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## **A study on the Perceptions and Expectations of Flexible Urban Spaces in Iran Using gap Analysis Model**

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### **Abstract**

Human is a compatible creature with the ability to grow the modern knowledge and new patterns of activity. Social pressures and cultural norms could affect formation of behavioral patterns and attitudes of urban planners. However, the framework is not static and could be changed over the time and the urban planners are responsible for controlling, conducting and evaluating the reflection of these changes and playing role in their formation. It should be noted that with such speed of changes in the current cities, realization of a degree of flexibility if required and the future prospects could clear flexible and creative cities as the contexts for economic, social and cultural development of societies and urban spaces could be important sites to meet needs of citizens and formation of social activities. Now in this study, which is a descriptive-analytical research in terms of nature, the main objective is to recognize required components in formation of flexible urban space in Iran and to measure the perceptions and expectations of flexible urban spaces in Iran. It should be mentioned that achievement of these spaces with flexibility capabilities needs firstly some preconditions including accessibility, diversity and readability. In this regard, at the first, qualitative data are collected using library method and the literature is reviewed to identify the most important components involved in formation of flexible urban space and then, the data are measured in frame of Delphi Method. Then, to clear the differences between expectations and perceptions, a questionnaire is used for paired mean comparison of components. Due to the difference between the existing and expected conditions, this issue was confirmed. Finally, for better understanding of the difference and using the gap scatter plot, relevant factors of physical system and energy were placed in the part of balanced and fixed factors, factors related to spatial and functional system and meeting needs of citizens as the problem and relevant factors of formation process and role of citizens in growth balance were observed.

**Key Words:** *flexibility, Iran Urban Spaces, flexible space component, Gap Analysis Model*

## Introduction

Urban space at the current age is not only a product, but also it could be formed in interaction with a society with main features including dynamicity. Change in nature of needs and role of audiences at the space and formation of new behavioral patterns could lead to need to change in urban space (Leach, 2003, 384). Therefore, an essential today is paying attention to this issue that how the changes of the current age could be adapted with human needs and trends for creation of urban spaces and provide potential environment for behavior and lifestyle in the contemporary people through creating a collection of capabilities in a special situation (Lang, 2011, 116). Today's people need interaction with others and the space they face and not necessarily having forcible and strict behavior in this place (Bennett, 2007, 86).

Therefore, with such challenging changes at the current cities, realization of a degree of flexibility is essential and the future prospects could clear flexible cities as contexts for development of societies and urban spaces, elements to provide conditions to meet needs of citizens and formation of social activities at the cities. According to importance of this issue, the rest of research has tried to identify the components of a flexible urban space and use Gap Analysis model to measure the perceptions and expectations of these urban spaces in Iran.

### Methodology

In terms of nature, this study is a descriptive-analytical research. In this type of research, the main purpose is collecting patterns and ideas to find deep understanding of this issue. For this purpose, a mixed approach is used with the aim of combining qualitative and quantitative methods to achieve appropriate method to realize research objectives. In this regard, at the first, the relevant literature is reviewed using library method and the most important factors affecting creation of flexible urban space (32 items) are extracted. Then, in

frame of Delphi method and using questionnaire, the items were measured and ranked in 3 steps and based on Snowball Method with statistical sample consist of 26 experts in field of urbanization and urban planning.

In factor analysis, fitness of desired factor structure is tested. According to classification of components in fundamental capabilities to create flexible urban spaces, factor analysis is used to evaluate construct validity of the research instrument. As this study should conduct the mean comparison of desired and existing situations, it is necessary to specify type of distribution of observations (normal or abnormal) and implement adequate statistical test based on that. To this end, Kolmogorov-Smirnov test is used. In this test, the H0 refers to normal statistical analysis and alternative hypothesis (H1) confirms abnormal distribution.

As data distribution in this study is normal, paired comparison parametric test is used for gap analysis. In gap analysis, using a 33-item questionnaire and sample size of 110 selected experts from all around Iran, the mean value of existing (perceptive) and ideal (expected) situations are compared and decision making is taken.

For more careful analysis, it is important to identify problematic factors in flexible urban spaces in Iran based on obtained gaps. For this purpose, scatter plot is used. The vertical axis of this plot is formed by existing (real) status and the horizontal axis is formed by expected (desired) status dimensions with gap. This plot could specify 4 analytical sections including consolidated balance, growth balance, critical and problematic balance.

### Literature review

The concept of flexibility has been considered seriously for a few years. Hence, a few integrated studies have been conducted in this field to the date and the literature of this concept, especially emphasis on urban space, should be hardly extracted.

In Persian references, only several articles and

theses are existed under the titles of “flexibility and flexible housing” (Ismail Dokht, 2011) and “flexible learning environments and a model to analyze flexibility in Iran traditional housing” (Eynifar, 2003), which have mostly investigated this issue in view of architecture. Eynifar has proposed a 2-D matrix of relevant concepts of flexibility in micro, middle and macro levels and has proposed a model to analyze flexibility in Iran traditional housing. However, among articles and books, the majority of works have been conducted to define and discriminate this concept. Adrian Forty (2000) in his book “Words and Buildings: A Vocabulary Of Modern Architecture”, has defined flexibility as one of the 18 key words of modern architecture. Moreover, other theorists such as Rabank, Sheppard and Tone (1973 and 1974), Hertzberg (1991), Grok (1992), McKrinor (1998) and Habraken (2008) have studied different dimensions of flexibility in short and not in form of a comprehensive research. In this regard only a single study has been conducted in field of deep identification of this concept and expression of practical aspects of relevant approaches comprehensively. Schneider, Tatjana and Jeremy Till (2007) in the book “Flexible Housing” and two articles of flexible housing: opportunities and limitations (2005); flexible housing: an approach to goal (2005) has defined this concept comprehensively and has also defined relevant terms and has described designation approaches and operational ideas to achieve to flexibility in housing (Ismail Dokht, 2011, 5).

