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## Article

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# Does urban mixed use development approach explain spatial analysis of inner city decay?

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## ABSTRACT

Generally speaking, population and activities have long been associated with central part of cities. This pattern with its special structure has exemplified itself in specific functional patterns followed by accommodation of mix urban land uses. Residences could recreate as well as having civilized interactions. It is been argued that the historical trend pertaining to moving away or abandoning inner city activities toward periphery followed by formation of sprawl development as well as changes in central city land uses have great impact upon urban areas status. It may result in social, economic and physical urban deterioration and decay. From urban planning policies and systems standpoints, inner city decay is associated with urban land use zoning as well as geometric typology pertaining to rationalism philosophy and modernism planning. It is argued that social, economic and physical properties associated with urban land uses including the existence of pedestrian areas, varied land uses and social spaces no longer apply to central part of the city taking into account this type of philosophy. This study deals with the central part of Shiraz. It aims to explain the relationship between urban developments based on mix used development and degree of urban deterioration and decay as opposed to urban efficiency. It further identifies indices and components associated with the spatial analysis of inner city decay as opposed to urban land uses efficiency. The methodological procedure of this study is based on functional spatial analysis using new urbanism paradigm with particular emphasis on urban mixed land uses. This Study suggests that there exist a negative linear relationship between urban land uses located in central Part of Shiraz and degree of inner city deterioration and decay level. It further suggests that urban inner city decay in Shiraz follows a specific spatial behavior both at district and neighborhood levels.

## 1. Introduction

Urban areas are experiencing great changes regarding the location and function of land uses especially in inner city centers. This situation is affiliated with Siam conference and its relevant agenda with particular emphasis on urban functionality. This led to a zoning of prime functions that is place of residence, work, recreation and urban transportation (Rahman, Alam, & Sirajul, 2008:4; Abaaszadegan & Razavi, 1985). It is argued that moving away businesses as well as efficient households from intercity due to

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functionality prescription may pave the way for creation of inner city decay namely social, economic and physical ones, since mixed land uses are responsible for the very dynamic urban atmosphere. This in turn, will lead to deprivation and existence of unemployment, low skilled labor force, low quality of dwellings, social poverty and delinquency in central part of cities (Yalcinta, 2008:13; Couch, Fraser, & Percy, 2003; Eldesberg, 1999:7). Urban development based on rationalism advice and modernism planning caused that those social, economic and physical properties including the existence of live social spaces, pedestrian areas and shopping centers as well as variation in land uses resulted from application of urban mixed uses no longer applies to central part of cities. Instead, large and disintegrated peripheral zone developed (Dobbins, 2009:5; Bell, 2004:6).

Beginning in 1921, Iran to some extent is affected by this phenomenon. Its manifestation could be seen in spatial and physical aspects of cities. This type of imbalanced developments could not conform to the origin, spirits and essence of Iranian cities (Habibi, 2006:205). The central part of present Iranian cities do not possess appropriate urban land uses which already had. The historical trend of urban development at some point did not follow its dynamic and vitality associated with central part of cities. In other words, the physical spatial foundations of traditional Iranian cities associated with urban land uses do not confirm with new social and economic needs of population. Thus, inner city instead of being revitalized became deteriorated. In effect, ignoring mixed uses may be responsible for problems such as poor quality of dwellings in Shiraz. In addition, extensive physical deterioration, low income potential and lack of live, social life are among other urban problems. This is associated with lack of mixed land uses which is tied to dynamic urban neighborhoods. In addition, the existence of genuine and skilled population capable of generating wealth this responsible for revitalized and live central city from physical and functional standpoints.

Shiraz population located in central part continuously declined between 1956 and 2016. It experienced -1 percent growth rate and both in and out migration. Taking a brief look at migration data during the study period reveals that only 25 to 30 percent of the population resides in a city has local origin. During this period of time 70 percent of local and genuine population left central part of the city. In addition, economic characteristics of inner city residences is associated with changes in variation and combination of land uses and its consequent impacts upon urban deterioration and decay level. The size of holdings is predominantly between 100- to 200 m<sup>2</sup> (Pardaraz consultancy, 2010). This corresponds to 27.8 percent of the total area. Buildings located in the study area simultaneously possess both historical and architectural values. However, there exist little resemblance between quality of the building and their foundations compares with standard of present buildings. Furthermore, the type of the buildings and their restrictions regarding their maintenance accelerate the rate of inner city decay and deterioration in the study area.

There exist some similarities between shape and magnitude of inner city decay of most of world metropolitan and Shiraz. However, ecological, sub cultural and political economy approaches associated with inner city decay are very far from the reality of Iranian cities. That is, those approaches are incapable of spatially analyzing this phenomenon regarding Iranian cities. Chicago School of thought which is predominantly based on physical environment treats inner city as a physical area grown out of central city part. It could be argued that this school of thought predominantly is based on capitalism system prevails in the USA (Piran, 1980). This school of thought possesses some theoretical and experimental limitations for applying to non-American cities. In fact, spatial analysis related to inner city decay of Iranian cities demands the application of other new approach best suited to their characteristics. It is argued that mixed land uses responsible for cities dynamics, liveliness and vitality could well be applied to inner city economic and social decay resulted from application of urban zoning. Central part of the cities with their traditional settings prior to these contemporary interventions have benefited from mixed urban uses and its consequence social, economic and functional liveliness, dynamic and vitality. In short, it possessed genuine urban life characteristics. It may be argued that there is a relationship between changes in urban land use pattern and the emergence and magnitude of urban decay and deterioration as opposed to urban land use efficiency. This will lead us to the major research question that is the relationship between changes in urban land uses pattern and inner city decay process going on in the central part of cities.

## 2. Theory and literature review

Increasing the rate of urbanization from one hand, and incapability of urban modernism approach regarding the achievement of social and economic welfare has led to application of mixed use development. The goal of this type of development is the coexistence of complimentary urban land uses. The outlook of this type of development is very promising. It may be considered as a very powerful and structural approach suitable for urban development. This approach is associated with healthy economy cycle and its subsequent revenues in urban neighborhoods. This type of development plan aims to stimulate common and cumulative sense among the residences. They try to make them understood that they as the residence are smart enough regarding the generation of job opportunities. In fact, plans relate to this type of development help them in this regard. Mixed use development approach generated out of new urbanism, sustainable developments and smart growth approaches (Rabianski, Sherwood Clements (2007); Stead & Hoppenbrouwer, 2004). In Europe this type of development is considered as a part of urban renaissance (Stead & Hoppenbrouwer, 2004) and compact city approach (Breheny, 1992). However, in the United States it is being treated as a part of new urbanism approach (Furuseth, 1997; Gyourko & Rybezynski, 2000). Since mixed land uses is dealing with environmental, social, institutional and planning aspects therefore it is being considered as a good option for creating livable, attractive and sustainable urban atmosphere. This type of urban development pattern is pretty flexible regarding different urban areas. From contextual and functional standpoints it is composed of four dimensions that are: share premises, horizontal, vertical and periodical dimensions. This type of development predominantly deals with the prime and basic urban land uses and is capable of creating very thriving urban land uses. Their major objective is to promote social welfare as well as urban health. These objectives are obtainable through closeness of place of residence to place of work and elimination of urban mono functionality (Witherspoon, Abbott, & Gladstone, 1976). It could be argued that mixed land uses pattern is being considered as a very pleasant strategy regarding the regularity of physical spaces needed

for the betterment of the societies. The primary objective of this type of development pattern deals with changes in present urban growth pattern (Downs, 2005). This in turn is associated with sustainable urban development form and good urban governance and their subsequent economic, social and justice and environmental specifications (Grant, 2003). A good way of achieving that pleasant environment is through application of mixed use development namely associated with creation of pedestrian area and public transit support all tied with sustainable and smart urban growth ideology (Schwanke, 2003; Cervero, 1988; Cervero, 1996).

