IMPACT OF SPATIAL CONFIGURATION ON FUNCTIONAL EFFICIENCY OF HOUSE LAYOUTS IN ERBIL CITY, IRAQ FROM 1900 TO 2010

BY

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DEDICATION

To My Beloved Wife…Kuestan,

The Symbol of Sacrifice, and Patience

&

To My Lovely Children…Anas, Bana, and Ahmad,

Where I See My Promising Future

الحمد لله رب العالمين والصلاة والسلام على سيد المرسلين، سيدنا محمد وعلى آله وصحبه أجمعين

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LIST OF ABBREVIATIONS

MD ……The Mean Depth of the spatial system

RA……..**.....** Integration value of space (Relative Asymmetry)

RRA…….. Integration degree of space (Real Relative Asymmetry)

D_K ……...Relative Asymmetry of space from a Diamond – shaped graph

H… ……...The unrelativised difference factor for three spaces

H^*……...The relativised difference factor of space

R……Space-link ratio (Ringiness of spatial system; tree-like structure/ringy structure)

L.…….The number of lines of the link between spaces in the Justified – graph

K……...Total number of spaces in the spatial system

a, b, c, and d……**.....**Space-type (the degree of spaceness)

J-G…..……..……...Justified graph of spatial system

H.L……...…..House layout

HCECR……HCECR, High Commission for Erbil Citadel Revitalization

IMPAK KONFIGURASI RUANG DALAM SUSUNATUR PELAN RUMAH DAN TAHAP FUNGSI EFISIENSINYA BAGI PERUMAHAN DI BANDAR ERBIL, IRAQ: DARI TAHUN 1900 HINGGA 2010

ABSTRAK

Penyelidikan ini adalah untuk mengenalpasti impak konfigurasi ruang terhadap tahap susunatur dan efisiensi fungsinya dalam pelan-pelan rumah yang dibina dari tahun 1900 hingga 2010 di Bandar Erbil, Iraq. Pelan-pelan perumahan di Bandar Erbil dipilih sebagai kajian kes ini kerana ia mempunyai stail yang pelbagai dipengaruhi oleh senibina tradisional dan moden. Pemilihan tahun 1900 sebagai permulaan masa kes kajian bukanlah ditentukan secara spontan tetapi ia dipilih kerana ia merupakan detik permulaan senibina moden dengan rakusnya mempengaruhi dan mendapat lebih tumpuan daripada senibina tempatan, yang mana situasi ini tidak berlaku pada zaman sebelumnya. Kajian literatur dalam penyelidikan ini meliputi dua bahagian. Bahagian pertama ialah kajian teori mengenai hubungan di antara konfigurasi ruang dengan susunatur pelan rumah untuk memahami tahap fungsi efisiensinya berasaskan Teori Ruang Sintaks. Bahagian kedua pula ialah kajian mengenai perubahan dan transformasi perkembangan rekabentuk susunatur pelan rumah di Bandar Erbil. Ia diklasifikasikan kepada empat masa yang berkala 30 tahun untuk setiap tempohnya iaitu tempoh 1900-1930, 1930-1960, 1960-1990 dan 1990-2010. Kaitan sejarah dengan rekabentuk susunatur, kategori susunatur, jenis, corak, dan sistem pengezonan ruang dan aktiviti menjadi rujukan utama pecahan mengapa waktu-waktu ini diklasifikasikan. Analisis ini merujuk kepada tahap perbezaan dan perubahan susunatur pelan rumah untuk setiap tempohnya. Penanda aras penilaian indikatornya ialah Purata Unjuran Ruang (MD), Relatif Sebenar Ruang Tidak Simetri (RRA), Faktor Perbezaan Ruang (H*), Nisbah Kaitan-Ruang (Ruang lingkungan) dan Jenis-Ruang (Darjah Ruangan). Indikator-indikator ini dianalisis menggunakan perisian Teori Ruang Sintaks iaitu program *Agraph-2009*. Analisis ini kemudiannya membuat perbandingan sampel untuk setiap kategori masa yang bertujuan untuk menunjukkan impak konfigurasi ruang dan fungsinya dalam susunatur pelan rumah berasaskan jawapan numerikal. Hasil kajian menunjukkan terdapat perbezaan dalam susunatur pelan-pelan rumah ini dari satu tempoh ke satu tempoh yang lain disebabkan oleh perubahan konfigurasi ruang dan fungsinya. Tempoh kedua (1930-1960) susunatur pelan rumah mempunyai susunatur yang paling efisien dengan skor 2.936 untuk MD, 1.012 RRA, 0.896 H*, 100% Ruang Lingkungan, dan 0.382 Darjah Ruangan jenis ‘c’ dan ‘d’. Hasil analisis ini menyokong hipotesis kajian yang mengandaikan efisiensi fungsi dalam susunatur pelan rumah dipengaruhi oleh konfigurasi ruang yang berlaku sepanjang masa berasaskan rujukan numerikal. Analisis Teori Ruang Sintaks merupakan sumbangan penyelidikan ini dalam menilai tahap efisiensi fungsi ruang dalam susunatur pelan rumah. Ia dapat memberi panduan dalam perkembangan rekabentuk susunatur pelan rumah di Bandar Erbil pada masa akan datang.

