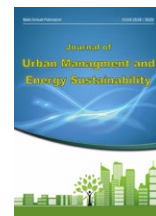


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Explaining the model of urban pattern formation in informal settlements in Iran

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ABSTRACT

Ignoring the poor social class in physical planning and urban housing causes the emergence and exacerbation of inequality and ultimately informal settlements. Recognition of informal settlement formation is so important to the extraction of patterns and types depending on the model evaluation. The methodology of research is descriptive-analytical, which has a development purpose. According to the nature of informal settlements in different views, criteria can be divided into social, economic, environmental, and economic branches but for the formation matter and its pattern, the environmental branch includes the physical dimension too. The collecting method is library resources and for evaluation, the Delphi method was applied. The result shows that it is possible to evaluate the localized indicators based on two environmental and physical components to evaluate the pattern of urban form in informal settlements. In general, there are two axes in the formation pattern of informal settlements in Iran. Proximity to the main transportation arteries due to the presence of land and lack of restrictions on housing construction and using topography to occupy land and create housing. With these two axes, it is possible to recognize the existing urban patterns by adding the structure of the access network to it and creating blocks and the type of granularity in it. According to the types of urban settlements, in future studies, the urban form of informal settlements can be classified according to the type of climate, topography, population, the use of urban spaces, etc., and presented in the proposed model for evaluation.

Running Title: Model of urban pattern formation in informal settlements



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1. Introduction

Today, half of the world's population consists of urban dwellers, and by the end of this century, the growth of this amount is estimated to 70%. According to the 2003 United Nations Human Settlements report, about 40% of the urban population in developing countries live in informal settlements, and this figure is expected to reach two billion people by 2030 (UN-Habitat, 2015b). The increase in population will bring a high growth rate of poverty, and this poverty appears in its current form, i.e., urban poverty, with consequences such as lack of housing and informal settlements in the context of the city (Yap and Sheng, 2016). Ignoring the poor social class in physical planning and urban housing, which appears in the field of wealth, causes the emergence and exacerbation of inequality and economic poverty, and ultimately informal housing (Banda and Mwale, 2018). This inequality causes class conflict in social strata to intensify. (Ezebilo and Thomas, 2019) But in general, the causes of the formation of informal settlements need in-depth investigations, but the type and shape of the patterns forming the form of informal settlements are also considered one of the urban challenges (Brown, 2021). Marginalization began to appear in London at the beginning of the industrial revolution, and today it is considered one of the main urban problems in all developing countries. (Garai and Narayana, 2018) This type of marginalization, which has a historical background, always promotes non-geometric and irregular patterns based on the local structure for its development (Soyinka and Siu, 2018). In the countries of the third world, the number of informal settlements is very high and in the last century, it is increasing strongly, the reasons for which can be pointed to the lack of a formal development plan by the governments (Weber and Mendelsohn, 2017). To control power, they generally tend to preserve interests (Dovey, 2019), interests that are without economic support for the poor strata and somehow help to create informal settlements (Dovey and Pafka, 2020). The settlement type provides its residents with free accessible land, livable housing, and urban infrastructure (Dovey et al., 2018). In contrast to the ease of access to land and the

creation of a variety of non-standard housing in these types of settlements, the resulting organic form is a window to an adaptive morphological process that adapts to the urban form over a long period. (Batty and Marshall, 2009) With existing land, transportation networks, labor markets, urban threats, local policies, etc., Patrick Geddes' theory of urban development is completely compatible with the patterned growth of informal settlements. (Caniggia and Maffei, 2001) In the subject of formal morphology of informal settlements, Conzen (1968) conducted studies based on the type of buildings, streets, as well as plots of land and city blocks, based on his evaluations, a supplementary process was carried out. Urban science happens gradually. (Moudon, 1997) In this regard, the pattern of informal settlements also has the typology of buildings, plots, and streets, which form the shape of its urban fabric. (Marshall, 2019; Scheer, 2016) Jacobs (1961) refers to a "complex organic" in the matter of informal settlements that are dynamically evolving and challenging the urban morphology. (Alexander et al. 1987) (Figure 1)

