



Using Spatial Justice in Urban Planning with The Systemic Thinking Approach

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Highlights

- The unbalanced distribution of land uses results in the morphing of the polar structures.
- The present study recognizes and analyze the dimensions of spatial justice in urban planning.
- The neighborhood layout model in the city is proposed based on the concept of spatial justice.

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Abstract

The unbalanced distribution of public land uses is one of the consequences of the rapid growth of cities in recent decades. This problem causes the unequal of citizens from urban services, which results in the morphing of the polar and dual spatial structures in the city space. The present study is to recognize and analyze the dimensions of spatial justice and apply this concept in urban planning. Therefore, it is applied research. The research method is descriptive-analytic. Qualitative data were collected with an open questionnaire and through interviews and reviewing library documents. The quantitative data used in numerical form and by the weighting of Delphi questionnaires were prepared. In this study, 12 professors, experts in the field of urban planning and management from five top universities of Tehran in Iran (Tehran University, Sharif University of Technology, Amirkabir University of Technology, The University of Tarbiat Modarres, and Shahid Beheshti University) were selected as the team of experts. Then, by forming the matrix of the interaction space justice elements and numerical coding of experts based on the logic of the cause-effect and the effect of each criterion on the system and conversely, effective spatial justice indicators in urban planning, were prioritized. The results of the analysis show that urban space has spatial justice when it includes the indicators of "simplicity and readability", "equality of opportunity" and "human scale". Finally, according to the results of previous stages, the neighborhood layout model in the city is proposed based on the concept of spatial justice.

1. INTRODUCTION

The problem of inequality in many countries is a fundamental challenge to develop; especially for those countries where the territory of their sovereignty includes vast geographical areas. These inequalities are a serious threat to achieving balanced development in regions and make it difficult to achieve unity and integrity national [1]. The rapid population growth is the introduction of extensive urban growth and development that has created a wide range of changes from local to global scale in land use; So that it can be said, the population of the cities has increased, but the services that meet their different needs are not provided in the appropriate manner [2]. This leads to a shortage of facilities and infrastructures. It also makes different urban groups have different access to these facilities [3].

Because urban services structure the physical, social, and spatial nature of the city, injustice in how it is distributed has an irreversible effect on the class separation in urban neighborhoods and poses serious challenges to urban planning [4]. A balanced space organization in cities is a kind of urban sustainability. This stability will be achieved when there are logical coordination and adaptation between different regions of the city and the fair distribution of facilities and services in cities [5]. The distribution of services in

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urban areas is used to facilitate the proper and optimal access of citizens. If the distribution of services and urban facilities is not based on the appropriate criteria, the services are not easily done and there may be an imbalance between the distribution of the population and the required service spaces.

The movement and reach of justice will be achieved when the allocation and distribution of facilities between the space and social units of cities are following the needs of the population and the principle of geographical equality. In this regard, when the evaluation of population distribution and services in urban spaces can measure the level of social justice and meet the basic needs of citizens within the framework of development and social plans and useful economic [6]. Therefore, the balanced distribution of facilities and services is a step towards eliminating regional imbalances. Because the greater the regional differences in different dimensions, the more the population and capital move towards the more attractive poles [7].

Spatial justice is a multi-dimensional, complex, yet emerging and interdisciplinary concept that in various forms in scientific fields such as urban planning, architecture, sociology, Geography and etc. has been studied. Spatial justice is a multi-dimensional, complex and new concept that has been studied in scientific spheres such as urban planning, architecture, sociology, Geography, etc. Based on this approach, justice has a spatial dimension and therefore can use a spatial attitude to detect injustice in the city [8]. Space justice is the fair and democratic distribution of interests and social responsibilities in space with different scales. Space justice considering the fact that space is produced in social form and the space produced to social relations is to strengthen the concept of social justice [9]. In spatial justice, we have two main approaches: 1- spatial distribution and 2- decision-making processes [10].

The first approach is based on questions about the spatial distribution or spatial-social distribution and efforts to achieve a geographic equal distribution based on the needs and demands of citizens. Such as access to urban services, job opportunities, access to health care, good air quality, etc. The second approach emphasizes decision-making processes. This approach also represents decision-making in the spatial, identity, and social actions. Like the existence of discriminatory approaches in shaping the urban space. In other words, space justice can also be seen as both product and process. A "product-oriented" spatial justice in the form of distribution patterns, which is fair or unfair, is in the geographical sphere. A "process" of space justice is discussed as forming processes into space. The theoretical framework of spatial justice is shown in Figure 1.

