

FACTORS CONTRIBUTING TO URBAN EXPANSION OF SHIRAZ CITY,
IRAN

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I would like to dedicate this thesis to my family, Reza, Khalil and Ali Akbar who have been great inspiration in completing this thesis.

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ABSTRACT

In recent years, urban expansion has become one of the crucial issues in modern cities. This affects natural resources and modifies urban built environments. In cities of developing countries, rapid urban population growth is an impetus to urban expansion. In turn, the need for land and housing to shelter this population as well as demand for social infrastructure has increased dramatically. Thus, the urban model is needed to solve developmental problems in cities. The issue in Shiraz City is that the city is faced with a scarcity of land. The current research is aimed at evaluating urban expansion so as to gain insight into factors generating the growth and its implication in Shiraz City. The quantitative research approach was adopted for the study. The questionnaire survey was used for data collection. The data were analyzed using Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Analytical Hierarchy Process (AHP). The results revealed four principal factors (environmental, sociocultural, economic and urban policy) as well as sixteen variables causing urban expansion in some parts of Shiraz City. The highest degree of variance is however accounted for by economic factor with a variance of 48.7%. The subsequent growth of the city gave rise to fourteen negative effects of urban expansion. Moreover, the research identified four criteria, twenty sub-criteria and two alternatives to be considered when constructing the AHP model. The results revealed that environmental criteria had the highest weight among the major criteria, while air pollution ranked first in the list of sub-criteria of the model. Finally, the developed model was successfully validated, ready for application and implementation. The model and information generated from this research are significant for mitigating the negative effects of urban expansion, so as to maximize the use of scarce urban land in Shiraz City.

ABSTRAK

Dalam kebelakangan ini, perkembangan bandar telah menjadi salah satu isu penting dalam bandar moden. Hal ini menjejaskan sumber asli dan mengubah persekitaran pembangunan bandar. Di bandar bagi negara yang membangun, pertumbuhan penduduk bandar yang pesat telah mendorong kepada perkembangan bandar. Oleh itu, tanah dan perumahan adalah perlu sebagai perlindungan kepada penduduk ini, serta permintaan untuk infrastruktur sosial telah meningkat secara mendadak. Maka, model bandar diperlukan untuk menyelesaikan permasalahan pembangunan di bandar. Matlamat kajian ini adalah untuk menilai perkembangan bandar bagi memahami faktor-faktor yang menjana kepada pertumbuhan dan implikasinya di bandar Shiraz. Pendekatan kajian kuantitatif telah digunakan bagi kajian ini. Kajian selidik dengan borang soal selidik digunakan untuk pengumpulan data. Data dianalisis menggunakan Analisis Eksploratori Faktor (EFA), Analisis Pemastian Faktor (CFA), dan Proses Analisis Hierarki (AHP). Keputusan mendedahkan empat faktor utama (persekitaran, sosio-budaya, ekonomi dan polisi bandar) serta enam belas pembolehubah menyebabkan perkembangan bandar di beberapa bahagian Shiraz City. Tahap varians menunjukkan faktor ekonomi adalah yang tertinggi iaitu varians sebanyak 48.7%. Pertumbuhan di bandar seterusnya memberikan empat belas kesan negatif perkembangan bandar. Malahan, kajian ini mengenalpasti empat kriteria, dua puluh sub kriteria dan dua alternatif untuk dipertimbang apabila membina model AHP. Hasil kajian menunjukkan kriteria alam sekitar mempunyai nilai pemberat yang paling tinggi antara kriteria utama, manakala pencemaran udara menduduki tempat pertama dalam senarai sub-kriteria model. Akhir sekali, model yang dibangunkan telah berjaya disahkan, sedia untuk diguna dan dilaksanakan. Model dan maklumat yang diperolehi daripada kajian ini adalah penting bagi mengurangkan kesan negatif perkembangan bandar untuk memaksimumkan penggunaan tanah bandar yang terhad di bandar Shiraz.

