rise building: Roj empire tower

				Environmental Indicatour	%
1,92	2,91	0,97		Indoor Environmental Quality (IEQ)	5,80
Y			Prereq1	➢Environmental tobacco smoke control	Required
	0,97		Credit	➢Providing natural ventilation	0,97
	0,97		Credit	➢Solar control and thermal comfort design	0,97
0,97			Credit	➢Natural lighting	0,97
		0,97	Credit	➢Considering of building envelopes	0,97
	0,97		Credit	➢View quality	0,97
0,95			Credit	➢Acoustic control	0,95
0	1,48	2,22		Outdoor Impact Quality (OIQ)	3,70
	0,74		Credit	➢Natural ventilation on nearby buildings	0,74
	0,74		Credit	➢Avoiding negative effect on surrounding	0,74
		0,74	Credit	➢Bird savers	0,74
		0,74	Credit	➢Consideration of global worming	0,74
		0,74	Credit	➢Direct contact with nature	0,74
2,22	1,48	0		Waste and Pollution (WP)	3,70
N			Prereq1	➢Recycling waste	Required
0,74			Credit	➢Land pollution	0,74
0,74			Credit	➢Reducing and avoiding wastes	0,74
	0,74		Credit	➢Air pollution	0,74
0,74			Credit	➢Noises pollution	0,74
	0,74		Credit	➢Reducing and avoiding dusty	0,74
2,80	0	0,90		Site Management (SM)	3,70
1,00			Credit	➢Responsible to the land and green area	1,00
0,90			Credit	➢Selecting site	0,90
		0,90	Credit	➢Open spaces and vertical green farms	0,90
0,90			Credit	➢Avoiding the destroy of surrounding	0,90
0	1,86	7,44		Energy and Atmosphere (EA)	9,30
N			Prereq1	➢Using energy efficiency	Required
		1,86	Credit	➢Minimum and optimise energy performance	1,86
		1,86	Credit	➢Providing onsite renewable energy	1,86
	1,86		Credit	➢CO2 emissions	1,86
		1,86	Credit	➢Reduced peak energy requirements	1,86
		1,86	Credit	➢Improve energy efficiency use	1,86
1,48	0,74	1,48		Material Use (MU)	3,70
N			Prereq1	➢Using local material	Required
		0,74	Credit	➢Using recycled and recyclable material	0,74
		0,74	Credit	➢Minimizing wasting material	0,74
	0,74		Credit	➢Building reuse	0,74
0,74			Credit	➢Using sustainable material	0,74
0,74			Credit	➢Easy maintenance material	0,74
0,00	0,74	2,96		Water Use (WU)	3,70
N			Prereq1	➢Water quality	Required
	0,74		Credit	➢Avoiding wasting water	0,74
		0,74	Credit	➢Rainwater collection	0,74
		0,74	Credit	➢Recycling rainwater	0,74
		0,74	Credit	➢Stormwater management strategies	0,74
		0,74	Credit	➢Reuse grey water	0,74
2,22	0,74	0,74		Building Services and Management (BSM)	3,70
Y			Prereq1	➢Metering and monitoring	Required
N			Prereq2	➢Time management	Required
N			Prereq3	➢Communication and IT management and services	Required
0,74			Credit	➢Electric equipment	0,74
0,74			Credit	➢Plumbing and drainage	0,74
0,74			Credit	➢HVAC systems	0,74
		0,74	Credit	➢Impact of city infrastructure	0,74
	0,74		Credit	➢Regular maintenance	0,74
2,80	0,90	0		Construction Practice (CP)	3,70
1,00			Credit	➢Efficiency in construction standerds and managemer	1,00
	0,90		Credit	➢Construction safty	0,90
0,90			Credit	➢Construction prosess	0,90
0,90			Credit	➢Durability and reliability	0,90

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Roj empire tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

				Socio-cultural Indicators	%
0	1,90	5,70		Local Opportunity (LO)	7,60
	1,90		Credit	➢ Building long-term relationship with local and client	1,90
		1,90	Credit	➢ Supplier satisfaction	1,90
		1,90	Credit	➢ Client satisfaction	1,90
		1,90	Credit	➢ Employee satisfaction	1,90
1,05	1,05	0		Construction and Staff (CS)	2,10
1,05			Credit	➢ Respect for staff	1,05
	1,05		Credit	➢ Partnership working	1,05
0,90	0,30	0,90		Accessibility and Traffic (AT)	2,10
N			Prereq1	➢ Shared public spaces and central districts	Required
		0,30	Credit	➢ Responsible to the main transportation.	0,30
		0,30	Credit	➢ Public transportation nodes	0,30
		0,30	Credit	➢ Minimize traffic disruption and delays	0,30
0,30			Credit	➢ Pedestrian and cyclist	0,30
0,30			Credit	➢ Acces with the disability	0,30
0,30			Credit	➢ Car park capacity	0,30
	0,30		Credit	➢ Cleaning the façade	0,30
0,70	1,40	0		Culture and Privacy (CAP)	2,10
Y			Prereq1	➢ Visual privacy	Required
N			Prereq2	➢ Private open space	Required
0,70			Credit	➢ The building culturally acceptable	0,70
	0,70		Credit	➢ Visual privacy for others	0,70
	0,70		Credit	➢ Consideration with religion and faith	0,70
0	0	2,10		Health and Wellbeing (HW)	2,10
		2,10	Credit	➢ Psychological feeling	2,10
1,60	0,50	0		Safety (S)	2,10
0,60			Credit	➢ Fire safety	0,60
	0,50		Credit	➢ Accidental falls from the height	0,50
0,50			Credit	➢ Safety while maintenance and cleaning	0,50
0,50			Credit	➢ Safity for construction workers	0,50
2,10	0	0		Vertical Transportation (VT)	2,10
1,05			Credit	➢ Elevators	1,05
1,05			Credit	➢ Travel time in elevator	1,05
0,70	1,40	0,00		Security and Crimes (SC)	2,10
	0,70		Credit	➢ Crime in corridors	0,70
	0,70		Credit	➢ Crime in elevators as rape and robbery	0,70
0,70			Credit	➢ Monitoring and controlling	0,70
1,05	0	1,05		Scale and Size (SS)	2,10
		1,05	Credit	➢ Human scale	1,05
1,05			Credit	➢ Building height	1,05
0	0,00	2,10		Children Behavior (CB)	2,10
N			Prereq1	➢ Behavior problem in children	Required
		1,05	Credit	➢ Children development	1,05
		1,05	Credit	➢ Playing space for children	1,05
0,00	1,26	0,84		Social and Community (SAC)	2,10
N			Prereq1	➢ Social interaction	Required
	0,42		Credit	➢ Effective channel for communication	0,42
	0,42		Credit	➢ Family and community	0,42
		0,42	Credit	➢ Who the neighbors are	0,42
		0,42	Credit	➢ Neighbor facility	0,42
	0,42		Credit	➢ The public realm of the livability of street	0,42
1,05	0	1,05		Heritage Respect (HR)	2,10
		1,05	Credit	➢ Respect to heritage and historical buildings	1,05
1,05			Credit	➢ Respect to whole of the Erbil citadel	1,05
0	0,70	1,40		Awareness and Education (AE)	2,10
		0,70	Credit	➢ Knowledge skills of users	0,70
	0,70		Credit	➢ Staffs knowledge	0,70
		0,70	Credit	➢ Spaces for education	0,70

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Roj empire tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

0,70	1,40	0		Semiotic Approach (SA)	2,10
0,70			Credit	➢Sign and symbolic	0,70
	0,70		Credit	➢Context architectural identit	0,70
	0,70		Credit	➢Placelessness and public realm	0,70

				Economic Indicatores	%
1,84	3,66	0		Local Economic Growth (LEG)	5,50
N			Prereq1	➢Support local community	Required
	1,83		Credit	➢Improved productivity	1,83
	1,83		Credit	➢Consistent profit growth	1,83
1,84			Credit	➢Developing client business	1,84

3,80	3,80	0		Jobs Opportunity (JO)	7,60
N			Prereq1	➢Employment local people	Required
	1,90		Credit	➢Providing job	1,90
	1,90		Credit	➢Working with local community	1,90
1,90			Credit	➢Provision of equal opportunity	1,90
1,90			Credit	➢Participation in decision making	1,90

0,70	3,40	1,40		Shorter and more Predictable (SP)	5,50
		0,70	Credit	➢Providing projects with low cost	0,70
	0,70		Credit	➢Provide multiple benefits of financincy to communities	0,70
		0,70	Credit	➢Provide projects with short lifecycle cost	0,70
	0,70		Credit	➢Reducing maintenance cost	0,70
	0,70		Credit	➢Reducing service cost	0,70
	0,70		Credit	➢Increased cost predictability	0,70
0,70			Credit	➢Ongoing costs	0,70
	0,60		Credit	➢Vanity height	0,60

2,75	2,75	0		Supply-side (Ss)	5,50
	2,75		Credit	➢Supply and demand	2,75
2,75			Credit	➢Reliability and reduction	2,75

2,50	5,00	2,50	+	Innoations (I)	10,00
2,50			Credit	➢Innovation in design	2,50
		2,50	Credit	➢Innovation in techniques and technologies	2,50
	2,50		Credit	➢Innovation in benchmarks	2,50
	2,50		Credit	➢Exemplary and enhancement level of performanc	2,50

34,88	39,37	35,75	Totals	110,00

Certificate	Percentage
No certified	< 40
D	40 - 49
C	50 - 59
B	60- 69
A	70-80
A+	>80

6.6.2 Office tower of World Trade centre –Gulan Park

6.6.2.1 Descriptive statistics and frequencies of Gulan tower

- *Personal Information of the participant*

A significant majority of participants (81%) were graduates, while a few were undergraduates (9.5%) and postgraduates made up (9.5%). Of the participants, almost 27.8% were engineers. Much of the users were between 20 and 30 years of age (almost 66.7%), while another significant number of respondents (16.7%) were between 31 and 40 years of age. As shown in table 32, the majority (almost 59.5% of respondents were female, compared to 40.5% who were male. It indicates that the bulk of users are young and female graduates.

Table 32: Descriptive statistics frequencies of the demography of participants in Gulan Park tower

Demo-Variables	Sub Variables	Frequency	Percentage
Education	Un -gradu.	4	9.5
	Gradu.	34	81
	Post-gradu.	4	9.5
Occupation	Engineer	7	27.8
	Other	35	72.2
Age	Under 20	1	2.4
	20-30	28	66.7
	31-40	7	16.7
	41-50	6	14.3
Gender	Male	17	40.5
	Female	25	59.5

- *Satisfaction for the environmental and socio-culture aspects of high-rise building and apartment/ office unit*

User satisfaction with high-rise work/living as a whole: The respondents' answers were based on a Likert scale of five points, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied".

Table 33: Descriptive statistics of satisfaction for the environmental and socio-cultural aspects in Gullan tower

Descriptive Statistics

		Minimum	Maximum	Mean	Std. Deviation
Environment aspect	Building location	2	4	3.14	.783
	Land management	2	5	2.93	.997
	Over shadowing	1	5	3.21	.842
	Natural light	2	5	3.48	.890
	Natural ventilation	1	5	3.31	1.297
	Water quality	1	5	3.21	.925
	Noise from nature	1	5	2.81	.890
	Noise by human products	2	4	2.43	.668
	Sound insulation	2	5	3.10	.656
	Pollution	1	5	2.86	1.160
	Thermal insulation	1	5	3.14	1.441
	Material and monitoring	2	5	3.05	.909
	Material use	1	4	2.86	1.049
	Construction quality	1	5	2.57	1.364
	Structure safety	2	5	3.05	.962
	Metric system	1	5	2.93	.997
	Finishing material	1	4	2.60	.885
	Water management	1	4	3.14	.647
	Orientation	1	4	2.90	.932
Socio-cultural aspects	Entrance	1	5	3.02	1.316
	Plan	1	4	3.14	.814
	Size	2	5	3.19	.862
	Interior design	1	4	3.24	.906
	View	2	5	3.45	.993
	Privacy level	1	5	3.21	1.025
	Interaction with neigh	2	3	2.57	.501
	Community space	1	5	3.19	1.348
	Green area	1	5	2.57	1.085
	Children playground	1	4	2.12	.954
	Safety for chldren	1	4	2.24	1.008
	Entertainment facility	2	4	2.90	.692
	Fiatures for disability	2	4	3.12	.772
	Annoucements	2	4	3.21	.782
	Sewage system	1	5	2.74	1.380
	Carpark capacity	1	4	2.38	1.058

In terms of the environmental aspects, it is obvious from table 33 that there is a lack of land management, a design that responds to natural noise and traffic, the use of materials and the quality of building. Correspondingly, it is stimulating to notice in

socio-cultural aspects that respondents report only on the drawbacks of contact with neighbours, the green area, the playground and the protection of entertainment facilities, the sewage system, and parking capacity.

- *Exist and absent different socio-culture issues*

For these five questions, the respondents' responses were "Yes", "No" and "No Idea".

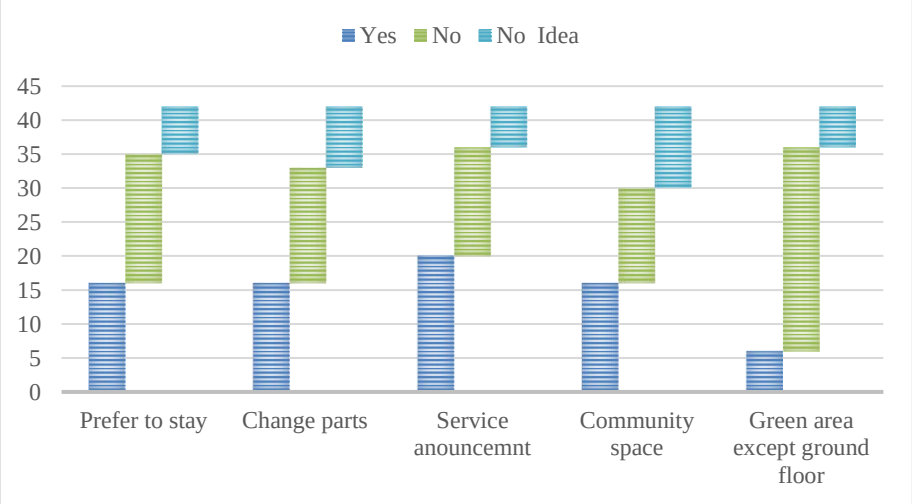


Figure 40: Exist and absent of the number of socio-culture side in World Trade centre tower.

The findings in the (figure: 40) indicate that for all five questions, fewer than half of the respondents replied with "yes".

- *Level of affordability for the different economic issues*

The users were asked about their general satisfaction with high-rise jobs. The respondents' answers were based on a Likert scale of five points, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied."

Table 34: Level of affordability of participant in Gullan tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation

For rent	2	4	2.67	.786
For sell	1	4	2.52	1.087
Water	1	4	2.67	1.052
Gas	1	5	2.86	1.221
Electricity	1	4	2.60	.857
Cleaning	1	4	2.55	.739
Waste collection	1	5	2.76	1.100
Other service	1	4	2.50	.773
Life cycle cost	2	4	3.10	.759

The result illustrates that the descriptive figures of the eight out of nine outcomes of the participant's affordability level are not considered to be sustainable, with a mean of less than three.

- *Payback period, supported of the local economy, and employees*

The results of the questionnaire were "Yes", "No" and "No Idea" for these three dimensions of the payback period, supported by the local economy, and workers.

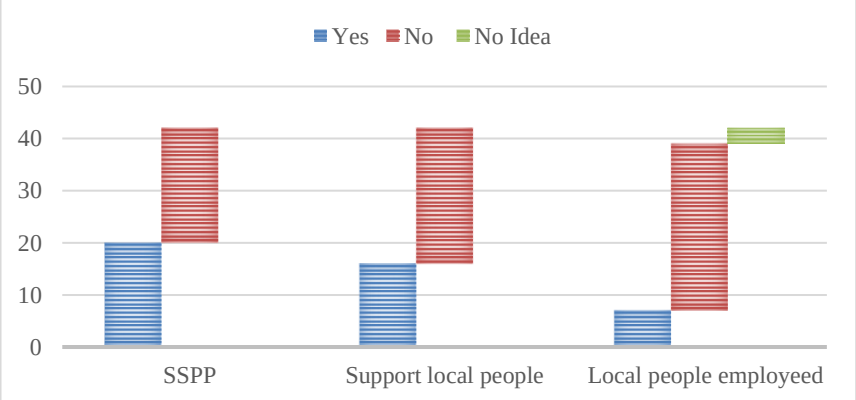


Figure 41: Descriptive statistics frequencies of some economic issues in office tower in World Trade center

For all three, the responses to the questionnaire suggest that the tower does not have a short payback period and does not help local residents and a few local workers.