In addition to that, some foundations create the role of grammatical criteria in creating a platform for its formation (Talen, 2012). Understanding this type of criteria can also have a direct impact on the morphology of informal settlements (Ben-Joseph, 2005) So that the main questions include; 1- What are the main indicators of identification in the formation of informal settlements? 2- With what indexes can the urban form of informal settlements be evaluated and adapted? In general, the questions raised try to explain the structure and work of the urban form and the patterns present in urban settlements in a comparative way, so that after examining the concept of informal life, its shaping dimensions can be explained conceptually and practically. and measured the meaningful relationship between content criteria and sub-criteria. The component structure of the research can challenge the innovation in the findings when the basis of this type of marginal context is raised based on the direct causes of the form, so the main goal in explaining the structure of the research is to examine the sources of occurrence and extract



Figure 1: An example of the morphological form of informal settlements, **the upper right image**: an informal settlement on the outskirts of Cape Town, South Africa. **The upper left image**: an example of an informal settlement, Kia Sands, South Africa. **Bottom image**: Aerial view of the urban form and the organic formation of the residential fabric

the optimal model of the attitude. Anomalies such as the organic and developmental formation of the urban form lie that can analyze this type of texture in the most appropriate way at the national level and measure the causes of the formation after analyzing the findings, the necessary results along with the type To provide the necessary systematic insight for mandatory implementation at the urban management level as well as strategy.

1.1. Research Background

According to specific studies on the subject of informal settlements, the topic of examining the morphology and patterns of its urban form is very rare. McCartney and [Kuffer et al. \(2017\)](#) in their studies based on the tradition of [Canzen](#), based

on the urban form of the informal settlement of Hayes, have emphasized the formation of morphology. Drummond (1981) has drawn the structural network of informal settlements in the city of Rio de Janeiro in Brazil and classified the type of construction and urban spaces in it. ([Zillman, 2000](#); [Fakade, 2000](#)) In addition, we can refer to the studies of [Hofman \(2015\)](#) and also [Taubenbock and Werthmann \(2015\)](#) who paid attention to the urban form of informal settlements and based on this, made evaluations in the sample have done cases. [Perlman \(1969\)](#) brought up the issue of marginalization and explained the context of informal settlements in the form of how the favelas of Rio de Janeiro, Brazil, in the form of a book entitled “Marginalization: Urban Poverty and Policies in Rio de Janeiro”

negative view He challenged the poverty of the city that prevailed until then. Stocks also drew a clear line between successful and unsuccessful communities or slums in another classification. (Kabir et al., 2010) Turner proposed a typology based on the dynamics of the groups living in this type of informal settlements and divided them into three categories: low-income newcomers or low-income newcomers, stabilizers, and searchers. The Human Settlements Organization has presented the general indicators for identifying poor neighborhoods at the global level, according to which, each slum household needs one or five specific facilities, such as durable housing, a suitable area for living, access to health facilities, and security of occupation. (UN-Habitata, 2015) in another research conducted by Richard Slizas (2016) entitled "Management of informal settlements based on geographic information" to identify these types of tissues using remote sensing technology and G.A.S. has discussed and proposed the adaptive cases of measuring these types of fabrics. Shaw and Das (2018) in their research entitled "Structuring the rights of poverty in informal settlements and its applications in reducing urban poverty" presented that the main indicators of the formation of informal settlements have also been considered and reviewed. In a general view, the mentioned research in the focus of the present research can be evaluated in several cases, so that most of the mentioned researches: 1- The conceptual and essential aspects of informal settlements are taken into consideration, which necessarily has some kind of purpose. Fundamentally, they have produced a level of information. 2- The issue of informal settlements has been raised in the discussion of identification with the standard divisions of several criteria, which researchers have not necessarily focused deeply on what and how this process is. 3- In an innovative form, concepts such as adaptive causes at the case level It is discussed, but they are not applied in the structural dimension. As a result, the concept of urban morphology in the form of informal settlements in the present research is considered by examining the concepts and factors involved and trying to explain the comparative model in the formation from the micro to the macro level.