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LIST OF ACRONYMS AND SYMBOLS

A ₁	-	air pollution
A ₂	-	land slope
A ₃	-	groundwater level
A ₄	-	water or wall
A ₅	-	green pace
AHP	-	analytical hierarchical process
B ₁	-	population density
B ₂	-	car dependency
B ₃	-	residential density
B ₄	-	different income level
B ₅	-	access to facilities
BHCP	-	bottom hole circulation pressure
C ₁	-	land development
C ₂	-	land price
C ₃	-	expenditure on travel
C ₄	-	time spend on travel
C ₅	-	distance of CBD
CBD	-	central business district
CIAM	-	congress internationaux d'architecture moderne
CM	-	compact model
D ₁	-	physical barrier
D ₂	-	current road
D ₃	-	shortage of land
D ₄	-	mixed land se
D ₅	-	open space
E ₁	-	mountain
E ₁	-	reduce emission and greenhouse gases

E ₁	-	high level of surface water in the south and southeast
E ₂	-	air pollution in south and east
E ₂	-	lake
E ₂	-	lower consumption of fossil fuel
E ₃	-	high level of groundwater in the south
E ₃	-	better health
E ₄	-	less energy consumption
E ₅	-	less pollution
E ₆	-	convert less land to urban uses
E ₇	-	leaving more land in a natural condition
EC ₁	-	high cost of infrastructural construction
EC ₂	-	high cost of conservation and renewal
EC ₃	-	large subdivided lots
EC ₄	-	low density
EP	-	environmental Problem
GIS	-	geographic information system
HUD	-	housing and urban development
LM	-	linear model
NO _x	-	nitrogen oxides
HC	-	hydrocarbons
CO	-	carbon monoxide
O ₃	-	ozone
MARS	-	modern architectural research group
SPSS	-	statistical package for the social science
AMOS	-	analysis of moment structure
PC	-	principal components
PM	-	particulate matter
X ²	-	chi-square
df	-	degree of freedom
CMIN	-	chi-square value
GFI	-	goodness of fit
CFI	-	comparative fit index
TLI	-	tucker lewis index
RMSEA	-	root square error of approximation

EFA	-	exploratory factor analysis
CFA	-	confirmatory factor analysis
SEM	-	structural equation model
AVE	-	average variance extracted
CR	-	composite reliability
ASV	-	average shared variance
MSV	-	maximum shared variance
$C_i^{(k)}$	-	consistency measure for alternative
CR	-	consistency ratio
d	-	acceptable margin of error for proportion being estimated
$e_i^{(k)}$	-	criterion k, the priority weights
n	-	the sample size
N	-	population
n	-	the number of alternatives
(p)(q)	-	estimate of variance
RI	-	the appropriate random index
t	-	value for selected alpha level
μ	-	consistency index

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Urban growth, urban expansion and urban sprawl are sometimes used synonymously by the laymen. However, these constructs are quite different. Urban growth is a sum of increase in developed land. One of its forms is expansion (Bhatta, 2010). Urban expansion as a dynamic process of land use change is a complicated socioeconomic phenomenon. It may be linked to details related to topography, transportation, land use, social structure and economy, but it is generally related to demography and economy in a city (Li, *et al.*, 2003).

Li *et al.* (2003) stated that urban expansion was implemented in the area which is under the pressure of the population growth. This population growth has triggered the land use change of the natural, garden and agricultural land into urban land use. Such a change in land use is usually one way. Urban population and urban land deficiency are two important urban issues which are commonly have caused the transformation of non-urban land into urban land. Additionally, it has caused increase of urban areas and consequent decrease in area use for natural and agricultural activities. Li *et al.* (2013) has mentioned that urban expansion is one of the major reasons for numerous ecological and environmental problems in urban areas and the surrounding regions. Understanding the process of urban development and its driving factors is crucial for urban growth planning and management so as to mitigate the adverse impacts of such growth. Moreover, urban expansion is associated with socioeconomic problems such as urban congestion, unemployment and lack of public

services (Bloom *et al.*, 2008). In general, population and opportunities are the two most important elements for urban expansion. Population increase may lead to absolute need for space, but the actual increase of the urban area is determined by the economy development (Li, *et al.*, 2003).

Urban growth is typically driven by a variety of forces that relate to one another based on different spatial and temporal settings (Verburg *et al.*, 2004). Basically, the socioeconomic drivers comprise of demographic, social, economic, political, and institutional factors, together with processes such as population and its change, industrial structure and its change, and technology and technological change (Thapa and Murayama, 2010). Technological networks have become key elements in modern life and increasingly influence the urban built form. The expansion of modern city is to a large extent determined by the distribution network of physical urban infrastructure for the purpose of transportation, information and communication, energy, water supply and wastewater collection system. These infrastructures are placed in close proximity to common right of way and transportation corridors (Yigitcanlar, 2010).