IMPACT OF SPATIAL CONFIGURATION ON FUNCTIONAL EFFICIENCY OF HOUSE LAYOUTS IN ERBIL CITY, IRAQ: FROM 1900 TO 2010

ABSTRACT

This study is to determine the impact of spatial configuration on the level of functional efficiency of house layouts in Erbil city in Iraq, from 1900 to 2010. Erbil city in Iraqi Kurdistan region is selected as the case study because the city has mixed styles of traditional and modern architecture. The period from 1900s to 2010s in this study is not coincidental, selected for the analysis because during this period, its architecture experiences the most rapid changes with an influence of modern architecture superseding over the traditional architecture, where this condition is not found in the earlier period. The literature study comprises two parts. The first part is a theoretical study of the relationship between spatial configuration and functional efficiency of the house layouts highlighting the key syntactical characteristics of spatial configuration and its impact on the level of functional efficiency, based on the Theory of Space Syntax in clarifying this relationship. The second part is an overview study on house layouts in Erbil city through an analytical-comparative description to the changes and transformations in their configurations; classifying the period (1900-2010) into four time periods with about 30 years' sequence for each period (1900-1930, 1930-1960, 1960-1990 and 1990-2010s) with reference to the historical events which influence their layout designs, categories of the house layouts, types, patterns, and zoning of spaces and activities. This analysis description to the stages and periods of house layouts reveals differences and changes over time. The main benchmarks and indicators that contributed in measuring the functional efficiency of house layouts are the Mean Depth of space (MD), the Real Relative Asymmetry of space (RRA), the Difference Factor of space (H*), Space-Link Ratio (R-Ringiness of space), and the Space-Type (the degree of spaceness). These indicators are analyzed using the Space Syntax's Theory by applying a software program, *Agraph-2009* which provides numerical results. This analysis compares entire samples of the house layout designs for each period. These numerical results indicate the impact of spatial configuration and functions of the house layouts. The result shows that house layout changes over time due to the process of spatial configuration and its functions. The second period (1930-1960) has the most efficient house layout with most of the mentioned indicators that applied in the process of evaluation, with numerical results 2.936 for MD, 1.012 RRA, 0.896 H*, 100% R-Ringiness of space, and 0.382 the degree of 'c' and 'd' types' spaceness. The result supports the research hypothesis which assumes that the functional efficiency of the house layouts is affected by the process of spatial configuration over time. The research contribution is that analysis using the Space Syntax's Theory contributes numerical results to support the hypothesis by indicating the level of efficiency. It guides towards innovative approach with tangible results for references in the future development of house layouts in Erbil City.

"*One of the most important ways in which the built environment carries the imprint of society is in the way space is organized for human purposes, which lies in the achievement of appropriate and efficient function of the house*." (Aspinall, 1993, p.337)

1. CHAPTER ONE - INTRODUCTION

1.1 Introduction

This chapter discusses the most prominent matters concerning this study. It sheds light on concerns related to this research and contains eleven sections including the research background, the reason behind this study, previous related research studies, statement of the problem, research hypothesis, research questions, research objectives, research framework, scope of the research, research limitation and summary of the chapters.