2. Materials and Methods

The excessive growth of the population has followed the growth of urbanization, and this in developing countries, with the increase in the level of enjoyment of the cities and the increasing deprivation of the villages, has caused unequal development in these two settlements, which has resulted in internal migrations and led to It has led to the creation of informal settlements (Kipper and Fischer, 2009). The term informal settlement is synonymous with the occupation of land by a person who does not own the land on which he has settled. And slum refers to an area with inappropriate and dirty houses and high density, this term dates back to the 1820s. Probably derived from Slum, which refers to a swampy and dirty place (Cowan, 2000). The original and primary origin of informal settlements and their process of emergence was traced to the industrial revolution and the countries that developed during it. After the industrial revolution, this type of settlement spread first in English cities and then to other European cities (Khazaie and Zivaryar, 2012). This has gradually manifested itself in all the cities of the world that have taken the path of development. Today, the majority of cities in the world, especially the cities that are developing, face the problems of this type of settlement (Rahnama and Tavangar, 2008). Many different terms have been used to describe informal settlements, each of which indicates aspects of the characteristics of these settlements. Among others, we can list spontaneous, unorganized, temporary, irregular, illegal, self-help, fringe, peripheral, shack, and low-income settlements (Te lintel et al., 2018). According to Reichertz (2019), an informal settlement is a group of housing units that are built on lands that are illegally occupied and people do not have legal claims regarding these lands (Clark, 2014). The Center for Human Settlements (2003) considers informal settlements as housing without legal frameworks and regulations that are established in cities and can be illegal in various ways (UN-Habitat, 2015). From the point of view of the World Bank, these settlements are affected by the low quality of housing and the environment and have been forgotten (Kazemian et al, 2012).

Informal settlements are a manifestation

of socio-economic injustice in the field of distribution of resources and facilities in the context of urban society, which causes their residents to not benefit from the benefits of urbanization (Gleeson, 2006 and Barrent, 2011). Informal settlements are the settlements of the urban population based on informal and illegal contracts and far from the rules and principles of the official land and housing market. The department does not provide a plan or program (Piran, 2002). In these settlements, the process of building and creating housing is opposite to its official and standard process. In such a way that after finding the land, people first start construction, which is usually in a very short and fast period and far from complying with the rules and regulations of housing construction, and after the completion of the work (that too in case of coercion by the municipality), they start to take legal action such as possession and service and other cases. This itself causes the provision of infrastructure for the fabric after its formation and practically deprives them of urban services (Porkheradmand et al, 2009). Informal housing is defined as shacks of prominent figures of urban poverty, which are formed in or near cities in the form of cars, without building permits and official urban development plans by a group of low-income groups with a low level of quantity and quality of life (Sarafi, 2002). The formation of informal settlements in Iran dates back to 1320-1325, which is one of the examples of urban poverty that arose in that period (Irandoost,

2009). Its intensification is related to the land reforms (1961), and the formation of industries in the cities, and as a result, the increase in migration from the village to the city, which itself caused a change in the spatial organization of the cities (Irandoost, 2009; Mojtahedzade, 2003; Habibi, 2008; Hesamian, 2009).

2.1. The causes of informal settlement: Iran Situation

In Iran, this phenomenon has been formed and expanded in different periods and under different titles. According to the statistics of the National Urban Regeneration Headquarters of the Ministry of Roads and Urban Development, 30 percent of the country's urban population, equivalent to 20 million people, live in informal settlements and dilapidated structures. These people live in more than 57,000 hectares of middle-class slums, 21,000 hectares of historical areas in city centers, and 48,000 hectares of informal settlements in the country. Wide areas of the country's cities are facing complex problems, especially urban poverty, lack of safety, and identity crises. Currently, there are 974 informal settlements in the country, and it is expected that the population of informal settlements will reach 11 to 13 million people, which includes 20% of the country's population. In general, informal settlements are not able to produce the desired urban quality due to the inappropriate basis of social relations and interactions, and they spread their identity inefficiency. Management is important. These types of tissues are mostly populated and have an



Figure 2: Examples of informal settlements around the big cities of Iran, **right image**: the marginal texture of the south-west of Tehran city, **middle image**: the slums of the southern heights of Mashhad city, **left image**: the texture of the Ide-lou neighborhood, Tabriz

organic transportation network, but considering their network structure, their formation process can also be considered from the proximity of the main arteries of the cities. (Figure 2)