Form and shape of the city is never static. Changes in cities form and shape have taken place throughout history, although not at an even rate. Cities and towns grew dramatically in the last half of the nineteenth century, a phenomenon related to industrialization (Spielvogel, 2009). Industrial revolution influenced the level of urbanization, the urban hierarchy, and the size and structure of cities (Caves, 2005). Decentralization is one of the physical expansions of an urban area and may involve expansion due to population growth as well as the redistribution of activities within the urban area (Goodall, 2011). Discontinuous expansion is another type of urban development even at densities comparable to existing settled areas, is costlier and less efficient than a more compact form of urban expansion. Much of the costs depend on maximum distances or maximum areas, and if these could be reduced by more continuous development, cost per units and per capita would be lower (Goodall, 2011).

Urban Land Economics during the first industrial revolution in the nineteenth century was associated with steam power, iron, coal and steel technology. But during

the second industrial revolution which began in the twentieth century, urban land economics was connected with electrical power, chemical developments and internal combustion engine innovation. The first industrial revolution experienced urban concentration. But the effect of second industrial revolution is felt in form of rural repopulation. This led to the emergence of new urban centers in rural areas. However, it is not a uniform occurrence in all rural places (Feldstein, 2009).

The theory of concentric zone generalizes the process and patterns of ecological change, based on struggle of different functions for the use of land. So, Burgess (1925) was the first American scholar to illustrate the typical processes of the expansion of the city by a series of concentric circles which he numbered to designate both the successive zones of urban extension and the types of areas differentiated in the process of urban expansion. His ideal construction representing the tendencies of any city to grow outward from its central business district consists of the loop of central business district, the transition zone of business, the zone of industrial workers' home, the zone of high class apartment building and the commuters' zone. Burgess's theory was based on the study of American cities, especially of Chicago, which were rapidly growing due to a high degree of technological development, with the accelerated human activities in the central business district which are located at the convergence of routes. This concentration of activities generated the process of urban expansion through invasion and succession and initiated the complementary process of decentralization.

Decentralization led to further physical growth, but was possible only with the expansion of technical services. Hoyt's sector theory was first proposed by Homer Hoyt in 1939, and held that, the different income groups of American cities tend to be located in distinct areas which could be thought of as sectors of a circle focusing on the central business district. Hoyt found that rent area in American cities tend to conform to a pattern of sectors rather than of concentric circles. The sector theory is however, not a complete alternative to that of Burgess. Hoyt confirmed his study by the growth pattern of residence of different grades of rent and did not closely examine the whole range of land use, as Burgess had done (Markandey and Anant, 2011).

1.2 Statement of the Problem

All cities in the world are confronted with one or another urban problem or urban issue. However, the scope of the problem is different from one to another. Urban expansion is significantly one of the most important changes which each city has experienced. These changes are highly associated with land resources, housing, transportation infrastructure, urban economic, urban rule and regulation. Therefore, urban models have been used to predict trends of urban expansion or future changes, to describe and evaluate impact of future developments, and to explore the potential effects of various policies. There are some advanced rules and regulations guiding urban expansion in developed countries. These rules are used for monitoring and serving as guideline for urban expansion. If strictly followed in developing countries, these rules would give rise to more expansion in some parts of the cities than others. Usually, adoption of these advance rules and regulations based on local plans in some cities creates some conflicts with the regional and national plans.

The major problem in Shiraz City is related to the urban expansion and deficiency of urban land. The urban expansion is continuing toward northwestern part of the city where the expanse of the land is generally unhindered. It is however, limited towards the northern, southern and eastern parts of the city by natural, physical and geographical features such as mountains and a lake. The natural physical mountains spread in a west-east orientation, while the lake is located in the eastern part of the city. These characteristics have influenced the creation of a linear urban expansion of the city. It is important to note that in many instances these problems cannot be overcome and consequently should be overlooked. Moreover, the existing physical barrier has led to shortage of urban land. In addition, the limited urban land has led to construction of low density buildings. It's make the issues relating to urban expansion and urban development of Shiraz makes very complex. On one hand, this complexity arises from the fact that some urban factors have accelerated the urban expansion toward the northwestern part of the city. On the other hand, during this time the urban expansion has created some acute problems for the city.