Private cars or taxis are used with respect to transportation facilities used by customers, and there are few public transit systems available. Some issues can also be explained from the observation that there is no recycled material used, most of the products are not local, there is no reuse of the water system as greywater or rainwater harvesting; the waste system is segregated quite initially; there is a good fire design system; and very little consideration of passive strategies as an opening solution as well as the absence a separation of the waste system.

- *Concern level of high-rise buildings*

The participants were asked to rate their tower's level of concern. All responses to these concerns were based on a Likert scale of five points where "1" was not concerned" and "5" was "extremely concerned".

Table 35: Concern level of high-rise buildings in Gullan tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Human scale	1	5	2.86	1.049
Children growth and beh.	1	5	2.45	1.152
Travel time	1	5	3.24	1.265
Corridor wating	1	5	3.21	1.371
Building height	1	4	2.64	.879
Isolated from ground	1	3	2.36	.533
Neighbord	1	5	2.60	1.170
Accedental falls	2	5	2.40	.665
Fire safety	2	5	3.48	1.215
Crime in lift	2	5	2.52	.773
Car park	1	5	2.45	1.400
Elevator breadown	1	5	3.40	1.231
Suicide	1	5	2.43	1.399
Children play ground	1	4	1.76	1.031
Privacy	2	5	3.36	.958
Symbolic attraction	1	5	3.86	1.299
Socila relation	1	5	3.10	1.340
Strain stress mental health	1	5	2.40	1.466
Failure of electricity	1	5	2.67	1.223
Water cut	1	5	3.24	1.100

The mean of the results descriptive statistics reveals that only eight out of twenty with a reasonably wide range of standing deviations are above three.

6.6.2.2 Scoring system and its result of World Trade tower

The score of sub-indicator; applying the net weighting to individually sub- indicator; averaging all weighted scores of sub- indicator within each indicator; and adding any points of creativity that might have been achieved. As explained in the previous case study, giving the weight or not giving it depends on the mean, standard deviation and Relative Essential Index.

Table 36: Scoring result of office tower of World Trade center according to MSSHRB-E

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

High-Rise building Checklist

Name of High-rise building: Gullan tower

				Environmental Indicatour	%
2,89	2,91	0,00		Indoor Environmental Quality (IEQ)	5,80
Y			Prereq1	➢Environmental tobacco smoke control	Required
0,97			Credit	➢Providing natural ventilation	0,97
	0,97		Credit	➢Solar control and thermal comfort design	0,97
0,97			Credit	➢Natural lighting	0,97
	0,97		Credit	➢Considering of building envelopes	0,97
	0,97		Credit	➢View quality	0,97
0,95			Credit	➢Acoustic control	0,95
0,74	0,00	2,96		Outdoor Impact Quality (OIQ)	3,70
0,74			Credit	➢Natural ventilation on nearby buildings	0,74
		0,74	Credit	➢Avoiding negative effect on surrounding	0,74
		0,74	Credit	➢Bird savers	0,74
		0,74	Credit	➢Consideration of global worming	0,74
		0,74	Credit	➢Direct contact with nature	0,74
0,00	1,48	2,22		Waste and Pollution (WP)	3,70
N			Prereq1	➢Recycling waste	Required
		0,74	Credit	➢Land pollution	0,74
	0,74		Credit	➢Reducing and avoiding wastes	0,74
		0,74	Credit	➢Air pollution	0,74
		0,74	Credit	➢Noises pollution	0,74
	0,74		Credit	➢Reducing and avoiding dusty	0,74
1,80	1,90	0,00		Site Management (SM)	3,70
	1,00		Credit	➢Responsible to the land and green area	1,00
0,90			Credit	➢Selecting site	0,90
	0,90		Credit	➢Open spaces and vertical green farms	0,90
0,90			Credit	➢Avoiding the destroy of surrounding	0,90
0	1,86	7,44		Energy and Atmosphere (EA)	9,30
N			Prereq1	➢Using energy efficiency	Required
	1,86		Credit	➢Minimum and optimise energy performance	1,86
		1,86	Credit	➢Providing onsite renewable energy	1,86
		1,86	Credit	➢CO2 emissions	1,86
		1,86	Credit	➢Reduced peak energy requirements	1,86
		1,86	Credit	➢Improve energy efficiency use	1,86
0,74	0,74	2,22		Material Use (MU)	3,70
N			Prereq1	➢Using local material	Required
		0,74	Credit	➢Using recycled and recyclable material	0,74
		0,74	Credit	➢Minimizing wasting material	0,74
		0,74	Credit	➢Building reuse	0,74
	0,74		Credit	➢Using sustainable material	0,74
0,74			Credit	➢Easy maintenance material	0,74
0,74	0,00	2,96		Water Use (WU)	3,70
Y			Prereq1	➢Water quality	Required
0,74			Credit	➢Avoiding wasting water	0,74
		0,74	Credit	➢Rainwater collection	0,74
		0,74	Credit	➢Recycling rainwater	0,74
		0,74	Credit	➢Stormwater management strategies	0,74
		0,74	Credit	➢Reuse grey water	0,74
2,96	0,00	0,74		Building Services and Management (BSM)	3,70
Y			Prereq1	➢Metering and monitoring	Required
N			Prereq2	➢Time management	Required
N			Prereq3	➢Communication and IT management and services	Required
0,74			Credit	➢Electric equipment	0,74
0,74			Credit	➢Plumbing and drainage	0,74
0,74			Credit	➢HVAC systems	0,74
		0,74	Credit	➢Impact of city infrastructure	0,74
0,74			Credit	➢Regular maintenance	0,74
0,90	2,80	0,00		Construction Practice (CP)	3,70
	1,00		Credit	➢Efficiency in construction standerds and managemer	1,00
0,90			Credit	➢Construction safty	0,90
	0,90		Credit	➢Construction prosess	0,90
	0,90		Credit	➢Durability and reliability	0,90

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Gullan tower

Consteuction	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

				Socio-cultural Indicators	%
1,90	5,70	0,00		Local Opportunity (LO)	7,60
	1,90		Credit	➢Building long-term relationship with local and client	1,90
	1,90		Credit	➢Supplier satisfaction	1,90
	1,90		Credit	➢Client satisfaction	1,90
1,90			Credit	➢Employee satisfaction	1,90
1,05	1,05	0,00		Construction and Staff (CS)	2,10
1,05			Credit	➢Respect for staff	1,05
	1,05		Credit	➢Partnership working	1,05
0,30	0,60	1,20		Accessibility and Traffic (AT)	2,10
N			Prereq1	➢Shared public spaces and central districts	Required
	0,30		Credit	➢Responsible to the main transportation.	0,30
	0,30		Credit	➢Public transportation nodes	0,30
		0,30	Credit	➢Minimize traffic disruption and delays	0,30
		0,30	Credit	➢Pedestrian and cyclist	0,30
0,30			Credit	➢Acces with the disability	0,30
		0,30	Credit	➢Car park capacity	0,30
		0,30	Credit	➢Cleaning the façade	0,30
1,40	0,70	0,00		Culture and Privacy (CAP)	2,10
Y			Prereq1	➢Visual privacy	Required
N			Prereq2	➢Private open space	Required
0,70			Credit	➢The building culturally acceptable	0,70
0,70			Credit	➢Visual privacy for others	0,70
	0,70		Credit	➢Consideration with religion and faith	0,70
0	0	2,10		Health and Wellbeing (HW)	2,10
		2,10	Credit	➢Psychological feeling	2,10
0,60	1,00	0,50		Safety (S)	2,10
0,60			Credit	➢Fire safety	0,60
		0,50	Credit	➢Accidental falls from the height	0,50
	0,50		Credit	➢Safety while maintenance and cleaning	0,50
	0,50		Credit	➢Safity for construction workers	0,50
2,10	0,00	0		Vertical Transportation (VT)	2,10
1,05			Credit	➢Elevators	1,05
1,05			Credit	➢Travel time in elevator	1,05
0,70	0,70	0,70		Security and Crimes (SC)	2,10
		0,70	Credit	➢Crime in corridors	0,70
	0,70		Credit	➢Crime in elevators as rape and robbery	0,70
0,70			Credit	➢Monitoring and controlling	0,70
0,00	2,10	0,00		Scale and Size (SS)	2,10
	1,05		Credit	➢Human scale	1,05
	1,05		Credit	➢Building height	1,05
0	0,00	2,10		Children Behavior (CB)	2,10
N			Prereq1	➢Behavior problem in children	Required
		1,05	Credit	➢Children development	1,05
		1,05	Credit	➢Playing space for children	1,05
0,42	1,26	0,42		Social and Community (SAC)	2,10
Y			Prereq1	➢Social interaction	Required
	0,42		Credit	➢Effective channel for communication	0,42
	0,42		Credit	➢Family and community	0,42
	0,42		Credit	➢Who the neighbors are	0,42
0,42			Credit	➢Neighbor facility	0,42
		0,42	Credit	➢The public realm of the livability of street	0,42
0,00	2,10	0,00		Heritage Respect (HR)	2,10
	1,05		Credit	➢Respect to heritage and historical buildings	1,05
	1,05		Credit	➢Respect to whole of the Erbil citadel	1,05
0	2,10	0,00		Awareness and Education (AE)	2,10
	0,70		Credit	➢Knowledge skills of users	0,70
	0,70		Credit	➢Staffs knowledge	0,70
	0,70		Credit	➢Spaces for education	0,70

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building:Gullan tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

0,00	2,10	0,00		Semiotic Approach (SA)	2,10
	0,70		Credit	➢Sign and symbolic	0,70
	0,70		Credit	➢Context architectural identit	0,70
	0,70		Credit	➢Placelessness and public realm	0,70

				Economic Indicatores	%
3,66	1,84	0,00		Local Economic Growth (LEG)	5,50
N			Prereq1	➢Support local community	Required
1,83			Credit	➢Improved productivity	1,83
1,83			Credit	➢Consistent profit growth	1,83
	1,84		Credit	➢Developing client business	1,84

3,80	1,90	1,90		Jobs Opportunity (JO)	7,60
N			Prereq1	➢Employment local people	Required
1,90			Credit	➢Providing job	1,90
		1,90	Credit	➢Working with local community	1,90
1,90			Credit	➢Provision of equal opportunity	1,90
	1,90		Credit	➢Participation in decision making	1,90

3,40	2,10	0,00		Shorter and more Predictable (SP)	5,50
	0,70		Credit	➢Providing projects with low cost	0,70
0,70			Credit	➢Provide multiple benefits of financincy to communitie:	0,70
0,70			Credit	➢Provide projects with short payback priod	0,70
	0,70		Credit	➢Reducing maintenance cost	0,70
	0,70		Credit	➢Reducing service cost	0,70
0,70			Credit	➢Increased cost predictability	0,70
0,70			Credit	➢Ongoing costs	0,70
0,60			Credit	➢Vanity height	0,60

2,75	2,75	0,00		Supply-side (Ss)	5,50
2,75			Credit	➢Supply and demand	2,75
	2,75		Credit	➢Reliability and reduction	2,75

0,00	7,50	2,50	+	Innoations (I)	10,00
	2,50		Credit	➢Innovation in design	2,50
	2,50		Credit	➢Innovation in techniques and technologies	2,50
	2,50		Credit	➢Innovation in benchmarks	2,50
		2,50	Credit	➢Exemplary and enhancement level of performance	2,50

32,85	47,19	29,96	Totals	110,00

Certificate	Percentage
No certified	< 40
D	40 - 49
C	50 - 59
B	60- 69
A	70-80
A+	>80

6.6.3 Justice tower (Erbil business & Trade centre tower)

6.6.3.1 Descriptive statistics and frequencies of Justice tower

- *Personal Information of the participant*

A significant majority of respondents (65.9%) were graduates, while a few were undergraduates and postgraduates (27.3%)(6.8%) respectively. (Nearly 27% of the participants were engineers. The majority (nearly 62.5%) of users were between 20 and 30 years of age, while another significant group of respondents (30.7%) were between 31 and 40 years of age. Most of the respondents (almost 59.1%) were male compared to 39.8% who were female and 1.1% others, as shown in table 37. This implies that the majority of users are young and male.

Table 37: Descriptive statistics frequencies of the demography of participants in Justice tower.

Demo-Variables	Sub Variables	Frequency	Percentage
Education	Un -gradu.	24	27.3
	Gradu.	58	65.9
	Post-gradu.	6	6.8
Occupation	Engineer	27	30.7
	Other	61	69.3
Age			
	20-30	55	62.5
	31-40	27	30.7
	41-50	6	6.8
Gender	Male	52	59.1
	Female	35	39.8
	Other	1	1.1

- *Satisfaction for the environmental and socio-culture aspects of high-rise building and apartment/ office unit*

User satisfaction with high-rise work/living as a whole: The respondents' answers were based on a Likert scale of five points, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied."

Table 38: Descriptive statistics of satisfaction for the environmental and socio-cultural aspects in Justice tower.

Descriptive Statistics

		Minimum	Maximum	Mean	Std. Deviation
Environmental aspects	Building location	2	4	3.16	.815
	Land management	2	5	2.41	.721
	Over shadowing	1	5	2.33	1.080
	Natural light	2	5	3.43	.828
	Natural ventilation	1	5	2.61	1.434
	Water quality	1	5	2.33	.991
	Noise from nature	1	5	2.76	.788
	Noise by human products	2	4	2.31	.594
	Sound insulation	2	5	3.05	.565
	Pollution	1	5	2.83	1.215
	Thermal insulation	1	5	3.23	1.420
	Material and monitoring	2	5	3.10	1.029
	Material use	1	4	2.86	1.008
	Construction quality	1	5	2.67	1.337
	Structure safety	2	5	3.01	.916
	Metric system	1	5	2.98	.897
	Finishing material	1	4	2.65	.858
	Water management	1	4	3.10	.644
	Orientation	1	4	3.06	.939
Socio-cultural aspects	Entrance	2	5	3.55	1.060
	Plan	1	5	3.11	1.096
	Size	1	5	3.04	1.100
	Interior design	1	5	2.76	1.173
	View	2	5	3.15	1.185
	Privacy level	1	5	3.24	1.555
	Interaction with neigh	1	4	2.83	1.277
	Community space	2	5	2.76	1.069
	Green area	1	5	1.83	1.048
	Children playground	1	4	1.42	.858
	Safety for chldren	1	5	1.51	1.071
	Entertainment facility	1	5	1.34	.963
	Fiatures for disability	2	5	3.08	1.059
	Annoucements	2	5	3.09	.990
	Sewage system	1	5	2.32	1.282
	Carpark capacity	1	5	3.02	1.296

It can be clearly seen that most of the environmental sub-indicators are absent from the table above and respondents report on the drawbacks of around half of the socio-cultural indicators.

- *Different cases of socio-culture issues*

The answers of the respondents were a "Yes", "No" and "No Idea" scale for these five questions.

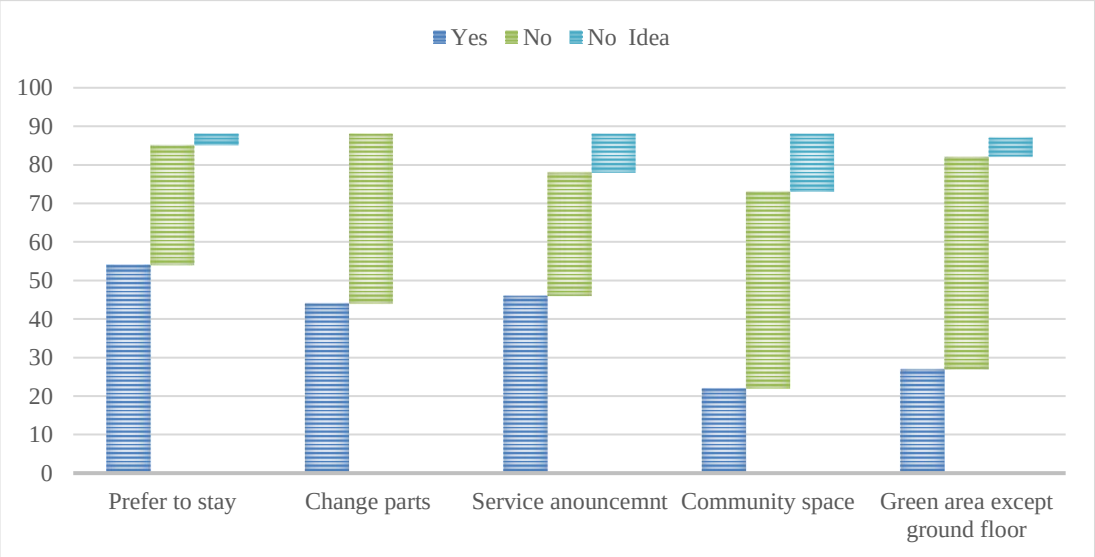


Figure 42: Exist and absent of the number of socio-culture side in Justice tower

Despite the lack of satisfaction with a large number of aspects, not agreeing with the design and making several improvements, most of them choose to remain in this building without community spaces or green areas (figure: 42).

