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Original Research Article

Analyzing the Optimal Pattern of the Spatial Syntax of the Access Network in Exhibition Stands Based on a Futurology Approach*

Azad Behmanesh¹, Mehdi Khakzand^{2**}, Hadiseh Kamran Kasmaei³

1. Ph.D. Candidate in Architecture, Department of Architecture, Pardis Branch, Islamic Azad University, Pardis, Iran.

2. Associate Professor, School of Architecture and Environmental Design, Iran University of Science and Technology, Tehran, Iran.

3. Assistant Professor, Department of Architecture, Pardis Branch, Islamic Azad University, Pardis, Iran.

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Abstract

Problem statement: Exhibition spaces are places where organizations, institutions, companies, and individuals provide their audiences with their latest achievements, products, developments, and innovations while also using the same space to make their consumers familiar with the goals their business entities seek. With this objective in place, the main goal of exhibitors joining an exhibition is to increase the number of visits to their booths. By designing the booths based on visitors' optimal movement and their behavioral patterns, the act of visiting the exhibition booths can be turned into something balanced and purposeful. The arrangement of exhibition booths can result in the identification of indicators that can contribute to the creation, guidance, and prediction of visitors' movements in and across the planned spaces.

Research objective: The purpose of the research is to explain the relationship between the body of the space and the movement behavior of users. Explaining the relationship between the body of the space and the user's movement behavior, which is determined by examining the analytical charts and tables produced by the software. Achieving the optimal pattern of relationships between access indicators, which is to improve the architectural quality of the exhibition space by promoting human communication and interaction.

Research method: The qualitative-quantitative method of research was employed in the current paper. In the section on the theoretical foundation, the descriptive-analytical method was used for the data-gathering process with a deep focus on library searching and documentary studies. The results, reviewed by specialists and experts, were based on the comments of the statistical community using the Delphi Method. The content analysis method was used for the quantitative data using Mic Mac, Scenario Wizard Software, and Depth Map. The final result here in this research method is applicable. In terms of nature, it is a combination of simulation and descriptive-analytical methods, and in the final step, logical reasoning was also used.

Conclusion: Based on the analysis of layout patterns and space syntax, the results of the research prove that the optimal movement pattern of the users of the exhibition space is affected by the layout of the exhibition booths, all based on the common linking indicators, access length-depth, and routes in expressing the importance of communication. The checkered pattern (the third pattern and as a balanced design idea) shows the access points—the ones that enjoy spatial openness all due to the construction of blocks and permeability attempting at creating spatial contrast. This area was created to form a central point in this space. The space defined by centrality leads to the formation of peripheral orders and correct interconnectedness.

Keywords: Space syntax (Arrangement), Access network, Exhibition stands, Future research approach.

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and in consultation of Dr. "Hadiseh Kamran Kasmaei" which has been done at Islamic Azad University, Pardis Branch, Faculty of Art and Architecture, Tehran, Iran in 2023.

**Corresponding author: +98(21) 77240467, mkhakzand@iust.ac.ir

Introduction

Human visual and movement characteristics in the architectural space are related to the theory of “space syntax,” which shapes the architectural space and social relations. In the view of this theory, space, and human activity do not have two independent and different natures; rather, as a single nature, they have two different appearances that are hidden in man and his movement and visual characteristics (Vaughan, 2007, 208). Exhibition booths in the contemporary era have been built without paying attention to the principles of movement and attraction of the audience in the space, which has caused the user to distance herself from the interior environment of such spaces because, as soon as the audience enters the exhibition spaces, they enter into an abstract space and cannot see the connection between themselves and the visual elements and the movement in the space in the building. Therefore, to link the audience, movement, and visual elements and also to achieve visual comfort (visual and structural integration), it seems necessary to use the optimal layout pattern in exhibition spaces. Also, in recent decades, the relationship between the way of movement, the audience, and the arrangement of visual elements in every exhibition space has changed, and the design of exhibition stands has been done without considering the principles of attracting the audience, which is not worthy of praise. Therefore, since the interior architecture and the construction of exhibition spaces in the present era of Iran are facing many challenges and what is being built is not considered to be in line with the design principles of exhibition spaces in Iran, Dealing with the solutions and approaches to designing the interior architecture of exhibition spaces that lead to optimal movement and visual patterns, along with the analysis of its principles and foundations, is a path-breaker in today’s architecture. In this regard, the exhibition spaces that are set up today with haste and without paying attention to the relationship between the