Western urban planning school of thoughts believes in two prime reasons associated with the application of mixed use development (Coupland, 1996):

- Reduction of interurban trips due to the existence of all of the needed activities and services in one locality that is less dependency upon car and great opportunities of public transit.
- The creation of live, healthy and attractive life as well as urban land use variation in central part of cities.

### 2.1. Theoretical framework of mixed use development

Taking into consideration Jacobs attempt and more specifically publication of her book entitled “Death and life of Great American cities” in 1961 created lots of critics regarding zoning of urban activities. The major critics was dealt with the prevalence of Sprawl development, lack of liveliness and functional segregation of land uses (Angotti, Hanhardt (2001); Grant, 2002; Hoppenbrouwer & LOUW (2005); Hirt, 2007). According to Jacobs’s writing, balanced combination of place of residence, workplace, services and activities will create a safe and livable social urban space. She believes in differences between primary land uses and secondary ones regarding purpose of combination (Hoppenbrouwer & LOUW (2005); Hirt, 2007). To her primary land use corresponds with residential one capable of gathering many active and energetic people together. Residential land use demands the existence of secondary uses including shops, restaurants, bars and other small businesses adjacent to place of their residence. Movement associated with the interaction of people and activities during different hours will lead to many tidal live movements in urban space. From Jacob’s point of view (Jacob, 1964) this in turn will lead to better distribution of demands during a day. It is argued that in urban development based on zoning just one type of land-use is being utilized. However, in mixed use development there exist more functional variations with respect to land uses. Mixed-use development is basically concerned with planning issue. In other word, more attention is being devoted to social, economic and functional aspects of urban land uses (Talen and Knaap, 2003). Urban theoreticians believe that mixed use development is being considered as a very prominent component of urban development paradigm comparing with smart growth, new urbanism and sustainable urban development paradigms (Downs, 2001; Hirt, 2007).

### 2.2. The dimensions of mixed use development approach

Rowley argued that functionally speaking the implementation of mixed use development could take place at different levels including building, blocks, neighborhood and even the entire city. This in turn, is associated with share premises, horizontal, vertical and periodical dimensions. Rowley model basically emphasizes residential and commercial typology capable of converting into other uses (Hoppenbrouwer & LOUW (2005)). He further added spatial scale to his model. Rowley believes that there is a difference between buildings, blocks, edges of street and neighborhoods. Moreover, there exist differences between metropolitan, interurban districts, small towns, suburbs and green fields dealing with mixed use approach. Rowley believes in an appropriate density regarding both different land uses and number of residence in order to guarantee live and active life (Rowley, 1996). To him key properties include size of the holdings and their penetration potential and permeability level.

He further added spatial scale to his methodological procedures and made a difference between buildings, blocks, street edges, districts and urban networks. The four areas in which mixed use could be implemented include central part of city, urban regional centers, suburban and peripheral zones and green fields located at the peripheries. However, they are different in terms of mixed land uses capabilities and potentials. From functional stand point those varied urban functions are capable of locating in some other areas as well (Rodenburg, Vreeker, and Nijkamp (2003)). As already mentioned mixed use development from functional standpoint is associated with share premise, horizontal, vertical and periodical dimensions. These are helpful for understanding of mixed use development (Hoppenbrouwer & LOUW (2005)). The combination of land uses may be affected by some other conditions as well (Rodenburg, 2005). Share dimension is associated with multipurpose functions all in one dwelling unit. It means that people may simultaneously reside and work in one building (Fig. 1).

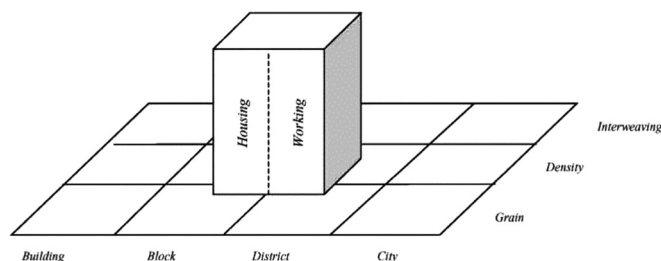


Fig. 1. Conceptual model of share premises dimension (Hoppenbrouwer & LOUW (2005)).

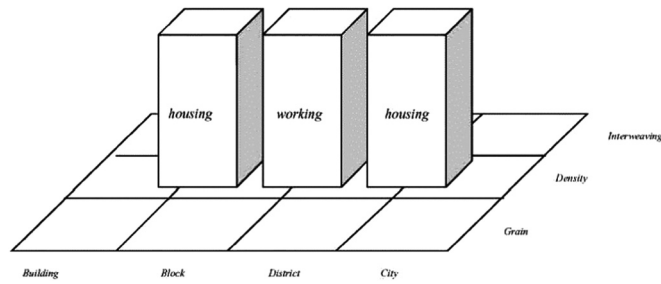


Fig. 2. Conceptual model of horizontal dimension (Hoppenbrouwer & LOUW (2005)).

The determination of share of each land uses is not an easy task. It follows the following relationship (Yinan & Chen, 2009):

$$a_1 = a_2 = a_3$$

$$F = a_1 f_1 + a_2 f_2 + a_3 f_3$$

Rowley believes in combination of functions located next to each other thing that Hoppenbrouwer and Louw called it horizontal dimension (Hoppenbrouwer & LOUW (2005)). In this dimension, Rowley's model provides a good basis for conceptualizing horizontal mixed-use development that primarily focuses on one particular mixed-use between buildings on the flat surface. This dimension is based on the assessment of variation in functions located in urban blocks or districts. With regard to this evaluation each block is subdivided into three separate and smaller homogeneous occupied spaces (Fig. 2).

This will lead to the following equation (Yinan & Chen, 2009):

$$F = \frac{Q}{S} = \frac{Q}{s_1 + s_2 + s_3} = \frac{Q}{\frac{Q_1 a_1}{f_1} + \frac{Q_2 a_2}{f_2} + \frac{Q_3 a_3}{f_3}} = \frac{1}{\frac{a_1}{f_1} + \frac{a_2}{f_2} + \frac{a_3}{f_3}}$$

Couple stories buildings accommodate multi functions which are vertically combined to each other and represent distinct land uses. This represents Vertical dimension of mixed use development (Atkins, 2005:12) (Fig. 3).

According to Rowley these buildings at the lowest level represents two land uses that is residential and commercial. At the other extreme they are associated with shopping centers, parking entertainment complexes, office buildings and dwellings. Due to shortage of land as well as high land prices in central part of cities, vertical land uses are predominantly associated with central part of cities. The planned repetition of vertical dimension of land uses will lead to nice and pleasant spatial arrangement in central part of cities. This type of pattern in combination with high population density corresponding with provision of ample job opportunities make these central part very fascinating (Gose, 2004). At past, vertical development of inner city had so much resemblance with military forts (Robertson, 1995). Nowadays, they have been converted into very live and active urban spaces which vertically accommodate offices, hotels, retail stores, services and entertainment facilities (Gose, 2004). However, we should not overlook the height restoration in these areas. This will lead to the following equation (Yinan & Chen, 2009):

$$F = K \frac{Q}{S} = K \frac{Q(a_1 + a_2 + a_3)}{S} = K \left( \frac{Q_1 a_1}{S} + \frac{Q_2 a_2}{S} + \frac{Q_3 a_3}{S} \right) = K (f_1 + f_2 + f_3)$$

The last dimension of Rowley model is associated with periodical one (Hoppenbrouwer & LOUW (2005)) (Fig. 4).

That is multiple functions are being conducted at different time period within one building. For instance, one uncovered public parking could be devoted to selling low income households products during the same time period. Hoppenbrouwer & LOUW (2005)

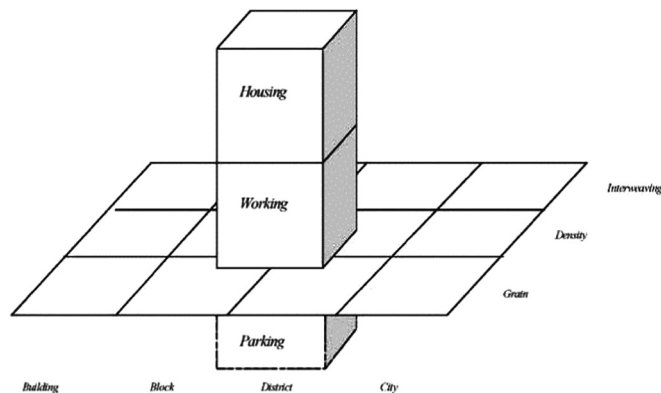


Fig. 3. Conceptual model of vertical dimension (Hoppenbrouwer & LOUW (2005)).