Many issues and issues can be listed as the causes of the formation of these settlements, and they are different and varied according to each city and case. Because of the amount, manner, and time of the development of each city, the conditions of the villages and villagers in the vicinity, and the area of influence of that city, the way of managing and dealing with the issues caused by the migrations and many such cases can be the causes and background for the formation of such Establish settlements in each city. Therefore, some major and main cases that are somehow common among all cases can be explained as follows; The discriminatory and impoverishing structure that has led to the unfair distribution of power and wealth in the society, the weakness of planning to respond to the housing needs of the low-income strata and the lack of provision of urban spaces to accommodate them, the lack of access of the strata in need to official systems credit and housing loans and construction and employment, the lack of support from the government and relevant institutions for these groups even in the direction of self-help house construction and uneven economic development of cities, focusing on industrial and service projects and the marginalization of the sector Agriculture

in certain eras such as the 20s and 30s, the latter case, has caused a deep class gap between urban dwellers and rural dwellers and the migration of rural groups to informal settlement areas. Zangiabadi et al. (2005), citing various reasons for the phenomenon of marginalization, consider migration as one of its important reasons (Zangiabadi et al., 2005). Immigration leads to the excessive growth of cities and leads to urbanization, in other words, immigration and urbanization are two related aspects. Migration expands urbanization and urbanization is the cause of migration (Brinley, 1966). In Iran, the factors affecting marginalization are explained by the transition from the traditional production system to the capitalist system, the distribution and dispersion of the population and activity at the country level, the high population growth and its impact on the rapid growth of metropolises (Hosseini, 2014). As a result, according to the structure of theories related to the structure of the formation of informal settlements as well as the formalization of informal settlements, the viewpoints of each of the theorists can be explained in the form of the following concepts, which can be called some such as the ecological viewpoint, the viewpoint He pointed out a period of poverty and marginalization, liberal views, radical views, the view of the political economy of space, etc. Based on these views, it is possible to formulate the factors of the formation of informal

Table 1: A general view on the topic of the formation of informal settlements from different points

View	Formation indicators and indexes	Sources
Ecological view	<ul style="list-style-type: none"> • Land use change • Lack of housing and lack of repair for its use 	(Momataz, 2018) (Hiraskar, 2018)
Periodic view of poverty and marginalization	<ul style="list-style-type: none"> • Lack of investment • The migration of villagers to the city 	(Zangiabadi and others, 2005) (Brinley, 1966) (Hosseini, 2005) (Sheikhi, 2001)
Liberal view	<ul style="list-style-type: none"> • A large population of poor households • Disorganization and social despair among the poor • Migration to find a job • The wide gap between social classes 	(Clark, 2015) (Zanjani, 2001) (Shakoui, 2006) (Irandoost, 2010)
Radical view	<ul style="list-style-type: none"> • Low level of wages • Reduction of investment in poor areas • Lack of investment incentives for the private sector 	(Jennervik, 2006) (Rabbani and others, 2004) (Irandoost, 2010)
The political economy of space view	<ul style="list-style-type: none"> • Relations between social classes • Accumulation of wealth and power in a city 	(Swain & Garasky, 2007) (Mincer, 1978) (Shibek, 2013)

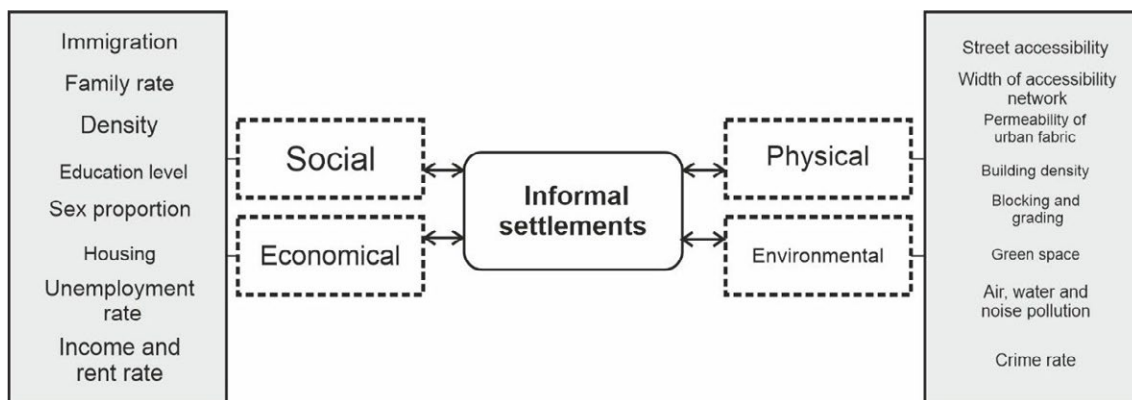


Figure 3: Dimensions of the formation of informal settlements in the conceptual framework of factors affecting it

settlements in Iran. (Table 1) and the structural factors that shape it, taking into account the structural conditions of the country of Iran and the analysis of multi-year challenges. (Figure 3)