1.2 The Research Background

Recent studies give the function a fundamental position in architecture. This theme has been addressed in several architectural texts, either by describing the functional dimension of buildings, or by prescribing design methods to solve and formally articulate it. This study attempts to understand the relationship between architectural ideas, design procedures and the ultimate realization of these ideas which architects and designers thought with in a form of spatial-functional systems.

Spatial configuration is the common theme of architects' and planners' interests. It represents the most consequential procedure among the influential factors of building design, particularly with regard to the function. Many studies and discussions have shed light on the dominant influence of the spatial configuration, highlighting the necessity of a multidisciplinary research amid the configuration of spatial-functional systems and design procedure (Hillier, et al., 1987a; Hillier & Hanson, 1988; Montiero, 1997; Major

et al., 1997; Amorim, 1999; Hillier, 1999; Orhun, 1999; Hanson, 2003; Kirsan, 2003; Guney, 2005; Bellal, 2007; Hillier, 2007; Kim & Lara, 2009).

This study focuses on how these ideas are embedded into the development of house layouts, by observing the functional effects of the spatial configuration on the efficiency of house layouts. It will take into account the configuration method of the interior domestic spaces as a general component in forming the house layout system. Moreover, it investigates the impact of spatial configuration on the functional efficiency of those layouts that may have changed over time.

Erbil city in Iraqi Kurdistan region is selected to be the case study because its unique local built environment, which represents a mix of traditional architecture and modern contemporary styles, reflects the reality of the situation of local architecture that complies with the approach of this research. Traditional and contemporary house layouts in Erbil city will be chosen to be analysed in terms of their morphological characteristics. The chosen period (1900s – 2010s) in this study is not coincidental, it has been adopted for analysis, due to the presence of both the styles and patterns of (traditional and modern) houses within this period, and this is not found in previous periods. Furthermore, up to now no study has focused on this issue. The study applies the theory of Space Syntax and its techniques through a licensed software programme to carry out the data collection. Analysis will be based on a comparison between the adopted house layouts in order to identify differences and similarities in their patterning. Ultimately, it provides architects and designers recommendations in a form

of design guidelines regarding house layout design for Erbil city, in terms of the function.

Application of Space Syntax theory in architectural design to interpret the spatial-functional structures provides a unique opportunity to research in this area. In this sense, syntactical analysis as a widespread field for architects and planners has a great share in already conducted researches (Jiang, et al., 2000; Peponis, 2001; Moreira, 2003; Manum, 2005; Zako, 2006; Sanli et al., 2007; Hillier, 2008, Bafna, et al., 2009). So far, the crucial effects of spatial configuration have been studied to diagnose the disorder in the spatial structures towards the specific aim, through impact of spatial configuration, particularly the syntactical and morphological characteristics of space on the degree of functional efficiency of house layouts, has not been proven yet.

1.3 The Reason behind this Study

This study addresses the functional efficiency of the house layouts, and thus it deals with the design of buildings as a whole. House design in terms of the function requires considerable priority to be studied; that residential buildings represent a wide sector of architecture. This needs to conduct further studies, addressing the functional dimension of these buildings. Noteworthy, contemporary designs in the city of Erbil do not pay much attention to function. Focusing on the formal side of the house led to disorder in the spatial-functional system of their layouts. In this sense, this study is an attempt to detect potential weaknesses in the efficiency of house layouts. For that, the research adopts an analytical and comparative approach in order to provide efficient solutions

that meet the changing requirements of contemporary life, without prejudicing the identity and privacy of the local community.

1.4 Previous Related Research Studies

Many studies have been dedicated by various researchers addressing the influence of the spatial configuration on the syntactical-functional structure of house layouts, in different societies, environments, and periods. Some of them are listed and debated briefly as follows:

1. Peponis (2001)

Peponis (2001) recommended that the architectural research require systematic theories (such as Space Syntax Theory) to describe regularities of form and its functions. He emphasized that the space should be treated as a relational system, in which the spatial patterns not only reproduce or accommodate patterns of behavior and social relationships, but also generate them. This study highlights the essential concept of the syntactic approach, assuming that the interior and exterior forms of spaces can be shaped according to certain cultural considerations and these forms in turn affect social relations, in one way or another.