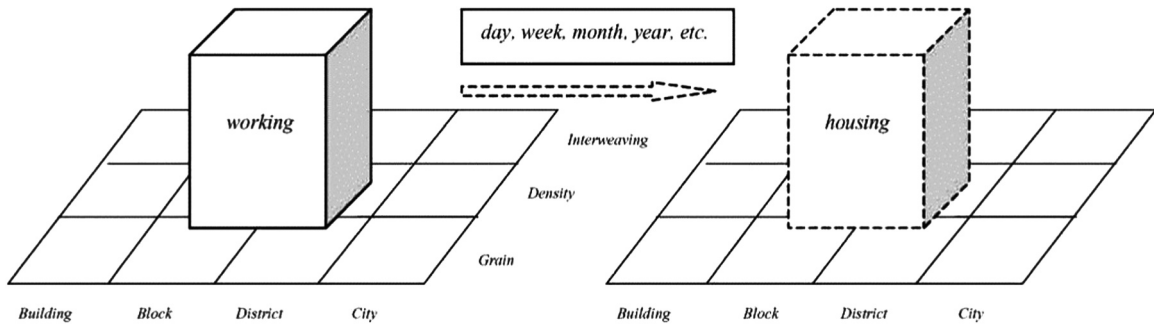


Fig. 4. Conceptual model of periodical dimension (Hoppenbrouwer & LOUW (2005)).

believe that Rowley did not fully deal with this dimension. It is suggested that the degree of concentration of development based on floor area ratio and associated time period of each function should be evaluated as well (Yinan & Chen, 2009).

### 2.3. The emergence of inner city decay and its associated spatial analysis

Inner city decay is being considered as a sociological process. That is city center is experiencing changes, depopulation, economic reconstruction, abandon buildings, high level of unemployment, disintegrated and diverse households, high level of crime and urban delinquency and unpleasant environment (Seifoldini, 2011). Moreover, shortage of dwellings, high drug and alcohol uses, and other problems make population fled from central part of cities which in turn would accelerate the level of inner city decay and deterioration (Bright, 2001). This in turn will lead to low level of investment needed for maintaining urban infrastructures and public services all responsible for physical deterioration of this part of the city. This is associated with lack of support regarding commercial and retail sectors located in central part of the cities. Researchers in this area believe in four main approaches that is ecological, sub-cultural, political economy and combination of all for understanding the spatial analysis of urban decay (Ding & Knaap, 2002). This approach each represents different measures and indices regarding this urban phenomenon. This type of study predominantly conducted in western spaces namely American cities. However, social, economic changes and transformations associated with Iranian cities as well as the existence of exterior factors impinge upon this urban phenomenon as well. Thus, it is argued that prevailing approaches regarding the spatial analysis of this changes and transitions, that is ecological, sub-cultural, political economy and combination of all represent some incapability. This is associated with social, economic settings of traditional cities. In effect, those approaches are not suited to traditional cities. One may argue that the application of mixed use development is appreciable. This approach in terms of principle is well suited to Iranian Islamic cities. It is argued that there is a relationship between functional physical changes of city center taking into consideration different land uses and Shiraz 'rate of inner city decay. Thus, the application of mixed use development is best suited for the analysis of spatial behavior of inner city decay and deterioration.

### 3. Materials and method

Shiraz comprised of 10 urban zones. Study area correspond to zone 8 with the area of 377 acres (2.5% of total city area). From historical and traditional standpoints central part of Shiraz Composes of 12 traditional districts accommodated varied land uses. Population changes during 1996–2006 suggests that population of central part of Shiraz plummeted from 675 85 in 1996 to 56445 in 2006. It means that during this decade 11140 moved away from this part of the city. Taking into consideration the application of mixed use development approach and its relationship with the degree of inner city decay this study possesses theoretical applied nature. The method of this study is based on functional spatial analysis of central part of Shiraz using new urbanism with its prominent principle that is mixed use development. Based on new urbanism paradigm, urban physical development should gear toward internalizing development process. This could facilitate physical reorganization of urban environment and the revitalization of the central part. This study aims to investigate Shiraz 'degree of inner city decay from mixed use development standpoint. Date analysis is based on spatial scales pertaining to Rowley conceptual, functional model as well as the extended Yinan & Chen model. This in turn demands application of technical and statistical methods including spatial analysis, data overlying technique, network analysis, analytical hierarchical process, Chi square test, regression correlation and the analysis of variation.

Exploration of mixed use development pattern and its relationship with degree of Shiraz's inner city decay predominantly demands application of combination of Rowley conceptual model and intensity zoning control model of Yinan and Chen. This in turn, lead to a real extent and zoning of inner city decay as opposed to locational efficiency of urban land uses. This model is capable of determining causal relationships between mixed uses and degree of inner city decay against urban land use efficiencies.

The analysis process comprises of the following:

- The investigation of mixed uses dimensions in the study area;
- Determination of areal extent or zoning regarding the intensity of land use efficiency based on mixed use;
- The identification of relationship between urban land use efficiency and the existence of mixed use development pattern;



The study domain of mixed land uses and inner-city decay are different. Therefore, one of the challenges pertaining to this study is to find a model capable of extracting the relationship between the phenomena of inner city decay and mixed use development. Attempts in this line of inquiry led to the selection of evaluation method regarding locational strength of the urban land uses. This method is based on micro economy theories since they deal with areal extent regarding the intensity and strength of urban land uses (Yinan & Chen, 2009). This model is well applied to those areas which accommodate mixed land uses especially the new ones. It tries to find out whether mixed land use pattern is an effective measure or not. It determines the areal extent of both strength and weakness of land uses regarding well designed and pleasant spatial structure. The major objective of mixed land uses development approach is to provide social, economic and physical utility for urban spaces. It is argued that there exist a positive relationship between degree of strength of land use and their efficiency. The extent of this variation is between plus and minus 1 which corresponds with most and least efficient uses. It further argues that efficiency of land uses is associated with inner city decay. This relationship helps to analyze the spatial behavior of inner city decay. This paper aims to extract the strengths and weaknesses associated with urban land uses. It further tries to find out the relationship between the efficiency of the land uses and inner city decay level. This demands to utilize other indices in addition to ones use by Yinan and Chen including social, economic and physical ones.

This paper based on mixed-use development model aims to extract the relationship between dimensions of urban land uses and their level of strength and weaknesses. This demands the application of indices use in Yinan and Chen study including social, economic and physical ones. Doing so helps to explain not only social, economic and physical aspects of inner city decay but also to come up with an effective strategy regarding urban revitalization. This study requires the application of analytical hierarchical process regarding the determination of both efficient and inefficient land uses for analyzing inner city decay. The application of Yinan and Chen urban land use model and its extension based on analytical hierarchical process (AHP) and ArcGIS software regarding determination of areal extent and zoning of degree of strength and weaknesses of the land uses is being considered as the best method in this regard. This is associated with least degree of error and at the same time possesses high level of precision and the speed needed for this type of analysis. The chosen indices and measures should be capable of investigating the inner city decay level and simultaneously being able to extract significant relationship between urban mixed uses and their efficiency level. With respect to analytical hierarchical process the number and variation of measures and indices may lead to some inconsistency issue. This analysis demands consistency ratio to be lower than 0.1. At the same time, high number of indices and variables make weighing and binomial computation both every time consuming and difficult. In order to deal these challenges application of principal component analysis is recommended. This leads to creation of one component named “level of development” which is comprised of social and economic variables. Migration ratio, the rate of out-migration, size of household, male and female literacy rate, number of households per dwelling, number of persons live in each residential units, total dependency rate, female employment ratio, male employment ratio and sex ratio are the variables embedded in the development component. This component in combination with nine other variables are capable of determining the level of efficiency, its areal extent and zoning as well as spatial behavior of inner city decay using analytical hierarchical process. List of other nine variables are as follows: proximity to services, level of development of the study area, quality of buildings and their penetration and permeability level, proximity to shopping centers, variations of land uses, accessibility, height of buildings, pattern of land uses and the size of the units.