According to the nature of this type of division in different views, criteria can be divided into social, economic, environmental, and economic branches. Therefore, he proposed the basic concepts as factors affecting the formation of these types of tissues; Household dimensions, population density, gender ratio, immigrant ratio, the burden of work, income, unemployment rate, housing value, building structure, residential per capita, building quality, accessibility, ownership, social crimes, green space, etc. (Figure 3) In general, to investigate the concept of informal settlements, it is necessary to know its dimensions to provide a framework for evaluation in a general analysis.

3. Methodology

This research is of a descriptive-analytical type, which has a development aim, but its fundamental characteristic can be pointed out, especially in explaining the depth of the theoretical foundations, the proposed model, and the framework. The method of collecting information is in the form of a library and field from references such as the architecture department of academic institutions and international data and at the field level. First, after examining the theoretical

foundations as well as the history of the research in the two dimensions of procedure and content, where there is an emphasis on clarifying the aim, not repeating it, factors are extracted as the result of the research framework and using the Delphi method as the final indicators proposed in the form of a model. Provided. In the Delphi method, in successive courses, by forming an elite board consisting of specialists in the field of architecture, university professors, and researchers in the field of architecture in the number of 10 people, in the form of a digital questionnaire using Google tools and sending the answers in the form of a link. is received, the type of answers is also set based on the Likert spectrum as very low, low, medium, high and very high impact. The number of factors affecting the issue of informal settlements and the factors of its formal formation, especially its urban pattern, are mentioned, after going through stages with the calculation of the specified average limit and the calculation of Kendall's coefficient for the answers, polling is stopped when a specified average is reached and the index The final results are proposed as a research framework. In the following, the extracted indicators are explained as the main model of the research as a result using intermediate analysis. It should be noted that the proposed model and its indicators are calibrated only based on the existing conditions in Iran, and in future research, the field of investigation can be extended to third-world countries.

4. Findings and Discussion

4.1. Findings of the implementation of the Delphi method

In the first round, the panel members identified 10 factors out of 15 factors that were extracted from successful research as having a high and very high impact on developing the proposed framework of the urban pattern formation model in Iran's informal settlements. The detailed and extended results related to the implementation of the first stage of questionnaire distribution are given in the following table. The factors of green space, air, water, and noise pollution, household size, housing quality, and urban management have been removed from the Delphi process due to their average importance of less than 2.5. (Table 2)

After the implementation of the first stage of assessment and evaluation of the opinion of the experts of the panel regarding the factors proposed and extracted from the theoretical bases and also receiving the suggestions of the panel members, in this round, to observe caution, all the factors extracted from the theoretical bases are again Together with the average opinion of the members in the first round and the previous opinion of the same member, it was provided to all the experts of the panel. The panel members

identified 6 factors out of 10 factors that were presented in the second round as having a high and very high impact (with an average greater than 3) on the proposed framework of the urban pattern formation model in Iran's informal settlements. The detailed and extended results related to the implementation of the second stage of questionnaire distribution are given in the table below. Kendall's coordination coefficient for the answers of the members about the order of the factors that had a high and very high influence in this round was 0.795, among which the factors of population density, building density, quality of urban infrastructure, and urban services were removed. has been (Table 3)

In the third round of compilation of the framework of the proposed indicators of the urban pattern formation model in informal settlements of Iran, along with the average opinion of the members in the second round and the previous opinion of the same member, it was made available to all the experts of the panel. The detailed and extended results related to the implementation of the third stage of questionnaire distribution are given in the table below. Kendall's correlation coefficient for members' answers about the order of the six factors was 0.798. (Table 4)

Table 2: Phase 1 of the fuzzy method in compiling the proposed indicators of the urban pattern formation model in informal settlements in Iran