2. Moreira (2003)

In his study of space according to Space Syntax Theory, Moreira (2003) illustrates that space can be understood as a relational situation. As such, this theory (Space Syntax) studies architectural space from a social viewpoint, establishing a method of

describing space in such a way as to make its social origins and consequences a part of that description, and create a link between morphological attributes of the space and the human expectations that must be satisfied.

3. Salheen (2003)

Salheen (2003) has pointed out that the functional features, carried by spaces within any system, are directly affected by the level of spatial configuration of the system in terms of spatial functional relations locally (the space itself) and comprehensively (the spatial system as a whole). The study clarifies the importance of the functional sustainability - inside building and at the urban level - to maintain the space in a high degree of efficiency within the system over time. Therefore, this would give the space a high degree of flexibility, qualifies it to accept different patterns of use which in turn leads to coincide with its surroundings.

3. Hanson (2003)

Hanson (2003) has introduced new, computer-based techniques designed to retrieve and interpret the social and symbolic information. She pointed out that the houses are not just assemblages of individual rooms but intricate patterns of organized space, governed by rules and conventions about the size and configuration of rooms in which domestic activities go together, how family members relate to one another in different spaces, and how and where guests should be received and entertained in the home. The various representations and measures show how domestic space provides a shared framework for everyday life, how social meanings are constructed in the home and how different sub-groups within society differentiate themselves through their patterns of

domestic space and lifestyles. In her study, Hanson explains that the spatial configuration in the domestic space is related to design of house and socio-cultural order. The study shows how domestic space can shape and embody social information, applying 'Space Syntax' a method for exploring large samples of house layout, to shed light on ordinary people's lifestyles and to test layouts at the design stage, particularly in terms of functional relationships.

5. Seo (2003)

Seo (2003) has described the transformation of the domestic code of house layouts in Seoul's city, Korea, to show that it is not simply the changing arrangement (configuring) of rooms but the interaction between the space and its activities within the domestic field, which can precisely define the space and give it its distinctive function. The study reveals that there is an indigenous concept of level-distinction, which was actively involved in the procedure of transformation. As well as, the evolution of housing in Seoul has been followed by certain topological paths to adapt the old genotypical properties regarding the function to the new built environment.

6. Dursun and Saglamer (2003)

Dursun and Saglamer (2003) have studied the transformation and changes occurred in different house layouts in the city of Trabzon in Turkey. They pointed out that there are some tendencies and rules in the organization of spaces created by cultural properties. The study recommended that the mathematical and graphical languages, like Space

Syntax, can be utilized as an effective tool to identify these rules, and contribute in giving a persuasive interpretation for those changes that may occur over time.

7. Manum (2005)

Manum (2005) has clarified that the space can be defined through the behavior and user's movement, and the nature of the effectiveness of space. According to his study, there are certain psychological formulas determined by the physical description of space within three main dimensions - as well as the time factor - contribute to give it another definition, such as guidance of a visual axis towards a certain point, or changing the locations of barriers and specific blocs of space, and this applies on both urban and architectural scales. Thus, when we change the use of space to another activity, this leads to the disintegration of space (decomposition of space), which then can be re-configured from inside - within its structure - and abroad - in its relations with neighboring - in a way that will reflect negatively or positively on the spatial-functional configuration of the system.

8. Guney (2005)

Guney (2005) has studied the organization of domestic space through a diachronic analysis of a sample consists of 108 apartment plans in Ankara, during the period (1920-2000). She identified spatial- functional patterns based on the syntactic data produced using convex space and j-graph analyses (Gamma analysis method). The study has applied the technique of a Difference Factor to measure the strength of the spatial genotypes in terms of the function. Additional measures have been introduced in

this study such as Space-Type analysis to define the shape properties of these patterns. In her study, Guney suggests that the apartment plans have been evolved in three phases in terms of sector differentiation, i.e. clustering of spaces based on functional and social requirements, and in relation to the exterior. The first phase can be described as the transitional phase from the design of the traditional houses to apartments, with a strong functional differentiation. The second phase designs, with weak boundary definition and higher values of "ringiness", have the highest degree of flexibility in space use. The last phase can be described as the modern apartment designs that have structures (layouts) carrying weak functional differentiation of spaces. Thus, the study sheds light on the functional dimension and the prospects for change and transformation of apartment plans over time.