Another major problem is that the city is expanding sporadically in size and structure, and is increasingly becoming a more over concentration of clusters in one side of the city. This urban pattern of ongoing development is expanding with generally low residential density in the northwestern part of the city. Therefore, in relation to acute shortage of land in the entire city, this kind of development pattern has created negative effects in the environment; these include, air pollution, increase in travel-time and travel costs, and waste of land. Reducing these negative effects of urban expansion are essential needs in today's cities. Therefore, an appropriate urban development pattern would be proposed for effective delivery of a plan for future urban expansion of Shiraz City, in which these urban expansion problems are drastically reduced.

1.3. Research Aim

The study aim was to find factors contributing urban expansion and its negative effects of urban expansion in Shiraz.

1.3.1 Research Objective

1. To identify the factors that lead to urban expansion in special parts of the city.
2. To evaluate the negative effects of this expansion.
3. To develop a model for mitigating the negative effects on urban expansion.

1.3.2 Research Question

1. What are the factors that lead to urban expansion in special parts of the city?
2. What are the negative effects of this expansion?
3. How can these negative effects be reduced?

1.4 Significance of the Research

In recent times, the complexity of urban expansion and urban development issues have arising based on land resources, residents' requirements, environmental and socio-economic aspects in the developing country of Iran. Most of Iranian cities would be faced with urban expansion issues especially those cities which are grappling with physical topographical limitations. Urban expansion is one of the most challenging issues for Shiraz City, where it takes place due to socio-economic growth with inappropriate planning for urban expansion. This urban expansion takes place as a strip between mountains and a road towards the northwestern part of the city. The urban expansion has shaped a few neighbourhoods in the northwestern part of the city. Consequently, this urban expansion is not based on comprehensive plan, but on requirements of a few urban organizations that have granted land to their employees.

A large number of previous studies have paid attention to urban expansion against which urban models were proposed to control and guide it. It is within this context that, most of the urban problems, including rapid population growth and shortage of land resources in developing cities like Shiraz has been similar. Therefore, some researchers such as Soria Y Mata and MARS group (Modern Architectural Research) suggested linear urban expansion to solve city congestion and air pollution. Moreover, Howard, (1899) proposed the Garden City concept to solve the problem that is caused by the industrial revolution. In addition, Burgess (1925) also proposed the concentric zone model to represent a city with different rings.

Shiraz city is not expanding based on modern linear development pattern, but based on an unplanned urban pattern. It is therefore significant for this research to find out what urban factors have accelerated the urban expansion towards the northwestern part of the city. The causes of growth in urban areas and those factors that are responsible for undesirable growth pattern or process of urban expansion are fundamentally important for the analysis of urban growth. Therefore, the consequence and significance of the current urban expansion, whether positive or negative, are investigated based on their outcomes in the city. There are some facts that show the

negative impacts of urban expansion including air pollution, increase travel time and cost. In addition, the scarcity of land has constructed by low density.

1.5 Scope of Research

The study has focus on the urban expansion and urban development of the northwestern part of Shiraz City. It begins from a theoretical review of the existing urban models and the constituent elements of urban development. At the same time, recent trends, direction and location of researches in urban development are characterized in this study. It is against this backdrop that the spatial structure and environmental limitations of urban development in Shiraz City would be explored, since, the intention of this study is to establish the relationship between environment and socio-economy on one hand, and urban development on the other hand. The scope of this study is defined as the northwestern part of the city which is consisting of five residential neighbourhoods. This area is the newest developed part of the city which has not experienced special changes like other parts of the city in terms of density and congestion of urban form. The speed of urban expansion in this part of the city is very high in comparison with other parts of the city because this is no constraint to physical development as observed in other parts of the city. While the site location of the city played a significance role in urban growth and development of northwestern part of the city.

In relation to urban expansion and urban growth, the study would investigate the two main problems of the city: the first one related to natural physical barriers to urban development (mountains and the Maharloo Lake), and the second one related to shortage of urban land. Initially, urban development in the northwestern part of the city mostly took place adjacent to main road ‘corridor.’ Hence, the most important element of the city’s urban development is transportation infrastructure and residential land use. By reviewing the urban spatial structure of Shiraz City, analysis of urban models would be developed. The linear model is the current status of the city form while the compact model is the developed by Analytical Hierarchical Process (AHP). Both the linear and compact models are applied to evaluate the urban development of

the northwestern part of the city. Moreover, Super Decision software was applied to calculate the priority and rank of the urban model. Consequently, Urban Compact Model is preferred for the future development of Shiraz City.