audience and the type of space have nothing to do with the principles of the interior architecture of the exhibition space because, in the contemporary era, the interior architecture of these spaces cannot meet the needs of the audience. Therefore, it is necessary to create a link between the audience, movement, and visual elements in exhibition spaces according to optimal visual patterns. Based on this, the method of arranging the space is to create the right relationship between human society and the architectural body, which examines the physical characteristics of the space. Due to the possibility of designers using the arrangement method and space syntax to predict users’ movement behaviors, this model can be used in the design process to create an interactive relationship between users’ behavior and the body of the space because the layout of the space generally uses three theories in the fields of mathematics, human geography, and philosophy, and in this regard, it uses related software for modeling and calculations, which is analyzed by factors and indicators. The role of the computer in the analysis and modeling stages is very influential and important. Explanatory charts are formed as one of the spatial analysis tools in this way based on graph theory; in this way, each environment is drawn as a node, and the connection between both spaces is drawn as a line connecting two nodes. Connection, access, depth, coherence, natural movement, and readability are the main indicators of structure analysis using this method. The main goal of the research is to understand the relationship between the movement behavior of users and the body of the environment to explain the optimal pattern of access for such spaces. The process and method of the present research to reach the goal are included in the future research approach, which not only will not be surprised when faced with the future and the deep sea of changes but is welcomed with knowledge and understanding of the future and an optimistic view so that the optimal model of the spatial layout of the access network in the exhibition stands can be obtained.

Research Background

Regarding the different angles of this type of research, many studies have been conducted in other areas of architecture, urban planning, and urban design. The foundation of the theory of space syntax by Hillier and Hanson in 1984 was based on research on the relationship between social and spatial forms in London, with the belief that space is the main and primary core of how cultural events are organized and that it is social. Although space itself is formed through economic, social, and cultural processes, it is usually considered a platform for social and cultural activities to the extent that its form is usually assumed to be invisible (Rismanchian & Bell, 2011). The theory of syntax, or space syntax, is a method for analyzing the structure of a space by analyzing the arrangement of the existing micro spaces and finding out their hidden features according to the spatial configuration. In fact, this theory is a collection of techniques and theories that study the configuration of space at the scale of architecture and urban planning and seek to discover how the structure of space configuration interacts with the social behavior of users (Hiller, 2007). Very simply, the spatial configuration that Hillier emphasizes in urban science has the same concept as the constellation in astronomy; in this way, apart from the characteristics of each star, the constellation also observes the relationship between them. In spatial configuration studies regarding architecture and urban planning, communication is studied individually without evaluating the characteristics of space. But Hillier, in a more professional language when explaining spatial configuration, portrays the importance of communication between spaces in one form (Fig. 1). He states that the configuration of spaces in a building or a city can be examined in the form of a graph; in this way, mathematical graph analysis can be used to understand it, and a qualitative phenomenon can be further analyzed quantitatively. This theory is based on tools for analyzing different structures of space, among which we can refer to the software related to this method

called Depth Map. This software was first developed and presented at Bartlett College, London, and was used to analyze the configuration of different spaces and predict the different behaviors of people in those spaces. This software contains indicators that are used in the analysis of a spatial configuration (Kiaee, Soltanzadeh & Heidari, 2019).