Num.	Factors	Number of responses	Average	Standard deviation	Minimum	Maximum
1	Street accessibility	23	4/66	0/25	3	5
2	Width of accessibility network	22	4/58	0/27	3	5
3	Green space	19	2/12	0/37	1	4
4	Air, water, and noise pollution	20	2/42	0/35	1	3
5	population density	17	4/10	0/27	2	4
6	Blocking	21	4/20	0/20	3	5
7	Grading	22	4/45	0/35	3	5
8	Building Density	21	3/30	0/28	2	4
9	Proximity to the main transportation network	21	4/21	0/46	1	3
10	Household-level	18	2/11	0/50	1	3
11	Quality of urban infrastructure	19	2/11	0/36	2	4
12	Housing quality	18	2/28	0/41	1	4
13	Urban Services	19	3/41	0/48	1	4
14	Topography	20	4/45	0/65	3	5
15	Urban Management	21	2/35	0/29	2	4

Table 3: Phase 2 of the fuzzy method in compiling the proposed indicators of the urban pattern formation model in informal settlements in Iran

Num.	Factors	Number of responses	Average	Standard deviation	Minimum	Maximum
1	Street accessibility	22	4/76	0/27	3	5
2	Width of accessibility network	23	4/65	0/29	3	5
3	population density	18	2/90	0/25	2	4
4	Blocking	22	4/40	0/25	3	5
5	Grading	23	4/55	0/38	3	5
6	Building Density	20	2/80	0/32	2	4
7	Proximity to the main transportation network	24	4/31	0/56	2	5
8	Quality of urban infrastructure	18	2/25	0/56	2	4
9	Urban Services	17	2/85	0/38	2	4
10	Topography	22	4/75	0/35	3	5

Table 4: Phase 3 of the fuzzy method in compiling the proposed indicators of the urban pattern formation model in informal settlements in Iran

Num.	Factors	Number of responses	Average	Standard deviation	Minimum	Maximum
1	Street accessibility	22	4/76	0/27	3	5
2	Width of accessibility network	23	4/65	0/29	3	5
3	Blocking	22	4/40	0/25	3	5
4	Grading	23	4/55	0/38	3	5
5	Proximity to the main transportation network	24	4/31	0/56	3	5
6	Topography	22	4/75	0/35	3	5

5. Result and Conclusion

5.1. Reasons for stopping polling

The results of the three rounds of implementing the Delphi method in the research show that a consensus has been reached among the panel members for the following reasons and the repetition of the rounds can be ended:

- In the second round, more than 50% of the members chose 6 influential factors in compiling the framework of the proposed indicators of the urban pattern formation model in Iran's informal settlements, who had an average greater than 3 among their factors.
- The standard deviation of the members' answers about the importance of the factors in the third round has decreased significantly compared to the previous rounds.
- Kendall's coordination coefficient for members'

answers about the order of factors in the third round is 0.798. Considering that the number of panel members was ten people, this amount of Kendall's coefficient is considered quite significant.

- Kendall's coefficient of coordination for the arrangement of the 6 influential factors in compiling the proposed indicators of the urban pattern formation model in the informal settlements of Iran in the third round compared to the second round only increased by 0/003 This coefficient or the degree of agreement between Panel members do not show significant growth between two consecutive rounds.
- The points given to the factors by the experts and elites indicate that the access indicators of roads, the width of the road network, and topography have the highest score and as a result, the most impact in explaining the model of the formation