- *Level of affordability for the different economic issues*

Users were questioned about their general satisfaction with high-rise working/living conditions. The respondents' answers were based on a Likert scale of five points, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied"

Table 39: Level of affordability of participant in Justice tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
For rent	1	5	3.23	1.337
For sell	1	5	3.07	1.143
Water	1	5	3.22	1.299
Gas	1	5	2.55	1.381
Electricity	1	5	1.82	1.150
Cleaning	1	5	2.72	1.438
Waste collection	1	4	2.41	.892
Other service	1	5	2.82	1.513
Life cycle cost	2	5	3.06	1.158

The table shows that almost half of the outcomes of a participant's affordability level are regarded as sustainable in descriptive statistics and their average is more than three.

- *Payback period, supported of the local economy, and employees*

A "Yes", "No and No Idea" to determine the outcomes of the questionnaire for these three dimensions of the Payback era, supported by the local economy and workers.

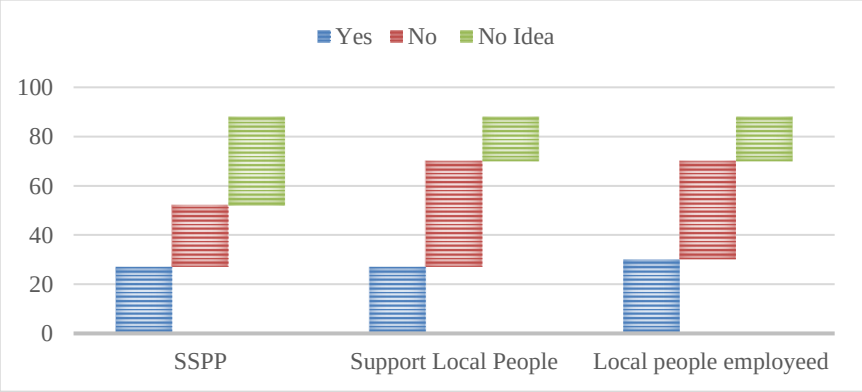


Figure 43: Descriptive statistics frequencies of some economic issues in Justice tower

The answers to the questionnaire for these three questions suggest that the tower does not have a short payback period and has no support from the local community and a few local employees.

Private cars or taxis are the transport facilities used by users, and there are very few public transport systems available to users. tnAnd some issues can be explained from the observation, such as; that no recycling material has been used, 80% of the material is not local, there is no reuse of the water system as greywater or rainwater harvesting; the waste system is isolated quite initially; there is no suitable fire design system; and very little consideration of passive strategies as a solution for opening up the waste system as well as poor efficiency when using the lift system, and no renewable energy system.

- *Concern of High-rise buildings*

The general concerns about high-rise living were defined by a number of points based on the literature review, such as; building height, human scale, child growth and behaviour, symbolic attraction, lack of neighbourhood amenities, lack of children's playing room, lack of visual privacy, lack of social contact, neighbours, emotional stress or mental health issues, and mental health problems, etc. These problems were asked to the participants to rate them. "All responses to these concerns were based on a Likert scale of five points where "1" was not concerned" and "5" was “extremely concerned”

Table 40: Concern level of high-rise buildings in Justice tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Human scale	1	5	2.33	1.362
Children growth and beh.	1	4	1.69	.914
Travel time	2	5	3.01	1.045
Corridor wating	1	5	3.08	1.366
Building height	1	4	2.39	1.066
Isolated from ground	1	5	3.14	1.383
Neighbord	2	5	3.15	1.034
Accedental falls	1	5	2.33	1.362
Fire safety	1	5	2.77	1.436

Crime in lift	1	5	2.45	1.082
Car park	2	5	3.20	1.063
Elevator breadown	1	5	3.09	1.475
Suicide	1	5	2.05	1.240
Children play ground	1	4	1.45	.815
Privacy	1	5	3.11	1.497
Symbolic attraction	1	5	2.40	.941
Socila relation	3	5	3.19	.544
Strain stress mental health	1	4	2.26	1.045
Failure of electricity	1	5	2.89	1.489
Water cut	1	5	3.11	1.108
Other	1	3	2.40	.558

In more than half of the responses, it was observed that there was a significant design gap taking into consideration sustainability as a key aspect. In fact, in a vast majority of the components in this high-rise building, sustainability measures were not considered.

6.6.3.2 Scoring system and its result of Justice tower

As mentioned above, by using the equation (Tam 2000), giving the weight or not giving it depends on the mean, standard deviation and Relative Important Index (RII): Relative Important Index (RII) = ∑W/(AN). Where W was the respondent's weighting for each aspect; A is the highest weight (A= 5); N is the sample size; and RII is the Relative Significant Index, 0≤ RII≤1.. And if (0≤ RII≤ 0.6) is small. The table below is a Justice Tower scoring estimate and its final output based on performance.

Table 41: Scoring result of Justice tower according to MSSHRB-E

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

High-Rise building Checklist

Name of High-rise building: Justice tower

				Environmental Indicatour	%
2,89	1,94	0,97		Indoor Environmental Quality (IEQ)	5,80
Y			Prereq1	➢Environmental tobacco smoke control	Required
	0,97		Credit	➢Providing natural ventilation	0,97
		0,97	Credit	➢Solar control and thermal comfort design	0,97
0,97			Credit	➢Natural lighting	0,97
	0,97		Credit	➢Considering of building envelopes	0,97
0,97			Credit	➢View quality	0,97
0,95			Credit	➢Acoustic control	0,95
0	2,22	1,48		Outdoor Impact Quality (OIQ)	3,70
	0,74		Credit	➢Natural ventilation on nearby buildings	0,74
		0,74	Credit	➢Avoiding negative effect on surrounding	0,74
	0,74		Credit	➢Bird savers	0,74
		0,74	Credit	➢Consideration of global worming	0,74
	0,74		Credit	➢Direct contact with nature	0,74
0,74	1,48	1,48		Waste and Pollution (WP)	3,70
N			Prereq1	➢Recycling waste	Required
	0,74		Credit	➢Land pollution	0,74
	0,74		Credit	➢Reducing and avoiding wastes	0,74
		0,74	Credit	➢Air pollution	0,74
		0,74	Credit	➢Noises pollution	0,74
0,74			Credit	➢Reducing and avoiding dusty	0,74
0,90	1,80	1,00		Site Management (SM)	3,70
		1,00	Credit	➢Responsible to the land and green area	1,00
0,90			Credit	➢Selecting site	0,90
	0,90		Credit	➢Open spaces and vertical green farms	0,90
	0,90		Credit	➢Avoiding the destroy of surrounding	0,90
0	1,86	7,44		Energy and Atmosphere (EA)	9,30
N			Prereq1	➢Using energy efficiency	Required
	1,86		Credit	➢Minimum and optimise energy performance	1,86
		1,86	Credit	➢Providing onsite renewable energy	1,86
		1,86	Credit	➢CO2 emissions	1,86
		1,86	Credit	➢Reduced peak energy requirements	1,86
		1,86	Credit	➢Improve energy efficiency use	1,86
1,48	0,74	1,48		Material Use (MU)	3,70
N			Prereq1	➢Using local material	Required
		0,74	Credit	➢Using recycled and recyclable material	0,74
0,74			Credit	➢Minimizing wasting material	0,74
		0,74	Credit	➢Building reuse	0,74
	0,74		Credit	➢Using sustainable material	0,74
0,74			Credit	➢Easy maintenance material	0,74
0,74	0,00	2,96		Water Use (WU)	3,70
N			Prereq1	➢Water quality	Required
0,74			Credit	➢Avoiding wasting water	0,74
		0,74	Credit	➢Rainwater collection	0,74
		0,74	Credit	➢Recycling rainwater	0,74
		0,74	Credit	➢Stormwater management strategies	0,74
		0,74	Credit	➢Reuse grey water	0,74
2,96	0,00	0,74		Building Services and Management (BSM)	3,70
Y			Prereq1	➢Metering and monitoring	Required
N			Prereq2	➢Time management	Required
Y			Prereq3	➢Communication and IT management and services	Required
0,74			Credit	➢Electric equipment	0,74
0,74			Credit	➢Plumbing and drainage	0,74
0,74			Credit	➢HVAC systems	0,74
		0,74	Credit	➢Impact of city infrastructure	0,74
0,74			Credit	➢Regular maintenance	0,74
0,90	1,90	0,90		Construction Practice (CP)	3,70
	1,00		Credit	➢Efficiency in construction standerds and managemer	1,00
0,90			Credit	➢Construction safty	0,90
		0,90	Credit	➢Construction prosess	0,90
	0,90		Credit	➢Durability and reliability	0,90

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Justice tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

				Socio-cultural Indicators	%
3,80	1,90	1,90		Local Opportunity (LO)	7,60
1,90			Credit	➢Building long-term relationship with local and client	1,90
	1,90		Credit	➢Supplier satisfaction	1,90
		1,90	Credit	➢Client satisfaction	1,90
1,90			Credit	➢Employee satisfaction	1,90
1,05	1,05	0,00		Construction and Staff (CS)	2,10
1,05			Credit	➢Respect for staff	1,05
	1,05		Credit	➢Partnership working	1,05
0,90	0,30	0,90		Accessibility and Traffic (AT)	2,10
Y			Prereq1	➢Shared public spaces and central districts	Required
0,30			Credit	➢Responsible to the main transportation.	0,30
	0,30		Credit	➢Public transportation nodes	0,30
		0,30	Credit	➢Minimize traffic disruption and delays	0,30
		0,30	Credit	➢Pedestrian and cyclist	0,30
0,30			Credit	➢Acces with the disability	0,30
0,30			Credit	➢Car park capacity	0,30
		0,30	Credit	➢Cleaning the façade	0,30
0,70	1,40	0,00		Culture and Privacy (CAP)	2,10
Y			Prereq1	➢Visual privacy	Required
N			Prereq2	➢Private open space	Required
	0,70		Credit	➢The building culturally acceptable	0,70
0,70			Credit	➢Visual privacy for others	0,70
	0,70		Credit	➢Consideration with religion and faith	0,70
0	0	2,10		Health and Wellbeing (HW)	2,10
		2,10	Credit	➢Psychological feeling	2,10
0,00	1,10	1,00		Safety (S)	2,10
	0,60		Credit	➢Fire safety	0,60
		0,50	Credit	➢Accidental falls from the height	0,50
		0,50	Credit	➢Safety while maintenance and cleaning	0,50
	0,50		Credit	➢Safity for construction workers	0,50
2,10	0,00	0		Vertical Transportation (VT)	2,10
1,05			Credit	➢Elevators	1,05
1,05			Credit	➢Travel time in elevator	1,05
0,00	0,70	1,40		Security and Crimes (SC)	2,10
		0,70	Credit	➢Crime in corridors	0,70
		0,70	Credit	➢Crime in elevators as rape and robbery	0,70
	0,70		Credit	➢Monitoring and controlling	0,70
0,00	0,00	2,10		Scale and Size (SS)	2,10
		1,05	Credit	➢Human scale	1,05
		1,05	Credit	➢Building height	1,05
0	0,00	2,10		Children Behavior (CB)	2,10
N			Prereq1	➢Behavior problem in children	Required
		1,05	Credit	➢Children development	1,05
		1,05	Credit	➢Playing space for children	1,05
0,42	1,26	0,42		Social and Community (SAC)	2,10
Y			Prereq1	➢Social interaction	Required
	0,42		Credit	➢Effective channel for communication	0,42
	0,42		Credit	➢Family and community	0,42
0,42			Credit	➢Who the neighbors are	0,42
	0,42		Credit	➢Neighbor facility	0,42
		0,42	Credit	➢The public realm of the livability of street	0,42
0,00	0,00	2,10		Heritage Respect (HR)	2,10
		1,05	Credit	➢Respect to heritage and historical buildings	1,05
		1,05	Credit	➢Respect to whole of the Erbil citadel	1,05
0,70	0,70	0,70		Awareness and Education (AE)	2,10
	0,70		Credit	➢Knowledge skills of users	0,70
0,70			Credit	➢Staffs knowledge	0,70
		0,70	Credit	➢Spaces for education	0,70

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Justice tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

0,00	0,70	1,40		Semiotic Approach (SA)	2,10
		0,70	Credit	➢Sign and symbolic	0,70
	0,70		Credit	➢Context architectural identit	0,70
		0,70	Credit	➢Placelessness and public realm	0,70

				Economic Indicatores	%
3,67	1,83	0,00		Local Economic Growth (LEG)	5,50
N			Prereq1	➢Support local community	Required
1,83			Credit	➢Improved productivity	1,83
	1,83		Credit	➢Consistent profit growth	1,83
1,84			Credit	➢Developing client business	1,84

1,60	3,80	1,90		Jobs Opportunity (JO)	7,60
N			Prereq1	➢Employment local people	Required
1,60			Credit	➢Providing job	1,90
		1,90	Credit	➢Working with local community	1,90
	1,90		Credit	➢Provision of equal opportunity	1,90
	1,90		Credit	➢Participation in decision making	1,90

3,50	2,00	0,00		Shorter and more Predictable (SP)	5,50
0,70			Credit	➢Providing projects with low cost	0,70
0,70			Credit	➢Provide multiple benefits of financincy to communities	0,70
0,70			Credit	➢Provide projects with short lifecycle cost	0,70
	0,70		Credit	➢Reducing maintenance cost	0,70
	0,70		Credit	➢Reducing service cost	0,70
0,70			Credit	➢Increased cost predictability	0,70
0,70			Credit	➢Ongoing costs	0,70
	0,60		Credit	➢Vanity height	0,60

2,75	2,75	0,00		Supply-side (Ss)	5,50
2,75			Credit	➢Supply and demand	2,75
	2,75		Credit	➢Reliability and reduction	2,75

0	2,50	7,50	+	Innoations (I)	10,00
		2,50	Credit	➢Innovation in design	2,50
	2,50		Credit	➢Innovation in techniques and technologies	2,50
		2,50	Credit	➢Innovation in benchmarks	2,50
		2,50	Credit	➢Exemplary and enhancement level of performanc	2,50

31,80	33,93	43,97	Totals	109,70

Certificate	Percentage
No certified	< 40
D	40 - 49
C	50 - 59
B	60- 69
A	70-80
A+	>80

6.6.4 Escan towers

6.6.4.1 Descriptive statistics and frequencies of Escan tower

- *Personal Information of the participant*

Many of the participants (57.8%) were graduates, while a few were undergraduates (31.3%) and postgraduates made up (10.9%). Of the participants, almost 34.4% were engineers. Much of the users were between 20 and 30 years of age (almost 59.4%), while another significant number of respondents (26.6%) were between 31 and 40 years of age. The majority (almost 53.1%) of respondents were male as opposed to 33.3% who were female and 2.8% as seen in table 42. Meaning that the majority of users are young and male.