Considering that the use of the space syntax method enables designers to predict the movement behavior of users in the space, this model can be used in the design process and create an interactive relationship between the body of the space and the behavior of the users (Abbas Zadegan, 2002). Bill Hillier's theory of natural movement called "natural movement" deals with the effect of spatial configuration in the formation of behavioral and social patterns such as movement patterns. He considers the most important factor in guiding the movement of pedestrians in the architectural space to be aligned with the configuration of the space alone (Hillier, Penn, Hanson, Grajewski & Xu, 1993, 31). Spatial configuration first directs the movement pattern in the city and then to make this movement efficient for spatial attractors and uses, it locates itself in line with them, and in this way, the spatial configuration can affect the distribution pattern of spatial attractors (Hillier & Vaughan, 2007). Based on the relationship between movement and morphology, this theory deals with the configuration of space and the way of communication between urban elements, so that spatial configuration alone can be considered the main factor in predicting pedestrian movement (Toker, Baran & Mull, 2005, 1). The relationship between attractions, spatial configuration, and movement is shown in Fig. 2. This figure states that while the spatial configuration can affect the movement as well as the spatial attractors, it cannot be affected by them; Of course, movement and space attractors can affect each other. This article confirms the primary factor of creating movement in direct relation to the spatial configuration and without knowing it, it is not possible to study the pattern of movement in architecture and urban

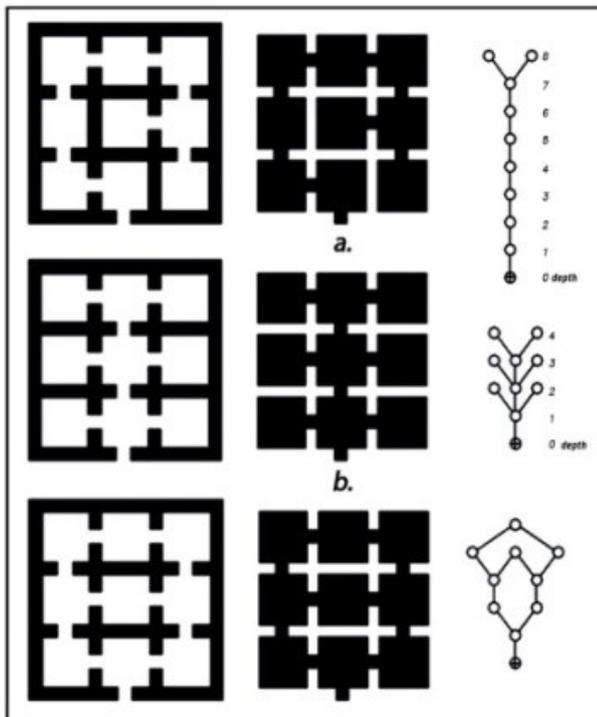


Fig. 1. An example of spatial configuration. Source: Hillier, 2007, 20.

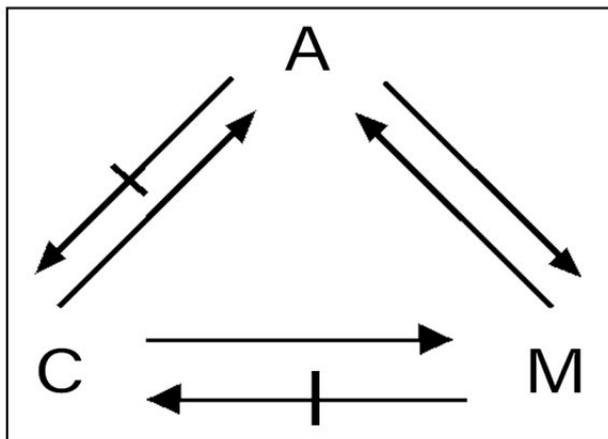


Fig. 2. Relationships of attraction, configuration & movement in space. Source: Hillier et al., 1993.

planning. Lay and colleagues (Lay, Reis, Dreux, Becker & Ambrosini, 2005) investigated the issue of readability and visibility in the relationship between spatial cognition and spatial behavior in spatial configuration. Rajabi, Zareh and Bagher Hosseini (2022, 5) In their article entitled “Synergy of Cognitive Maps and Space Layout Techniques in Identifying and Analyzing the Sociability of Physical Spaces Under the Influence of Spatial Territories (Case Example: Shahrak Ekbatan, Tehran)” using qualitative-quantitative research method and Depth