In other studies, types of flexibility (Pena and Parshall, 2012, 84) and need to make urban spaces flexible have been studied (Thompson, 2002). Over the years, some studies have been conducted in field of urban and public spaces and necessity of flexibility in these places (Gehl, 2013). Moreover, in a study under the title of “public space of urban environment”, classification of flexibility is studied (TehBor Tsong, 2011).

### Concept of urban space

In a conceptual view, urban space could be considered as an organized phenomenon of information emerged in form, performance and meaning. The formation context and enhancement of social life of a society that could be an indicator of culture and the urbanization style of a civilization could be considered as the objective urban space created by combination of social relations in physical context in conceptual field and in line with required performances of society (Majedi, Mansuri and Haji Ahmadi, 2011, 263).

From functional perspective, urban space should be considered as an external space placed among the buildings. These spaces could be defined by facades and city roof (Paumier, 2004; Chau, 2000).

The position of urban spaces among the created elements at the city in different scales is underlying, so that it could be mentioned that urban space is the only unique element of the built environment at the city, which is in field of practices of engineers, architects and urban planners.

### Achievement to high-quality urban space

In order to enhance activity level of urban space, Gehl (2004), Paumier (2004), Davies (2007) and Evans (2007) believe that 7 qualities are required to create and develop urban space including safety, comfort, inclusiveness, attractiveness, durability, good management and flexibility. It should be noted that flexibility has key role. Modern attitude to urban spaces with flexibility approach tends to define and reuse space, individuate open spaces, creation of marginalized social opportunities due to the environment and in framework of dynamic urban spaces and access networks at urban spaces (Thompson, 2002, 59).

### Concept of flexibility

Lexically, flexibility means competencies of adaptability with any situation and environment (Moein, 2008), something that is bendable (Dehkhoda, 1998, 3765) and easy changeability to fit the environment and changes in



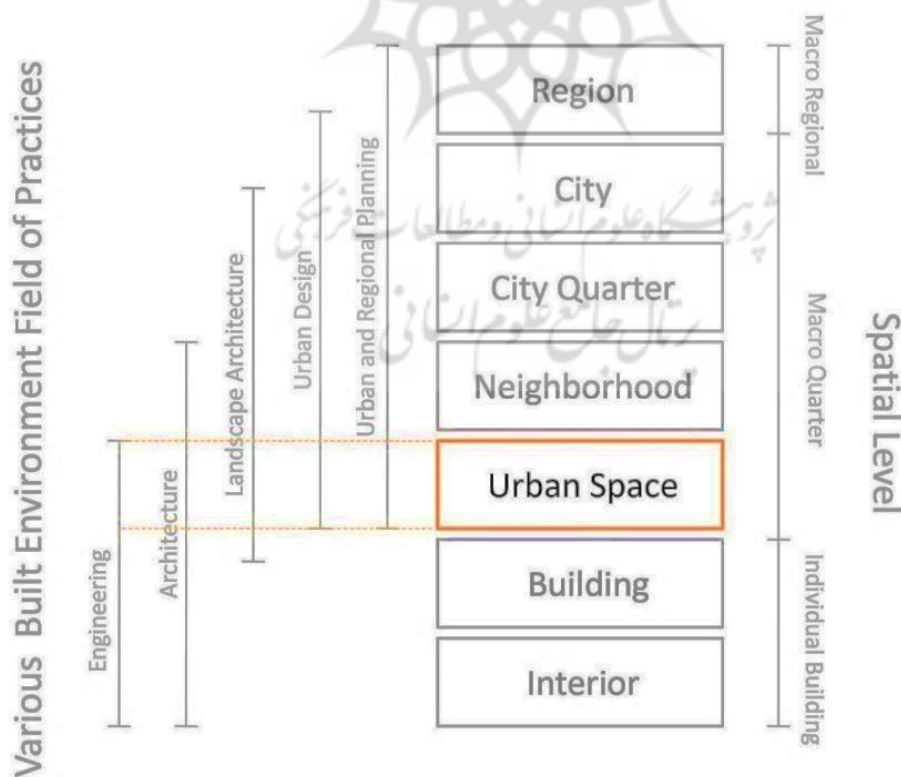
Row	Author	Year	Title	Results
1	Ian Bentley	1985	Responsive environments	The study introduces flexibility as one principle to achieve responsive environment and tries to realize this issue through taking some strategies and decisions.
2	Adrian Forty	2000	Words and Buildings	In his book "Words and Buildings": modern architecture vocabulary, he has defined flexibility as one of the 18 key words of modern architecture
3	Pena and Parshall	2001	Problem seeking: an architectural programming primer	Types of flexibility and need to making urban spaces flexible are investigated.
4	Catharine Ward Thompson	2002	Urban open space in 21 <sup>st</sup> century	In this study, it has been tried to investigate something that is expected from urban open space of 21 <sup>st</sup> century in individual and social view and the study has also tried to challenge urban open space in terms of democratic perspective and public accessibility.
5	David R Godschalk	2003	Urban hazard mitigation: creating resilient cities	The study introduces cities as complicated and continuous systems, which considering the existing connections in the network could result in increased resilience. Mitigation of vulnerability, increase in adaptability, participation, connection of urban networks and existing uses at the cities could be factors affecting resilience at cities.
6	Hyogo	2005	Framework for action 2005-2015: building the resilience of nations and communities to disasters	A 10-year operational framework made by UN member states and the guidelines to create flexibility, along with advancement controlling system in national level is presented.
7	Schneider and Till	2005	Flexible housing: the means to the end	Comprehensively, in addition to define this word and relevant words, the designation approaches and operational ideas to achieve to flexibility in housing is considered.
8		2005	Flexible housing: opportunities and limits	
9		2007	Flexible housing	
10	Amaratunga and Haigh	2011	Post-disaster reconstruction of the built environment: rebuilding for resilience	Through collecting the articles and theories of various people in a complex, reconstruction of built environments after disasters for purpose of resilience are investigated and it has been found that resilience should be considered among requirements of reconstruction.
11	TB Tsong	2011	Public spaces urban environment	In the study under the title of "public spaces urban environment", in addition to analyze flexibility, the classification of this concept is considered.
12	Tilio et al	2011	Resilient city and seismic risk: a spatial multicriteria approach	Cities have been studied from 3 aspects including natural structure, static society and public activities. Also, increase in resilience in every aspect is considered as a factor to increase resilience