9. Zako (2006)

Zako (2006) has addressed the changes and adjustments that may arise in residential spaces over time, through an investigation for the spatial configuration of courtyard houses in Baghdad city. The study demonstrated that the way of configuration reflects the social relationships between the people who inhabit the house and their visitors. This investigation has been carried out using Space Syntax both as a theoretical and analytical framework to analyse the spatial configuration of the courtyard houses in order to establish, confirm and clarify the underlying social structure that gave rise to this type of houses, thus linking the social and spatial orders together.

10. Çil (2007)

Çil (2007) has studied the transformation of the domestic space in Kula town in Turkey, from the late 18th century to the year 2007. The study focused on a theoretical point which is that the house is the physical framework of a household's everyday life, a manifestation of taste and identity, and a site of performance. The analysis of this study includes a comparison of the changes in the typological and syntactic qualities of those transformed spaces. Additionally, the study suggested the aspects that can be considered as fundamentals of transformation to understand the relationship between the space types and the social logic that are embedded in them.

11. Sanli et al., (2007)

In her study, Sanli (2007) has clarified that the houses are not only physical shelters for human beings, but also they are informative formations identifying a specific culture or lifestyle. Additionally, she suggests that, by the help of the analysis techniques of Space Syntax, abstract rules underlying spatial forms can be uncovered throughout analysing different house layouts in different periods.

12. Hillier (2007)

One of the architectural trends which linked the concept of sustainability and building function is the theory of Space Syntax, which includes series of researches and studies that have emerged in the unit of advanced architectural studies (UAAS), Bartlett's school of architecture in University College London (UCL). It was pioneered by professor (Bill Hillier) alongside a group of researchers, aimed within the basic

orientation to the analysis of different morphological patterns of buildings and cities. This theory has developed a method for describing and analysing the space to give it a comprehensive and clear definition and its relationship with the other neighboring spaces. In his theory, Hillier (2007) supposed that each built environment possesses genetic patterns (genotype) latent in their spatial-functional systems; and every physicist thing (phenotype) has a syntactic base that represents the specific rule for generating and forming possible and potential physical forms. The methodology of this theory and its techniques provides a possibility to explore the syntactic rules of space by two properties. The first is Symmetry - Asymmetry (this feature refers to the depth of spatial relations within the system); and the second, is Distributenddness - Non-distributenddness (which refers to the options of available ways for access to all spaces-flexibility and efficiency of the system functionally). Furthermore, this methodology, through the results of their applications, identifies important mechanisms to achieve continuity of space and lifetime, through raising its efficiency and performance degree at both levels of urban and architecture.

13. Bellal (2007)

Bellal (2007) has pointed out that the social events can be expressed according to the way of spatial configuration of the house layout. The topological structure of space is a fundamental mean by which society constitutes itself, and thus, the spatial patterns of buildings both embody and shape social patterns. In this context, the researcher refers that the hospitality towards visitors is one of the cultural and religious obligations, yet the spatial interface between visitors and inhabitants lies embedded in social and

religious norms, which regulate the penetration and receiving of visitors into the house. Bellal, through his study, has intended to explore and interpret the syntacticality of such socio-spatial relationship between the use and pattern of space by detecting the "depth property" from the entrance. The study highlights the significance of the entrance space and the transition zone in M'zab culture (Algeria), in regulating the interface between inhabitants and visitors.

14. Kim and Lara (2009)

Kim and Lara (2009) have investigated whether the spatial analysis of Korean apartment plans can explain certain changes in the apartment unit design in relation to socio-cultural trends. The study intended to analyse Korean apartment layouts from the 1990s to the 2000s, in order to clarify the characteristics of Korean apartment housing. Based on this analysis, the study revealed how spatial configuration is correlated to social implications; and how these spatial characteristics contributed to approach designing Korean apartment layouts.

In general, many of the above studies have focused on the spatial configurations and the functional relationships between house layout spaces in different societies and periods from the socio-cultural viewpoint. None of the studies mentioned above had studied, discussed or investigated in aspects related to the spatial configuration of house layouts in Erbil city. Consequently, this highly confirms the significance of this research.