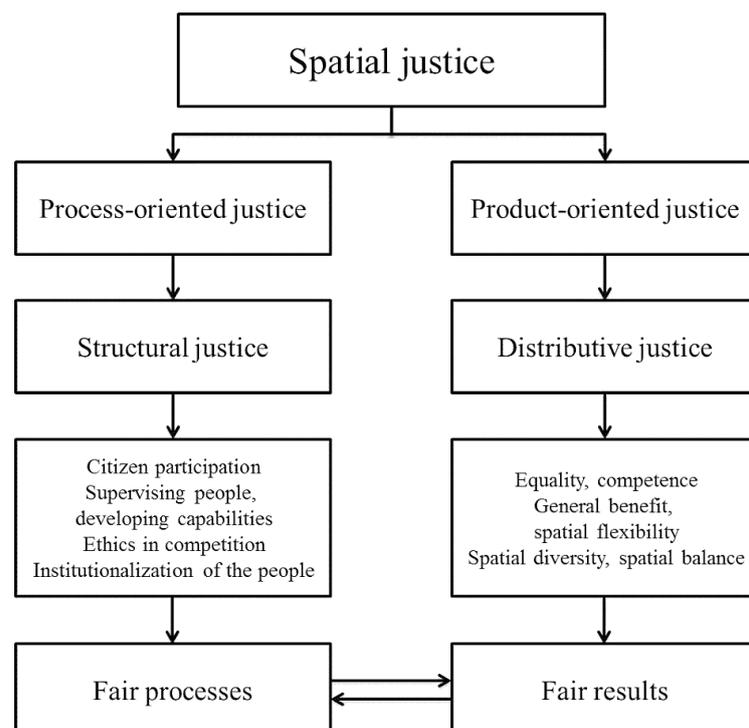


Figure 1. The theoretical framework of spatial justice

Therefore, explaining the framework of the concept of spatial justice in the city and applying it (for realization) can help urban planning and management. In this regard, the purpose of this study is to identify and analyze the dimensions of spatial justice and to use this concept in urban planning.

2. LITERATURE REVIEW

The history of attention to justice in the urban space is divided into three general periods. The first period of years before Plato is included until contemporary times. During this period, justice has always been a fundamental issue among political science scientists. But Urban science specialists refused to direct entry into the topic of justice [11]. Accordingly, various thinkers have studied this concept and several definitions have been given to justice. Sometimes justice was interpreted as ultra matter and sometimes as tangible and measurable. In the middle period, after a change in the approach to urban studies in the 1960s and 1970s, experts and thinkers with a critical view of the city began to discuss ethical issues [11]. This period was the beginning of the literature of justice in the city and attempts to the revision of the relationship between space, development, power, and planning [8].

In this regard, contemporary theorists, along with the traditions of the dominant planning in the world, described how the relationship between justice, accountability and the city. Also, the application of these concepts in the form of an urban planning system was discussed [12]. During the third period and from 1990 onwards, urban researchers openly considered the issue of justice [11]. In this meantime can be mentioned communication planning theories (Judith E. Innes; Patsy Healey), towards Kayhan 1 and 2 (Leonie Sandercock), discourse Planning (Frank Fischer), city of justice (Heather Campbell), general planning (Peter Marcuse), the equal planning (Norman Krumholz) and space justice (Mustafa Dikec) [13]. It was also in the course that the approach of spatial justice was expressed openly by urban planners. In the field of space justice in the distribution of urban services, research has been conducted to mention some of them in Table 1. An Example of space justice research is shown in Table 1.

Table 1. An Example of space justice research [14-25]

Researchers	Year	Research topic
Tsou et al.	2005	Access-oriented indicators related to spatial justice in urban services
Buzzelli	2008	Justice in the living environment of Canadian cities
Albo	2009	Challenges of the Urban Social Justice Movement
Pearsal & Pierceb	2010	Environmental justice, urban sustainability and it's related to urban planning
Sajedi	2010	Social justice and its role in sustainable development
Rahnama & Zabihi	2011	Distribution of public utilities in the field of spatial justice
Bullard	2015	Environmental justice in the United States
Lorestani et al.	2016	Spatial distribution of urban services using urban planning models
Taqvaei et al.	2016	Measurement of spatial justice within the framework of justice-oriented city theory
Ouyang et al.	2017	Spatial deprivation of public services in urban Immigrant areas
Stephens & Church	2017	Environmental justice and health
Li et al.	2017	Equality of limited public services and regional inequality in China

Research on spatial justice has largely focused on the per capita use of access to urban services. Also, the access of individuals, population with and without services and the way of locating services based on the radius of service, has been neglected. Therefore, innovation is the current research, presenting a structural model in the urban arrangement based on the concept of spatial justice.