1.6 Conceptual Framework

A city is a combination of many integrated elements and complex sub-systems which represent themselves through the shape of a complex settlement. Population and technology are two main items which influence urban expansion. However, when city population increases, there is a need for city expansion. In fact, when industrialization and advent of modern transportation increases in Shiraz City, it leads to destroying old walls which surrounds the city and as a consequence city expansion. Any effort to control or modify the urban expansion, therefore, will affect these systems. Alternatively, these system changes also affect the trend of urban expansion. Although the effect of different parameters on urban expansion may not be equal, it is important to know the relationship among these influential parameters and urban expansion.

Historically, the cities were developed due to growing of urban population (EEA, 2006). The city is expanded in different forms. However, it can be divided in two main development categories: continuous urban expansion and discontinuous urban expansion. So that, these urban expansions, during the time, can produce different in size, use, shape and density.

Until a few decades ago, main road and mass transportation from city center toward out of the city encouraged urban expansion alongside of main urban road and also peripheral expansion of urban areas. The difference made by transportation; not only allowed the urban expansion, but also legalized high concentration of people and activity to expand (Hall and Pfeiffer, 2000). The development of the modern city can be driven by a variety of other powerful factors, including individual housing preferences, commercial investment decisions, increased mobility, and effectiveness of land use policies in the urban area (EEA, 2006). In the recent decades, the processes

of controlling and managing the pattern of urban land use have been the matter of experiment, with the anxiety of government with urban dilemmas, the development of metropolitan planning, and the acceptance of different character of regulation such as zoning and subdivision (Bengston *et al.*, 2004; Karolien *et al.*, 2012).

Cities are generally known to be a living system. This system is very complex, consisting of aspects which are; environmental, economic, social, cultural, and policies related. City under the population growth pressure started to develop and expand toward border and fringe. Generally, this kind of expansion can be classified into categories including discontinuous and continuous expansion. It is naturally that during this expansion, city will face different urban problems. Thus, a few urban models, including the garden city, linear city, concentric theory, sector theory, multiple nuclei, and compact model, have been proposed as solutions to the problems.

Linear expansion of Shiraz City is an outcome of two major elements encompassing population growth and limitation of physical topography. Moreover, some urban elements such as economic, social, environmental, cultural and urban policy influence the expansion toward northwestern part of the city. In this area, density, land use, transportation and layout are the most important urban forms which contribute to linear expansion. Currently, this expansion has created some urban problems consisting of air pollution, travel cost and travel distance. Furthermore, the city envisages urban land scarcity. It is therefore critical to find effective ways to solve, or at least, to reduce these urban problem – in line with this, Figure 1.1 delineates the attempt by this research to achieve this goal.