Table 42: Descriptive statistics frequencies of the demography of participants in Escan towers

Demo-Variables	Sub Variables	Frequency	Percentage
Education	Un -gradu.	20	31.3
	Gradu.	37	57.8
	Post-gradu.	7	10.9
Occupation	Engineer	22	34.4
	Other	42	65.6
Age	Under 20	4	6.3
	20-30	38	59.4
	31-40	17	26.6
	41-50	5	7.8
Gender	Male	34	53.1
	Female	30	46.9

- *Satisfaction for the environmental and socio-culture aspects of high-rise building and apartment/ office unit*

Respondents' responses were based on the five-point Likert scale, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied"

Table 43: Descriptive statistics of satisfaction for the environmental and socio-cultural aspects in Escan tower

Descriptive Statistics

		Minimum	Maximum	Mean	Std. Deviation
Environmental aspects	Building location	2	4	2.97	.796
	Land management	1	4	2.27	1.144
	Over shadowing	1	5	2.34	1.101
	Natural light	1	5	3.33	1.404
	Natural ventilation	1	4	2.25	.777
	Water quality	1	5	2.16	1.130
	Noise from nature	2	5	3.11	.978
	Noise by human products	1	5	3.31	1.457
	Sound insulation	1	5	3.06	1.402
	Pollution	1	4	2.83	.865
	Thermal insulation	1	5	2.61	1.229
	Material and Monitoring	1	5	2.31	1.367
	Material use	1	5	2.17	1.092
	Construction quality	2	5	3.03	.854
	Structure safety	1	5	2.70	.954
	Metric system	2	4	3.05	.677
	Finishing material	1	4	2.28	1.147
	Water management	1	4	2.20	1.057
	Orientation	1	5	3.08	.822
Socio-cultural aspects	Entrance	2	5	3.48	1.039
	Plan	1	5	3.08	1.074
	Size	1	5	2.95	1.061
	Interior design	1	5	2.73	1.144
	View	2	5	3.08	1.186
	Privacy level	1	5	2.87	1.215
	Interaction with neigh	1	4	2.28	1.188
	Community space	1	3	2.23	.556
	Green area	1	5	1.80	1.011
	Children Play ground	1	4	1.41	.830
	Safety for chldren	1	5	1.47	1.038
	Entertainment facility	1	5	1.30	.920
	Fiatures for disability	2	5	3.23	1.050
	Annoucements	2	5	3.09	1.019
	Sewage system	1	5	2.30	1.243
	Car park capacity	1	4	2.06	.833

It can be clearly seen that the majority of sub-indicators in the environmental and socio-cultural aspects of the respondents are missing from table 43.

- *Different cases of socio-culture issues*

The answers of the respondents to these five questions were "Yes," "No and No Idea."

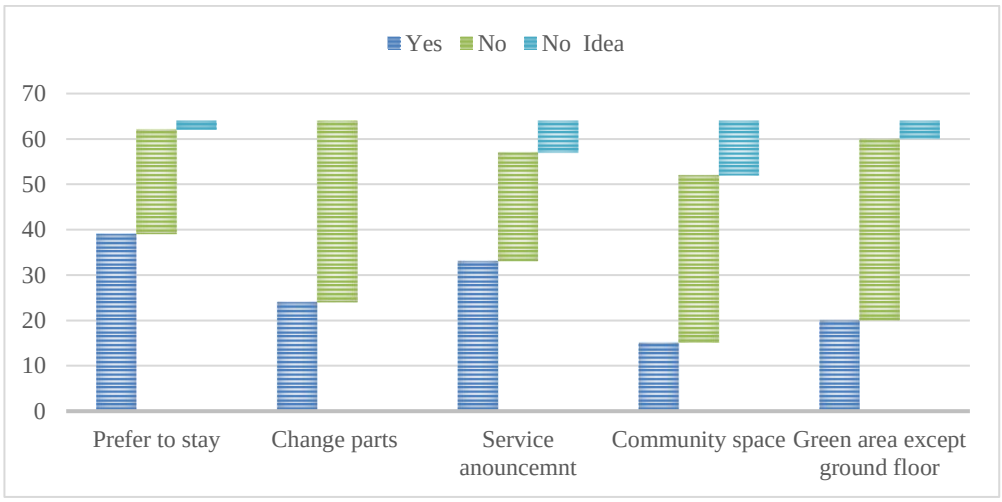


Figure 44: Exist and absent of the number of socio-culture side in Escan tower

Answering questions about the number of socio-cultural sides in figure 44 reveals that while not agreeing with the community room and not having a green area but the ground floor, most of them choose to stay on.

- *Level of affordability for the different economic issues*

The users were asked about their overall satisfaction with high-rise building living. Respondents' responses were based on the five-point Likert scale, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied"

Table 44: Level of affordability of participant in Escan towers

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
For rent	2	5	3.34	1.144

For sell	1	5	3.03	1.140
Water	2	5	3.14	1.111
Gas	1	5	2.59	1.400
Electricity	1	5	1.80	1.129
Cleaning	1	5	2.66	1.439
Waste collection	1	5	2.30	1.191
Other service	1	5	2.80	1.524
Life cycle cost	1	4	2.47	.816

The table above indicates that the descriptive statistics for most of the participants are unacceptable and that the majority of the services in the tower are costly, particularly when compared to their income.

- *Payback period, supported of the local economy, and employees*

Apartment users were asked for their views on a variety of different economic issues. The results of the questionnaire for these three dimensions of the payback era, supported by the local economy, and the employees were "Yes", "No" and "No Idea."

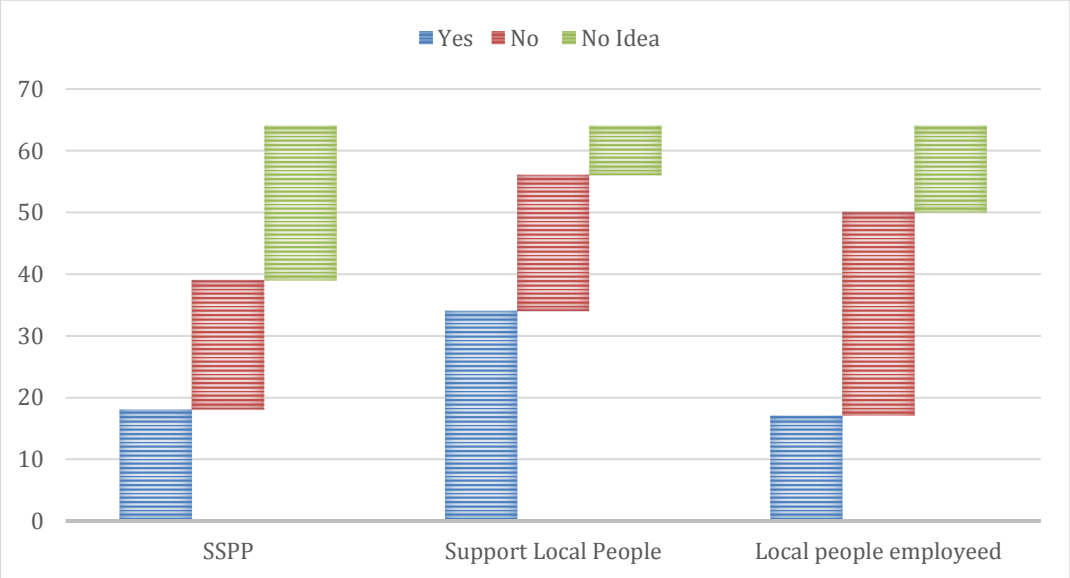


Figure 45: Descriptive statistics frequencies of some economic Escan towers issues

The answers to the questionnaire for these three reveals that the tower does not have

a short payback time and has a little help from local residents and a few local workers (figure: 45).

Private cars or taxis are used for the transportation of users to public transport. In addition, it could be clarified from the fact that there was no use of recycled items, that the majority of materials were not local, that there was no re-use of the water supply system as grain or rainwater; that the waste supply is very intractable, the building has a poor fire design system and provides very few passive strategies as a solution for loopholes.

- *Concern of High-rise buildings*

Participants were asked to rate the level of concern in their tower. All the responses to these questions were focused on the five-point Likert scale, where "1" indicated "not concerned" and "5" indicated "highly concerned".

Table 45: Concern level of high-rise buildings in Escan tower

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Human scale	1	5	2.34	1.336
Children growth and beh.	1	4	1.69	.924
Travel time	2	4	2.91	.886
Corridor wating	2	4	2.80	.800
Building height	2	5	2.81	.941
Isolated from ground	1	5	2.66	1.472
Neighbord	1	4	2.45	.975
Accedental falls	1	5	2.28	1.362
Fire safety	1	5	2.70	1.444
Crime in lift	1	5	2.45	1.154
Car park	1	5	2.20	1.072
Elevator breadown	1	5	3.03	1.469
Suicide	1	5	2.02	1.228
Children play ground	1	4	1.44	.814
Privacy	1	5	2.06	1.283
Symbolic attraction	1	5	2.31	1.037
Socila relation	2	5	2.81	.664

Strain stress mental health	1	4	2.23	1.050
Failure of electricity	1	5	2.94	1.500
Water cut	1	5	2.59	1.269
Other	1	3	2.42	.558

It is evident from the above table that there is a lack of concern for high-rise buildings. All sections are ignored or not considered to be sustainable, except for the elevators.

6.6.4.2 Scoring system and and its result of Escan towers

Giving a weight or not depends on the mean, the standard deviation and the relative significant index as described in the previous case studies. The table below displays the estimation of the score of the Escan towers and the final performance.

Table 46: Scoring result of Escan towers according to MSSHRB-E

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

High-Rise building Checklist

Name of High-rise building: Escan tower

9,39 10,56 21,05

				Environmental Indicatour	%
2,89	1,94	0,97		Indoor Environmental Quality (IEQ)	5,80
Y			Prereq1	➢Environmental tobacco smoke control	Required
		0,97	Credit	➢Providing natural ventilation	0,97
	0,97		Credit	➢Solar control and thermal comfort design	0,97
0,97			Credit	➢Natural lighting	0,97
	0,97		Credit	➢Considering of building envelopes	0,97
0,97			Credit	➢View quality	0,97
0,95			Credit	➢Acoustic control	0,95
0,74	0,00	2,96		Outdoor Impact Quality (OIQ)	3,70
		0,74	Credit	➢Natural ventilation on nearby buildings	0,74
		0,74	Credit	➢Avoiding negative effect on surrounding	0,74
0,74			Credit	➢Bird savers	0,74
		0,74	Credit	➢Consideration of global worming	0,74
		0,74	Credit	➢Direct contact with nature	0,74
0,00	3,70	0,00		Waste and Pollution (WP)	3,70
N			Prereq1	➢Recycling waste	Required
	0,74		Credit	➢Land pollution	0,74
	0,74		Credit	➢Reducing and avoiding wastes	0,74
	0,74		Credit	➢Air pollution	0,74
	0,74		Credit	➢Noises pollution	0,74
	0,74		Credit	➢Reducing and avoiding dusty	0,74
0,00	1,80	1,90		Site Management (SM)	3,70
		1,00	Credit	➢Responsible to the land and green area	1,00
	0,90		Credit	➢Selecting site	0,90
		0,90	Credit	➢Open spaces and vertical green farms	0,90
	0,90		Credit	➢Avoiding the destroy of surrounding	0,90
0	0,00	9,30		Energy and Atmosphere (EA)	9,30
N			Prereq1	➢Using energy efficiency	Required
		1,86	Credit	➢Minimum and optimise energy performance	1,86
		1,86	Credit	➢Providing onsite renewable energy	1,86
		1,86	Credit	➢CO2 emissions	1,86
		1,86	Credit	➢Reduced peak energy requirements	1,86
		1,86	Credit	➢Improve energy efficiency use	1,86
0,74	0,74	2,22		Material Use (MU)	3,70
N			Prereq1	➢Using local material	Required
		0,74	Credit	➢Using recycled and recyclable material	0,74
		0,74	Credit	➢Minimizing wasting material	0,74
		0,74	Credit	➢Building reuse	0,74
	0,74		Credit	➢Using sustainable material	0,74
0,74			Credit	➢Easy maintenance material	0,74
0,00	0,74	2,96		Water Use (WU)	3,70
Y			Prereq1	➢Water quality	Required
	0,74		Credit	➢Avoiding wasting water	0,74
		0,74	Credit	➢Rainwater collection	0,74
		0,74	Credit	➢Recycling rainwater	0,74
		0,74	Credit	➢Stormwater management strategies	0,74
		0,74	Credit	➢Reuse grey water	0,74
2,22	0,74	0,74		Building Services and Management (BSM)	3,70
Y			Prereq1	➢Metering and monitoring	Required
N			Prereq2	➢Time management	Required
Y			Prereq3	➢Communication and IT management and services	Required
0,74			Credit	➢Electric equipment	0,74
	0,74		Credit	➢Plumbing and drainage	0,74
0,74			Credit	➢HVAC systems	0,74
		0,74	Credit	➢Impact of city infrastructure	0,74
0,74			Credit	➢Regular maintenance	0,74
2,80	0,90	0		Construction Practice (CP)	3,70
1,00			Credit	➢Efficiency in construction standerds and managemer	1,00
	0,90		Credit	➢Construction safty	0,90
0,90			Credit	➢Construction prosess	0,90
0,90			Credit	➢Durability and reliability	0,90

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Escan tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

				Socio-cultural Indicators	%
0	5,70	1,90		Local Opportunity (LO)	7,60
	1,90		Credit	➢Building long-term relationship with local and client	1,90
	1,90		Credit	➢Supplier satisfaction	1,90
		1,90	Credit	➢Client satisfaction	1,90
	1,90		Credit	➢Employee satisfaction	1,90
0,00	1,05	1,05		Construction and Staff (CS)	2,10
	1,05		Credit	➢Respect for staff	1,05
		1,05	Credit	➢Partnership working	1,05
0,60	0,30	1,20		Accessibility and Traffic (AT)	2,10
N			Prereq1	➢Shared public spaces and central districts	Required
	0,30		Credit	➢Responsible to the main transportation.	0,30
0,30			Credit	➢Public transportation nodes	0,30
		0,30	Credit	➢Minimize traffic disruption and delays	0,30
		0,30	Credit	➢Pedestrian and cyclist	0,30
0,30			Credit	➢Acces with the disability	0,30
		0,30	Credit	➢Car park capacity	0,30
		0,30	Credit	➢Cleaning the façade	0,30
1,40	0,70	0		Culture and Privacy (CAP)	2,10
N			Prereq1	➢Visual privacy	Required
N			Prereq2	➢Private open space	Required
0,70			Credit	➢The building culturally acceptable	0,70
	0,70		Credit	➢Visual privacy for others	0,70
0,70			Credit	➢Consideration with religion and faith	0,70
0	0	2,10		Health and Wellbeing (HW)	2,10
		2,10	Credit	➢Psychological feeling	2,10
0,50	1,10	0,50		Safety (S)	2,10
	0,60		Credit	➢Fire safety	0,60
		0,50	Credit	➢Accidental falls from the height	0,50
	0,50		Credit	➢Safety while maintenance and cleaning	0,50
0,50			Credit	➢Safity for construction workers	0,50
1,05	1,05	0		Vertical Transportation (VT)	2,10
1,05			Credit	➢Elevators	1,05
	1,05		Credit	➢Travel time in elevator	1,05
0,00	0,70	1,40		Security and Crimes (SC)	2,10
		0,70	Credit	➢Crime in corridors	0,70
		0,70	Credit	➢Crime in elevators as rape and robbery	0,70
	0,70		Credit	➢Monitoring and controlling	0,70
0,00	1,05	1,05		Scale and Size (SS)	2,10
		1,05	Credit	➢Human scale	1,05
	1,05		Credit	➢Building height	1,05
0	0,00	2,10		Children Behavior (CB)	2,10
N			Prereq1	➢Behavior problem in children	Required
		1,05	Credit	➢Children development	1,05
		1,05	Credit	➢Playing space for children	1,05
0,42	0,42	1,26		Social and Community (SAC)	2,10
N			Prereq1	➢Social interaction	Required
		0,42	Credit	➢Effective channel for communication	0,42
		0,42	Credit	➢Family and community	0,42
		0,42	Credit	➢Who the neighbors are	0,42
0,42			Credit	➢Neighbor facility	0,42
	0,42		Credit	➢The public realm of the livability of street	0,42
0,00	0	2,10		Heritage Respect (HR)	2,10
		1,05	Credit	➢Respect to heritage and historical buildings	1,05
		1,05	Credit	➢Respect to whole of the Erbil citadel	1,05
0	0,00	2,10		Awareness and Education (AE)	2,10
		0,70	Credit	➢Knowledge skills of users	0,70
		0,70	Credit	➢Staffs knowledge	0,70
		0,70	Credit	➢Spaces for education	0,70

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

High-Rise building Checklist

Name of High-rise building: Escan tower

0,00	1,40	0,70		Semiotic Approach (SA)	2,10
		0,70	Credit	➢Sign and symbolic	0,70
	0,70		Credit	➢Context architectural identit	0,70
	0,70		Credit	➢Placelessness and public realm	0,70

				Economic Indicatores	%
1,84	1,83	1,83		Local Economic Growth (LEG)	5,50
Y			Prereq1	➢Support local community	Required
		1,83	Credit	➢Improved productivity	1,83
	1,83		Credit	➢Consistent profit growth	1,83
1,84			Credit	➢Developing client business	1,84

1,90	1,90	3,80		Jobs Opportunity (JO)	7,60
N			Prereq1	➢Employment local people	Required
1,90			Credit	➢Providing job	1,90
		1,90	Credit	➢Working with local community	1,90
		1,90	Credit	➢Provision of equal opportunity	1,90
	1,90		Credit	➢Participation in decision making	1,90

3,40	0,70	1,40		Shorter and more Predictable (SP)	5,50
0,70			Credit	➢Providing projects with low cost	0,70
0,70			Credit	➢Provide multiple benefits of financincy to communiti	0,70
		0,70	Credit	➢Provide projects with short lifecycle cost	0,70
		0,70	Credit	➢Reducing maintenance cost	0,70
	0,70		Credit	➢Reducing service cost	0,70
0,70			Credit	➢Increased cost predictability	0,70
0,70			Credit	➢Ongoing costs	0,70
0,60			Credit	➢Vanity height	0,60

2,75	2,75	0		Supply-side (Ss)	5,50
2,75			Credit	➢Supply and demand	2,75
	2,75		Credit	➢Reliability and reduction	2,75

0	2,50	7,50	+	Innoations (I)	10,00
		2,50	Credit	➢Innovation in design	2,50
		2,50	Credit	➢Innovation in techniques and technologies	2,50
	2,50		Credit	➢Innovation in benchmarks	2,50
		2,50	Credit	➢Exemplary and enhancement level of performance	2,50

23,25	33,71	53,04	Totals	110,00

Certificate	Percentage
No certified	< 40
D	40 - 49
C	50 - 59
B	60- 69
A	70-80
A+	>80

6.6.5 Quattro towers

6.6.5.1 Descriptive statistics and frequencies of Quattro towers

- *Personal Information of the participant*

A significant majority of respondents (81.6%) were graduates, while a few (9.2 %) were undergraduates and postgraduates another (9.2%). Almost 11.8% of the participants were engineers. The majority (nearly 69.7%) of users were between 20 and 30 years of age, while another significant group of respondents (15.8%) were between 31 and 40 years of age. The majority (nearly 56.6%) of respondents were female, compared to 43.4 per cent who were male, as shown in table 47. This means that the majority of users are graduates, young and male.