3. RESEARCH METHOD

The present study is based on applied objectives and the research method is descriptive-analytic. Therefore, with a rational approach and deductive using the extraction of benchmarks and taking advantage of System thinking, analysis Method (DEMATEL), a new evaluation system called Urban Metrics Assessment (UCE: Urban Criteria Evaluation) development Found. Qualitative data were collected with an open questionnaire and through interviews and reviewing library documents. The quantitative data used in numerical form and by the weighting of Delphi questionnaires were prepared. In this study, 12 professors, experts in urban

planning, geography and urban planning and architecture from the top five universities of Tehran in Iran (the University of Tehran, Sharif University of Technology, Amirkabir University of Technology, Tarbiat Modares University, and Shahid Beheshti University). These experts were selected as a team of experts according to the characteristics of the level of activity and the field of study and using random sampling. The validity of the questionnaires was confirmed by experts and their reliability through Cronbach's alpha coefficient (0.818).

The first stage consists of an open questionnaire in which the most important factors affecting spatial justice in urban planning were given to the group of experts, which ultimately 10 criteria were selected as the spatial justice indicators in the city. In the second stage, a questionnaire was completed for determining the key factors through paired weighting and systematic analysis (correlation of variables with numbers between 0-4). The Urban Criteria Evaluation (UCE) system uses the DEMATEL system of thinking in urban planning, which can be used to evaluate urban criteria and prioritize the parameters affecting urban planning, and includes the following steps: UCE System Thinking Method Algorithm for Assessing Urban Criteria is shown in Figure 2.

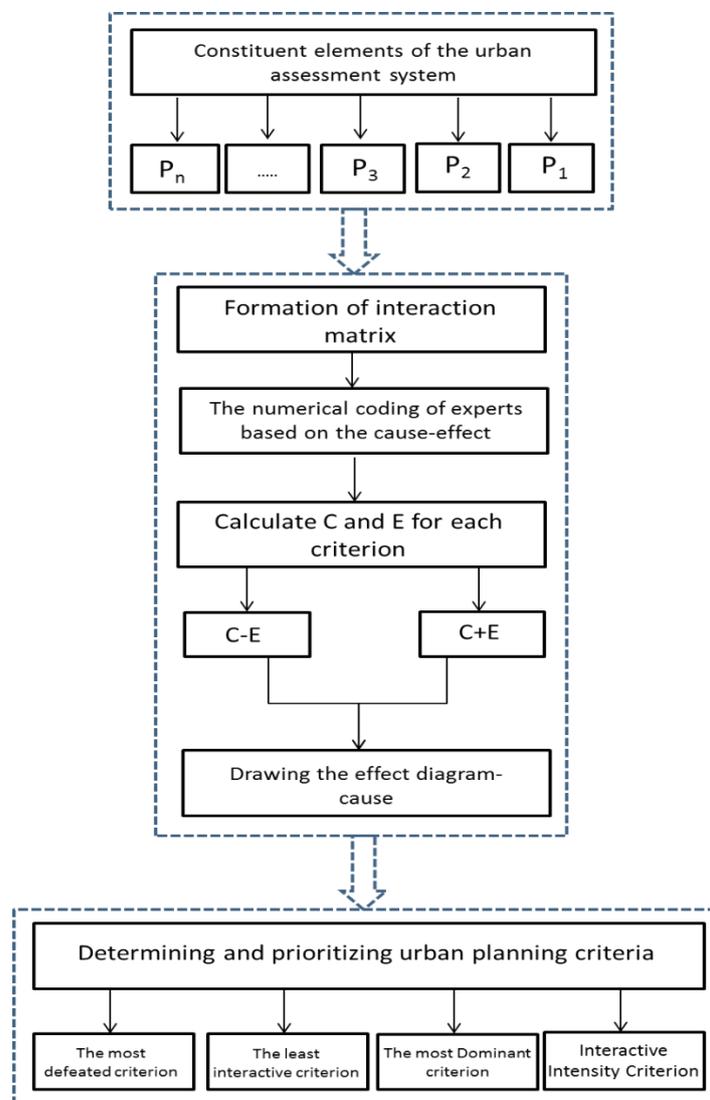


Figure 2. UCE system thinking method algorithm for assessing urban criteria

- 1) Determining the constituent elements of the urban evaluating system (p_i)
- 2) Forming the indicators of the interaction matrix in urban evaluation
- 3) Numerically encoding experts' views based on the cause-effect
- 4) Computing the value of cause (C) and effective (E) of each UCE