1.5 Statement of the Problem

Spatial organization of functional layouts of houses plays a significant role in achieving the degree of spatial-functional efficiency which varies over time. So, any change in these systems leads to lack and weakness in the functional efficiency and the performance degree of these layouts.

One of the most important objectives of sustainable architecture is upgrading the performance and the efficiency of the interior spaces within buildings. Proper handling of the functional dimension of spaces (internal and external) for buildings and surrounding areas plays an influential role in continuity and sustainability of these spaces in its functions efficiently over time. However, these spaces, which may perform functions competently in a certain period, may lose their efficiency due to the change in patterns of activities or to diversion of a movement path between interior and exterior, private and public spaces, or changing the location of furniture and so on, which requires a functionally successful dealing with this issue. It should be noted that the spatial configurations of dwellings may be quite different in different periods, regions, cultures and societies. Societies establish an order on their living spaces and reflect their characters in these spaces. There is a strong relationship between the space and human relations. The differences in social systems lead to a morphological variety in dwelling layouts (Sungur & Çağdaş, 2003).

The previous studies showed that the human behavior is a powerful factor in formulating and directing the space organization. These studies revealed the existence

of a close relationship between the functional structures of house layouts with the social systems of building's occupants. Furthermore, these studies illustrate the transformation of house typology, and show the way of alteration to accommodate social, environmental, and economic changes.

Many of these studies proved that the analysis techniques of Space Syntax theory, supported by a wide range of knowledge, will contribute greatly in the formulation of spatial models in a concrete form. The techniques of this theory can be accepted as a useful tool for defining similar and different characteristics between different house layouts in different periods (Tucker, 2002; Dursun and Saglamer, 2003; Hanson, 2003; Guney, 2005; Bellal, 2007; Sanli et al., 2007; Manum, 2009).

Against the backdrop of the above scenario, the problem of research revolves on how to achieve sustainable architecture across an investigation of traditional and contemporary house layouts with respect to the function. How the impact of the spatial configuration on the functional efficiency of these layouts can be investigated and examined. To verify this relationship, the research depends on the idea of (Space Syntax) and its techniques, to detect the differences and similarities in the spatial-functional systems for these layouts. This paves the way to establish general rules and principles in a form of design guidelines concerning the house layouts in Erbil city, in terms of function (Hillier et al., 1987a, 1987b; Hillier & Hanson, 1988; Aspinall, 1993; Seo, 2003; Salheen, 2003; Zako, 2006; Hillier, 2007; Çil, 2007; Hillier, 2008).

1.6 Research Hypothesis

The research hypothesis is to test the argument that: functional efficiency of house layout is influenced by spatial configuration over time with reference to the period from 1900s to 2010 in Erbil city, Iraq.

1.7 Research Questions

The research will focus on five main questions, which are:

- What are significant characteristics/factors of spatial configuration which affect the functional efficiency of house layouts?
- How can the spatial configuration and functional efficiency being affected over time?
- Do the contemporary house layouts functionally incompetent?
- Do the traditional house layouts functionally competent?
- How can Space Syntax theory able to support the evaluation of spatial configuration and functional efficiency of house layouts?

1.8 Research Objectives

In order to translate the research into practical steps, the research purports to pursue the following objectives:

- To analyse the functional efficiency of the spatial configuration of house layouts.
- To evaluate the level of functional efficiency of house layouts from 1900 to 2010.

- To determine the spatial-functional inequalities in the configuration of house layouts over time.

1.9 Research Framework

To put forward recommendations in a form of design guidelines regarding the house layouts in Erbil city, the research framework of this study can be summarized and organized below in three parts namely (1) literature review, (2) research methodology, and (3) analysis as follows:

1. Part one: Literature review

The literature review follows the tendency set out below and will be implemented in five parts as follows:

i. At the outset, previous research and studies in similar contexts to the current research will be reviewed to shed light on the advantages and disadvantages of these studies in order to fill the knowledge gap.

ii. Afterwards, the definitions of keywords will be reviewed and then the contribution of spatial configuration will be indicated.

iii. Then, an overview of house layout evolution in Erbil city over the period 1900s to 2010s, in terms of their characteristics design will be clarified.

iv. The fourth part deals with the application of Space Syntax theory in architectural design regarding the house layouts design.

v. Finally, the syntactical characteristics of spatial configuration affecting the functional efficiency of house layouts will be identified.