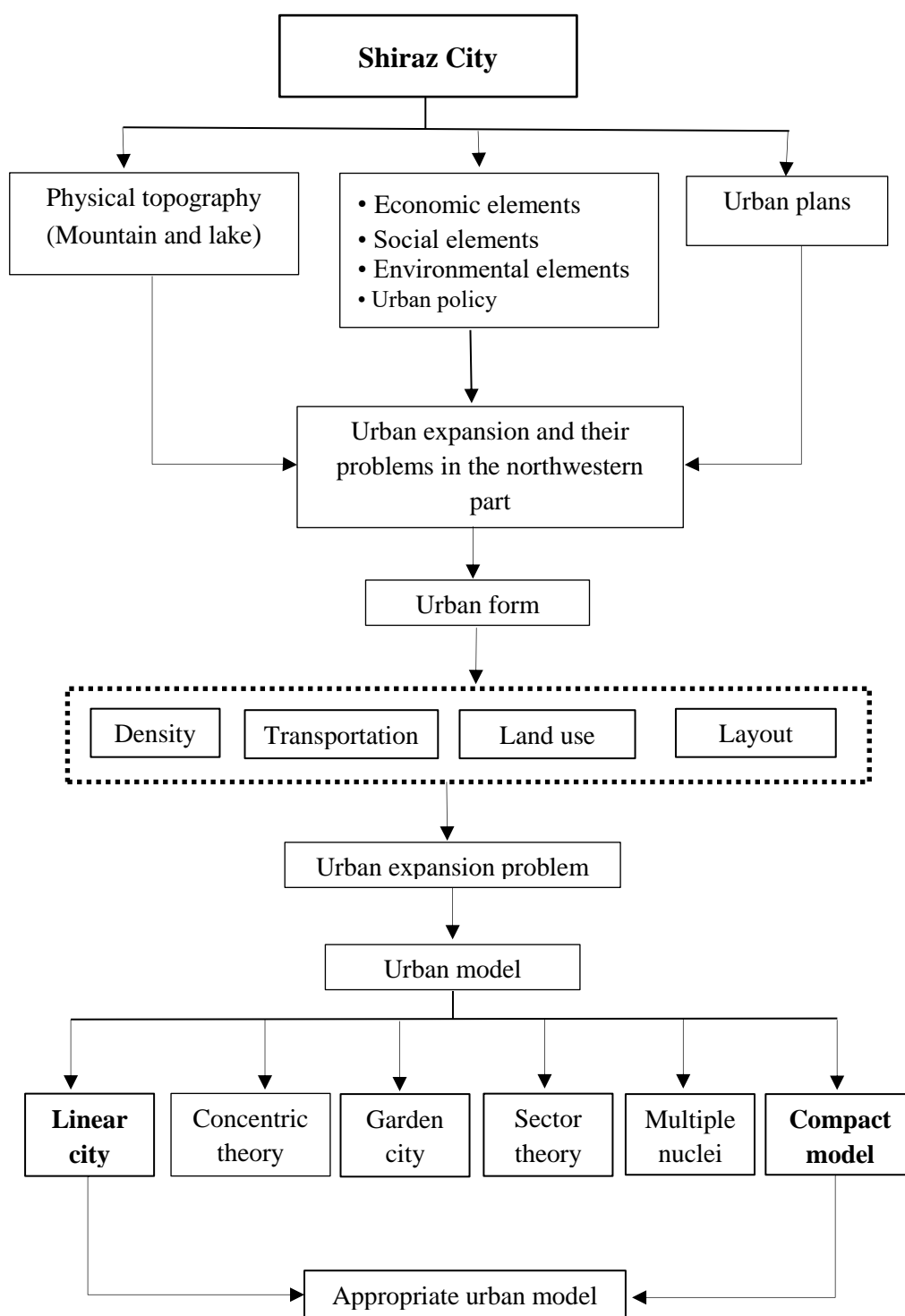


Figure 1.1 Conceptual Frameworks of Shiraz's Urban Expansion

1.7 Thesis Outlines

The organization of this thesis is as follows. This thesis is organized into seven chapters.

Chapter 1 provides a background of study, statement of problem, research aim, research question, research objective, significance of the research and scope.

Chapter 2 introduces a brief history of urban expansion potentials, urban form and some related issues, such as elements of urban form. It also concentrates on the literature review of conventional theories and models in urban planning that are associated to urban form and physical development of the city. These models and theories consist of Ebenezer Howard's, Garden City, Soria Y Mata's linear city and compact model.

Chapter 3 investigates the process of urban expansion in the northwestern part of Shiraz City. The city includes two parts, the first one is related to the old part which is the outcome of Iranian civilization and cultural development, and the second part which is the modern part and it is shaping according to the new urban plans that are coming from abroad. With the entrance to the process of globalization by the oil resources which has contributed to the increase urbanization, the city structure was changed to more modern style. Approval of the economic plans have influenced on the process of urban expansion. The potential of the area that influenced urban expansion were discussed.

Chapter 4 introduces the methodology used in this research. Exploratory Factor Analysis (EFA) is used to extract factors which have affected urban expansion and confirmatory factor (CFA) analysis is used to measurement these factors. Questionnaire and observation are methods which are used for data collection. Moreover, Analytical Hierarchy Process (AHP) method is used to select the best urban model to reduce the negative effect of urban expansion.

Chapter 5 presents data analysis and result in the study. Exploratory Factor Analysis (EFA) is used to extract significant factor and Confirmatory Factor Analysis (CFA) is used to measurement the factors that has influenced urban expansion. The result and discussion of Analytical Hierarchy Process (AHP) is also explained in the chapter.