- 5) Computing C+E and C-E
- 6) Drawing a cause-effect graph of urban metrics assessment
- 7) Determining and prioritizing the criteria of urbanism
- 8) Determining the interactive, predominant criteria and the least important ones.

In the third step, according to the results obtained from the previous steps, the neighborhood layout model in the city based on the concept of spatial justice has been proposed.

System Concept and System Thinking: The DEMATEL technique provided by Gabus and Fonetla [26]. To study the complex issues, their analysis and the creation of a structure based on this analysis were presented. It is a group decision-making method, based on paired comparisons, and the group adjudication of experts. It is a new method used to analyze the cause and effect relations of evaluation criteria [27] and to re-evaluate the relationship among the factors [28]. These factors exist in the system by applying the principles of graph theory and extracting the cause and effect relationships, providing a hierarchical structure, such that the extent of relations is given as numerical scores [26]. The method was successful in many fields like marketing strategies, control systems, security issues, development of the skills of global managers, and group decision-making [29,30]. DEMATEL System Thinking Technique Algorithm is shown in Figure 3.

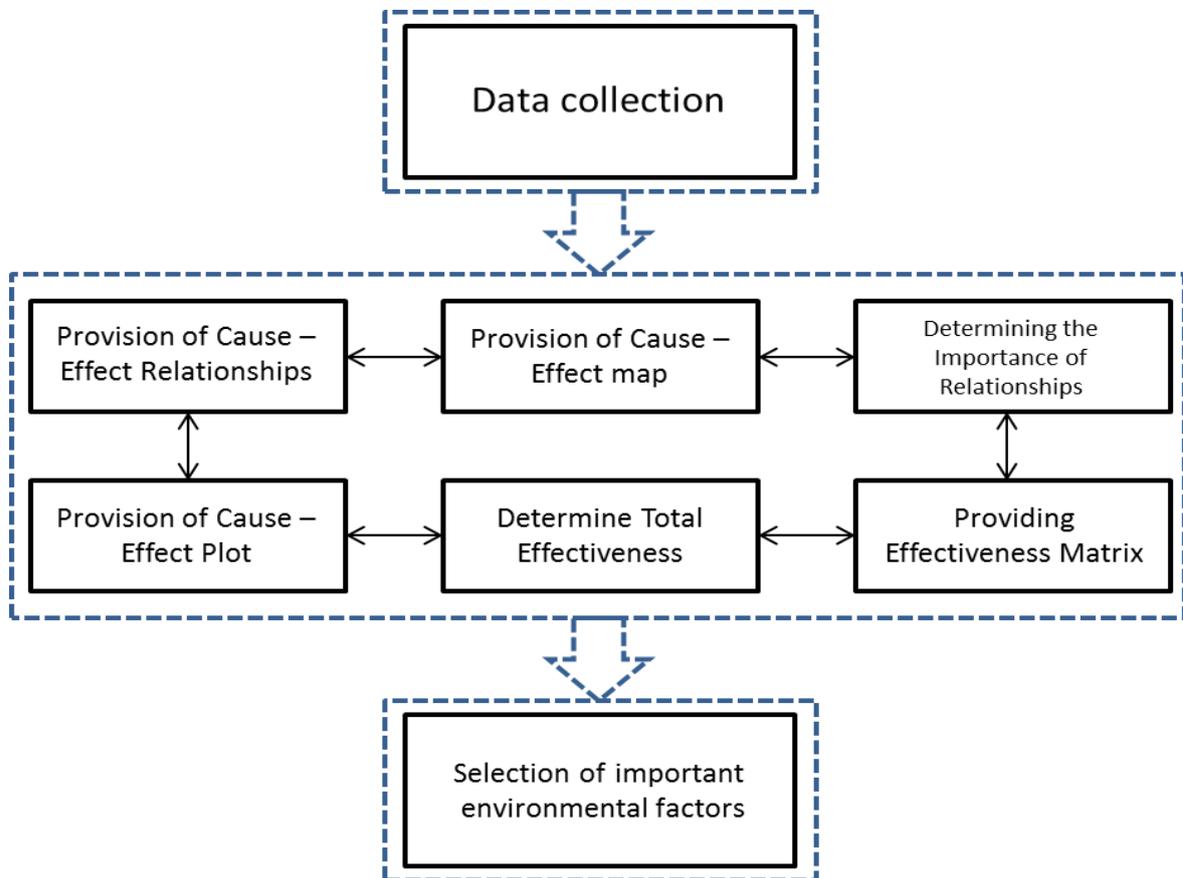


Figure 3. DEMATEL system thinking technique algorithm

Interaction Matrix: In engineering systems, the identification of critical parameters, influencing ways, reciprocal loops, and evaluation of an appropriate engineering technique are conducted by an interaction matrix. It is a square matrix that has on its main diameter effective parameters of the system's behavior and non-linear elements indicating the interaction parameters. As shown in Figure 4, in a hypothetical system with two parameters A and B: Parameter A