Map software, they concluded that in addition to the variables of integration and connection of the public domain, which is confirmed by the quantitative method, it also shows the effectiveness of variables such as geometry and vegetation, which cannot be identified by the quantitative method. In addition, the arrangement of semi-private territory in blocks is recognized as another variable in people’s willingness to be in the space. Therefore, quantitative and qualitative methods complement each other in analyzing the sociability of physical space. In their article entitled “Evaluation of the role of physical and functional factors in the sociability of Iran’s traditional markets using the space syntax technique (case example: Tabriz market)” with the descriptive-analytical and field research method and also the use of Depth Map software, Najjari Nabi & Mahdinezhad (2020, 67) found that spatial values and space syntax in different parts of the market have fundamental differences; so that the structure and social cohesion of the bazaar have been greatly reduced and the degree of integration of the newly built streets has increased. In their article entitled “Feasibility of development of space syntax components in the analysis of traditional houses” using descriptive-analytical research method and Depth Map software, Kiaee, Peyvastehgar and Heidari (2020, 111) concluded that in some cases, despite the influence of spaces in drawing explanatory diagrams, the necessary sensitivity is no necessary distinction between types of space in these diagrams. Also, in other cases, some features, while they are part of the main features of the building, differentiate the spatial quality between different buildings. In their article entitled “Logic of Spatial Arrangement of Khuzestan Plain Settlements” by using phenomenological research method and Depth Map software, Mohammadiyan, Safari & Karam (2019, 147) came to the conclusion that the behavior of the rivers of Khuzestan in interaction with the heritage of Persian Gulf sea defenses defines the rule of urban settlement in this space. At the same time, the shape of the river meander

explains the rule of rural settlements in this space. In their article entitled “Analysis of the relationship between the spatial structure and the movement behavior of users using the method of space syntax (case study: Central Campus of Tehran University)” using the qualitative-quantitative research method and Depth Map software, Kalantari, Ekhlasi, Andaji Garmaroodi, Khameneh (2019, 215) concluded that one of the important reasons for the crowding and density of users in some parts of the space, as well as the solitude and abandonment of some other parts, are the presence of a physical architectural structure in the target site. In their article entitled “Analysis of the relationship between spatial structure and the occurrence of urban crimes with the help of space syntax method (case study: theft crimes in Tehran)” using a descriptive-analytical and comparative method as well as Depth Map software, Jabari, Mihan, Kalantari and Mohammadi (2019, 2) concluded that if commercial uses are located on a regional and urban scale, there will be more types of crimes related to them. Macro-integrations, therefore, seem to encourage crime for uses that are often associated with commercial activities. In their article titled “Study of the relationship between cognitive maps and computer modeling of space syntax software in understanding sociable environments” using qualitative-quantitative research methods, Heydari and Farhadi (2018, 17) concluded that the matching of reproductive-non-reproductive cognitive maps and spatial configuration maps has a significant relationship with achieving a comprehensive approach in recognizing sociable environments. Also, these factors show the role of spatial configuration in identifying low-cost solutions to improve the spatial structures of educational environments in a social sense. According to the background of the current research, it was found that no research has been done on the analysis of the optimal pattern of the spatial syntax of the access network of exhibition stands with a research approach for today and the future, and it is the first research in this field.

Theoretical Foundation

• Exhibition architecture and exhibition stands

Architectural design is a visual program for creating works. Each design or composition consists of two main parts: architectural design elements and design principles (Ahmadi, 2012). According to the limited records of research about the architecture of the interior space of the exhibition and exhibition stands, part of the definitions of the architectural trend of this field can be reviewed and searched in the book “Pattern of exhibit stand design process” written by Azad Behmanesh (2018). Explanation of the physical signs that the architectural design and activities are among the important identifiers that define the exhibition stand in association with the way of access and movement. Investigating the spatial arrangement and its characteristics in the exhibition booths seeks to understand the relationship between the structural values and the form resulting from the space syntax and the concepts. Perhaps it is more correct to consider the design of an exhibition in a combined process, which, in summary, includes various disciplines such as architecture, interior design, environmental design, ergonomic engineering, environment, lighting, mechanics, electronic and digital media, audio equipment, architectural graphics, print graphics, and other design concepts. But the independent nature of exhibition design and its effects should not be neglected. The power of this environment is in presenting and interpreting information as well as attracting audiences and its impact on thoughts and ideas. creating an appealing user experience informs the exhibition’s storytelling (Lake-Hammond, 2006). The designers of the exhibition facilitate effective communication with the audience by using space, environment, and movement and gaining real experiences, and by using the potential of the environment to convey the message; they create a communication space between the message and the environment. The correct understanding of the two words space and display are essential