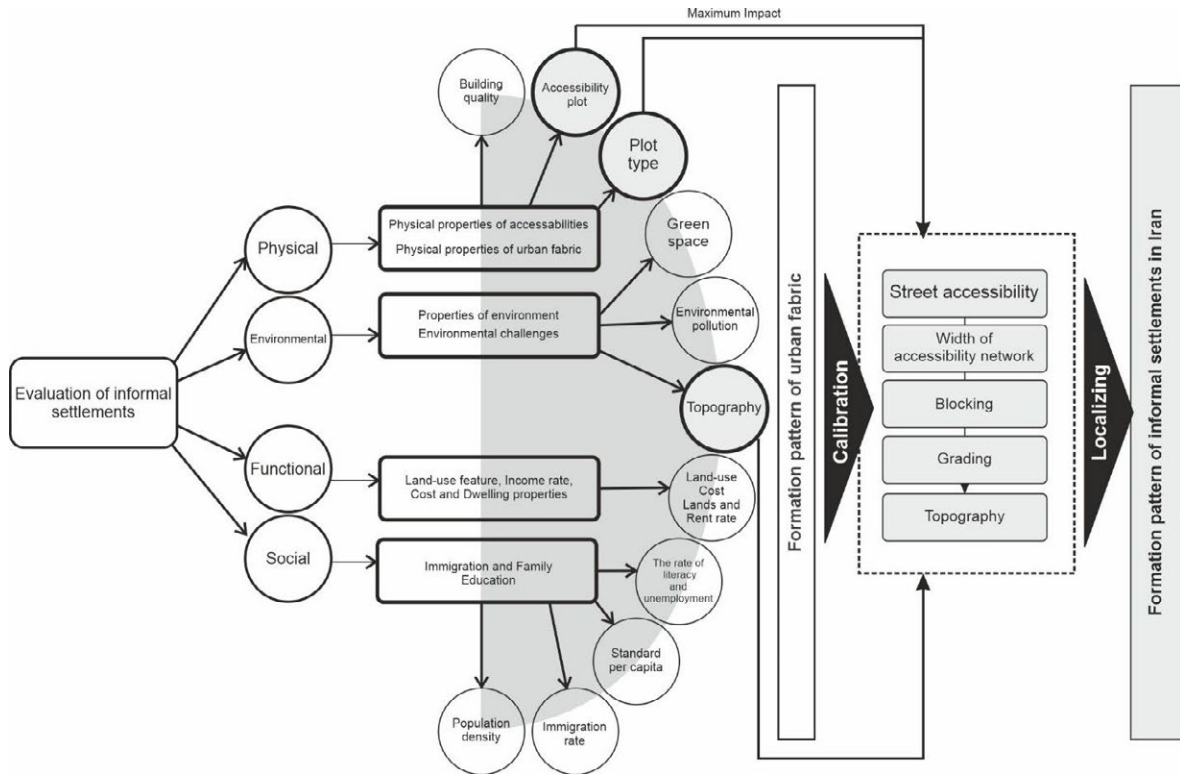


Figure 4: The structural model of the research to evaluate the pattern of urban formation in informal settlements

Table 5: Operational explanation of criteria, sub-criteria, and measurement metrics with the qualitative assessment of informal settlements with the migration approach in marginal contexts.

Indicator	Index	Metric	Type of evaluation
Physical	Street accessibility	<ul style="list-style-type: none"> Graph structure of access hierarchy 	Qualitative
	Width of accessibility network	<ul style="list-style-type: none"> Passage width 	Quantitative
	Blocking	<ul style="list-style-type: none"> Block size Block order 	Quantitative
	Grading	<ul style="list-style-type: none"> Grain area in square meters Ground floor plan form and its shape Quality of buildings 	Quantitative
	Proximity to the main transportation network	<ul style="list-style-type: none"> Distance from the main artery 	Quantitative
Environmental	Topography	<ul style="list-style-type: none"> The amount of height above the surface Topographic structure 	Quantitative and Qualitative

of the urban pattern in the informal settlements of Iran in the process. Compilation of the framework is the suggested indicators in the perception of form, based on which the structural model and the research framework can be presented (Figure 4 and Table 5).

According to the research process and examination of the theoretical foundations, as well as the use of the research background in the Delphi method to achieve the effective factors on the formation of the urban pattern in the informal settlements of Iran, it is possible to predict the extent of the limitation of this type of structure. In future studies, methods such as MAXQDA can be used to check the number of concepts involved, as well as to personalize and test them, and evaluate the results in a specific structure. Therefore, based on the mentioned concepts, to achieve the appropriate method for evaluating informal settlements, focusing on the pattern of formation in the marginal context, a structural model can be presented, which, by examining the mentioned criteria, tries to refine the sub-criteria involved in Evaluation of this type of informal settlements. (Figure 4)

The result is that it is possible to evaluate the localized indicators based on two environmental and physical components to evaluate the pattern of urban form in informal settlements. These types of indicators can involve more dimensions in the optimized model. In general, there are two axes in the formation pattern of informal settlements in Iran:

1. Proximity to the main transportation arteries due to the presence of land and lack of restrictions on housing construction
2. Using topography to occupy land and create housing

With these two axes, it is possible to recognize the existing urban patterns by adding the structure of the access network to it and creating blocks and the type of granularity in it. According to the types of urban settlements, in future studies, the urban form of informal settlements can be classified according to the type of climate, topography, population, the use of urban spaces, etc., and presented in the proposed model for evaluation.

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