is located on the upper left, and Parameter B is located on the bottom right. In the upper right, the effect of A to B is shown, and in the bottom left, the effect of B is shown on A. The interaction matrix for two parameters and the Semi-quantized coding method for the ESQ expert is shown in Figure 4.

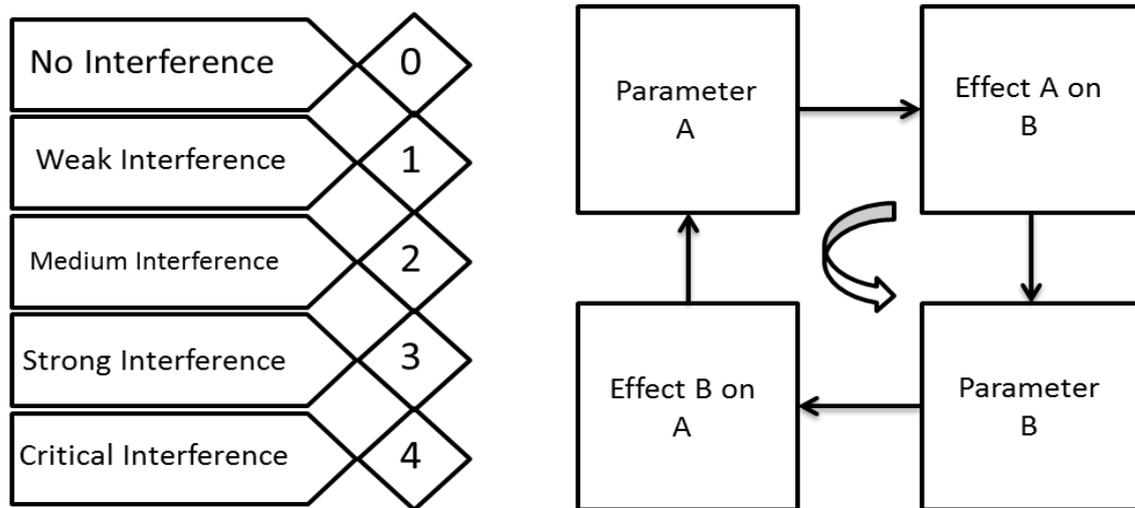


Figure 4. Right) The interaction matrix for two parameters A and B; Left) Semi-quantized coding method for the ESQ expert [31]

Cause-Effect Plot: This plot shows the effect of parameters influencing the interaction matrices, the ability to identify parameters of design, and the intensity of interactions of each one of the systems' behavior. In the cause-effect diagram, the effect of a parameter on the effect system and the system's effect on the effect parameter is described. After encoding the matrix, we can calculate the sum of each row and column. The set of row values is shown as the cause and with C, and the sum of the values of the column with E. So the value of C presents the path with which P_i has effects on the system and E shows the effects of the system on P_i .

The sum of values of each row and column for each parameter can be transferred to a cause-effect plot. In this case, the parameters are in cloud form in E and C space and represent a complex system. The attention to the positions of these points, which represent the main parameters of the system, is very important in the development and usefulness of the system theory presented in this section. Accordingly, the Interactive Intensity Criterion is the parameter that has the highest C+E value. The components with the least interaction are those that have the lowest value of C+E. The most predominant components are the parameters with the highest value of C-E. So, it can be said the parameter affects the system more. The least important components are those with the lowest value of C-E.