This study aims to investigate degree of inner city decay in Shiraz from intervention of mixed use development dimensions. Data analysis is based on spatial scales pertaining to Rowley conceptual, functional model as well as the extended Yinan & Chen model. This in turn demands application of technical and statistical methods including spatial analysis, data overlying technique, network analysis, analytical hierarchical process, Chi square test, regression correlation and the analysis of variation. Exploration of mixed use development pattern and its relationship with degree of Shiraz's inner city decay predominantly demands application of combination of Rowley conceptual model and intensity zoning control model of Yinan and Chen. This in turn, led to a real extent and zoning of inner city decay as opposed to locational efficiency of urban land uses. This model is capable of determining causal relationships between mixed uses and degree of inner city decay against urban land use efficiencies.

The analysis process comprises of the following:

- The investigation of mixed uses dimensions in the study area
- Determination of areal extent or zoning regarding the intensity of land use efficiency based on mixed use development pattern
- The identification of relationship between urban land use efficiency and the existence of mixed use development pattern

The study domain of mixed land uses and inner-city decay are different. Therefore, one of the challenges pertaining to this study is to find a model capable of extracting the relationship between the phenomena of inner city decay and mixed use development. Attempts in this line of inquiry led to the selection of evaluation method regarding locational strength of the urban land uses. This method is based on micro economy theories since they deal with areal extent regarding the intensity and strength of urban land uses (Yinan & Chen, 2009). This model is well applied to those areas which accommodate mixed land uses especially the new ones. It tries to find out whether mixed land use pattern is an effective measure or not. It determines the areal extent of both strength and weakness of land uses regarding well designed and pleasant spatial structure. The major objective of mixed land uses development approach is to provide social, economic and physical utility for urban spaces. It is argued that there exist a positive relationship between degree of strength of land use and their efficiency. The extent of this variation is between plus and minus 1 which corresponds with most and least efficient uses. It further argues that efficiency of land uses is associated with inner city decay. This relationship helps to analyze the spatial behavior of inner city decay. This paper aims to extract the strengths and weaknesses associated with urban land uses. It further tries to find out the relationship between the efficiency of the land uses and inner city

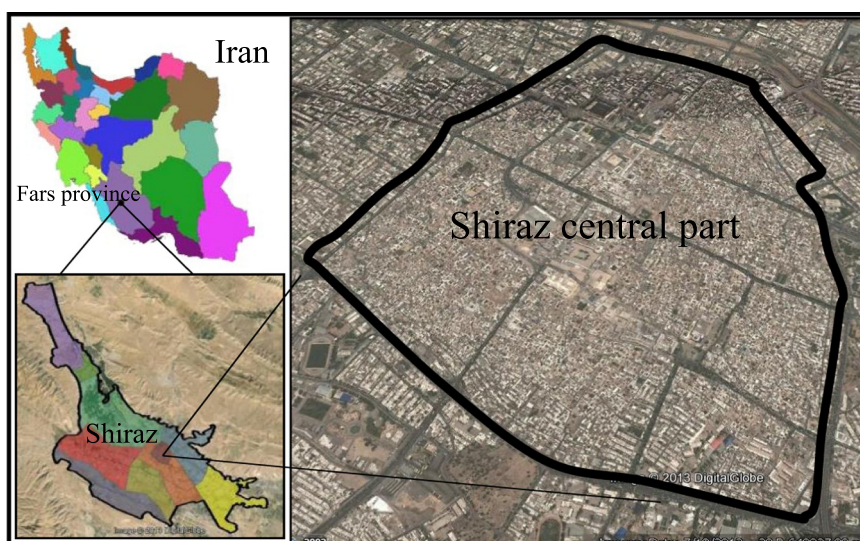


Fig. 5. Study area.

decay level. This demands to utilize other indices in addition to one used by Yinan and Chen including social, economic and physical ones.

This paper based on mixed-use development model aims to extract the relationship between dimensions of urban land uses and their level of strength and weaknesses. This demands the application of indices use in Yinan and Chen study including social, economic and physical ones. Doing so helps to explain not only social, economic and physical aspects of inner city decay but also to come up with an effective strategy regarding urban revitalization. This study requires the application of analytical hierarchical process regarding the determination of both efficient and inefficient land uses for analyzing inner city decay. The application of Yinan and Chen urban land use model and its extension based on analytical hierarchical process (AHP) and ArcGIS software regarding determination of areal extent and zoning of degree of strength and weaknesses of the land uses is being considered as the best method in this regard. This is associated with least degree of error and at the same time possesses high level of precision and the speed needed for this type of analysis. The chosen indices and measures should be capable of investigating the inner city decay level and simultaneously being able to extract significant relationship between urban mixed uses and their efficiency level. With respect to analytical hierarchical process the number and variation of measures and indices may lead to some inconsistency issue. This analysis demands consistency ratio to be lower than 0.1. At the same time, high number of indices and variables make weighing and binomial computation both very time consuming and difficult. In order to deal, these challenges application of principal component analysis is recommended. According to Factor Analysis Model, it leads to creation of one component named “level of development” which is comprised of social and economic variables as: migration ratio, the rate of out-migration, size of household, male and female literacy rate, number of households per dwelling, number of persons live in each residential units, total dependency rate, female employment ratio, male employment ratio and sex ratio are the variables embedded in the development component. This component in combination with nine other variables are capable of determining the level of land efficiency, its areal extent and zoning as well as spatial behavior of inner city decay using analytical hierarchical process. List of other nine physical variables are: proximity to services, level of development of the study area, quality of buildings and their penetration and permeability level, proximity to shopping centers, variations of land uses, accessibility, height of buildings, pattern of land uses and the size of the units. As noted above, this study aimed to investigate degree of inner city decay in Shiraz from intervention of mixed use development dimensions, so it could be the greatest difference between the method of this research with the others and in findings too. Study area corresponds with central part of Shiraz (Fig. 5).

## 4. Results and discussion

### 4.1. Zoning of inner city decay

As noted above, the intensity zoning control model is going to analysis of land efficiency. So, urban decay could be calculated if the needed variables are changed to others which related to urban decay. Since, mixed use development approach believes it can restore vitality to a deteriorated urban fabric, so it can be concluded that the lively urban areas are those that are closer to mixed use plans and vice versa. By this logic, first step is calculating the mixed use dimensions of the region<sup>1</sup>.

Second step is regarding the extraction of relationship between inner city decay and urban mixed uses is the formation of binomial

<sup>1</sup> - Mixed use dimensions of the region have been calculated and the results have been interfered in the model.