Attaining this part of the research will pave the way in the next stage to start the process of syntactical analysis, applying Gamma analysis method.

2. Part two: Research work (Research methodology)

This part of the research will cover the following topics:

i. Materials and methods

ii. Variables and indicators of measurement

iii. Data collection

iv. Data processing

v. The case and the sample.

3. Part three: Analysis

Based on previous research and studies, this research applies a numerical representation of spatial configuration characteristics affecting the functional efficiency of house layout, utilizing the *A Graph* sofware programme (Gamma analysis method). *A Graph* is a package contains a number of tools created by "Space Syntax" limited for use in its academic research and consulting projects. Included in the current release are tools for computing integration and point depth on a variety of 'spatial objects', such as architectural layouts and urban systems. License for using this software programme has been obtained from the Bartlett School of Architecture, University College London (UCL), (see Appendix-B).

House layouts will be translated and represented by J-graphs for application in the *A Graph* programme. The outcome of this representation will be interpreted, discussed, and classified for the purpose of comparison, in order to identify similarities and differences in the spatial-functional patterning of these house layouts, access to set up recommendations in a form of design guidelines for house layout design in the city of Erbil (see Figure 1.1).

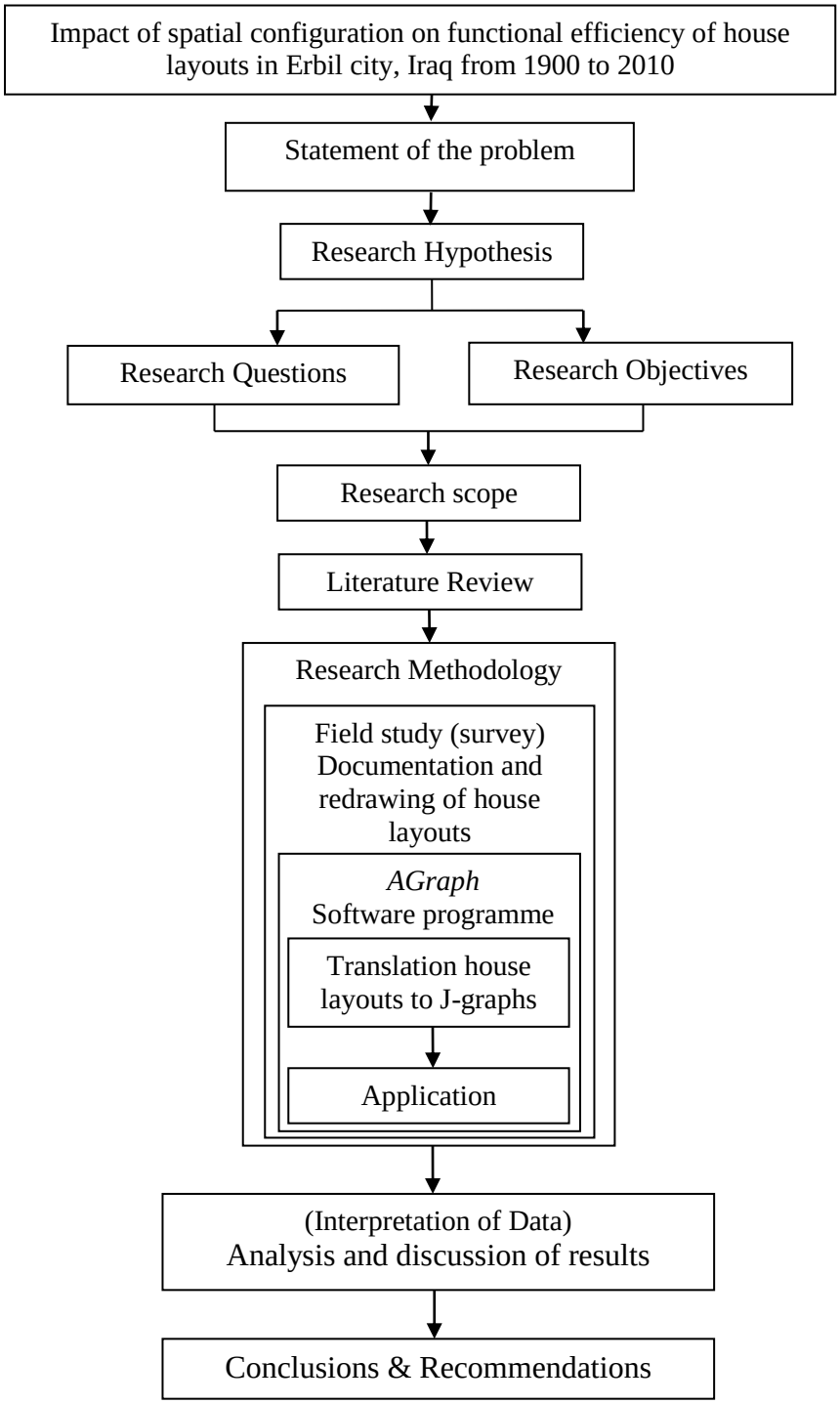

Figure 1.1 Research Framework

1.10 Scope of the Research

This research is to study the spatial configuration and functional efficiency in the field of architecture in general, covering the internal spaces of houses, in particular. As noted, the characteristics of the spatial configuration play a pivotal role in shaping and formulating these spaces in terms of functionality.

Therefore, it aims to assess the development of the spatial configuration to the functional efficiency of house layouts, in Erbil city, Iraq. Erbil city is selected as a case study because it offers distinctive cases due to its unique built environment, which represents a mix of traditional architecture and modern contemporary styles (Figure 1.2), which reflects the reality of the situation of local architecture. This study tackles the spatial configuration of house layouts as a common parameter for various aspects of design, especially in terms of the function. Accordingly, the research study will put forward recommendations regarding the house layout design in general and Erbil city, in particular.

Figure 1.2: Old part of Erbil city (left-traditional city), and the city recently (right-modern city). Source: Google earth (2009)

1.11 Research Limitation