Table 47: Descriptive statistics frequencies of the demography of participants in MRF towers

Demo-Variables	Sub Variables	Frequency	Percentage
Education	Un -gradu.	7	9.2
	Gradu.	62	81.6
	Post-gradu.	7	9.2
Occupation	Engineer	9	11.8
	Other	67	88.2
Age	Under 20	2	2.6
	20-30	53	69.7
	31-40	12	15.8
	41-50	9	11.8
Gender	Male	33	43.4
	Female	43	56.6

- *Satisfaction for the environmental and socio-culture aspects of high-rise building and apartment/ office unit*

Respondents' responses were based on the five-point Likert scale, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied."

Table 48: Descriptive statistics of satisfaction for the environmental and socio-cultural aspects in Quattro towers

Descriptive Statistics

		Minimum	Maximum	Mean	Std. Deviation
Environmental aspects	Building location	2	4	3.13	.806
	Land management	2	5	2.55	.737
	Over shadowing	1	5	2.36	1.092
	Natural light	2	5	3.45	.839
	Natural ventilation	1	5	2.58	1.490
	Water quality	1	5	2.37	.991
	Noise from nature	1	5	2.79	.789
	Noise by human products	2	4	2.34	.623
	Sound insulation	2	5	3.05	.586
	Pollution	1	5	2.87	1.215
	Thermal insulation	1	5	2.34	1.239
	Material and Monitoring	1	4	1.99	1.064
	Material use	1	4	2.22	1.040
	Construction quality	1	5	2.66	1.342
	Structure safety	2	5	3.05	.951
	Metric system	1	5	3.29	1.105
	Finishing material	1	4	2.64	.860
	Water management	1	4	2.13	.869
	Orientation	2	4	2.66	.776
Socio-cultural aspects	Entrance	1	5	2.95	1.394
	Plan	1	4	3.14	.812
	Size	2	5	3.17	.806
	Interior design	1	4	3.11	.918
	View	1	5	2.64	1.080
	Privacy level	1	5	2.72	1.184
	Interaction with neigh	1	3	2.46	.642
	Community space	1	5	3.01	1.322
	Green area	1	5	2.55	1.076
	Children playground	1	5	2.48	1.389
	Safety for chldren	1	4	2.33	.999
	Entertainment facility	2	4	3.04	.599
	Fiatures for disability	2	5	3.12	.879
	Annoucements	1	4	2.67	.985
	Sewage system	1	4	2.18	1.055
	Car park Capacity	1	4	2.45	1.112

Accordingly, in both the environmental and socio-cultural dimensions, it is encouraging to notice that the participants reflected only on the advantages of the quarter indicators.

- *Different cases of MRF socio-culture issues*

The answers of the respondents to these five questions were "Yes", "No" and "No Idea".

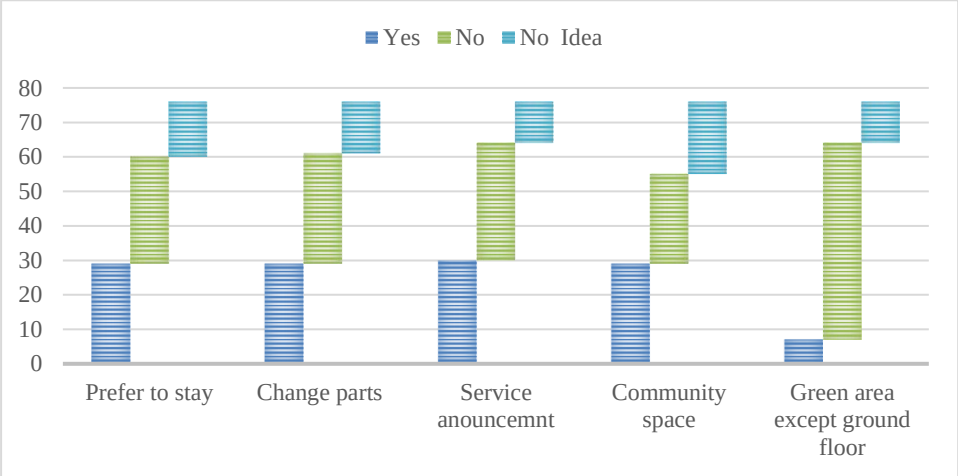


Figure 46: Exist and absent of the number of socio-culture side in MRF towers

The answer to the questions on the number of socio-cultural sides in figure 46 indicates that many of them do not choose to remain further in these towers.

- *Level of affordability for the different economic issues*

The users were asked about their overall satisfaction with living in this high-level building. Participants' reactions were based on the five-point Likert scale, where "1" indicated "not satisfied" and "5" indicated "extremely satisfied"

Table 49: Level of affordability of participant in MRF towers

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
For rent	2	4	2.78	.826
For sell	1	4	2.63	1.118
Water	2	5	2.62	.799
Gas	1	5	2.83	1.204
Electricity	1	4	2.66	.888
Cleaning	1	4	2.51	.792
Waste collection	1	5	2.82	1.151

Other service	2	4	2.54	.720
Life cycle cost	1	5	3.14	.812

The table indicates that descriptive statistics show that the implications of the respondents' affordability level cannot be viewed as sustainable.

- *Payback period, supported of the local economy, and employees*

Apartment users were asked for their views on a number of different economic matters. The results of the survey for these three dimensions of the payback period, supported by the local economy, and the employees were "Yes," "No" and "No Idea."

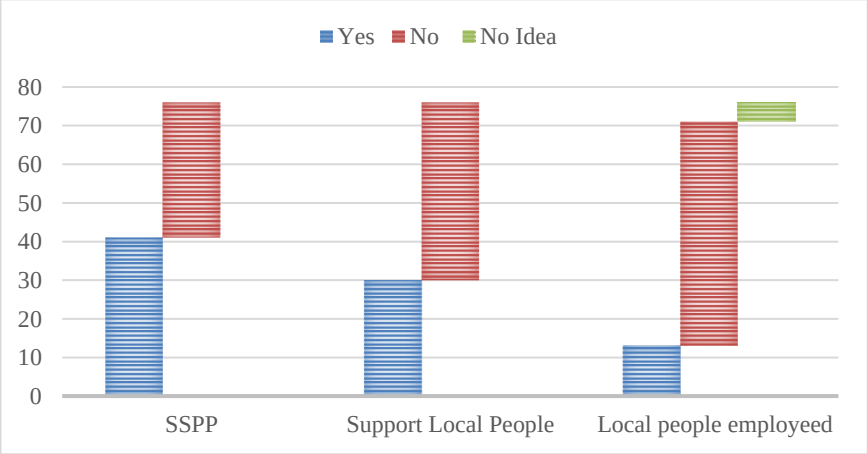


Figure 47: Descriptive statistics frequencies of some economic issues in Quattro towers.

The responses to the questionnaire for these three demonstrates that this tower is not like others. They have a limited payback period but also have a little financial support from local residents and a few local workers (figure: 47).

According to the responses gotten, the transport facilities are used by users. There are also private cars or taxis but very few public transport systems available to users.

From observations, some issues can be clarified; the absence of recycled material used the, majority of which is not local, no re-use of the water system for septic tanks or rainwater harvesting; preliminary separation of the waste system; there is an appropriate fire design system; but very little consideration is given to passive strategies as a solution for problems.

- *Concern of High-rise buildings*

As with other towers in this sample, participants were asked to rate the level of concern at their tower. All the responses to these questions were focused on the five-point Likert scale, where "1" indicated "not concerned" and "5" indicated "highly concerned".

Table 50: Concern level of high-rise buildings in MRF towers

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Human scale	1	4	2.49	.757
Children growth and beh.	1	5	2.45	1.063
Travel time	1	5	3.30	1.222
Corridor wating	1	5	3.38	1.366
Building height	1	4	2.32	.867
Isolated from ground	1	4	2.61	.767
Neighbord	1	4	2.45	1.038
Accedental falls	2	5	2.33	.575
Fire safety	2	5	3.43	1.193
Crime in lift	1	4	2.21	.899
Car park	1	5	2.20	1.386
Elevator breadown	1	5	3.42	1.181
Suicide	1	5	2.41	1.425
Children play ground	1	4	1.68	.941
Privacy	1	5	2.95	1.106
Symbolic attraction	1	5	2.74	1.408
Socila relation	1	5	3.21	1.340
Strain stress mental health	1	5	2.46	1.238
Failure of Electricity	1	5	2.83	1.124
Water cut	1	5	3.36	1.003

The mean of descriptive analysis of the results reveals that only six out of twenty are above three with quite a wide variety of different variations.

6.6.5.2 Scoring system and results of Quattro towers

Trying to give or not giving weight depends on the mean, the standard deviation and the relative important index as described in the previous case studies. The following table is a rating calculation of the Roj Empire Tower and the final score of the Roj Empire Tower.

Table 51: Scoring result of Quattro towers according to MSSHRB-E

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

Consteuction		
	Yes	Confident
	-	Somewhat confident but uncertain to get credit
	No	Not confident

High-Rise building Checklist

Name of High-rise building: Quattor MRF tower

				Environmental Indicatour	%
1,92	2,91	0,97		Indoor Environmental Quality (IEQ)	5,80
Y			Prereq1	➢Environmental tobacco smoke control	Required
	0,97		Credit	➢Providing natural ventilation	0,97
		0,97	Credit	➢Solar control and thermal comfort design	0,97
0,97			Credit	➢Natural lighting	0,97
	0,97		Credit	➢Considering of building envelopes	0,97
	0,97		Credit	➢View quality	0,97
0,95			Credit	➢Acoustic control	0,95
0	1,48	2,22		Outdoor Impact Quality (OIQ)	3,70
	0,74		Credit	➢Natural ventilation on nearby buildings	0,74
		0,74	Credit	➢Avoiding negative effect on surrounding	0,74
		0,74	Credit	➢Bird savers	0,74
		0,74	Credit	➢Consideration of global worming	0,74
	0,74		Credit	➢Direct contact with nature	0,74
0,00	2,22	1,48		Waste and Pollution (WP)	3,70
N			Prereq1	➢ Recycling waste	Required
	0,74		Credit	➢Land pollution	0,74
	0,74		Credit	➢Reducing and avoiding wastes	0,74
		0,74	Credit	➢Air pollution	0,74
		0,74	Credit	➢Noises pollution	0,74
	0,74		Credit	➢Reducing and avoiding dusty	0,74
1,80	1,90	0,00		Site Management (SM)	3,70
	1,00		Credit	➢Responsible to the land and green area	1,00
0,90			Credit	➢Selecting site	0,90
	0,90		Credit	➢Open spaces and vertical green farms	0,90
0,90			Credit	➢Avoiding the destroy of surrounding	0,90
0	1,86	7,44		Energy and Atmosphere (EA)	9,30
N			Prereq1	➢Using energy efficiency	Required
	1,86		Credit	➢Minimum and optimise energy performance	1,86
		1,86	Credit	➢Providing onsite renewable energy	1,86
		1,86	Credit	➢CO2 emissions	1,86
		1,86	Credit	➢Reduced peak energy requirements	1,86
		1,86	Credit	➢Improve energy efficiency use	1,86

0,74	0,74	2,22		Material Use (MU)	3,70
N			Prereq1	➢Using local material	Required
		0,74	Credit	➢Using recycled and recyclable material	0,74
		0,74	Credit	➢Minimizing wasting material	0,74
		0,74	Credit	➢Building reuse	0,74
	0,74		Credit	➢Using sustainable material	0,74
0,74			Credit	➢Easy maintenance material	0,74
0	0,74	2,96		Water Use (WU)	3,70
Y			Prereq1	➢Water quality	Required
	0,74		Credit	➢Avoiding wasting water	0,74
		0,74	Credit	➢Rainwater collection	0,74
		0,74	Credit	➢Recycling rainwater	0,74
		0,74	Credit	➢Stormwater management strategies	0,74
		0,74	Credit	➢Reuse grey water	0,74
2,96	0,00	0,74		Building Services and Management (BSM)	3,70
Y			Prereq1	➢Metering and monitoring	Required
N			Prereq2	➢Time management	Required
N			Prereq3	➢Communication and IT management and services	Required
0,74			Credit	➢Electric equipment	0,74
0,74			Credit	➢Plumbing and drainage	0,74
0,74			Credit	➢HVAC systems	0,74
		0,74	Credit	➢Impact of city infrastructure	0,74
0,74			Credit	➢Regular maintenance	0,74
0,90	1,90	0,90		Construction Practice (CP)	3,70
	1,00		Credit	➢Efficiency in construction standerds and managemer	1,00
0,90			Credit	➢Construction safty	0,90
		0,90	Credit	➢Construction prosess	0,90
	0,90		Credit	➢Durability and reliability	0,90

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Quattor MRF tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

				Socio-cultural Indicators	%
0	5,70	1,90		Local Opportunity (LO)	7,60
	1,90		Credit	➢Building long-term relationship with local and client	1,90
	1,90		Credit	➢Working with local community	1,90
		1,90	Credit	➢Provision of equal opportunity	1,90
	1,90		Credit	➢Participation in decision making	1,90
0,00	1,05	1,05		Construction and Staff (CS)	2,10
	1,05		Credit	➢Respect for staff	1,05
		1,05	Credit	➢Partnership working	1,05
0,30	0,30	1,50		Accessibility and Traffic (AT)	2,10
N			Prereq1	➢Shared public spaces and central districts	Required
	0,30		Credit	➢Responsible to the main transportation.	0,30
		0,30	Credit	➢Public transportation nodes	0,30
		0,30	Credit	➢Minimize traffic disruption and delays	0,30
		0,30	Credit	➢Pedestrian and cyclist	0,30
0,30			Credit	➢Acces with the disability	0,30
		0,30	Credit	➢Car park capacity	0,30
		0,30	Credit	➢Cleaning the façade	0,30
0,00	1,40	0,70		Culture and Privacy (CAP)	2,10
N			Prereq1	➢Visual privacy	Required
Y			Prereq2	➢Private open space	Required
	0,70		Credit	➢The building culturally acceptable	0,70
		0,70	Credit	➢Visual privacy for others	0,70
	0,70		Credit	➢Consideration with religion and faith	0,70
0	0	2,10		Health and Wellbeing (HW)	2,10
		2,10	Credit	➢Psychological feeling	2,10
0,60	1,00	0,50		Safety (S)	2,10
0,60			Credit	➢Fire safety	0,60
		0,50	Credit	➢Accidental falls from the height	0,50
	0,50		Credit	➢Safety while maintenance and cleaning	0,50
	0,50		Credit	➢Safity for construction workers	0,50
2,10	0,00	0		Vertical Transportation (VT)	2,10
1,05			Credit	➢Elevators	1,05
1,05			Credit	➢Travel time in elevator	1,05
0,70	0,00	1,40		Crimes and Security (CS)	2,10
		0,70	Credit	➢Crime in corridors	0,70
		0,70	Credit	➢Crime in Elevators as rape and robbery	0,70
0,70			Credit	➢Monitoring and Controlling	0,70
0,00	1,05	1,05		Scale and Size (SS)	2,10
		1,05	Credit	➢Human scale	1,05
	1,05		Credit	➢Building height	1,05
0	0,00	2,10		Children Behavior (CB)	2,10
N			Prereq1	➢Behavior problem in children	Required
		1,05	Credit	➢Children development	1,05
		1,05	Credit	➢Playing space for children	1,05
0,42	0,42	1,26		Social and Community (SAC)	2,10
Y			Prereq1	➢Social interaction	Required
0,42			Credit	➢Effective channel for communication	0,42
	0,42		Credit	➢Family and community	0,42
		0,42	Credit	➢Who the neighbors are	0,42
		0,42	Credit	➢Neighbor facility	0,42
		0,42	Credit	➢The public realm of the livability of street	0,42
0,00	2,10	0,00		Heritage Respect (HR)	2,10
	1,05		Credit	➢Respect to heritage and historical buildings	1,05
	1,05		Credit	➢Respect to whole of the Erbil citadel	1,05
0	1,40	0,70		Awareness and Education (AE)	2,10
		0,70	Credit	➢Knowledge skills of users	0,70
	0,70		Credit	➢Staffs knowledge	0,70
	0,70		Credit	➢Spaces for education	0,70