**Table 1**  
Binomial matrix related to variables associated with urban decay.

Indicators	Economics and social development	Proximity to services	Quality of buildings	Permeability of urban fabric	The pattern of land uses	Proximity to shopping center	Variation in land uses	Accessibility	The size of units	The height of building story
Economics and social development	1	0.25	0.3333	0.3333	0.2	0.1667	0.1429	0.25	0.25	6
Proximity to services	4	1	5	5	0.3333	1	0.25	4	5	4
Quality of buildings	3	0.2	1	2	0.125	0.1667	0.125	0.3333	1	2
Permeability of urban fabric	3	2	0.5	1	0.1111	0.1667	0.125	1	2	4
Mixed Use dimension	5	3	8	9	1	5	1	5	8	7
Proximity to shopping center	6	1	6	6	0.2	1	0.25	4	7	6
Variation in land uses	7	4	8	8	1	4	1	5	6	6
Accessibility	4	0.25	3	1	0.2	0.25	0.2	1	3	4
The size of units	4	0.2	1	0.5	0.125	0.1429	0.1667	0.3333	1	5
The height of building story	0.1667	0.25	0.5	0.25	0.1429	0.1667	0.1667	0.25	0.2	1

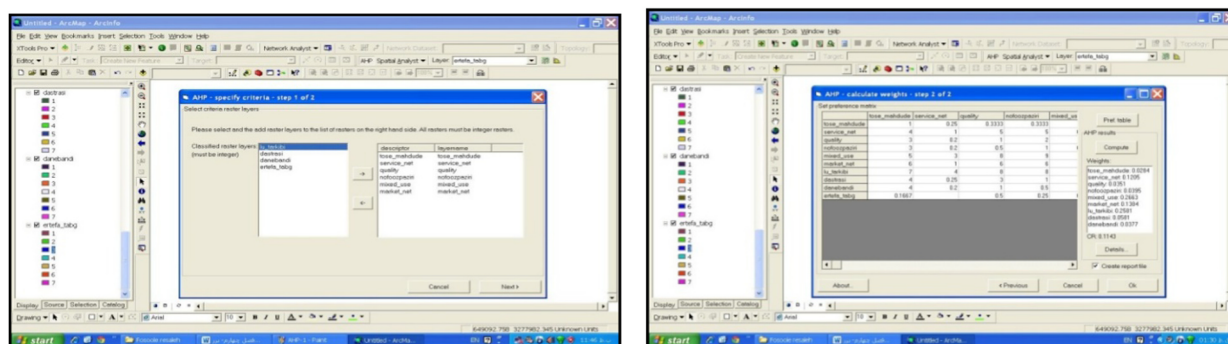


Fig. 6. Indices regarding AHP and ArcGIS and binominal matrix.

Table 2

Weight score indices and their compatibility.

#	Indices	The extent of magnitude						
		1/7	2/7	3/7	4/7	5/7	6/7	7/7
1	Economics and social development	0.0035	0.0071	0.0106	0.0141	0.0177	0.0215	0.0248
2	Proximity to services	0.0172	0.0344	0.0516	0.0688	0.0861	0.1032	0.1205
3	Quality of buildings	0.0051	0.0101	0.0151	0.0201	0.0251	0.0301	0.0351
4	Permeability of urban fabric	0.0056	0.0112	0.0168	0.0224	0.0281	0.0236	0.0395
5	The pattern of land uses	0.0380	0.0760	0.1140	0.1520	0.1900	0.2281	0.2663
6	Proximity to shopping center	0.0198	0.0396	0.0594	0.072	0.0991	0.1188	0.1384
7	Variation in land uses	0.0368	0.0737	0.1106	0.1474	0.1843	0.2212	0.2581
8	Accessibility	0.0083	0.0166	0.0249	0.0332	0.0415	0.0489	0.0581
9	The size of units	0.0053	0.0106	0.0160	0.0213	0.0266	0.0318	0.0377
10	The height of building( story)	0.0025	0.0051	0.0076	0.0102	0.0128	0.0153	0.0179
Compatibility of the statistics		0.11						

comparison matrix. This is followed by assigning numbers from 1 to 9 to each of the variables and indices in accordance with their impact and role (The Delphi method is used for optimal scoring in AHP model). It is argued that if row wise variables comparing with column wise ones were identical or possess superiority then the associated value of “x” would be anywhere from 1 to 9 otherwise the amount would be  $1/x$ . the results of AHP model is showed in Table 1 and Fig. 6.

Application of binomial comparison and analytical hierarchical process and the relevant weighting and scoring suggests that urban mixed uses with value of 0.27 and height of the building with the value of 0.018 have the highest and least weights respectively. Based on statistics corresponding to compatibility which is 0.11, it is argued that all of the variables and indices regarding compatibility have a good status for the purpose of determination of areal extent and spatial behavior of inner city decay and deterioration.

Third step, regarding spatial analysis algorithm, it is needed to rasterize the marginal weight of the variables has done via seven classes of raster map (7 classification in this case). So in this step, the weight range between one of seven to seven of seven of marginal weight has associated with each variable. Table 2 shows marginal score and weights as well as their compatibilities regarding each variable.<sup>2</sup>

Spatial analysis was conducted via application of overlying technique using seven classes and ten variables. This in turn, will lead to the creation of weight level in association with level of location efficiencies. Fig. 7 indicates the areal extent and zoning of inner city decay and urban locational efficiencies in the study area. This Figure classified the areal extent of inner city decay as opposed to locational efficiencies. It ranges from totally decayed areas to least amount of deterioration which corresponds with least locational efficiencies and highest level of efficiency respectively.

In fact, low level of locational efficiency is associated with highest level of inner city decay and deterioration. The area corresponds with medium level of locational efficiency and moderate level of inner urban decay and deterioration comprised 50.6% or 150.8 acres. The corresponding figures for areas with relatively high level of locational efficiency and high-level of inner city decay and deterioration is 20.7% and 61.6 respectively. Only 2% or 5.8 acres of the constructed area is associated with least level of inner city decay and deterioration. Table 3 and Fig. 8 show floor area ratio and its corresponding area as well as the degree of locational efficiency and magnitude of inner city decay and deterioration.

<sup>2</sup> - Total weight range of each variable (or seven of seven of variables weight range) has brought from AHP model.

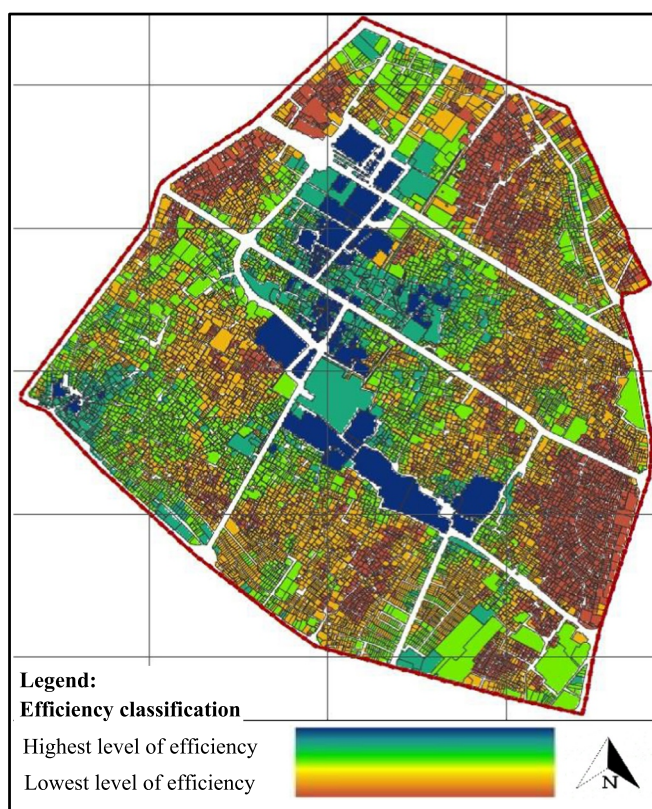


Fig. 7. The areal extent and zoning of Shiraz inner city decay as opposed to locational efficiency.

**Table 3**

Floor area ratio based on zoning of inner city decay.