4. RESULTS

We specify the relationship between urban space and space justice by using the System thinking Method UCE in assessing urban metrics, and say that a city must possess what features and criteria to have "space justice".

Step 1: According to the study and analysis of theories related to urban spatial justice in the form of different intellectual ideas mentioned in previous topics (introduction and background of the research) and the results of the first stage questionnaire, in this study 10 criteria were extracted. Aesthetic (P_1), human scale (P_2), diversity (P_3), equality of opportunity (P_4), security (P_5), simplicity and readability (P_6), identity and sense of belonging to space (P_7), inclusiveness (P_8), Liberty (P_9), Denial of Marginalization (P_{10}) in the study of spatial justice in urban design.

Step 2 & 3) First, we created the matrix of the elements of the spatial justice evaluation, and according to the impact of each criterion on the system and the system on the criteria, the coding is done based on Table 2. Matrix Interaction Criteria and Numerical coding of Experts at UCE is shown in Table 2.

Table 2. Matrix interaction criteria and numerical coding of experts at UCE

Urban evaluation components	P ₁	P ₂	P ₃	P ₄	P ₅	P ₆	P ₇	P ₈	P ₉	P ₁₀
P ₁	-	1	0	1	2	3	1	1	1	1
P ₂	1	-	4	2	3	4	4	4	2	2
P ₃	0	2	-	0	1	3	1	3	2	4
P ₄	2	1	2	-	3	2	3	4	3	4
P ₅	3	2	2	3	-	3	2	2	3	2
P ₆	3	3	3	2	3	-	3	2	3	3
P ₇	2	2	1	3	1	3	-	4	1	2
P ₈	0	2	3	3	1	0	4	-	3	2
P ₉	1	2	2	0	2	1	3	1	-	2
P ₁₀	0	2	2	2	3	3	2	3	1	-

Step 4 & 5) We compute the values of Cause (C) and Effect (E) based on the algebraic series of rows and columns. To determine the prioritization of the criteria, we computed the values of C+E and C-E, which yielded the following results: Identification and Prioritization of Effective Elements in the UCE System Thinking Method are shown in Table 3.

Table 3. Identification and prioritization of effective elements in the UCE system thinking method

	Urban assessment criteria									
	P ₁	P ₂	P ₃	P ₄	P ₅	P ₆	P ₇	P ₈	P ₉	P ₁₀
C	11	25	16	24	22	25	19	18	14	18
E	12	17	19	16	19	22	23	24	19	22
C+E	23	42	35	40	41	47	42	42	33	40
C-E	-1	8	-3	8	3	3	-4	-6	-5	-4

(Note: For C-E values, the absolute value is considered.)

Step 6) Draw the cause-effect plot. In this plot, the point that has the least distance from the bisector line, and represents the least important criterion. Cause-Effect Chart is shown in Figure 5.

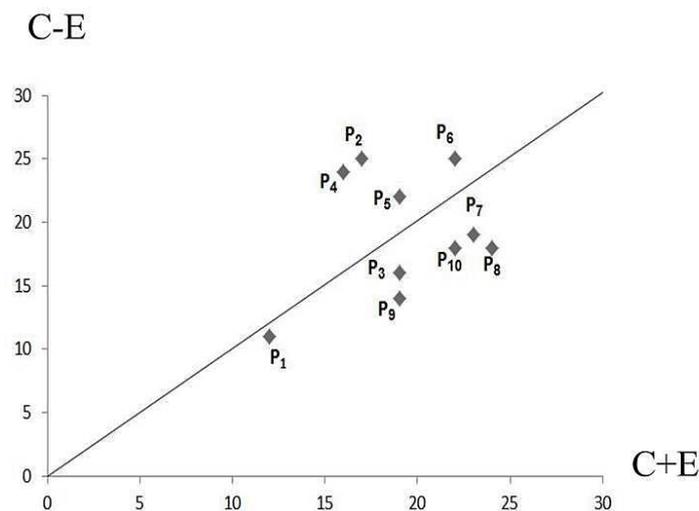


Figure 5. Cause-Effect Chart

Step 7 & 8) Based on the results of Tables 2 and 3 and the cause-effect chart, the priority criteria for establishing spatial justice were identified, including:

- The most interactive component in creating spatial justice (the highest value of C+E): “Simplicity and readability”

- The most predominant component in creating spatial justice (the highest value of C-E): “Equality of opportunity” and “Human scale”
- The component that has the least interaction to create a city as spatial justice (the lowest value of C+E): “Aesthetic”
- The least important component in creating spatial justice (the lowest value of C-E): “Aesthetic”

Thus, urban space has spatial justice when it embodies the characteristics of "Simplicity and readability", "Equality of opportunity" and "Human scale".