▲ Table 1. Relevant researches of flexibility, Source: author (2016)

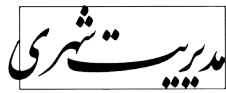


13	Allan Bryant and	2012	Resilience as a framework for urbanism and recovery	Resilience of cities and role of open spaces in resilience against earthquake are considered and the role of urban planning and rehabilitation planning in increasing resilience is emphasized.
14	Eckart	2012	Flexible urban drainage systems in new land-use areas	This study has shown that flexibility is a solution for deep decision making in field of urban design with the existence of certainty in future.
15	Jan Gehl	2013	Cities for people	Investigations are conducted in field of urban and public spaces and necessity of flexibility at these places.
16	Afhami and Alizadeh	2013	Aesthetics of flexible spaces	This study has investigated flexible spaces and necessity of using these spaces, along with rapid changes of the society.
17		2014	Flexibility of housing architecture in the age of population evolutions	This study has used descriptive-analytical method and has investigated the concept of flexibility how to use it in field of population evolutions.
18	Eynifar AR	2014	A model to analyze flexibility in Iran traditional housing	Eynifar has proposed a 2-D matrix of relevant concepts of flexibility in micro, middle and macro levels and has provided a model to analyze flexibility in Iran traditional housing.
19	UNISDR	2015	Sendai framework for disaster risk reduction 2015-2030	Guideline to prevent new risks and reduce current risk of disasters leading to prevention and reduction of facing hazards, vulnerability and increased readiness for responsiveness and recovery and enhancement of resilience.

▲ Table 1. Relevant researches of flexibility, Source: author (2016)



▲ Figure 1. Position of urban space among various built environments (Moughatin, 2007; Chau, 2000)



different situations (Mardomi and Delshad, 2010, 110). The term “flexibility” is taken from the Latin word “flexibilis” (bending and smooth) and it means lexically “capability to be changed” (Oxford Dictionaries, 2016), “capability to cope with conditions and new changes” (Merriam-Heritage Dictionary), changeability, “capability to cope with variable conditions”, “capability of easy changing” (Longman English Dictionary Online, 2016) (Afhami and Alizadeh, 2013, 59). The concept of flexibility could be considered as action of a tree that is bended against wind and has returned to its original form again (Kaluza and Blecker 2005; Sennett, 2006). In short, flexibility is the ability to be yield pressure and the ability to return to the original physical form. There are various meanings for the term “flexibility” and hence, it is difficult to achieve an exact meaning in a special situation for this term (Lynch, 2002, 214). The true and exact meaning of flexibility refers to physical properties such as elasticity, yield to pressure and reconstruction of physical form (Kaluza and Blecker 2005; Sennett, 2006). However, the term flexibility could be used as a property to face ambiguities in planning and decision-making processes.

Saleh et al (2001) have defined flexibility as a rich and ambiguous term that is highly associated with positive features. According to these scholars, majority of authors have defined flexibility directly as the changeability in order to achieve to modern conditions, needs and functions, ability to respond to future changes or the ability to improve the future performance of a system. Exact definition of flexibility is a precondition to discriminate the concept of flexible creation and understand it. Defining the subject is required as a basis and foundation for a measurement method, which shows concept of flexibility in turn (Upton, 1994; Hocke, 2004).

#### **Flexible urban space**

The concept of flexibility in urban fabric and space is loaned from the literature and stud-

ies on behavior of environmental system in coping with stresses and disputes caused by exterior factors (Davic and Welsh, 2004) and shows continuity of relations inside a system (Barnett, 2001, 978).

Flexibility in designation includes activities taken in relation to changeability to achieve new use and function (Afhami and Alizadeh, 2013, 59). In environmental architecture and design, the aim by the term flexibility is organization of a manmade space and changing it to achieve new conditions, needs and functions (Eynifar, 2003, 66).