MSSHRB-E: Measurement Scale For Sustainable High-Rise Building - Erbil

High-Rise building Checklist

Name of High-rise building: Quattor MRF tower

Consteuction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident

0,00	1,40	0,70		Semiotic Approach (SA)	2,10
	0,70		Credit	➢Sign and symbolic	0,70
	0,70		Credit	➢Context architectural identit	0,70
		0,70	Credit	➢Placelessness and public realm	0,70

				Economic Indicatores	%
3,66	1,84	0,00		Local Economic Growth (LEG)	5,50
N			Prereq1	➢Support local community	Required
1,83			Credit	➢Improved productivity	1,83
1,83			Credit	➢Consistent profit growth	1,83
	1,84		Credit	➢Developing client business	1,84

3,80	1,90	1,90		Jobs Opportunity (JO)	7,60
N			Prereq1	➢Employment local people	Required
1,90			Credit	➢Providing job	1,90
		1,90	Credit	➢Supplier satisfaction	1,90
1,90			Credit	➢Client satisfaction	1,90
	1,90		Credit	➢Employee satisfaction	1,90

3,40	2,10	0,00		Shorter and more Predictable (SP)	5,50
	0,70		Credit	➢Providing projects with low cost	0,70
0,70			Credit	➢Provide multiple benefits of financincy to communities	0,70
0,70			Credit	➢Provide projects with short lifecycle cost	0,70
	0,70		Credit	➢Reducing maintenance cost	0,70
	0,70		Credit	➢Reducing service cost	0,70
0,70			Credit	➢Increased cost predictability	0,70
0,70			Credit	➢Ongoing costs	0,70
0,60			Credit	➢Vanity height	0,60

0,00	2,75	2,75		Supply-side (Ss)	5,50
		2,75	Credit	➢Supply and demand	2,75
	2,75		Credit	➢Reliability and reduction	2,75

2,50	2,50	5,00	+	Innoations (I)	10,00
2,50			Credit	➢Innovation in design	2,50
	2,50		Credit	➢Innovation in techniques and technologies	2,50
		2,50	Credit	➢Innovation in benchmarks	2,50
		2,50	Credit	➢Exemplary and enhancement level of performance	2,50

25,80	40,66	43,54	Totals	110,00

Certificate	Percentage
No certified	< 40
D	40 - 49
C	50 - 59
B	60- 69
A	70-80
A+	>80

6.7 Case studies comparison with principles

As far as energy and the atmosphere is concerned, the assumed energy crisis in the region and the city, energy and the environment are all affected either by their usage or by their development. The condition is almost identical in the use of water and even in building materials.

It is evident that all the towers have immense economic advantages, and that is the main and apparent rationale for the development of high-rise buildings both locally and globally, but the reason they are unsustainable in economic terms is that they do not serve local citizens and do not have clear benefits for Erbil's local community.

The impact of socio-cultural non-sustainability in many units is growing, and owners are seeking to convert their purpose from the original function by modifying the furniture and renting or even using themselves. A number of units has also been changed from residential to office space.

Others could see the site as the key infrastructure of Erbil and the public transport system as another unsustainable indicator. Node and transport networks are not relevant. This statement also points out that high-rise buildings cannot be separated from the city and are difficult to construct within sustainable areas if they are not planned. Some other aspects of non-sustainability have a direct impact on themselves as towers where the identity of customers is more alien than that of the local community as opposed to cultural views. In other words, most customers are foreign people.

The sustainability of each tower is highlighted in figure bellow, they are all confronted with a socio-cultural dilemma, and in this case, residential towers are more than commercial and mixed-used towers while commercial high-rise buildings are far better off than residential towers. As a result, none of the buildings should acquire a SHRBM-E certificate (figure: 48).

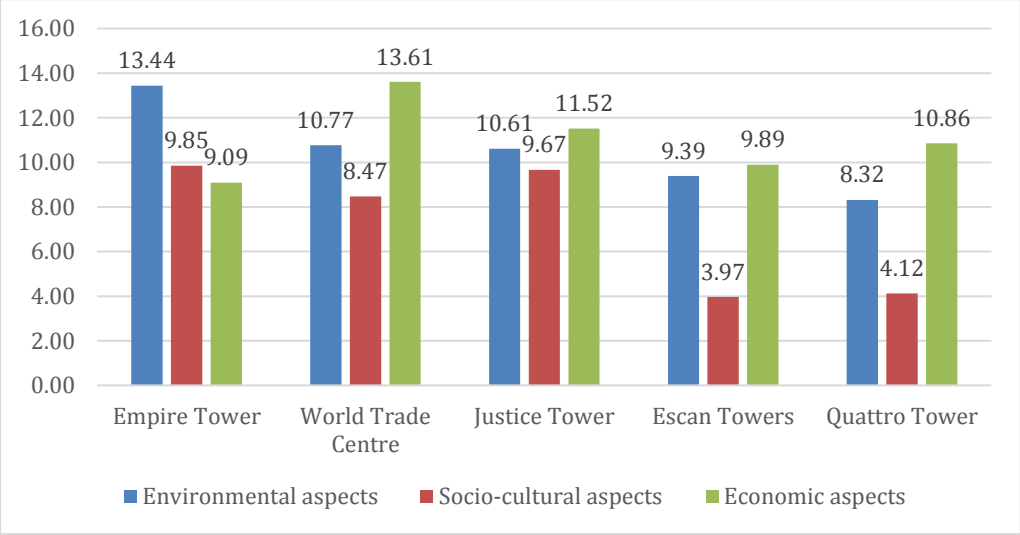


Figure 48: Selected high-rise buildings in terms of environmental, socio-cultural and economic aspects in the level of sustainability.

6.8 Chapter summery

This chapter could be summerised as:

- Dark caverns stemming from the shadows by high-rise buildings have been known to cause problems, such as increased street congestion, winter conditions, and workers' distress due to lack of sunlight. The fact that buildings are still casting out some kind of showdown and altering patterns of air movement in their surroundings also affects their purifying qualities. Perhaps more so, some high-rise buildings cast broad shadows on public squares such as playgrounds, parks and other construction sites.
- Their orientation towards the sun appears not to be optimal. Although the

orientation of some of the towers is manageable, the vast majority tend to have solar issues, such as overheating during the summer.

- Due to the lack of rules governing the angle of vision and the organisation of the scale, several mega-structures have been erected that obstruct each other's views and can be easily identified. One such structure that has been adversely affected by this pattern is the city's coveted attraction the Erbil Citadel.
- While the architecture and decorative features of the buildings should take into account protection, privacy and temperature, this has hardly been the case.
- Due to the fact that these buildings hardly contribute to the local climate and adapt to it the energy needed for heating, cooling and ventilation appears to be significantly high and adversely affecting the environment.
- The use of large generators for mechanical equipment and power generation typically results in less than desirable levels of noise, environmental emissions and also decreases the total lifetime of the house. Both of which could easily be avoided if they were taken into consideration at the early stages of the design process.
- Access to public transport from buildings is also less than desirable, with almost all residences responding solely to their private cars and not to public transport.
- Based on the points mentioned above for high-rise buildings in the city, it can usually be inferred that there is no overall plan for improving the lives of inhabitants of the city, their health or the economy. This suggests a lack of direct concern for sustainability concerns and environmental friendliness.
- It is disappointing that designers and architects do not understand the possible advantages that could be realized and study into the limited effect of different design techniques on high-rise buil

Table 52: Results for all five high-rise buildings according to the new measurement of sustainable high-rise buildings.

	Indicators	*Roj Empire Tower*				*World Trade Centre*				*Justice Tower*				*Escan Towers*				*Quattro Tower*			
Environmental Aspects	Indoor Environmental Quality	Y	1.92	2.91	0.97	Y	2.89	2.91	0	Y	2.89	1.94	0.97	Y	2.89	1.94	0.97	Y	1.92	2.91	0.97
	Outdoor Impact Quality		0	1.48	2.22		0.74	0	2.96		0	2.22	1.48		0.74	0	2.96		0	1.48	2.22
	Waste and Pollution	N	2.22	1.48	0	N	0	1.48	2.22	N	0.74	1.48	1.48	N	0	3,7	0	N	0	2.22	1.48
	Site Management		2.80	0	0.9		1.8	1.9	0		0.9	1.8	1		0	1.8	1.9		1.8	1.9	0
	Energy and Atmosphere	N	0	1.86	7.44	N	0	1.86	7.44	N	0	1.86	7.44	N	0	0	9.3	N	0	1.86	7.44
	Material Use	N	1.48	0.74	1.48	N	0.74	0.74	2.22	N	1.48	0.74	1.48	N	0.74	0.74	2.22	N	0.74	0.74	2.22
	Water Use	N	0	0.74	2.96	Y	0.74	0	2.96	Y	0.74	0	2.96	Y	0	0.74	2.96	Y	0	0,74	2.96
	Building Services and Management	N	2.22	0.74	0.74	N	2.96	0	0.74	Y	2.96	0	0.74	Y	2.22	0.74	0.74	N	2.96	0	0.74
	Construction Practice		2.80	0.9	0		0.9	2.8	0.0		0.9	1.9	0.9		2.8	0.9	0		0.9	1.9	0.9
Socio-cultural Aspects	Local Opportunity		0	1.9	5.7		1.9	5.7	0		3.8	1.9	1.9		0	5.7	1.9		0	5.7	1.9
	Construction and Staff		1.05	1.05	0		1.05	1.05	0		1.05	1.05	0		0	1.05	1.05		0	1.05	1.05
	Accessibility and Traffic	N	0.9	0.3	0.9	N	0.3	0.6	1.2	Y	0.9	0.3	1.2	N	0.6	0.3	1.2	N	0.3	0.3	1.5
	Culture and Privacy	N	0.7	1.4	0	N	1.4	0.7	0	Y	0.7	1.4	0	N	1.4	0.7	0	N	0	1.4	0.7
	Health and Wellbeing		0	0	2.1		0	0	2.1		0	0	2.1		0	0	2.1		0	0	2.1
	Safety		1.6	0.5	0		0.6	1	0.5		0	1.1	1		0.5	1.1	0.5		0.6	1	0.5
	Vertical Transportation		2.1	0	0		2.1	0	0		2.1	0	0		1.05	1.05	0		2.1	0	0
	Crimes and Security		0.7	1.4	0		0.7	0.7	0.7		0	0.7	1.4		0	0.7	1.4		0.7	0	1.4
	Scale and Size		1.05	0	1.05		0	2.1	0		0	0	2.1		0	1.05	1.05		0	1.05	1.05
	Children Behavior	N	0	0	2.1	N	0	0	2.1	N	0	0	2.1	N	0	0	2.1	N	0	0	2.1
	Social and Community	N	0	1.26	0.84	Y	0.42	1.26	0.42	Y	0.42	1.24	0.42	N	0.42	0.42	1.26	Y	0.42	0.42	1.26
	Heritage Respect		1.05	0	1.05		0	2.1	0		0	0	2.1		0	0	2.1		0	2.1	0
	Awareness and Education		0	0.7	1.4		0	2.1	0		0.7	0.7	0.7		0	0	2.1		0	1.4	0.7
	Semiotic Approach		0.7	1.4	0		0	2.1	0		0	0.7	1.4		0	1.4	0.7		0	1.4	0.7
Economic Aspects	Local Economic Growth	N	1.84	3.66	0	N	3.66	1.84	0	N	3.67	1.83	0	Y	1.84	1.83	1.83	N	3.66	1.84	0
	Jobs Opportunity	N	3.8	3.8	0	N	3.8	1.9	1.9	N	1.6	3.8	1.9	N	1.9	1.9	3.8	N	3.8	1.9	1.9
	Shorter and more Predictable		0.7	3.4	1.4		3.4	2.1	0		3.5	2	0		3.4	0.7	1.4		3.4	2.1	0
	Supply-side		2.75	2.75	0		2.75	2.75	0		2.75	2.75	0		2.75	2.75	0		0	2.75	2.75
Innovations (+)			2.5	5.0	2.5		0	7.5	2.5		0	2.5	7.5		0	2.5	7.5		2.5	2.5	5.0
Totals			34.88	39.37	35.75		32.85	47.19	29.96		31.8	33.93	44.27		23.25	33.71	53.04		25.8	40.66	43.54

Construction			
	Yes		Confident
	-		Somewhat confident but uncertain to get credit
	No		Not confident
			Required

Chapter 7

CONCLUSIONS OF THE RESEARCH AND RECOMMENDATIONS

7.1 Introduction

This chapter will summarize the results of this study and sets out conclusions based on the integration of research results, analysis, synthesis and interpretation. Drawbacks to this study and conditional statements are assessed with respect to the implementation of the measurement tool that proposed. Furthermore, suggestions for the proposed calculation and further study are proposed towards the end of this chapter (figure: 49).

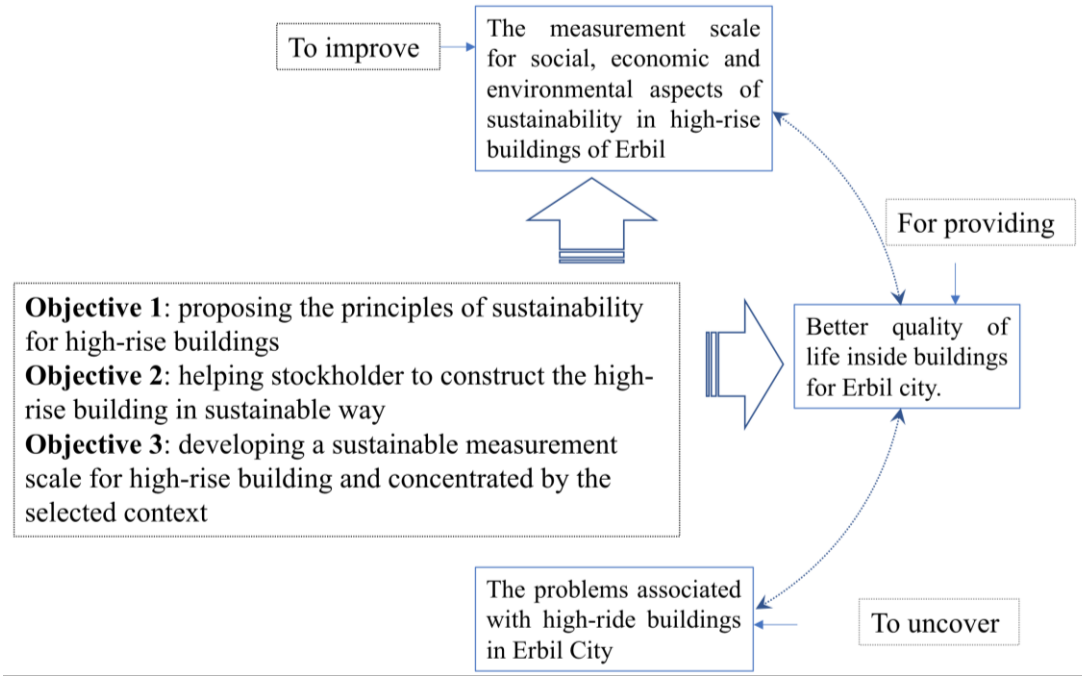


Figure 49: The stated thesis aim and objectives.