This research is limited to the study of spatial configuration and the functional efficiency in the field of architecture in general, covering the layout of the residential buildings in particular. Due to the multiplicity and diversity of the aspects of efficiency, the study will be limited to deal with it in terms of functional-use efficiency of interior spaces of the house. As noted, the characteristics of the spatial configuration play a pivotal role in shaping and formulating these spaces in terms of functionality.

Therefore, the research focuses on the impact of those characteristics in the organization and arrangement of house layouts, particularly in the city of Erbil, for the period from 1900 to 2010. It should be pointed that raising such issues, holds a great importance in the field of architectural designs, in particular, the design of houses, which may change its spatial-functional structures over time. Hence, the research seeks to reveal the strengths and weaknesses of house layouts adopted and approved in the period mentioned above in order to achieve efficient design solutions to prolong the life of these layouts for the longest possible period of time without radical changes.

1.12 Summary of the Chapters

This research study is structured to six chapters as follows:

Chapter One: Introduction

Chapter one as the introduction of the thesis deals with the proposal of the research. This is organized in eleven parts in addition to an ensuing part discussing the structure

of the thesis (summary of chapters). The main sections covered by this chapter can be summarized as follows: the research background, the motive behind this study, previous related research studies, statement of the problem, research hypothesis, research questions, research objectives, research framework, scope of the research, research limitation and the summary of the chapters.

Chapter Two: Spatial Configuration and Functional Efficiency

This chapter provides relevant definitions of terms and key words used in this study, such as spatial configuration and functional efficiency of interior spaces. The first part of this chapter gives an introduction to the concept of architectural space through shedding light on architectural interior spaces, and design characteristics of interior spaces. The second part addresses the concept of spatial configuration in architecture, specifically, through discussing the main related themes such as the social dimension of spatial configuration, spatial configuration between theory and application, and the main factors affecting on the spatial configuration of the house. The third part describes the relationship between spatial configuration and functional efficiency of the house, which includes the concept of functionality of the house, and how to interpret the spatial-functional relationships of the house. The fourth part of the chapter illustrates the key syntactic characteristics of spaces related to the topic of spatial configuration and functional efficiency of interior spaces. Furthermore, the chapter presents how to classify the main spatial - functional sectors (zones) of the house.