in relation to exhibition spaces. In addition, the definition of space is a relative matter and can express different truths about a person, situation, or object in different societies. The word “display” means to show something that is usually hidden; it deals with the complete description of a theory or design theory, etc. (Behmanesh, 2018, 21). Giles Velarde in his book *Designing Exhibitions* (2001) states that the position of the designer between the scientific source of information and the visitor is of great value for the exhibition planning process. He argues that “the designer’s primary interpretive role, like that of a translator, must be performed in both technical and exhibition language by someone fluent in it.” The specialization of exhibition design can be partially attributed to the professionalization of design planning during the 20th century when the improvement of quality standards led to the division and differentiation of design fields. As industrial and graphic design professionals sought to distance themselves from their architectural parent, on the other hand, exhibition design is also an innovative job with a range of jobs and traditional media, artists, graphic, industrial, and interior designers as well as architecture in the diversity of skills and how to communicate with exhibitions along with the set of maintenance requirements, which has been a project-oriented approach. A coordinated approach to the planning, process, and concept of the exhibition requires communication and knowledge between the designer and the audience/audiences (Lake-Hammond & Noel, 2017). The contemporary exhibition process has become a partnership between curators, designers, educators, technicians, and increasingly, the audience itself. Throughout the 20th century, the evolution of the field of design from focusing on objects and symbols to complex orders of interactions has made systems suitable for solving communication problems (Buchanan, 2005). According to various experimental narratives in the emerging field of exhibition design, the concept of a successful exhibition comes from a deep understanding of the subject of the exhibition and

the ability to convey information, which explains the designer’s role in interpreting its content for a dynamic and attractive exhibition experience. The designer explains the meaning of the space by developing the way of access and movement in narrative frameworks, and finally, they are displayed with colors, graphics, surfaces, and materials. Circulation means the movement pattern in an area or a building or a space in a building that provides access to different parts for people or services. Also, circulation is an important aspect of architectural design, but it is often considered primary. Circulation is an area dedicated to the movement that connects different parts of the building to a coherent network (Puusepp, 2010, 44). In 2017, Yafei Ou & et al. investigated the design of the exhibition space based on service design thinking: case example: observation of Beijing rehabilitation technical assistance for the elderly exhibition hall. The results of the survey indicate that the design of exhibition spaces for the elderly requires the use of movement patterns and 2D and 3D pictograms. Also, extensive lighting helps this process a lot. High visual resolution can make navigation easy (Ou, Wang, You, Tao & Liu, 2017). Werner also states that the wayfinding performance and the ability of humans to find direction depend on the geometric relationships between different parts of space (Wineman & Peponis, 2010, 100). One of the key components in the interpretation of the exhibition space is the orientation and continuity of movement along a designer’s comprehensible storyline to the entire exhibition.

• Space Syntax

This method includes theories and techniques for analyzing the configuration of space, which were presented by Bill Hillier and Julian Hanson in the late 1970s based on the theories of Christopher Alexander and Philip Steadman after years of studying and finding the influencing factors and hidden patterns beyond (Bazai, Ghasemi Sichani, Shojaei & Madahi, 2020). Space syntax is the use of variables obtained from the analysis of space

Table 1. Types of Exhibition. Source: Authors.