7.2 Contributed of the research

The thesis seeks to cover all the objectives of the research, which are; to develop the measurement tools for the social, economic and environmental sustainability aspects of high-rise buildings in Erbil city, in order to improve the quality of life of buildings in Erbil city. It is also aiming to uncover the problems associated with high-ride buildings in Erbil city and three targets. This has been achieved through a number of measures. The overview of the goals and study questions in accordance with the results is outlined as follows:

> "What are the parameters of economic, social and environmentally sustainable high-rise buildings globally, and how can apply high-rise buildings in a sustainable way and are they work with thinking of all pillars?"

A broad literature review has shown that the key aspects and principles of sustainable architecture, sustainable design, sustainable high-rise, and different dimensions of sustainable construction are understood. To explore the limits and criteria of high-rise, economically, socially and environmentally safe buildings. Environmental sustainability criteria for HRBs have been identified worldwide as: environmental and climatic conditions, emissions and waste management, site management, electricity and building materials. Correspondingly, the global criteria of socio-cultural sustainability for HRBs were identified as: local opportunity, communication and social interaction, access to potential requirements and traffic, health and well-being, culture and faith, and, safety and protection. Congruently, the global economic sustainability criteria for HRBs have been recognized as: local economic growth, employment and occupations, costs and finance, supply and demand, and finally short-

term and more predictable. Thus, via the above, "Objective 1: Proposing the principles of sustainability for high-rise buildings" may be investigated.

> "What would be the nature and form of a measurement tool, relevant to developing countries, particularly the high-rise building condition?"

A broad screen analysis was shown to understand the global sustainable rating system and to examine the essence and shape of a measuring tool which has existed globally by high-lighting the timeline for sustainable rating system growth around the world with a sustainable high-rise rating system. The high-rise building concerns the design and development of a model, particularly for high-rise buildings, for the social and environmental sustainability aspects.

> "What, according to participants, are the main criteria for achieving all principles of sustainability for high-rise buildings according to site study?"

It has also been achieved by presenting information on the physical settings and development of Erbil city, qualitatively exploring the perception of sustainable high-rise buildings at different stages and the preferences and requirements for socially, economically and environmentally sustainable high-rise buildings in Erbil city. This was achieved by analyzing qualitative data on the basis of a semi-structured interview. There is also a sustainable evaluation planning tool with its HRBs indicators in Erbil city. It is also the way to examine the " Objective 3: developing a sustainable measurement scale for high-rise building and concentrated by the selected context".

There is a Sustainable Measurement Scale with their High-Rise Buildings Indicators in Erbil city with certain points. As presented in the diagram below, this study identified nine environmental indicators, fourteen social indicators and four economic

indicators for the production of scales for environmentally, socially and economically sustainable high-rise buildings in the city of Erbil. The environmental component consisted of 52 issues, the social component consisted of 48 issues and the economic component consisted of 19 issues chapter (figure: 50).

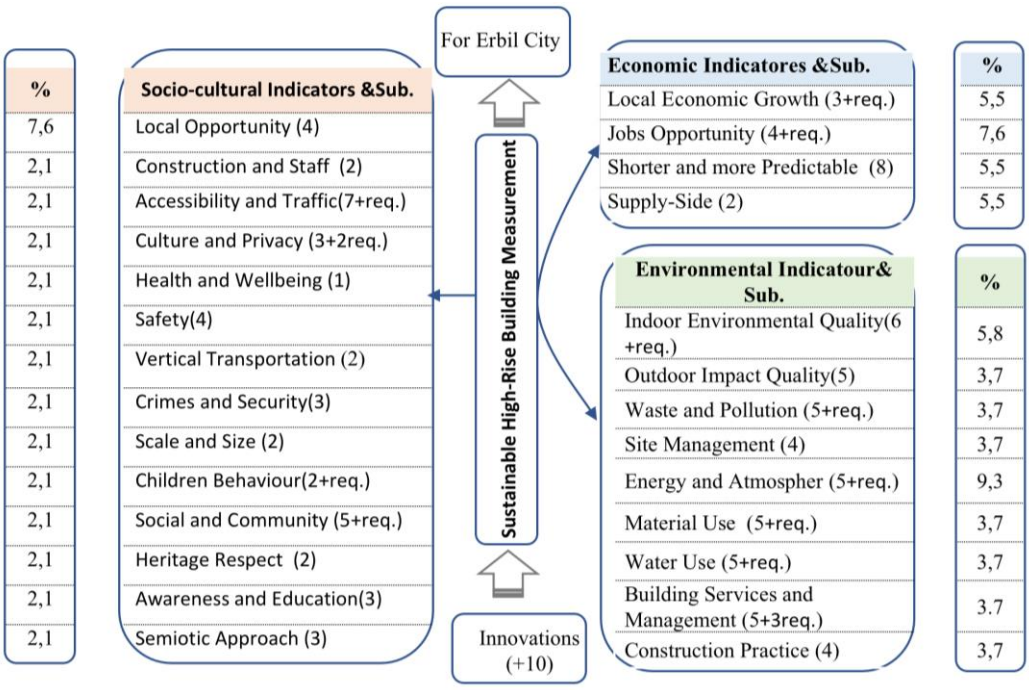


Figure 50: Sustainable measurement scale with their indicators and weighted. Source: (by author).

"How can the high-rise buildings be evaluated according to sustainability and local condition?"

There is a checklist for the assessment and there is a specific strategy for the weighting scale that those indicators that support more than one pile and the region that clearly suffers from them will receive credits from more than one hand especially those indicators that have a clear role to play in sustainability, according to the context report. To achieve the second goal of this report, which is to "help stakeholders build

high-rise buildings in a sustainable manner", the following questions have to be answered.

Accordingly, to support the main research questions the set up sub-questions are:

"Can the high-rise buildings ever be sustainable and how?"

A broad literature review has been shown to explain the main aspects and principles of high-rise buildings with sustainability considerations. Therefore, by discussing high-rise building statuses in the equilibrium of sustainability (2.6) and the issues of high-rise buildings (5.4), it can be inferred that high-rise buildings should not be contrasted with other low-rise buildings and that they should be evaluated separately.

"What are the current conditions and problems of high-rise buildings in Erbil city?"

Quantitative data analysis is designed on the basis of the consumer questionnaire surveys of the five high-rise buildings. Further, site evaluation to learn about sensitive issues that participants may not be able to speak about as well as assessing their sustainability status using the proposed scale measurement model was required. Unfortunately, none of them could get the score needed to get the certificate.

7.3 Recommendation for the MSSHRB-E

It is expected that the legislation and standards of high-rise buildings in Erbil will improve in the country in the coming years. As a result, rules and regulations will be justifiable and up-to-date over time, sustainable technology, local skills and awareness of issues will move forward and sustainable building recitals could be enhanced. It should be noted, in particular, that the proposed criteria in this study are by no means exhaustive or conclusive. If this model is to be adopted, it is recommended that the standards specified in the conceptual scheme be revised or modified gradually over

time. In other words, it should be noted that while this study is the first step towards achieving sustainable high-rise buildings in Erbil, more innovative techniques could be explored and the proposed measurement scale will need to be revised and adjusted on the basis of new tenant requirements.

In any state, the government, including the Parliament of the different branches and sub-sectors, should begin the process of legislating and establishing various building codes and measuring practices and regulations in the region, which would not only protect buildings from disruptive effects, but would also protect them from all other burdens that the region's socio-cultural, economic and environmental issues might have.

This can be achieved by funding, promoting and developing a data collection and research center in this field. The Ministry of Planning, in collaboration with other related public and private bodies, should set up committees consisting of academic experts and practitioners who can objectively learn and improve various codes of practice and building regulations for the study area and the region. These committees should promote ongoing research efforts in the various engineering disciplines needed to keep the codes up-to-date.

7.4 Suggestions for future research and development

The following aspects are recommended for further research:

- Improvement of a sustainability measurement scale that specified for countries-in another developing region, using this model, MSSHRB-E, as the basis and following the model or methodology adopted in this report.

- Production of acceptable weightings for situations or metropolises in the region other than those defined in this study.
- Developing unique sustainable measurement scales for other types of buildings in the same region, using the MSSHRB-E as a base, as well as assuming the model or method adopted in this research.
- Designing effective strategies in depth for each of the metrics of this model in order to achieve the available points.
- Assessment of measures of the model and its criteria in the region.

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APPENDICES

Appendix A: Interview's documents

Participant information sheet for expert and authority

Department of Architecture
Eastern Mediterranean University
Famagusta, Turkish Republic of Northern Cyprus

Information sheet
For expert and authority

Thank you very much for participating in this study. Please take a few more minutes to read the following information, which will explain the aims and purpose of the research further. If you have any questions, please feel free to ask the researcher whose contact details are stated below.

I am an Iraqi PhD student at the Faculty of Architecture, Department of Architecture, Eastern Mediterranean University, North of Cyprus. My research topic is "**Developing a measurement scale for sustainable high-rise building in city of Erbil".** This study aims to develop a measurement scale for sustainability in high-rise buildings in Erbil. The measurement scale proposed in this study could be used to set the criteria for sustainability in high-rise buildings in Erbil. In order to create a suitable assessment framework for Erbil, it is essential to understand the most important concerns of building stakeholders in pursuing sustainable building development in Erbil.

Therefore, I would like to invite you to participate in a questionnaire survey that consists of issues that may be important in developing sustainable high-rise buildings in Erbil city. The survey should take about 15-20 minutes to complete. The findings from the survey will be an integral part of the research, leading to the thesis that will be submitted for the degree of Doctor of Philosophy.

The results will be confidential and will only be seen by the researcher. You do not need to give your name when completing the survey. The information obtained from the survey will be discussed with the researcher's supervisors.

If during the completion of this questionnaire you felt any distress or discomfort and you would like to speak, please contact the researcher (name, email, phone number) or you may also the research supervisor (email) with any questions.
Once again thank you for your valuable contribution to this research. Your participation is greatly appreciated.

Assist. Prof. Dr. ERCAN HOŞKARA (Supervisor)
Faculty of Architecture, department of architecture
Eastern Mediterranean University
Email: ercan.hoskara@emu.edu.tr

Wezha Hawez Baz (PhD candidate)
Ph. No: 05391001810 (North of Cyprus),
07501127791 (North of Iraq)
Email: 16600098@students.emu.edu.tr

I am looking forward to receiving your positive reply and I do appreciate your participation in this research project.

Yours Sincerely,
Wezha Hawez Baiz

The text of this consent form was developed based on the sample form from the link below:
https://bayek.emu.edu.tr/en/forms

Consent form for expert and authority

Department of Architecture
Eastern Mediterranean University
Famagusta, Turkish Republic of Northern Cyprus

Consent Form

For experts and authorities

Dear participant,

Please take a few minutes to read the following information on this research carefully before you agree to participate. **If at any time you have a question regarding the study, please feel free to ask the researcher who will provide more information.**

Of course, you are not obliged to participate in this research and are free to refuse to participate. You may also withdraw from the study at any point without giving any reason. In this case, all of your responses will be destroyed and omitted from the research. If you agree to participate in and complete the study, all responses and questionnaires will be treated **confidentially**. Your name and identifying information will be kept securely and separately from the rest of your questionnaire. Data will be stored for a maximum of six years after the study. Once the data is analyzed, a report of the findings may be submitted for publication.

To signify your voluntary participation, please complete the form below.

Please tick the boxes to confirm that you agree to each statement.

1. I confirm that I have read and understood the information sheet for this study and have had the opportunity to ask any questions. ☐
2. I understand that my participation is voluntary and that I may withdraw from the study at any time without explanation. ☐
3. I am aware that I should retain a copy of this Consent Form, when completed, and the attached Information Sheet. ☐
4. I agree to take part in the research project titled: Developing a measurement scale for sustainable high-rise building in city of Erbil. ☐

Signature: ..... Date: ....

Witness to complete:

I have described to..... (name of subject) the nature of the research to be carried out and in my opinion she/he understood the explanation.

Signature: ..... Date: ....

The text of this consent form was developed based on the sample form from the link below:
https://bayek.emu.edu.tr/en/forms

Interviews sample

Survey-1: experts and authorities interviews

Please find time to answer these questions as fully as possible. Your individual details shall not be made available to others. The information you divulge will remain in the keeping of the researcher only for as long as the collation period. Your knowledge and assistance are greatly appreciated.

Section one: personal background information of the participant

The main purpose of this section is to collect general information about the respondent characteristics that is personal background, including name, contact information, occupation, highest level of education awarded, career ' experience, place of work, and job title.

. . . . . .

1. Name (optional): _____Contact No/ email (optional): _____

2. Occupation:

□Architect □Planner □Engineer □Civil engineer

3. Highest level of your current education:

□ B. Sc. □ M.Sc. □PHD □Others

4. How many years do you have experience in your career:

□1-4 □5-9 □10-15 □16-25 □more than 25

5. Nature of Work Carried Out (Job Title): _____

Section Two: General issues

This section was designed to understand the awareness level of the respondents about the sustainability and sustainable high-rise buildings through their experience and their plan for the future; also, it was designed to identify the main driving forces of high-rise buildings in this city.

. . . . . .

6. Do you have any idea about sustainability and sustainable high-rise buildings? If yes, please explain

7. What is your institution/ company's experience with the sustainable high-rise

building and its assessment tool? What has been your approach?

8. Does your institute or company have plans for future sustainable measurement scale development of high-rise buildings in Erbil city? Please explain.

9. According to a universal call to sustainability and sustainable buildings, in your opinion, how can the federal government better implement sustainable building measurement scales into their management plans?

10. Why they have High-Rise Buildings in Erbil City and the reasons for their boom?

Section Three: Certain Response - Possible Techniques

The main purpose of this section is to identify main problems of the Erbil's high-rise buildings and show the experts and stakeholders' opinion on both good and bad sides of those buildings according to all three sustainable piles.

11. What are the problems exist in high-rise buildings of Erbil city and please could you explain both good side and bad sides of the high-rise buildings according to all following three sustainable aspects?

1. Environmental issues:

(Location of the site, Impact on neighboring, While construction period, Building construction management, Environment inside the unit, Management of water, Arrangement of waste, Management of energy and efficiency, Others……..)

2. Socio-cultural issues:

(Social Communication, Flexibility, Culture and heritage, Views from the building units, Comprehensive of elders and disability, Security and confidence, Human health, Unit size and height, Others ……)

3. Economic issues:

(Renewable energy, Natural sources, Affordable the unit either for rent or sell, Maintenance of the building units, Distance from Public transportation, Lower life cycle cost, Short, simple payback period, Support of the local economy, Majority of employees are from the local people, Others……...)

Section Four: Concern of high-rise buildings

Section four was established to recognize the concern of high-rise buildings should be considered in different stages that are important to develop the measurement scales.

. . . . . .

12. Please, could you specify the concern of high-rise buildings, which are important to develop measurement scales of sustainability, should be considered while all process of design, construction, and uses?

Section Five: Extra questions

Section five was designed to identify the various local priorities that have a clear effect and roles on designed high-rise building sustainable rating system from the point of experts and authorities views and any other ideas that they want to share.

. . . . . .

13. What local priorities do you think have effect on sustainable rating systems of high-rise buildings?

14. What other ideas would you want to point out and share with us?

Thank You For Your Valuable Time

Appendix B: Questionnaire's documents

Participant information sheet for users

Department of Architecture
Eastern Mediterranean University
Famagusta, Turkish Republic of Northern Cyprus

Information sheet
For users

Thank you very much for participating in this study. Please take a few more minutes to read the following information, which will explain the aims and purpose of the research further. If you have any questions, please feel free to ask the researcher whose contact details are stated below.

I am an Iraqi PhD student at the Faculty of Architecture, Department of Architecture, Eastern Mediterranean University, North of Cyprus. My research topic is "**Developing a measurement scale for sustainable high-rise building in city of Erbil".** This study aims to develop a measurement scale for sustainability in high-rise buildings in Erbil. The measurement scale proposed in this study could be used to set the criteria for sustainability in high-rise buildings in Erbil. In order to create a suitable assessment framework for Erbil, it is essential to understand the present scenario of high-rise living and working in Erbil

Therefore, I would like to invite you to participate in a questionnaire survey that consists of issues that may be important in developing sustainable high-rise buildings in Erbil city. The survey should take about 15-20 minutes to complete. The findings from the survey will be an integral part of the research, leading to the thesis that will be submitted for the degree of Doctor of Philosophy.