5. DISCUSS

The question that arises here is: How to use, these attributes and criteria (introduced as indicators of spatial justice in the city, according to the results of the Systemic Thinking Analysis (UCE) as the most interactive and dominant criteria), in the metrics of an urban structure, to help identify a city as justice-oriented space. In Table 4, to retrieve any feature, a solution is presented, as follows. Providing a way to retrieve the urban space indexes with spatial justice is shown in Table 4.

Table 4. Providing a way to retrieve the urban space indexes with spatial justice

The components and indexes of spatial justice	Approaches
Simplicity and readability	<ul style="list-style-type: none"> -The use of integrated architecture with simplicity and readability in walls. -Facilitating access and simplifying the identification of the situations for everyone. -Creating an appropriate and lasting city in mind. -Using signs and symptoms. -Designing the readable landscapes to understand the space quickly. -Creating transparency in edges and walls. -Constructing proportions and horizontal and vertical rhythms the common principles of visual response. -Expressing graphic elements concerning the nature of the places and the ability to recognize and generalize all the visual elements in the contents.
Equality of opportunity	<ul style="list-style-type: none"> -Strengthening public spaces for interaction between women and men and different age groups. -Creating shops and playgrounds for kids and benches for mothers. -Creating interactive spaces to enhance social interactions. - Proper access to public transport in the city. - Balance in having different areas of urban uses and services.
Human scale	<ul style="list-style-type: none"> -Improving physical penetration in buildings and urban spaces. -Making flexible designs to enhance the building's capabilities and activities. -Using small scale and human scales in design. -Utilizing the walls of buildings through the use of absorption activity, which most people oppose.

It can be concluded from recent studies about urban spatial justice that the neighborhoods in the city should enjoy a soft, uniform, and united texture. The neighborhood should act as an attractive element and perform as a symbol of Identity. The shape of the neighborhood of the city with regard to social interactions needs to plan and also designed. If the main public space of the neighborhood should multi-functionally be responsible for various social, cultural, and religious functions. Therefore, it is recommended that the main public space be located on the main axis of the project to provide an attractive perspective. The pattern of roads and accesses ought to follow an organized order. The distance from the farthest reach of the neighborhood to the main public space should not exceed the access ability of the elderly and children for walking.

It should also be considered a hierarchy of spaces on a human scale. The hierarchy of alleys and neighborhood passages are designed to be a dead-end, hence, there is no way strangers for crossing to the neighborhood cuts the texture of the neighborhood. This condition creates a sort of security for the residents. It is better than the type of materials for the texture and the walls are domestic, original, and enduring. The

colors used should be enjoyed the authenticity and local originality which is laid in harmony with the local environment. Regarding the mentioned features, the following pattern is proposed for the city based on three priority criteria of spatial justice. The Proposed model for the neighborhood in the city based on spatial justice is shown in Figure 6.