Exhibitions and Booths	
Descriptions	Titles
In the architectural designing and the construction of exhibition-related spaces, there is no emphasis on creating a link with the past but instead, we can detect a deep look into the future with a realistic point of view. Therefore, when designing these spaces there is much effort to reduce the mass and on the other side to increase the space reposition.	Future-oriented schools of thought versus traditionalist schools
This current thought came up after the industrial revelation and subsequently the emergence of modernity in the mid-19th.	Tech-based mass production vs. non-tech production (traditional)
The design and structuring of these spaces are fully different from the ones we have been witnessing in the common spaces we used to see. The exhibition spaces are changeable and they enjoy a fixed proliferation structure. Since there is no contact with the custom-oriented factors, these structures except for their technology and engineering parts, have no ties with ecology, culture, and elements alike. These structures, on the other side, are a good element for describing social matters most brilliantly so that each space of this type can play a key role in presenting a reflection of the abilities and capabilities of one group in acquiring more success in gaining up-to-date technology.	Being temporary vs. being permanently
The structuring elements of these spaces themselves enjoy a limited number of capabilities for being presented properly. It means that these elements are shipped to the final project site from the factory in mass mode. This causes the designer not to create a wide variety number of elements of different forms and this finally causes repeated, mass-produced forms.	Technology vs. Form
Since the constructing elements of these spaces are coming from the industry side, the shape and form of these spaces are rigid in their natures.	Brutalism vs. visual layout “a triumph of industry and technology on the environment”

Table 2. Types of Exhibition Booths. Source: Authors.

Descriptions	Types of Booths
Middle “with 3 sides open or in peninsula mode” Lateral “U-shaped” Central “Island mode” L-shaped “best for visitors’ commuting” End-side Customized booth construction	1. Types of booths all based on their placement in the expo halls
Pre-fabricated, modular, and portable booth construction	2. Types of booths from the viewpoint of form and structure
Indoor booths Outdoor booths	3. Types of booths from the viewpoint of space and placement
Single floor booths Double floor booths	4. Types of booths from the viewpoint number of floors

configuration in recognizing the patterns of different geometric elements. This theory is directly related to the way humans perceive, move, and use any kind of space system. The visual and movement characteristics of space create human relationships in the concept of place (Hamedani Golshan, 2015). Computer methods and techniques for modeling that analyze the configuration of space based on the basic concepts of human behavior—movement, visual perception, and activity. Models use simple geometric features, such as lines of sight and movement or visual fields of perception, to create

a network of spatial elements. The considered geometric elements can be a line, a convex space, or a point, depending on the type of space being analyzed (Van Nes & Yamu, 2021, 3). Then this network becomes a relationship pattern or a graph representation that can be quantitatively analyzed to determine the relative role of each space in the system configuration and understand how its constituent elements are related as a whole or in their components. Linear spaces when the topic of research is movement and convex spaces when the emphasis is on social interactions, as well as

when the topic is complex behavioral patterns, are visible (Dettlaff, 2014, 286). The important point in understanding exhibition spaces is to consider the situation of the observer because the viewer of the work is often moving and, in most cases, not fixed, which affects the entire design and composition of the work. In this case, it is possible that the viewer will not be exposed to the visual effects of the environment for a long time and will leave the location affected by the mentioned elements. If people's perception of the environment is not the same as the perception expected by the designers, they may blame them. It is noteworthy that the space syntax method is not only a simple modeling tool but also a method for understanding the complexities of the environment, its morphological logic, and its development pattern, as well as the behavioral patterns in them (Van Nes & Yamu, 2014, 239). Space syntax is one of the methods introduced to understand the invisible structures and systems behind architectural forms and phenomena (Bahraini & Taghabon, 2012). However, structural analyses face limitations that lead to the presentation of relative results. In addition, in the literature related to the arrangement of space, indicators such as "depth", "link", "selection", "control," and "difference of space" are usually discussed in the structural analysis of space and the relationship between the perceptions of the audience and the physical components of the space (Kiaee, Peyvastehgar & Heidari, 2020, 112). Finally, the basic goal of space syntax theory is to find approaches to describe the configuration of space. Such a description should be able to discover the hidden social logic in its underlying layers and provide the context for secondary theories about social and cultural events (Hamedani Golshan, 2015). A review of the literature on the use of spatial syntax in exhibitions and exhibition stands shows that although various studies have been conducted on the use of this method in architecture, no independent research has been conducted to examine and compare the spatial arrangement in exhibition spaces to understand its relationship with access and the move has not been made.