The degree of inner city decay	The degree of efficiency	Floor area ratio	Area (Acre)	Magnitude
Highest level of urban decay	Least locational efficiency	5.7	17.0	1.218
Relatively high urban decay	Poor locational efficiency	21.1	62.8	2.311
Medium level of urban decay	Medium locational efficiency	50.6	150.8	2.574
Little urban decay	Relativity high locational efficiency	20.7	61.6	3.166
Least level of urban decay	Highest locational efficiency	2.0	5.8	4.229
		100.0	28.1	Total

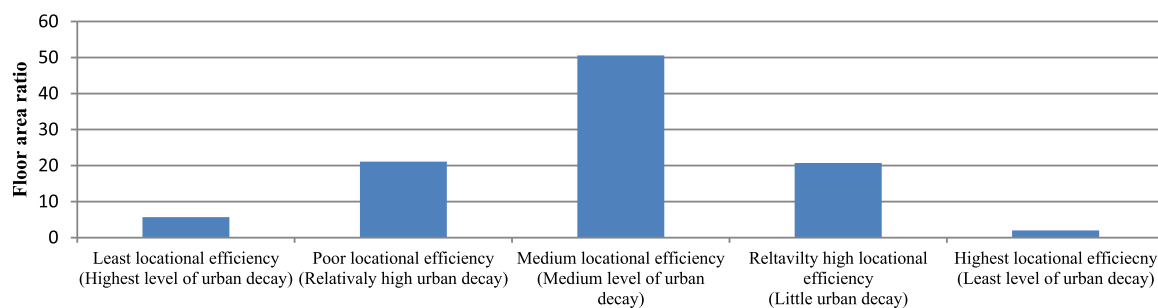
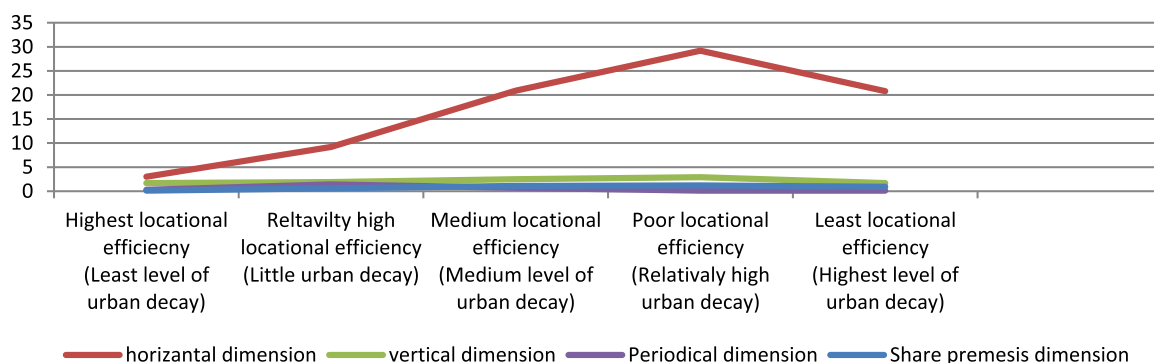


Fig. 8. Related share of area associated with the intensity of urban decay.

**Table 4**

Comparison regarding zoning of urban decay and locational efficiency based on mixed use development dimensions.

The degree of locational efficiency	The degree of urban decay	Floor area ratio	Dimension of urban mixed uses			
			Share premises dimension	Horizontal	Vertical	Periodical
Highest locational efficiency	Least level of urban decay	5.0	0.1	3	1.7	0.3
Relativity high locational efficiency	Little urban decay	13.2	0.6	9.2	1.9	1.4
Medium locational efficiency	Medium level of urban decay	25.1	1.1	20.9	2.5	0.7
Poor locational efficiency	Relatively high urban decay	33.3	1.2	29.2	2.9	0.1
Least locational efficiency	Highest level of urban decay	23.4	0.9	20.8	1.7	0.1
Total	100.3	100	3.9	83.1	10.7	2.6

**Fig. 9.** Graphical representation of comparison regarding zoning of urban decay and locational efficiency based on mixed use development dimensions.

#### 4.2. The analysis of relationships between the dimensions of urban mixed use and degree of inner city decay

Taking into consideration the conceptual theoretic call framework associated with urban mixed uses as well as the objective of this paper regarding the extraction of relationship between urban mixed use development and spatial analysis of inner city decay level, this study aims to first analyze the relationship between urban mixed used development and degree of the decay associated with inner city in the study area, and second to determine the relationship among variables and measures impinge upon the mentioned approach and occurrence of inner city decay. However, in order to better identify the areal extent and zoning of this phenomena, the investigation gears toward the four dimensions associated with mixed-use development. Based on Table 4 and Fig. 9 the least degree of inner city decay is associated with horizontal dimension (8.2%) followed by the vertical (1.7%). Periodical dimension corresponds with only 0.3%. This is followed by share premise dimension (0.1%).

According to Fig. 7 with respect to areas associated with low degree of decay and deterioration all of the four dimensions are proportionally existed. However, heading toward more decayed and deteriorated areas, horizontal dimension has superiority. In the areas with least degree of inner city decay, vertical dimension of mixed uses compared with periodical and share premise dimensions posse's higher value. Fig. 10 shows the areal extent and zoning of inner city decay taking into consideration four dimensions associated with urban mixed land uses. According to this figure the higher the magnitude of horizontal dimension of urban land uses the higher would be the inner city decay level. On the other hand, whenever the share of dimensions are relatively identical that is they have appropriate combination, the degree of inner city decay diminished and as a result one could see an increase in locational efficiency. This proves Rowley point of view regarding mixed use development. He believes that mixed use development is only successful if they benefit from appropriate functional combination.

#### 4.3. The statistical investigation of the relationship between the dimensions of urban mixed land uses and inner city decay

This study predominantly deals with spatial analysis of relationship between the occurrence of urban mixed use development and degree of Shiraz's inner city decay and deterioration. Dimensions associated with urban mixed uses are treated as independent variables and urban decay considered as dependent variable. Taking into consideration the nature of the data which is continuous, Pearson chi-square test was used (Table 5). Taking into account the value associated with Pearson chi-square (0.0) as well as the likelihood ratio one could conclude that there exist 100% relationship between the degree of locational efficiency, the magnitude of inner city decay and the dimensions associated with mixed urban land uses. Thus, the null hypotheses which indicate the lack of relationship between these two variables get rejected. That means the existence of relationship between dimensions of mixed urban land uses and degree or intensity of inner city decay got accepted. However, in order to find out the magnitude and nature of the relationship whether it is linear or curvilinear as well as the prediction of one variable based on the other, Pearson regression correlation analysis was applied (Table 6).

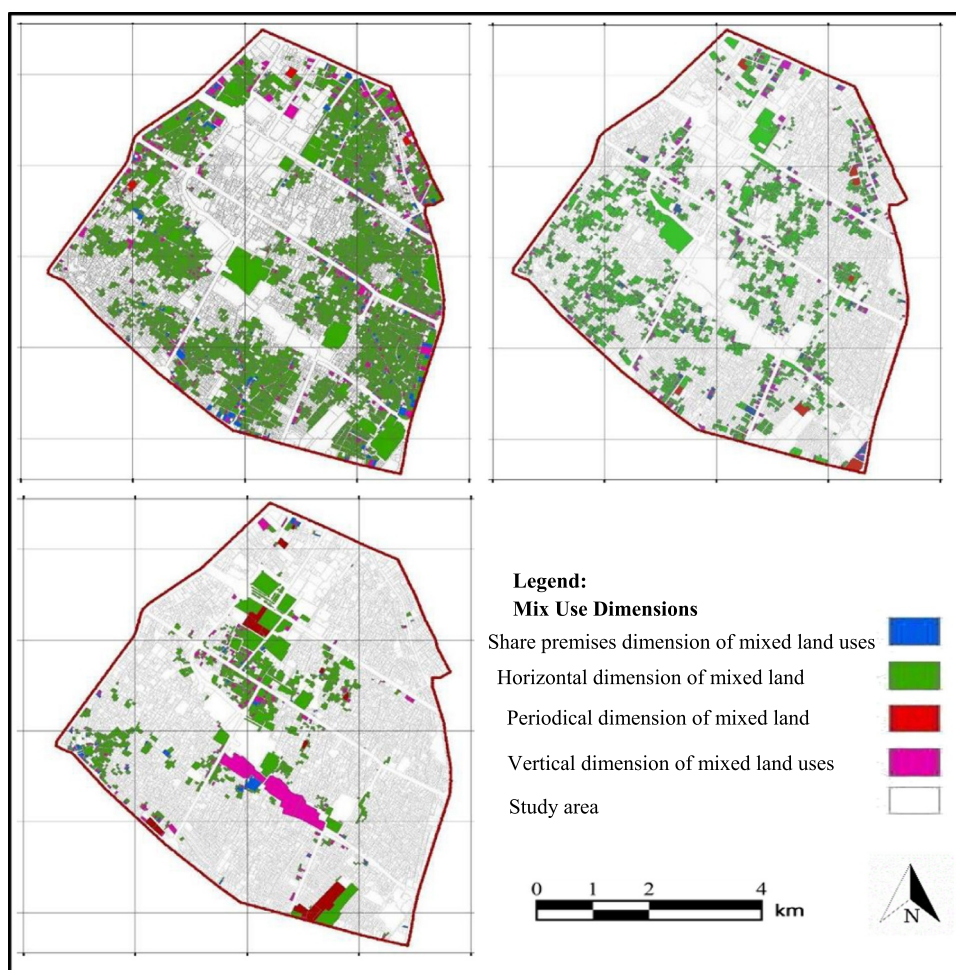


Fig. 10. The areal extent of the study area based on mixed use development and degree of urban decay.