An issue in field of urban spaces is to accept that these spaces should be responsive to various needs created as a result of formation of new lifestyles and existence of different cultures and values and variety of attitude and their expressions. Also, it should be noted that whether it could be trusted that what is suitable for a group in the space is not a barrier to enjoyment and meet needs of other groups. Hence, it should be accepted that urban spaces could not be considered as 19th century parks. These parks were like melting pots with the capability to melt all people from different cultures as a unit nation. However, today's needs tend to create spaces like salad bowl, in which different people and cultures could gain individual expression with various needs (Thompson, 2002, 60). According to the mentioned, the main purpose by creating flexible spaces is to create new spaces for required functions through changing spatial and physical structure and at the same time, preserving place identity.

#### **Requirements of achieving to flexible urban space**

Undoubtedly, creation of flexible urban space with the ability to provide various options in order to meet needs of citizens needs some conditions and requirements, which could be investigated in two groups of spatial and physical requirements.

## Spatial requirements to create flexible urban spaces

### Structural balance:

Conrad Hal Waddington (1970), English Biologist, has proposed a structural attitude in relation to systematic attitude: through planting wheat seeds, although some changes may be observed during its growing process, it has fixed identity. It means that wheat could not be changed into beet. Waddington has introduced this fixed factor as structural balance, which is responsible for preserving the identity during the changes (Eslami, 2013, 38). It should be noted that formation of structural balance as one requirement in flexible urban space and during the changes at the city could lead to preservation of space identity over the time.

### Accessibility

Only the accessible places for the citizens could give the right to choice to meet their needs. With the interpretation, quality of accessibility - number of potential ways and routes to an environment – could be considered as axial factor to achieve flexible urban space.

### Diversity

Diverse spaces are spaces with easy access, which could direct proposed options of space and the process of applying experiences

(Bentley et al, 2007, 6).

### Readability

Citizens can take benefit of options supplying the quality when they have the ability to understand the spatial system of place and what happens there. Readability is a quality, which could provide conditions to make a space understandable (Bentley et al, 2007, 113).

Physical requirements to create flexible urban space

### Positive exterior spaces

Flexible urban space is a positive and integrated space with certain quality and limit, which could provide optimized size and appropriate form adjusted with the space function and identity (Davies, 2007).

### Multifunctional spaces and buildings

An essential issue in access to flexible urban space is formation of multifunctional spaces and buildings at this environment. The main indicators of flexible spaces could be coping ability and adaptability, which could be created in line with encompassing various functions over the time and formation of various activities in the space.

### Active counters

The interaction between buildings and public spaces could be one of the most important issues considered in flexible urban space and this could be realized through creating semi-



▲ Figure 2. Stoic for protection from sun and rain (Bentley et al, 2013)



▲ Figure 3. place for social interactions (Bentley et al, 2013)

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▲ Figure 4. place for sitting and waiting (Bentley et al, 2013)

public space as passage space. These areas are formed after interaction of adjacent interior private activities and wide range of exterior activities in these edges.

#### Appropriate facilities

A space to be used for different purposes should be a comfort and attractive space and provide appropriate facilities. These facilities could prevent unpleasant feelings of space in citizens and could also enrich enjoyment feelings of users.

#### Capabilities of flexible urban space

In rest of the research, proposed classification of Lynch is used to provide the capabilities extracted from theoretical literature in frame of formal and process means.

#### Results

The first step in this study is identification of the most important capabilities affecting creation of flexible urban space. For this purpose, through review of theoretical framework, the major capabilities affecting creation of flexible urban space are identified. Then, the capabilities have been analyzed based on a consensus of experts using Delphi Method (table 2).

The identified capabilities as a result of review of theoretical framework were provided for a group of experts and urban senior directors across the country. According to limitations of availability of these individuals, snowball

method is used to collect required data in this section. In this field, the capabilities were provided for the experts in 3 steps and they were asked to express their complementary opinions in addition to determine the significance of each capability.

According to results of Delphi, 17 capabilities in table 3 were extracted as main capabilities for formation of flexible urban spaces. Based on obtained scores by each capability, Delphi model is used to rank the capabilities.

#### Factor analysis test

As the ultimate goal of this study is to analyze expectations and perceptions of flexible urban space in Iran, high amount of identified capabilities (17 items) has led to difficulty in designing and testing proposed questions. Hence, the number of these capabilities should be decreased. To this end, factor analysis is used. Factor analysis is a technique than makes it possible to reduce high amount of dependent variables in form of less amount of latent dimensions. In other words, the statistical method is responsible for finding a way to purify the existing information in several main variables and changing them into smaller factors with lowest amount of narrowing down the information.

It should be mentioned that in this test, with the confirmation of normality of observations and to use factor analysis, two primary



tests of KMO and Bartlett are investigated. KMO and Bartlett test (table 4), with value higher than 0.5 for KMO test and sig level lower than 0.05 for Bartlett test could show usefulness of factor analysis for the existing data and competency of sampling for this test.

Moreover, for more accuracy of calculations and lack of sameness of number of questions in each capability, it has been tried to use mean values of answer of questions of each capability in estimation of total variance.

The last column of this table shows that all factors (factors 1-5) confirm 73.3% of changeability of main research variables. In other words, using these 5 factors instead of

17 capabilities could indicate same capabilities to more than 73%. The high amount could be a confirmation on this issue that using classification of items could result in more richness of the study.