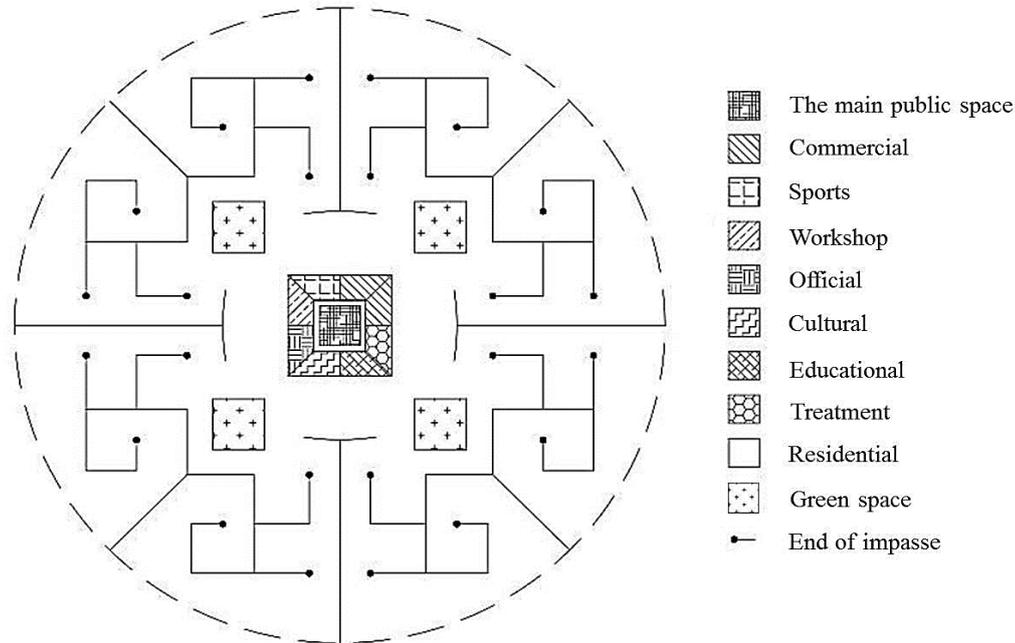


Figure 6. Proposed model for the neighborhood in the city based on spatial justice

In the proposed model of the neighborhood in the city, the distance from the farthest reach of the neighborhood to the main public space is estimated at 40 houses, which range from 400 to 500 meters (each house is 10 to 15 meters in width). Considering the density and Optimal levels for other users, a population of about 3500 to 4000 people is ordered. The Transit network should be designed based on the climatic condition so that the main space of the residential areas is easily placed in the direction of taking advantage of favorable climatic conditions. The density of construction in maximum rate is considered 120% due to interference in the sunshine and wind blowing. 4 pieces of green landscapes and 8 playgrounds for the leisure time of the residents are also offered in the residential area without disturbing any ride.

6. CONCLUSION

The concept of justice is a concept of social and more in urban planning content towards justice, the urban planning process will automatically move towards a pivotal and equitable justice. It is necessary to introduce the concept of justice in the context of urban planning, to identify the criteria of this concept. Reflection on the criteria of spatial justice is indicative of their diversity. These criteria depend on the time, location, and political and social changes of communities. The criteria for acceptance of space justice in this study, which were extracted through the library study, relies on logical analysis of the questionnaires that have been completed by the expert's Group and included 10 criteria. These criteria are prioritized by the new system Thinking Technique (UCE). The results of the analysis showed that the interactive criterion is "simplicity and readability" (C+E=47), the most dominant criterion are "equality of opportunity" and "human scale" (C-E=1), and finally, the least interactive and defeated criteria is aesthetic (C-E=8). An in-depth study of these criteria shows that justice-oriented urban planning is more concerned with issues such as the equitable distribution of resources and services, respect for civil rights, analysis of power relations, participatory and public planning. Finally, based on the implementation of strategies for using priority indicators, the layout pattern of spaces in the city is proposed according to spatial justice.

The results of this study show that urban planning based on spatial justice can be implemented when it adheres to the principles of accepting differences in society, empowering the lower classes in power relations, and intervening in citizens during politics. Setting for the future of the city and universalizing

urban planning. Spatial justice in terms of distributive justice, which is more widely accepted, is a necessary goal of urban planning and management, but it is not enough on its own. In order to achieve space justice in the urban community, opportunities must be provided for all people with access to urban resources and services. In this case, everyone is entitled to such resources and services based on their ability and merit. Urban planning and management based on spatial justice will be a slogan until not everyone recognizes society and does not create the necessary conditions. Accordingly, the city of justice-oriented should focus on better distribution of services and facilities, reduction of distance in neighborhoods, improvement of accesses and public transportation, and improvement of the quality of urban infrastructure.

Therefore, paying attention to deprived urban areas in order to create equality according to the current situation of the city, equality in physical, psychological, economic and financial access to the city, fair division of urban space, proposed strategies to create equality in the concept of spatial justice. Also, the proposed strategies to create a balance in the concept of spatial justice are: providing a mechanism for distributing services equal and tailored to the needs of the population, pathology of the current situation and identifying deficiencies in services and infrastructure, developing a process for resolving disputes in management Urban.

Finally, it is important to note that the theoretical and practical model proposed in this study only illustrates the generalities. However, sufficient climatic, cultural and ecological knowledge must be obtained for each region. Also, to the extent of the day's expertise, identify weaknesses, strengths, opportunities, and then the detailed design and details. It is hoped that with the efforts of urban thinkers, this proposed pattern will be completed and more functional.

CONFLICTS OF INTEREST

No conflict of interest was declared by the authors.

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