**Table 5**

Chi-Square Computation for determination of degree of decay and the dimension of mixed use development.

Chi-Square Test			
	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	1792.470	36	0.0
Likelihood ratio	1332.905	36	0.0
Linear-by-linear association	461.238	1	0.0
N of valid cases	12669		

The significance level associated with above variables is 0.0. That explains the existence of 100% relationship with the corresponding variables. P-value of Pearson regression is + 0.191. Table 7 shows the amount associated with variation analysis due to the existence of linear relationship between the mixed use development and inner city decay.

The ratio between square of average pertaining to regression and the one associated with the residuals(F) is equal to 478.6 taking into consideration of p-value and observed significant level that is 0.00 which is smaller 0.05 one could strongly reject the null hypothesis that is the existence of Linear relationship would be proven. Table 8 corresponds to regression coefficient regarding both dependent and independent variables. Taking into account the value associated with T and p, again null hypothesis that is the lack of relationship between dependent and independent variables get rejected.

This study proves that spatial behavior of Shiraz inner city decay follow a distinct and similar pattern at all of the levels including district and neighborhoods levels (Table 9).

The inner city of Shiraz which has structured from 8 historical neighborhoods, somewhat has inherited general structure of its previous mixed and divers land uses. It is clear that the previous structure of Shiraz inner city land uses has changed over time. But,



**Table 6**

Regression coefficient related to intensity of decay and mixed land use dimension.

		Degree of locational efficiency as opposed to decay	Combination of land uses
Pearson correlation	The degree of locational efficiency as opposed to inner city decay	1.000	0.191
	The combination of land uses	0.191	1.000
Sig. (1-tailed)	The degree of locational efficiency as opposed to inner city decay	0	0.000
	The combination of land uses	0.000	0
N	The degree of locational efficiency as opposed to inner city decay	12669	12669
	The combination of land uses	12669	12669

**Table 7**

The amount of analysis of variation with respect to mixed use development and degree of inner city decay.

ANOVA <sup>b</sup>					
Model		Sum of squares	Df	Mean square	Sig.
1	Regression	142.194	1	142.194	478.629
	Residual	3763.190	12667	0.297	0.000 <sup>a</sup>
	Total	3905.384	12668		

<sup>a</sup> Predictors (Constant): Combination of land uses<sup>b</sup> Dependent variable: The degree of inner city decay as opposed to locational efficiency**Table 8**

The amount of analysis of variation with respect to mixed use development and degree of inner city decay.

Coefficients <sup>a</sup>					
Model		Non-standardized coefficients		Standardized coefficients	Sig.
		B	Std. error	Beta	
(Constant)		1.794	0.041		43.290
Combination of land uses		4.609	0.211	0.191	21.878

<sup>a</sup> The degree of locational efficiency**Table 9**

Summation of statistical tests related to rejection or acceptance of hypothesis.

#	Independent variables	Independent variable: The existence of inner city decay located in central part of Shiraz				
		Relationship	The intensity of relationship in percentage	Direction of relationship	Ratio relationship	The degree of its impact in percentage
1	Changes regarding the combination of urban land uses in central city of Shiraz	Have	100	Negative	1 to 4.6	19.1
2	Proximity to shopping centers	Have	100	Negative	1 to 6.8	57.4
3	Proximity to services	Have	100	Negative	1 to 7.7	
4	Variation in land uses	Have	100	Negative	1 to 3.3	
5	Accessibility	Have	100	Negative	1 to 8	
6	Building height	Have	100	Negative	1 to 21	
7	Other variables including the size, permeability, quality of building, and level of economic and social development	Have	10	Negative		23.5

its remaining skeleton along with mixed use approach provided a new method for analyzing the process of inner city decay especially for Shiraz and the same cities. According to the mentioned method, the spatial pattern of Shiraz inner city decay follows concentric zone pattern. That is the more we get away from central part the higher would be the level of decay as well as locational efficiency. It further suggests that regarding spatial behavior Shiraz inner city decay, the neighborhoods which accommodate varied land uses as well as combination of the uses at smaller scale would have similar behavior and mechanism at higher levels of analysis (Fig. 11).

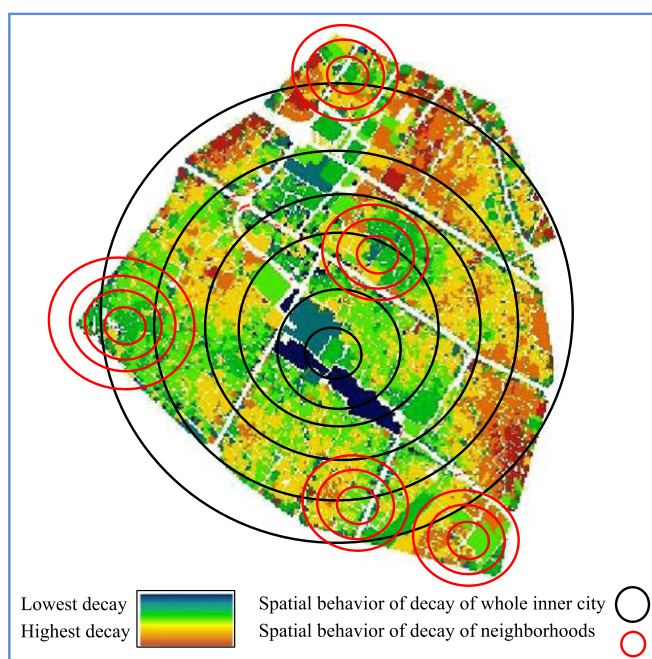


Fig. 11. General pattern regarding the impact of mixed use development approach associated with the degree of Shiraz inner city decay.

This new method (the combination of mixed land use and inner city decay view) can produce a new analytical approach for spatial analysis of decay and efficiency of urban centers.