Table 5 has shown the values of factors loads of conflicting items with each latent variable. For more facility, only values of loads higher than 0.5 are presented in this table. Each question should have high load in one latent variable (factor) to show that the question is only belonged to one group. High load for more than one group is in contrary with concept of factor analysis theoretically. This is because; a question can't be considered in two factors at the same time. Moreover, each question

Formal means	Micro scale (components of flexible urban spaces)	Creation of non-fixed spaces (soft design)	(Schneider and Till 2007); (Dittoe and Porter 2007)
		Pre-fabrication and using modular	(Lynch 1984); (Siu and Wong 2015), (Eghbali and Hesari, 2013)
		Providing extra capacity (storage space)	(Lynch 1984); (Bentley et al. 2013), (Eghbali and Hesari, 2013)
		Use of diverse and flexible materials, technologies and services a	(Lynch 1984); (Durmisevic and Linthorst 2000); (Reilly 2001) (Eghbali and Hesari, 2013), (Afhami and Alizadeh, 2012)
		Sustainable utilization of space	(Siu and Wong, 2015)
		Proportion of size and form of space and amount of flexibility	(Bentley et al, 2013), (Eghbali and Hesari, 2013)
	scale	Compliance (compliance of urban space functions)	(Montgomery 1998); (De Toni and Tonchia 2005); (Habraken 2008); (Pena and Parshall 2012); (Bentley et al. 2013), (Doostmohammadian et al, 2015), (Lang, 20110, (Eynifar, 2003)
	Middle (organization of flexible urban space)	Expandability (scalability) (expandability)	(Malofiy 1998); (Reilly 2001); (Pena and Parshall 2012); (Kakuei Ezbarami, Soheili and Shirinkam Chori, 2014); (Grouter, 2014); (Eynifar, 2003)

▲ Table 2. Capabilities affecting creation of flexible urban space (extracted from the literature), Source: Esteghlal et al (2016).

Changeability	(Lynch 1984); (Hitt, Keats and DeMarie 1998); (De Toni and Tonchia 2005) (Pena and Parshall 2012); (Bentley et al. 2013); (Mardomi and Delshad, 2010); (Husseini and Hajipour, 2008); (Eynifar, 2003); (Doostmohammadian et al, 2015); (Mahdabinejad et al, 2011)
Responsiveness (quick) to change	(Sanchez 1995); (Golden and Powell 2000); (Hulsmann, Grapp and Li 2006); (Nadkarni and Narayanan 2007); (Siu and Wong 2015); (Eghbali and Hesari, 2013); (Afhami and Alizadeh, 2012); (Hajipour and Moradi, 2010)
Convertibility	(Pena and Parshall 2012); (Bentley et al. 2013); (Doostmohammadian et al, 2015)
Multifunctional (remove boundaries)	(Golden and Powell 2000); (Reilly 2001); (Pena and Parshall 2012); (Bentley et al. 2013); (Siu and Wong 2015); (Mahdabinejad et al, 2011); (Asefi and garshasbi, 2011); (Borhani Darian, 2007); (Eynifar, 2003)
Integration of (spatial integration)	(Watkins, Lodge and Best 2002); (Afhami and Alizadeh, 2012); (Mahdabinejad et al, 2011); (Mardomi and Delshad, 2010); (Doostmohammadian et al, 2015)
Variability	(Pena and Parshall 2012); (Bentley et al. 2013); (Doostmohammadian et al, 2015); (Husseini and Hajipour, 2008); (Eynifar, 2003)
Open plan design	(Montgomery, 1988); (Brown, Dixon and Gilham, 2014); (Mahdabinejad et al, 2011); (Mirmoghtadaei, 2011)
Spatial organization (horizontal or vertical)	(Wurman 1986); (Bentley et al. 2013); (Doostmohammadian et al, 2015); (Mahdabinejad et al, 2011); (Husseini and Hajipour, 2008)
Development of communication network	(Lynch 1984); (Bentley et al. 2013)

▲ Table 2. Capabilities affecting creation of flexible urban space (extracted from the literature), Source: Esteghlal et al (2016).

		The interior development and planning of space	(Dudek 2012); (Roberts and Stockport 2014); (Kakuei Ezbarami and Shirinkam Chori, 2014); (Bolurchi, 2014); (Husseini and Hajipour, 2008); (Doostmohammadian et al, 2015)
		Sectioning the spaces (spatial separation)	(Lynch 1984); (Roberts and Stockport 2014); (Eghbali and Hesari, 2013); (Mahdavinejad et al, 2011); (Habibi, 2010)
		Timing and durability of activities	(Lynch 1984); (Wurman 1986); (Husseini and Hajipour, 2008)
		More efficiency	(Montgomery 1998); (Golden and Powell 2000); (Doostmohammadian et al, 2015)
	Macro scale (adjacency)	The relationship between the internal and external environment for attracting uncertainty	(De Toni and Tonchia 2005); (Ebrahimipour Aziri, Asil Nopasand and Ahmadi Saravani, 2015); (Doostmohammadian et al, 2015)
		Meeting needs in exterior environment	(Reilly 2001); (Pena and Parshall 2012); (Eynifar, 2003)
		Right to choose more options to meet needs	(Hulsmann, Grapp and Li 2006); (Bentley et al. 2013); (Bolurchi, 2014); (Hajipour and Moradi, 2010)
	Process means	adequate information about the decision-making process	(Lynch 1984); (Bentley et al. 2013)
		Controlling space ownership and transferable right to development	(Lynch 1984)
		Training citizens to cope with changes	(Lynch 1984)
Paying attention to microclimate and efficient use of energy		(Bentley et al. 2013); (Siu and Wong 2015)	

▲ Table 2. Capabilities affecting creation of flexible urban space (extracted from the literature), Source: Esteghlal et al (2016).