The results will be confidential and will only be seen by the researcher. You do not need to give your name when completing the survey. The information obtained from the survey will be discussed with the researcher's supervisors.

If during the completion of this questionnaire you felt any distress or discomfort and you would like to speak, please contact the researcher (name, email, phone number) or you may also the research supervisor (email) with any questions.
Once again thank you for your valuable contribution to this research. Your participation is greatly appreciated.

Assist. Prof. Dr. ERCAN HOŞKARA (Supervisor)
Faculty of Architecture, department of architecture
Eastern Mediterranean University
Email: ercan.hoskara@emu.edu.tr

Wezha Hawez Baz (PhD candidate)
Ph. No: 05391001810 (North of Cyprus),
07501127791 (North of Iraq)
Email: 16600098@students.emu.edu.tr

I am looking forward to receiving your positive reply and I do appreciate your participation in this research project.

Yours Sincerely,
Wezha Hawez Baiz

The text of this consent form was developed based on the sample form from the link below:
https://bayek.emu.edu.tr/en/forms

Consent form for users

Department of Architecture
Eastern Mediterranean University
Famagusta, Turkish Republic of Northern Cyprus

Consent Form
For users

Dear participant,

Please take a few minutes to read the following information on this research carefully before you agree to participate. **If at any time you have a question regarding the study, please feel free to ask the researcher who will provide more information.**

Of course, you are not obliged to participate in this research and are free to refuse to participate. You may also withdraw from the study at any point without giving any reason. In this case, all of your responses will be destroyed and omitted from the research. If you agree to participate in and complete the study, all responses and questionnaires will be treated **confidentially**. Your name and identifying information will be kept securely and separately from the rest of your questionnaire. Data will be stored for a maximum of six years after the study. Once the data is analyzed, a report of the findings may be submitted for publication.

To signify your voluntary participation, please complete the form below.

Please tick the boxes to confirm that you agree to each statement.

1. I confirm that I have read and understood the information sheet for this study and have had the opportunity to ask any questions. ☐
2. I understand that my participation is voluntary and that I may withdraw from the study at any time without explanation. ☐
3. I am aware that I should retain a copy of this Consent Form, when completed, and the attached Information Sheet. ☐
4. I agree to the researcher taking photographs of the interior and exteriors my flat/office. ☐
5. I agree to take part in the research project titled: Developing a measurement scale for sustainable high-rise building in city of Erbil. ☐

Signature: ..... Date: ....

Witness to complete:

I have described to..... (name of subject) the nature of the research to be carried out and in my opinion she/he understood the explanation.

Signature: ..... Date: ....

The text of this consent form was developed based on the sample form from the link below:
https://bayek.emu.edu.tr/en/forms

Questionnaire

Survey-2: users of high-rise buildings' questionnaire

Perception of residents and those persons that work in high-rise buildings in Erbil city

Questionnaire Survey.

Please find time to answer these questions as fully as possible. Your individual details shall not be made available to others. The information you divulge will remain in the keeping of the researcher only for as long as the collation period. Your knowledge and assistance are greatly appreciated.

Section one: personal Information of the participant

This section is to collect the information about the respondent's background, such as name, contact number, Occupation, and their gender. Also, it is to gather about building's name, floor and flat number, and the area.

1. Please specify the following information:

Education_____ Occupation/ Job _____

Your age group?

□Under 20 □20-30 □31-40 □41-50 □51-63 □ above 63

Gender: □Male □Female □ other

2. Please specify the following information about the building:

Name of buildings_____ Number of floor _____

Number of flat/ unit_____ Apartment/ office unit area (m2): _____

Section two: Environmental aspects

The questions in this section are to find out the user's satisfaction for either living or working on the environmental issues of their buildings and unit/flat as location, lighting, pollutions, materials... etc Also, it is to discover about either existing or absenting of some other environmental issues in the buildings.

3. Please share your opinion about your satisfaction for the following environmental aspects of your high-rise building and apartment/ office unit

Not satisfied	Somewhat satisfied	Moderately satisfied	Very satisfied	Extremely satisfied
①	②	③	④	⑤

Following environmental aspects	①	②	③	④	⑤
Building location					
Land management					
Overshadowing					
Natural light in your apartment/ office unit					
Natural ventilation- air movement					
Water pollution					
Noise pollution from natural					
Noise pollution by human's product					
Sound insulation					
Pollution by any human's product					
Thermal insulation					
Material and monitoring					
Materials used as a wall partition, electricity wire, water pipe, finishing, etc...					
Construction quality					
Structural safety					
Metric system for electricity, water and gas usage					
Finishing materials accorded to fire resistance					
Waste management					
Orientations					

4. Please answer by yes, no, or no opinion on the following questions.

Issues	Yes	No	No Idea

Does Recycling material have been used?			
Are the materials from local?			
Does the building have reuse of the water system as greywater or rainwater harvesting?			
Is there any separating the waste system?			
Does the fire system design well?			
Are there any passive strategies as a solution for openings as shading devices?			
Does it have a renewable energy system?			
Is there any energy efficiency of using light sources			
Is there any system of energy efficiency in using lifts?			

Section Three: Socio-cultural aspects

The questions in the section are to investigate the user's satisfaction, for either living or working, on the Socio-cultural issues of their buildings and unit/flat as privacy, views plan arrangement,...etc Also, it is to discover about either existing or absenting of some other socio-cultural issues in the buildings and the attractive points of high-rise buildings.

5. Please share your opinion about your satisfaction for the following socio-cultural aspects of your high-rise building and apartment/ office unit

Socio-cultural aspects	①	②	③	④	⑤
Entrance and lobbies					
Plan arrangement					
The size of the office unit/ apartment					
Interior design and decoration					
View from your office/ apartment					
Privacy level					
Interaction space with the neighbored /others					
Community space quality					
Green area					
Children's playground spaces (apartment)					
Safety for children					
Entertainment facility					
The necessary features for disability and elders					
Announcements about services					
Sewage system					
Car park capacity					

6. Please answer by yes, no, or no opinion on the following questions.

Issues	Yes	No	No Idea
Do you still prefer to stay/work in this unit?			
Have you changed any parts in your apartment/office unit?			
Does the building have announcements about services?			
Does the building have spaces for Community?			
Is there any green area except ground floor such as balcony, corridor?			

7. What attracted you to live/work in this high-rise building?

□ Stunning views □ Less noise and air pollution □ Natural Light and ventilation □ Peaceful □others.....

8. From which floor do you think is too high for working/ living on it:

□ from10th □from 15th □from 20th □more than 25th

9. If it is in your hand, which floor are you going to choose for living/ working on it?

□ground floor □ from10th □from 15th □from 20th □more than 25th

10. Do you need a balcony? _____

If yes, for which purposes do you like to use? _____

. . . . . .

Section Four: economical aspects

The questions in this section to examine the level of affordability, according to the users, on the economic issues as rent and sell prices and services' prices...etc Also, it is to discover about payback period, supporting the local economy and local people employees.

. . . . . .

11. Please share your opinion about the level of affordability for the following

different issues

Not affordable	Somewhat affordable	Moderately affordable	Very affordable	Extremely affordable
①	②	③	④	⑤

Different issues	①	②	③	④	⑤
For rent					
For sell					
Water					
Gas					
Electricity power					
Cleaning					
Waste collection					
Other services (such as lifts and security unit, etc.)					
Life cycle cost					

12. Please answer the followings by yes, no, or no opinion

Issues	Yes	No	No Idea
Does it have a short simple payback period?			
Is it supported of the local economy?			
Are the majority of employees from local people?			

13. Which facility are you going to use normally?

□ Public services □ private care □ bicycle □ motorcycle □other……

Section Five: concern of high-rise buildings

Question 14 was designed to investigate the respondents' concerns about various issues of high-rise buildings and their units such as human scale, travel waiting, clime in different parts...etc

14. Share your opinion by a tick (√) from 1(not concerned) to 5 (extremely concerned) on your concern level of high-rise buildings.

Concern of high-rise buildings	①	②	③	④	⑤
Human scale					
Children Growth and their behaviour					
Travel time lifts					

Corridor waiting for the lifts					
Building height					
Isolated from ground					
Neighbors					
Accidental falls from height					
Fire safety					
Crime in lifts and corridor					
Car park					
Elevator breakdown					
Suicide					
Children's playground					
Privacy					
Symbolic attraction					
Social relation and interaction					
Strain, distress and mental health					
Failure of electricity					
Water cut					
Others.....					

Section Six: Open-end question

The questions in this section are to obtain the respondent's opinion about the advantage and disadvantage are in the high-rise buildings with the possibility of improving their unit/apartment. Also, to share any other things that the respondents want to share.

. . . . . .

15. What are the benefits and drawbacks of living/ working in high-rise buildings in general?

16. How could the office unit/ apartment be improved?

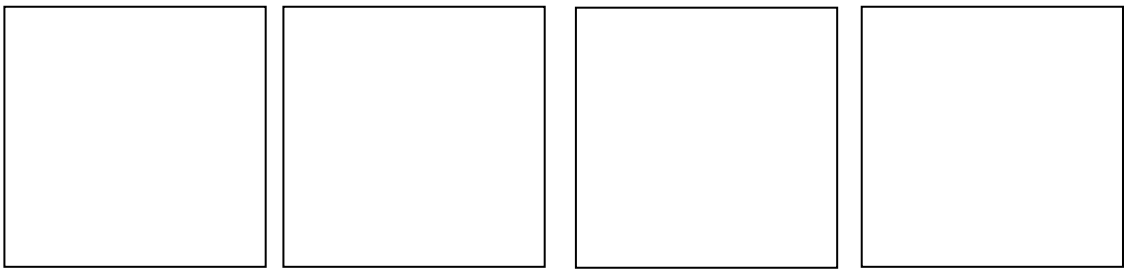
17. Do you want to share any other things?

Thank You For Your Valuable Tim

Appendix C: Observations

Observation Form while Field Study

Building name: _____ Location: _____
Date of visit: _____



East view West view North view South view

Different views of the building

Section One: General issues

This section was designed to understand and evaluating the general issues of the building, it was designed to identify the main subject of high-rise buildings within this city urban spaces.

For evaluating the different issues, there is scoring scheme from 1 (poor) to 5 (excellent)

Poor	Below average	Average	Good	Excellent
①	②	③	④	⑤

General Issues	①	②	③	④	⑤
Location of the building according to its surrounding					
Effect of building height on the Erbil skyline					
The physical relationship of the tower with the existing environment in term of form or height (height harmony)					
Design building appearance accruing to street scape					
Others……..					

Section two: Environmental aspects

This section is to find out the state of some environmental issues of the buildings. In another word, it is to discover about either existing or absenting of some environmental issues in the buildings.

Environmental issues	①	②	③	④	⑤
The ecological or agricultural value of the site					
Proper selection of the land					
Building located on the site					
Façade material selection considering a sustainable approach					
Durable building material					
Reuse and recycle					
Proper material selection for Minimum maintenance and cleaning					
Damage of existing soil and water bodies					
Any innovation					

Other environmental issues:

……
…….

Section three: Socio-cultural aspects

The purpose of the section three is to investigate score, for either living or working, on the Socio-cultural issues of the buildings and unit/flat as communication integration, being as a landmark, and the heritage value. Also, it is to observe some other socio-cultural issues in the buildings and the attractive points of high-rise buildings.

Socio-cultural issues	①	②	③	④	⑤
Communication integration					
Being as a landmark of Erbil city					
Visual impact of the building on any historical sites/ buildings nearby					
The heritage value of the building at the urban level					
Perceivable green					

Suitable green usage between floors					
Separation of public and service entrances					
The pedestrian areas within the site (landscape design)					

Other socio-cultural issues:

……
…….

Section Four: economical aspects

This section is to examine and discover the score of different issues, according to the users, on the economic issues as distance from public transportation, supporting the local economy and local people employees.

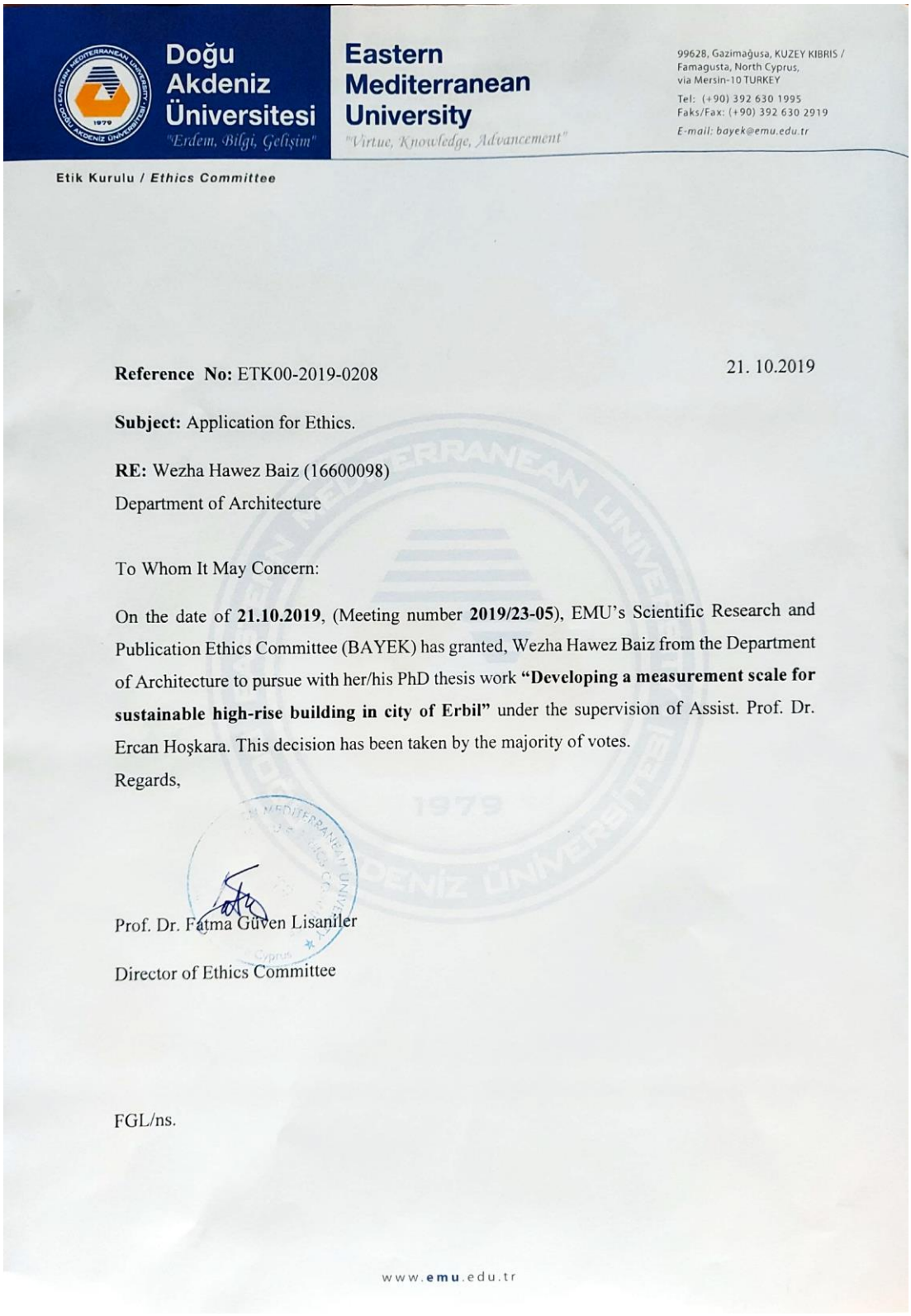
. . . . . .

Economic issues	①	②	③	④	⑤
Distance from public transportation					
Using natural source and renewable energy					
Support of the local economy					

Other environmental issues:

……
……

Appendix D: Approval latter



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Etik Kurulu / *Ethics Committee*

Reference No: ETK00-2019-0208

21. 10.2019

Subject: Application for Ethics.

RE: Wezha Hawez Baiz (16600098)
Department of Architecture

To Whom It May Concern:

On the date of **21.10.2019**, (Meeting number **2019/23-05**), EMU's Scientific Research and Publication Ethics Committee (BAYEK) has granted, Wezha Hawez Baiz from the Department of Architecture to pursue with her/his PhD thesis work **"Developing a measurement scale for sustainable high-rise building in city of Erbil"** under the supervision of Assist. Prof. Dr. Ercan Hoşkara. This decision has been taken by the majority of votes.

Regards,

Prof. Dr. Fatma Güven Lisaniler

Director of Ethics Committee

FGL/ns.

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