Chapter 6 presents discussion on factors and variables which influenced urban expansion. The estimated covariance among factors are discussed. The importance of urban factors influenced urban expansion and the negative effects which is resulted from the urban expansion due to beta coefficient, factor loading and estimated covariance of the measurement model has been discussed.

Chapter 7 summarizes the findings, limitation of the research, and proposes a future research on compact development (see Figure 1.2).

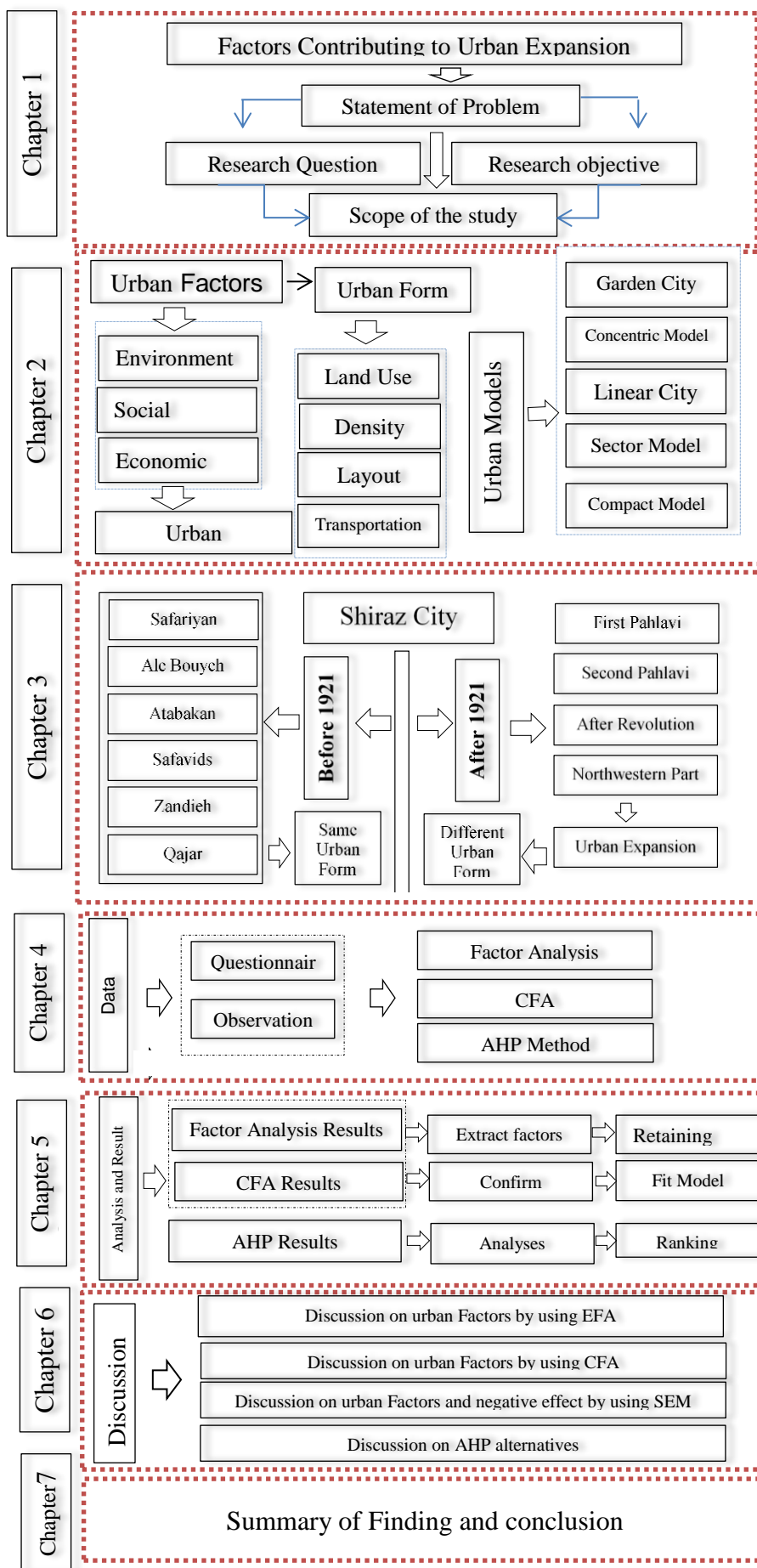


Figure 1.2 Diagram of Thesis Outline

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