	Simultaneous formation of space and activity	(Lynch 1984)
	Improving security and more control of citizens on space (affecting the environment)	(Lynch 1984); (Siu and Wong 2015); (Kakuei Ezbarami, Soheili and Shirinkam Chori, 2014); (Habibi, 2010); (Mardomi and Delshad, 2010); (Doostmohammadian et al, 2015)
	Gaining experience (influence of the environment)	(Mardomi and Delshad, 2010); (Husseini and Hajipour, 2008)
	Human relations (humanism)	(Doostmohammadian et al, 2015); (Mardomi and Delshad, 2010); (Husseini and hajipour, 2008)

▲ Table 2. Capabilities affecting creation of flexible urban space (extracted from the literature), Source: Esteghlal et al (2016).

Capability	Score	Rank
Compliance (compliance of urban space functions)	4.62	1
Changeability	4.36	2
Right to choose more options to meet needs	4.31	3
Considering human relations (humanism)	4.29	4
Physical and visual access	4.29	5
More efficiency and sustainable use of space	4.29	6
Convertibility	4.23	7
Multifunctional (remove boundaries)	4.21	8
Variability	4.21	9
Simultaneous formation of space and activity	4.15	10
Responsiveness (quick) to changes	4.14	11
Training citizens to cope with changes	4.14	12
Appropriate information for decision making and design process	4.14	13
Meeting needs in a complex of relevant urban spaces	4.08	14
Considering microclimate and optimal energy consumption	4.07	15
Creation of non-fixed spaces (soft design)	4.00	16
Improvement of security and more control of citizens on space (affecting the environment)	4.00	17

▲ Table 3. Ranking capabilities to create flexible urban space using Delphi Model, Authors (2016)

Evaluation of sampling competency based on KMO		0.671
Bartlett test	X <sup>2</sup>	912.138
	df	461
	Sig	0.039

▲ Table 4. KMO and Bartlett tests, Author (2016)



Factors	Initial eigenvalues			Extracted sum of squares		
	Total	Variance percent	Cumulative percentage	Total	Variance percent	Cumulative percentage
1	5.882	34.601	34.601	5.882	25.864	25.864
2	2.467	14.513	49.114	2.467	15.106	40.970
3	1.594	9.378	58.492	1.594	15.080	56.050
4	1.433	8.427	66.920	1.433	8.639	64.689
5	1.086	6.389	73.309	1.086	8.620	73.309
6	.996	5.856	79.165			
7	.828	4.868	84.033			
8	.752	4.421	88.454			
9	.670	3.943	92.397			
10	.488	2.868	95.265			
11	.320	1.883	97.149			
12	.222	1.308	98.457			
13	.153	.898	99.355			
14	.068	.400	99.755			
15	.026	.154	99.908			
16	.011	.063	99.971			
17	.005	.029	100.000			

▲ Table 8. Kolmogorov-Smirnov test in two sections of existing and desired statuses, Author (2016)

should have high load in one factor. Hence, to modify this issue, Varimax Rotation is used. As it is clear in table 6, all questions have high load in their own group and hence, applied classification is confirmed.

5 factors obtained from table 6, according to the nature of questions and the information about the components in theoretical framework and through advice of professors, have been named as responsiveness to need, spatial and functional system, physical system, formation process and role of citizens and energy and sustainability.

#### Testing normality of observations

As it was mentioned before, to determine type of statistical tests used in the research, the type of data distribution should be firstly determined. For this purpose, Kolmogorov-Smirnov test is used and the results of this test for both parts of questionnaire (existing and desired status) are presented in table 8.

According to values higher than the criterion value (0.05) for both groups, it could be mentioned that with the probability level of 95%, the existing observations have normal distribution. Accordingly, to continue the analyses,

set of parametric tests should be applied. To measure the significance of capabilities and factors, one-sample t-test is used and for gap analysis, paired sample t-test is used.

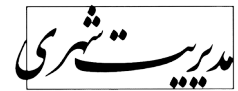
#### One-sample t-test

According to sig value in table 9, the result of t-test for all questions (q1-q33) and factors (F1-F5) in existing status shows acceptable range of capabilities in Iran and significance of all of them.

In other words, the results in table 9 show that experts have found that all capabilities and relevant factors in flexible urban space in Iran are significant. However, the strong confirmation about the identified significance can't prove that these items are in such situation that is expected. For this purpose, a test should be taken between what is perceived and what is expected (existing and desired status). In rest of paper, paired sample t-test is used to analyze this issue.

#### Gap analysis test

According to confirmation of normal distribution of observations in previous test, paired t-test parametric test is applied and the results are presented in table 10.



