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The Influence of Transportation and Land-Use Strategies on The Development Criteria, Case study: Shiraz City

Mostafa Amiri[1], Dr. Mehdi Ravanshadnia[2*] and Dr. Mohammad Bagher Nobakht Haghighi[3]

1Master student of Department of Civil-Construction Engineering and Management, Science and Research Branch Islamic Azad University, Tehran, Iran
2 Construction Engineering and Management Group, Assistant Professor, Science and Research Branch Islamic Azad University, Tehran, Iran
3 Ph.D. in Economics Professor of Center for Strategic Research

*Email: ravanshadnia@yahoo.com

Abstract
Accurate land use strategies may result in the success of cities in the world. There are many examples of traffic congestion, inappropriate services, unwanted inflation, insufficient access and other problems that started with inappropriate urban divisions land use. This paper reflects the results of a research investigating the effect of land use on neighborhoods, access, restrictions, and physical fitness of one of the major Iranian cities; Shiraz.
In order to fulfill the research, the effects of the transportation system of Shiraz on the land use criteria has been investigated. The map of the city on the seven groups of usage containing residential, commercial, industrial, services, green space, agricultural land and wasteland has been extracted from positioning data. Physical fitness factor maps, access, neighborhood effects, and limit usage has been checked. It should be noted that in this case the automation cell, the weighted average method and Boolean logic has being applied. By combining the map of these effective factors, the potential of user position on the cell surface has been calculated for the desired user, and taking into account the user's demand, use was placed. The investigation of the road transportation system of Shiraz municipality demonstrates the role of access and the importance of this issue on land use.
Keywords: Transportation System, Development, Land-use, shiraz, Iran

1. Introduction

Interactions between transport and land used as a two-way relationship between land user and accessibility, which is dependent on transportation, can be considered. These two factors are so interdependent to each other that to determine which one at first change the other one, it is very difficult. On the other hand, by creating or changing a new user, absorbed or produced trips and on the other by creating a new facilities and transportation such as construction of new highway, or increasing public transport facilities, attraction of one place is increases and this cycle always continues. This relationship is often called the "link" or "cycle" of transport - land use, which emphasizes a relationship with feedback. Most models of transportation includes a component of land use that integrated with it or at least established a poor relationship with that. (Shirzadi, 2008)

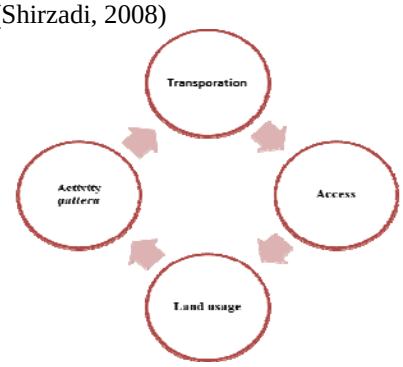

Figure 1: the relationship between transport and user

Figure 1 illustrates the relation between transpiration and user. As we can see in figure, transportation and use with help of available elements and activities Connect to each other. Use distribution at ground level (For example, residential or commercial, etc.), Led to the creation of specific activities in the area (For example, life, work, education and shopping). The distribution of human activities, causing spatial interactions or trips in the transport system. Distribution of transport infrastructure in the region is causing the opportunities for spatial interactions, which creates the concept of access. Accessibility distribution Causes competition and changes in user. (Wegener, 2004).
Access concept in the fields of city planning, transportation and geography plays an important role, and is a tool that is effective in municipal decisions. However, the access definition and structure have a poor measurement. In addition, find a comprehensive definition of access is difficult, complex, and depending on the application examined from different perspectives. (Mousavi, 2012).
Access has several definitions, depending on the application. Hansen knows access as an interaction potential with opportunity. Dokvi and Martin defined access as the ease level of individuals to choose their

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desired activities, by desirable mode of transport in certain places. Other definitions of access as follows:

- •Access the benefit or advantage obtained by a transport system- identifies the land use
- •Access indicates the ease of access to one location from other locations, and so in general we can say that is indicate the relative opportunities for communication and interaction between the locations.
- •Access indicates the availability of one location from other locations, or access of one location to other locations.