## 5. Conclusion

The exploration of the spatial behavior of inner city decay based on the application of mixed use development approach in central part of Shiraz demands extracting the relationship between inner city decay and proximity to shopping centers and services, variation of land uses, accessibility level and the height of the buildings. It is argued that these measures and variables comprised the theoretical and functional bases of mixed use development approach. These in turn is associated with liveliness, vitality and dynamic of the urban neighborhoods. Results based on Pearson Chi square test shows a high relationship between these independent variables and the degree of inner city decay in central part of Shiraz. The coefficient level corresponding to these relationship are 0.413, 0.326, 0.56, 0.120 and 0.065 respectively. Corresponding “R” figures are 41.3, 33.6, 56.12 and 6.5 percent respectively taking into consideration 0.1 significant levels. This study based on analysis of variation suggests that these variables are capable of explaining 57.4 percent of the variation of spatial behavior of inner city decay of central part of Shiraz taking into consideration urban mixed use development. The regression coefficient suggests that 1 unit increase in the chosen independent variables that is proximity to shopping centers and services, variation in land uses, accessibility and the height of the buildings is associated with 6.8, 7.7, 3.3, 8 and 20.9 unit decrease in the level of inner city decay as dependent variable. The behavior of the average associated with residuals of these variables is similar to overall application with regard to urban mixed uses located in the central part of the city. That is the average of the value pertaining to the residuals of the mentioned variables as independent variables is 0.0 and their standard deviation is 1. This in turn indicates that all of the variables responsible for the analysis of relationship between independent variables and dependent variable are properly chosen. Moreover, the linear relationship is firmly confirmed as well. According to the statistics there exist a negative relationship between changes in dimension of the urban mixed uses and degree of inner city decay in the central part of the city. This relationship is associated with five variables that are the dimensions of urban mixed uses, variation in urban land uses, proximity to shopping centers and services accessibility and the height of the buildings located in the study area. Pearson Chi square test indicates the existence of high relationship between the degree of inner city decay and all of the independent variables. Furthermore Pearson regression coefficient (r) correspond with high significant level as well. This statistic compares with 19.9. This could well highlight the relationship between these variables against spatial analysis of Shiraz inner city decay level. This statistics indicates that 19.1 percent of Shiraz inner city decay could well be justified by pattern of mixed used development. This bears on an outstanding message. This figure is associated with spatial behavior of Shiraz inner city decay level. Regression coefficient associated with both dependent and independent variables indicates that with 1 unit increase in dimension of urban mixed land uses located in Shiraz central part, one could see 4.6 unit decrease in the level of inner city decay. In other words, there exist a negative linear relationship with the ratio of 1/4.6 between the changes in urban land use combination level and spatial behavior of inner city decay. That is close to 1/5 of the Shiraz occurred inner city decay is being explained by changes in the combination of urban land uses.

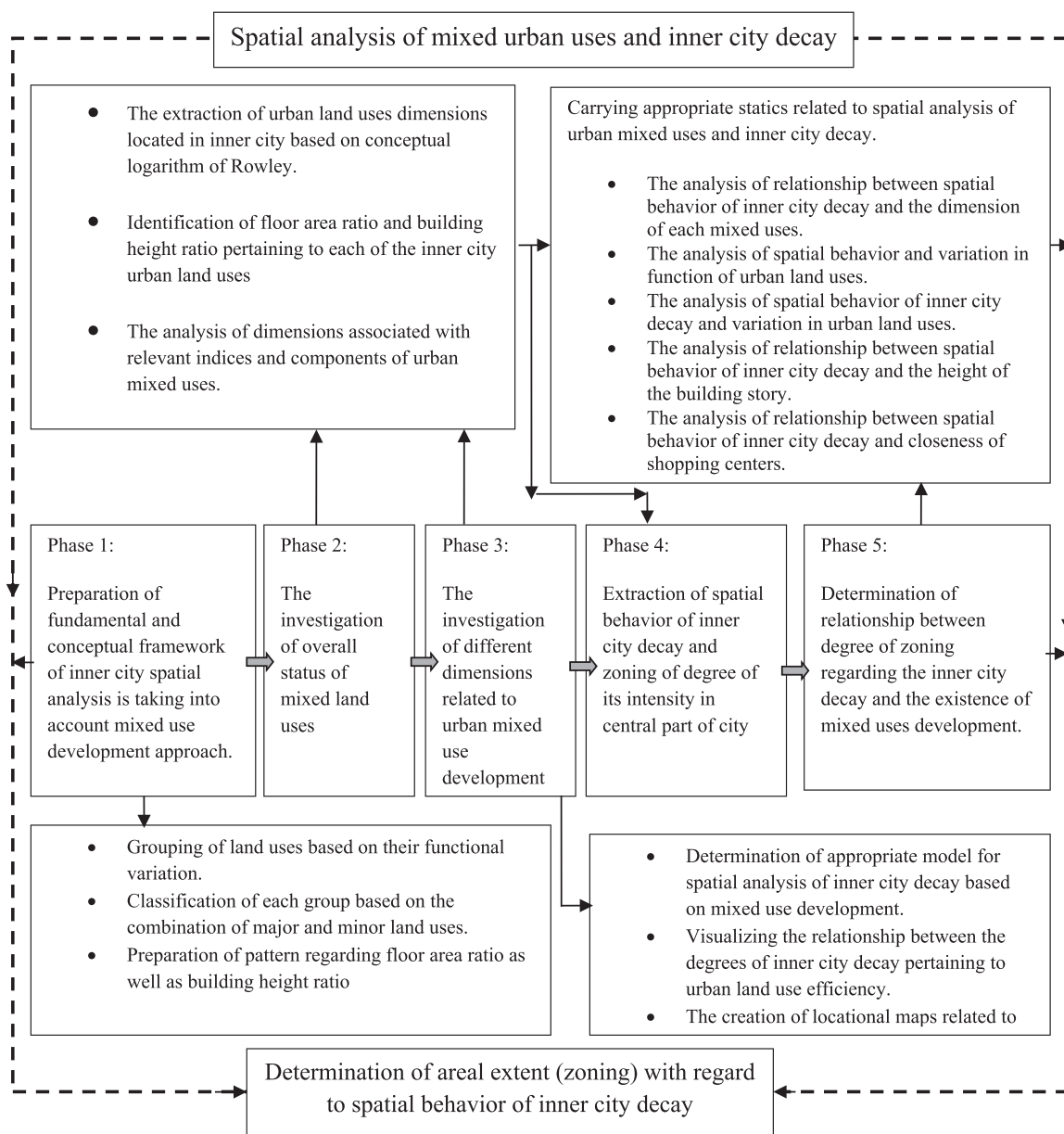


Fig. 12. Spatial analysis model related to all metropolians of Iran with respect to urban inner city decay.

Residual value pertaining to the variables bears interesting message. That is the appropriateness of the selected variables as well as linear relationship pattern and fixing rate of error for assessing the degree of inner city decay.

According to Table 9, 57.4 percent of spatial behavior of Shiraz inner city decay is supposed by variables associated with mixed use development approach. This percent compared with Rowley conceptual model of mixed use development are more. In mixed use view, it is argued that share premise, horizontal, vertical and periodical dimensions of mixed use development approach are capable of explaining 19.1 percent of spatial behavior of Shiraz inner city decay. However, percentage associated with variables correspond with this approach is 38.3 percent more. The prominent message of this paper is the spatial analysis of all dimensions associated with mixed use development and its relationship with the degree of decay as opposed to locational efficiency in central part of Shiraz. However, the consideration of other variables beside the ones associated with Rowley conceptual model is more important for deterioration of spatial behavior of Shiraz inner city decay. This in turn helps to extend Rowley model of mixed use development and opens up a new angle with respect to application of mixed used development within urban spatial analysis framework. The given framework is very applicable for urban renewal process as well. According to Fig. 11 spatial behavior of inner city decay both at neighborhood and study area level show concentric zone pattern. This study further suggests that historical, commercial and religious linear pattern as well as their ramifications in central neighborhoods were associated with little degree of decay and deterioration

compared with inner city level. This sort of spatial behavior is being affected by the existence of the mixed uses and variation of the uses. This paper further suggests that those historical areas as well as their branches which are located in the heart of the neighborhood very much benefit from variation of in land uses and mixed use development pattern. Taking into consideration the finding of this study one could conclude that mixed use development approach theoretically is capable of spatially analyzing central part of city. It is argued that the application of this approach with respect to explanation of inner city decay process and its spatial behavior in central part of Shiraz could well be suited for other metropolises as well. This study further concludes that mixed use development from theoretical standpoint has enough potential to be applied in other cognitive areas including urban geography. Another conclusion is that there exist a significant relationship between changes in land use combination and physical and functional performance of the cities and the occurrence of inner city decay level. Moving away from this approach is associated with increase in degree of inner city decay. In the other hand, when the urban fabric is highly compatible with mixed use development, the inner city decay decreases as well. This study highly suggests the application of mixed use development. This approach through an appropriate analytical algorithm could well be applied to urban spatial analysis. Fig. 12 indicate the analysis of spatial behavior of inner city. This model shows the cycle of urban decay. It has conceptual nature and is predominantly based on the theoretical framework of mixed use development with its spatial analytical capability.

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