Capability (factor No)	1	2	3	4	5
Responsiveness (4)	0.734				
Responsiveness (14)	0.611				
Responsiveness (15)	0.808				
Spatial and functional system (3)		0.840			
Spatial and functional system (5)		0.643			
Spatial and functional system (6)		0.756			
Spatial and functional system (12)		0.810			
Spatial and functional system (13)		0.562			
Physical system (1)			0.586		
Physical system (11)			0.652		
Formation process and citizens (7)				0.604	
Formation process and citizens (8)				0.536	
Formation process and citizens (10)				0.658	
Formation process and citizens (16)				0.594	
Formation process and citizens (17)				0.701	
Energy and sustainability (2)					0.829
Energy and sustainability (9)					0.618

▲ Table 6. factor load of questions in varimax rotation (total number of questions is 33 and the results of questions related to each capability is considered as mean value)

Factor (dimension)	Capability
Responsiveness to needs	Responsiveness (quick) to changes
	Meeting needs in a complex of relevant urban spaces
	Right to choose more options to meet needs
Spatial and functional system	Changeability
	Multifunctional (remove boundaries)
	Variability
	Compliance (compliance of urban space functions)
Physical system	Convertibility
	Creation of non-fixed spaces (soft design)
Formation process and citizens	Physical and visual access
	Appropriate information for decision making and design process
	Training citizens to cope with changes
	Considering human relations (humanism)
	Simultaneous formation of space and activity
Energy and sustainability	Improvement of security and more control of citizens on the space (affecting the environment)
	More efficiency and sustainable use of space
	Considering microclimate and optimal use of energy

▲ Table 7. Classification of flexible urban space capabilities in Iran, Author (2016)

		Desired status	Existing status
Number		110	110
Normal parameters	Mean	3.89936	3.94848
	SD	0.138994	0.274930
Final difference	Absolute	0.07	0.114
	Positive	0.048	0.078
	Negative	-0.070	-0.114
Z value of K-S test		0.733	1.198
Sig		0.656	0.114

▲ Table 6. factor load of questions in varimax rotation (total number of questions is 33 and the results of questions related to each capability is considered as mean value)

The Sig level below 0.05 in table 10 shows the gap between existing status and expected status. In other words, the values show that there is significant difference (gap) between perception and expectation of flexible urban spaces in Iran. The situation has been obtained for both mean value of all items in questionnaire (comparison 6) and factors separately (comparisons 1-5).

In other words, the results in table 9 show that as the acceptable significance (minimums) in one-sample t-test is confirmed, there is gap between what is perceived in Iran about capabilities of flexible urban spaces and what is expected in view of experts. However, naturally, the gap is not same in all fields. Therefore, for better recognition of the gaps, scatter plot is used (figure 5). In this plot, status of each capability is shown based on two desired and existing statuses.

In problematic position, evaluation of existing status is in high level; although there is no high expectation from this section. However, in opposite point, critical status is existed and the high desired status and low existing status could show perceived underdevelopment in this field. As it is illustrated in the plot, first (responsiveness to needs) and second (spatial and functional system) factors could be the challenge in this field. However, this could not show lack of inefficiency in other dimensions with gap.

The position of consolidated balance shows that desired and exiting statuses are both in low level. It means that the experts are less

concern about these factors. On the contrary, in the position of growth balance, both desired and existing criteria are in high level and this shows necessity of paying special attention to these factors. In other words, experts believe that they should pay more attention to improvement of formation process and role of citizens, since this is the most underlying factor.

#### Discussion and conclusion

Nowadays, identification of urban spaces and appropriate creation of these spaces could be a way to meet needs of people of the society. However, in many cities, urban spaces have been formed as focus points of the city designed due to temporary and permanent functions in these places and the physical divisions have shown attention and presence of people. According to the concept of flexibility and combining this concept in relevant texts of this field, the research has firstly tried to investigate 3 key words of resilience, sustainability and flexibility, so that the term "resilience" means responsiveness to stresses caused by hazards and the terms "sustainability" and "flexibility" are actual and potential capabilities expected from prediction of urban space. The capabilities extracted from the literature and Delphi model included 17 items as capabilities to create flexible urban space. According to the ranking, the capabilities including compliance (compliance of urban space functions), changeability, and right to choose more options to meet needs and considering human relations (humanism) could be introduced as

Criterion value						
Item	t-value	df	Sig	Mean diff	Confidence interval (95%)	
					Min	Max
1	10.539	109	0.000	0.873	0.71	1.04
2	11.312	109	0.000	0.900	0.72	1.06
3	17.416	109	0.000	1.082	0.96	1.20
4	8.889	109	0.000	0.752	0.58	0.92
5	10.035	109	0.000	0.862	0.69	1.03
6	12.699	109	0.000	1.009	0.85	1.17
7	15.462	109	0.000	1.110	0.97	1.25
8	10.478	109	0.000	0.880	0.71	1.05
9	6.556	109	0.000	.587	0.41	0.76
10	12.924	109	0.000	0.972	0.82	1.12
11	6.680	109	0.000	0.627	0.44	0.81
12	9.725	109	0.000	0.809	0.64	0.97
13	12.375	109	0.000	0.981	0.82	1.14
14	10.790	109	0.000	0.936	0.76	1.11
15	18.166	109	0.000	1.109	0.99	1.23
16	17.416	109	0.000	1.082	0.96	1.20
17	19.045	109	0.000	1.200	1.08	1.32
18	12.501	109	0.000	0.982	0.83	1.14
19	13.639	109	0.000	1.055	0.90	1.21
20	12.673	109	0.000	0.982	0.83	1.14
21	12.775	109	0.000	0.945	0.80	1.09
22	13.992	109	0.000	1.009	0.87	1.15
23	16.596	109	0.000	0.982	0.86	1.10
24	16.784	109	0.000	1.027	0.91	1.15
25	13.524	109	0.000	1.018	0.87	1.17
26	14.905	109	0.000	0.991	0.86	1.12
27	12.951	109	0.000	0.918	0.78	1.06
28	9.634	109	0.000	0.844	0.67	1.02
29	9.153	109	0.000	0.800	0.63	0.97
30	9.321	109	0.000	0.817	0.64	0.99
31	9.082	109	0.000	0.743	0.58	0.91
32	8.285	109	0.000	0.764	0.58	0.95
33	8.317	109	0.000	0.752	0.57	0.93
Responsiveness to need (F1)	31.033	109	0.000	0.914	0.856	0.978
Spatial and functional system (F2)	21.275	109	0.000	.831	.753	0.91
Physical system (F3)	38.558	109	0.000	1.041	.987	1.09
Formation process and citizens (F4)	36.183	109	0.000	0.948	0.896	1.00
Energy and sustainability (F5)	33.275	109	0.000	0.822	0.773	.871