After access is defined as the major impact of transport, the allocation of use will be defined. Process of use allocation, as the different allocation of use to specified units location within an area is defined (Sante-Riveira et al, 2008). This process involves interaction between proportion of land and use demand in the study area. Assess the suitability of the land, is an essential part of the process of land use allocation (Sante-Riveira et al, 2008). The main purpose of assessing the suitability of the ground, predicts the inherent capacity of the land to support a specific use for a long time without degradation, in order to minimize the social, economic and environmental costs (Bhagat et al, 2009) .

In several studies, a series of different measures of environmental, social, economic and environmental suitability, neighborhood (interaction between uses), and access restrictions for determining land suitability is determined (Verburg and Overmars, 2009; Karimi, 2010) that in the following theoretical principles and factors are described separately.

1.1 Determination of Environmental suitability

Environmental suitability of land requires the inherent characteristics of the study area with use requirements (FAO, 1976). this suitability are based on studies of soil, climate and topography, the most important group of environmental information required to assess the land Suitability, is built (Salam et al, 2005; Bhagat et al, 2009). As mentioned in the previous section, land suitability evaluation to determine the compatibility of land for a specific type of work are taken into account. Thus, the suitability of land that is meaningful only when certain types of uses with special needs, are present (FAO, 1976).

In determining the suitability of land for different types of applications, need to determine the maps of Criteria factors is effective. In the production of criteria maps, usually spatial analysis in GIS environment used (NisarAhamed et al, 2000; Bhagat et al, 2009; Karimi et al, 2010). After determining the criteria maps of effective factors, and determine the suitability of the environment, weighting and combining them arises. In this study, to determine the degree of environmental suitability for use, Makhdoom model is used. In addition, in the combination of criteria maps, multi-criteria method is used (Ceballos-Silva and Lopez-Blanco, 2003; Salam et al, 2005; Pourebrahim et al, 2011; Passuello et al, 2012).

1.2 Determine the effect of neighbourhood

In the process of use allocation to a single place, in addition to considering the characteristics of each unit, considering the spatial distribution of land around it is also necessary, And this work is done by modeling the interaction between uses. Usually modeling the interaction between different applications on each other is called neighborhood effect. That this important Often by using a Cellular Automata (CA) is calculated. (Verburg et al., 2004). Cellular Automata, is modelling the possibility of use change of a cell, according to the neighboring cells uses. More specifically, The effect of each pixel neighborhood, The cumulative effect of all adjacent pixels in radius of influence according to the use and the distance based on equation 1 is calculated (Karimi, 2010):

$$N_{in} = \sum_{d} \sum_{k} w_{dik} \cdot d = \sqrt{dx^2 + dy^2} \qquad (1)$$

In the above equation N_{in} represents the effect of neighboring pixels with $i$use i and w_{dik}indicate the effect of each adjacent pixel with k use to the central pixel i with a i use that has a distance d from each other.

1.2.1 Cellular Automata

The Cellular automata is suitable for modelling constructive behaviour and self-generating. In fact, cellular automata are discrete dynamical systems whose behaviour is based entirely on the relationship. In CA, Space defined as one or Multidimensional network of cells and each cell has properties that vary over time. Variable amounts of each cell at any time is mode of the cell. In addition, the mode of all the cells over a period shows mood and behaviour of the entire system. CA model has five main elements include cellular space, neighbourhood, transport law, Set of mode s and time. These elements are briefly described in the following.

Cellular space: cells in cell automation as Mosaic is located next to each other, and Create Cellular space. This mosaic can be different shapes such as triangular, tetrahedral, and hexagonal and in different dimensions of one-dimensional, two-dimensional and three-dimensional located next to each other.

Neighbourhood: Neighbourhoods in fact is the cells adjacent to a cell that affect dimensional modes. In the two-dimensional mode, there are three popular neighbourhood.

Radius neighbourhood that contains special cells located in specific radius within the central cell. Neumann von neighbourhood that includes four up and down and left

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and right neighbourhood cells of the central cell. Moore neighbourhood where eight adjacent cells surrounding the central cell. Figure 2 is a demonstration of how to define the neighbourhood of cellular automata model (Liu, 2009).

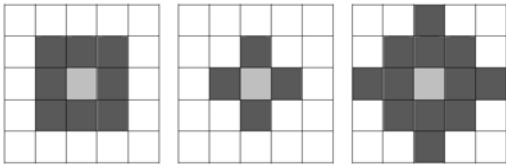

Figure 2: shows a demonstration of how to define the neighborhood of cellular automata model

The size of the neighbourhood, a very important parameter in the definition of transfer and accuracy functions. According to the theory of CA, General attitudes of self-organizing system, is according to the local laws. Based on the type of work, to what extent a process is local, one of the questions, select number of factors that have an impact on small areas. However, the choice of some factors such as the development of roads and transport, in entire area is effective. Therefore, the choice of neighbourhood size can have a significant impact on the accuracy of CA model (Karimi, 2010).

The transfer rules: the transfer rules provided algorithms to transform cells from one mode to another mode over time and indeed are rules that governed the transition between modes of a cell, since entrance of these rules are the cell neighbourhood, these rules are called local. Transfer rules and how to define the rules, is an indicator for the model, And how to define these rules will be differentiated CA models from each other.

Set of modes: Each cell in each time can only have a one mode of the set of all possible modes. In urban cellular automation, the cells mode may represent land use or land cover. In cellular space, mode of cells are usually discrete that in reality is not like that, and in these modes, fuzzy sets is recommended.

Time: According to the automation cell, each cell at successive time steps by repeating the steps of cellular automation rules, considering the mode of its neighbouring cells will change. However, these time steps can have different speeds for different cells.

1.3 Determine the Level of Access

One of the factors in the process of use allocation is the availability to existing road network. Access as one of the factors in the allocation process; cause the development of economic competitiveness in the region and changing the value of land adjacent to transport system that this leads to use change (Ameri and Barge Gol, 2009). The concept of access in issues related to use allocation, mostly with the notion of partial access to various locations relative to the transport system have been proposed. In this definition, the level of access for each location according to the Euclidean distance is measured from the nearest point of the road network.

1.4 Specifying Constraints

Allocation of land to a use, influenced by policies and many limiting factors (Liu et al, 2007; Falah Shamsi al, 2005). These policies and restrictions, including rules and regulations, approved development plans and set of environmental, social and economic risks respectively. For example, the construction of industrial uses in the space of 50 km of Isfahan and 120 km from Tehran is prohibited.

2. Research Method

As explained above, Land suitability Influenced by four factors access, neighbourhood, limitations and physical fitness. Each is briefly described below.

- Physical fitness that defines the degree of suitability of a particular cell to change to a specific user. Physical fitness plans are based on the physical properties of the region.
- Limitation includes spatial constraints for assigning a user to a cell. For each user, there are a time series of restriction maps that users in that period, change user is not possible.
- The availability of places, usually according to the Euclidean distance from the lowest point on the road network and using an empirical relationship comes into the equation 2 (Engelen et al, 1997).

$$A_{ik} = \frac{1}{1 + D_{ij}/a_i} \qquad (2)$$

In this equation, A_{ik} represents the availability level of pixel i with user k, D_i represents pixels i Euclidean distance to nearest pixel belongs to the network roads, and a_k indicate the importance of user access k to the roads network. In this study, by using the above equation, use access levels according to the Euclidean distance from the nearest point of the roads network has been set. The relationship between the effects of road transport on the users are ignored. Included in the survey, according to the types of uses are interested in the near or far from any roads, a more complete formula is used.

$$A_{scf} = \frac{a_{sf}}{D_{sc} + a_{sf}} \qquad (3)$$

In this equation, D_{sc} is the distance between the cells c and nearest cell covered with a link s and a_{sf} indicating the importance of appropriate infrastructure s access to user f. (Mousavi, 2012).