▲ Table 9. Evaluating significance of capabilities and factors to create flexible urban space, Author (2016)



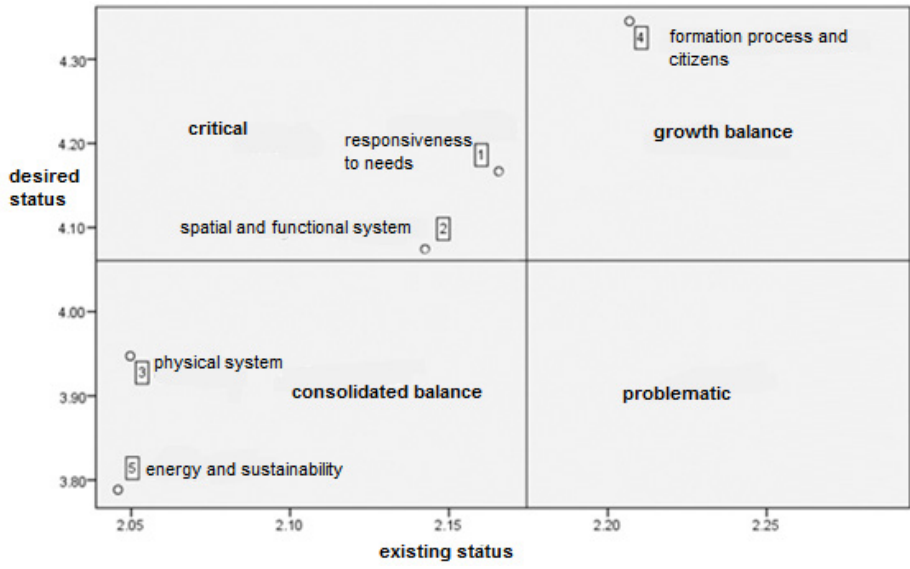
	Paired gaps	average deviation from the mean		
		Mean	SD	
Comparison 1	Responsiveness to need	-0.0923	.4188	.0399
Comparison 2	Spatial and functional system	-0.0925	.3617	.0364
Comparison 3	Physical system	-0.1264	.3846	.0367
Comparison 4	Formation process and citizens	-0.2407	.6091	.0580
Comparison 5	Energy sustainability	-0.1953	.6778	.0646
Comparison 6	Total status	-0.1286	.5623	.0536

	Paired gaps	Confidence interval of 95%		t-value	df	Sig
		Min	Max			
		Comparison 1	Responsiveness to need			
Comparison 2	Spatial and functional system	-0.1646	-0.0203	-2.541	109	0.012
Comparison 3	Physical system	-0.1990	-0.0537	-3.445	109	0.001
Comparison 4	Formation process and citizens	-0.3559	-0.1256	-4.145	109	0.000
Comparison 5	Energy sustainability	-0.3233	-0.0672	-3.002	109	0.003
Comparison 6	Total status	-0.2348	0.0231	-2.398	109	0.018

▲ Table 10. paired sample t-test (gap analysis), Author (2016)

Factors	Question No	Gap analysis (desired status)	Gap analysis (existing status)
Responsiveness to need	4-14-15	4.15	2.17
Spatial and functional system	3-5-6-12-13	4.06	2.14
Physical system	1-11	3.65	2.03
Formation process and citizens	7-8-10-16-17	4.37	2.21
Energy and sustainability	2-9	3.65	2.03

▲ Table 11. Scatter of the gap between research factors



▲ Figure 5. scatterplot of factors' gap (author, 2016)

the most important capabilities to create flexible urban space. Then, the capabilities were classified in 5 groups of fundamental capabilities of creating flexible urban space and significant different was observed between existing and desired statuses in all factors using paired sample t-test.

According to obtained results, responsiveness to needs of citizens (factor 1) and paying attention to spatial and functional system of urban space (factor 2) are the most underlying challenges to create flexible urban space in Iran, since the existing status in this sector is too weak and the expectations are too much. Critical value of a variable shows that it has some limitations and deficits in this field and the upcoming way for its development is difficult. The problem of lack of responsiveness of urban spaces to needs of citizens in majority of regions of Iran and inattentiveness of citizens to attend in these places could be a proof on this issue. Hence, paying attention to needs of citizens and considering required spatial system in urban spaces could be the main requirements of formation of urban spaces in Iran. Growing balance shows that the process of formation and control of citizens is in acceptable range; although it is expected that the factor could be improved and

the capability could gain attentions more than before. However, consolidating balance shows that there is no sufficient information or significant hope to physical system and considering the issue of energy and sustainability to create flexible urban spaces and protection of natural environment in Iran. These factors, especially issue of energy, have not gained attentions despite to their underlying role.

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