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The process of determining the suitability of land to every single place, in addition to considering the characteristics of each unit, considering the spatial distribution of land around it is also necessary. This work is done by modeling the interaction between uses, usually modelling the interaction between different applications on each other, Neighbourhood effect is called, that this most important thing often by using a cellular automata (CA) is calculated.(Verburg et al., 2004). Cellular automata, modelling a possibility of user change according to the one use neighbouring cells. More specifically, the neighbourhood effect of each pixel, of cumulative effect of all adjacent pixels in radius of influence with respect to users and their distance is calculated according to the equation 4 (Karimi, 2010):

$$N_{ik}=\sum_d \sum_k w_{dik} \cdot d=\sqrt{dx^2+dy^2} \quad (4)$$

In the above equation N_{ik} represents the effect of Central pixel neighbourhood i with User k and w_{dik} Represents the effect of each pixel adjacent to the User k on central pixel i with User k with distance d from each other.
In this study, the radius of the neighbourhood of 196 adjacent cell is considered as the neighbourhood distance.
After calculating the attribution of environmental parameters, neighbourhood, availability and limitations, these parameters are combined using a correlation to determine the fitness for any use.

$$P_{ik}=(W_s \times S_{ik}+W_n \times N_{ik}+W_a \times A_{ik}) \times Z_{ik} \quad (5)$$

In this relation, S_{ik}, N_{ik}, A_{ik} and Z_{ik} , Respectively represent Environmental suitability criteria, neighbourhood, accessibility, Limitation of user unit k , W_s , W_n and W_a respectively is the weight of Environmental suitability criteria, neighbourhood and accessible.
In Figure 3 the procedure overview is given.

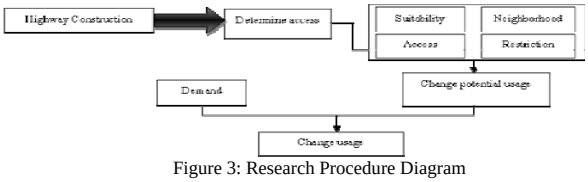

Figure 3: Research Procedure Diagram

Shiraz is one of the major cities in Iran and is the capital of Fars Province. Based on the latest Census Statistical Center of Iran in 2006, the city had a population of 1214808 people that this number in 2009 increased to 1455073. City of Shiraz, with a length of 40 km and a width of 15 to 30 km with a total area of 1268 square kilometers, rectangular in shape and is geographically located in the southwest of Iran and the central part of the Persian Gulf. This City from the West to the Drak Mountain, from the north to the mountains Bamoo, Sabzpooshan, Chel Magham and Baba Kohi (From the Zagros Mountains) is limited. City of Shiraz, according to the latest administrative divisions is divided into 9 Independent metropolitan area and have 15 regional traffic and 156 traffic area. Shiraz environment surrounded by relatively high mountains like solid fence, which are of particular importance in maintaining city, Shiraz surrounding mountains are relatively high solid fence, surrounding the city in terms of special importance. The geographic coordinates of Shiraz is 29 degrees 36 minutes north and 52 degrees 32 minutes east, and its height between 1480 and 1670 meters above sea level varies in different parts of the city.

At the beginning, the data should be prepared that this process can be expressed as follows:

- Determine the factors affecting the local process
- Collect required data for elements
- Formation of layers of raster
- Homogenization of Study area
- Build raster with dimensions 100 x 100 mm

Then, study and modelling the rest of the elements


Figure 4: the study area

This section examines the changes due to the development of the transportation system. The scenario described in this section is: Suppose the highway development in the East to the West.

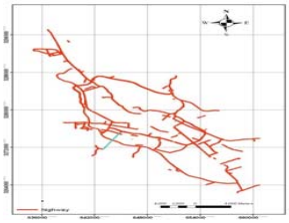
Figure 5: Show highway development according to the scenario

According to the regulations of the Department of Housing and Urban Development, Road transport in three groups of arterial, major and minor is placed. Arterial road into two general groups' freeways and highways, main roads into grade 1 and 2 and sideways to sub-level 1, 2 and 3 are divided. In this study, the data were grouped accordingly.

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By providing the questionnaire, with the help of expert knowledge, the degree of importance of each type of access for each type of road have been investigated, and this information is collected in the following table:

Table 1: shows the degree of importance of each user access to any type of roads

Use	Highway and Freeway	Main road	By-Way
Residential	0.1	0.8	**0.9**
Commercial	0.2	0.8	**0.9**
Industrial	1	0.6	**0.2**
Services	0.5	0.7	**0.8**
Green space	1	0.7	**0.9**

At the beginning, by using spatial analysis in ArcGIS software, Euclidean distance of each point of the study area is calculated for each type of roads. Since the model is cell based, Software output as raster enter the model environment. The model developed in Matlab, Therefore, the output of analysis enter the model. It should be noted that the importance of access each user in a variety of ways, through the expert opinion in the model has been applied. In addition, weights between zero and one is given.

Suitability quantifying the impact of future land use physical element. Suitability is calculated using the weighted average and the results with values between 0 and 10 will be explained. In this section, to measure the physical fitness of several factors involved in the topography, slope and elevation factors to be considered. According to the data in the highlands of Shiraz city, this data as raster layer raster between heights of 1467 meters to 2182 meters are located. At first turned Layer height into three classes [2200-2000], [2000-1700] and [1700-1500] and then in turn to each of these classes, the numbers 1, 6 and 10 is given. With this act is try to normalize the height in the interval [10-1]. Normalization process on the slope raster layer that with help of Arc GIS modules Spatial Analyst software prepared from height map, also performed. Finally, by using these two layers, physical fitness by overlay analysis produced. In addition, output raster map with cell dimensions of 100 x 100 square meters with a colour spectrum that represents numbers between 0 and 10 is produced that shown in Figure 6. It should be noted that this map is normalized again and in the range [0-1] enter the module determine the potential change.

Table 2: how to weighting the Physical measures

Height		Slope	
Weight	amount	Weight	**amount**
10	1500-1700	10	**%1-%15**
6	1700-2000	6	**%15-%25**
1	2000-2200	1	**%25<**

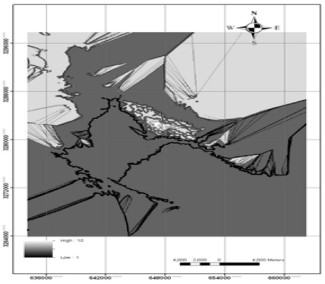


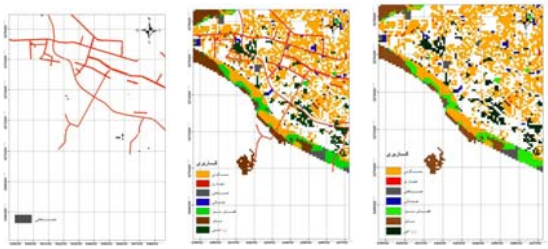
Figure 6: map of Physical fitness area

2.1 Demand

In land use process, One of the effective elements is the area required for each user is usually the demand step, in this study, a statistical regression method is used. Thus, the average demand of users in different years is available, and according to the statistics, the average demand per year was calculated.

2.2 Attribution

As explained in the previous section, attribution is a process that involves interaction between the land use and user demand, conditions prevailing in the study area is considered. In the previous section, Fitness that affected by four access elements restrictions, neighbourhood and physical fitness calculated using matlab programming, And then by considering the demand, fitness program output enters the Attribution program that is written in matlab. Finally, matlab output enter the ArcGIS environment and becomes figure 7.



C B A

Figure 7: A - change of use before Highway Construction B - changes due to highway development and C - How to increase industrial uses after the Highway Construction

Table 3: displays the results of use change after the Highway construction

use	The number of pixels before the Highway construction	The number of pixels after the Highway construction

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Residential	3237	3216
Commercial	115	115
Industrial	41	170
Services	482	479
Green space	178	174
Arid	2340	2332

3. Conclusion

Cities in the modern world are affected by several factors. The issue has caused the complexity of the issues related to the city and urban. Among the current important phenomenon of cities, is use changes issue in the city. This legislation is very much influenced by variables. These variables can include the rising cost of land, development services in the area, construction of new facilities and so on.

In the current study, we tried to identify factors influencing the urban use change modeling and identifying Effective factors on this process. After identifying two overall factors of demand and the potential for use change, is trying to model each of these factors. From Determinant parameters for the potential use change, suitability of environment, political constraints, Neighborhood effect and access have been investigated.

The results demonstrate the role and importance of the issue of access on land use change and that users are more valuable exposure in areas that are of interest to have the appropriate access.

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