• Futurology

In recent years, many researchers from different disciplines have developed quantitative and qualitative methods for logical future forecasting. Rationality in this context means knowing or being aware of the possibility of different futures that are far from being determined or known with absolute certainty. Foresight is defined as helping to make decisions under uncertainty rather than predicting the future. Most future research approaches will rely on subjective human judgment as part of qualitative research. However, various tools have been developed and applied to reduce this bias by encouraging collective judgment, generating ideas to generate different judgments, identifying differences between views about the future, and demonstrating consistency or inconsistencies between and within these views (Bibri, 2018). Futurism is a trans-civilization and trans-discipline science that has placed the discovery of possible futures and efforts to build a desirable future at the top of its goals (Tobchi Thani, Mohammadi & Khazaei, 2020, 102). Futurism can be classified based on three ways of thinking about the future (Banister & Stead, 2004):

- 1- Possible future (what could happen?): Scenario studies are included as descriptions of possible future situations and their developments in this state.
- 2- Probable future (what is most likely to happen?): includes studies that are characterized by a predictive nature and mainly focus on historical and interpretive data as well as trend analysis.
- 3- Preferred Futures (What would we prefer to happen?): Sustainability-related futures studies that focus on desirable futures, such as predicting preferences and norms.

In a general statement, futurology can be called the science of the future, because it tries to transform today's changes in a specific and specific direction into tomorrow's desired realities, and with this approach, fulfill the possibility of aligning changes with desired desires and futures from a foresight perspective (Arab loodaricheh, Shahivandi & Moradi Chadgani, 2021, 83). Future research can

be classified based on the field studied in terms of simplicity or complexity (Pedram, 2018). In particular, if the context is predictable and largely controllable, a planning approach such as forecasting may be appropriate, and if it is unpredictable and uncertain, an alternative approach such as scenario planning is more appropriate (Chatterjee & Gordon, 2006). Futures research has moved from predictive to prospective paradigms (Hosseini Golkar, Ghazi Nouri, Thaghafi & Ayouzi, 2017). There is no consensus on unit classification and the most appropriate approach to a prospective study. The researcher's worldview and goal is the most important criterion for determining the future research method, whose approach should be used to achieve the goal because the future has not yet happened and the researchers of the future are forced to choose some analysis methods that are typically used with scientific and traditional methods to study the present and the past. The desired methods in the discussion of future research studies include a spectrum from quantitative methods to creative methods or a combination of the two. In this research, two methods of Delphi and scenario writing based on different perspectives of the future have been used. Reaching an optimal scenario with 8 variables related to the access network and movement in the exhibition space, which was finally analyzed with the space syntax software. In such a combined framework, it is possible to build models of knowledge management to support and improve planning methods in the design of exhibition spaces, focusing on access and movement. Of course, it also offers a broader analysis in explaining the exhibition architecture and exhibition stands. The start of new experiments, according to the different choices of the 8 bias indicators obtained in the optimal scenario, can be expressed differently and appropriately according to the access methods and how to move in association with the relevant agents.

Research Method

This research was carried out by using the

qualitative-quantitative research method to measure the optimal pattern of the spatial syntax of the access network in exhibition stands. The theoretical basis of the research was examined using the descriptive-analytical method and the data was gathered in the form of library and documentary studies. In field studies, after identifying the criteria and sub-criteria output from the study stage, the required data and information were collected and analyzed in a targeted manner, and the plans and images related to the layout of the Tehran International Exhibition Halls and Shahr Aftab were prepared. Then, using the "Depth Map" software, the communication and space syntax components were investigated, with an emphasis on access and how to move in the exhibition stands. In general, the results obtained from the qualitative findings, in addition to the interconnected variables and connecting the territories, should be confirmed by the quantitative results as well. The practical purpose of this research was to study one of the most important issues in architecture and interior design by using the existing theoretical foundations. To carry out this research according to the purpose of the research, the following steps were taken:

The research method: it is a combination of content analysis, argumentative and inferential, simulation, and calculation, which has been comparatively validated (Figs. 3 & 4).

Content analysis: "Content analysis is a method of studying and analyzing relationships in a systematic, objective, and quantitative way to measure variables". Using this method in the current research to measure variables instead of directly observing people's behavior or asking them to answer scales or interview, the researcher looks for his choices and questions in them." Sampling in this method is carried out as a survey.

• Computational

The calculation method is mainly in the interaction analysis and structural analysis using Mic Mac and Scenario Wizard analytical software, and the results obtained about the movement variable and accesses

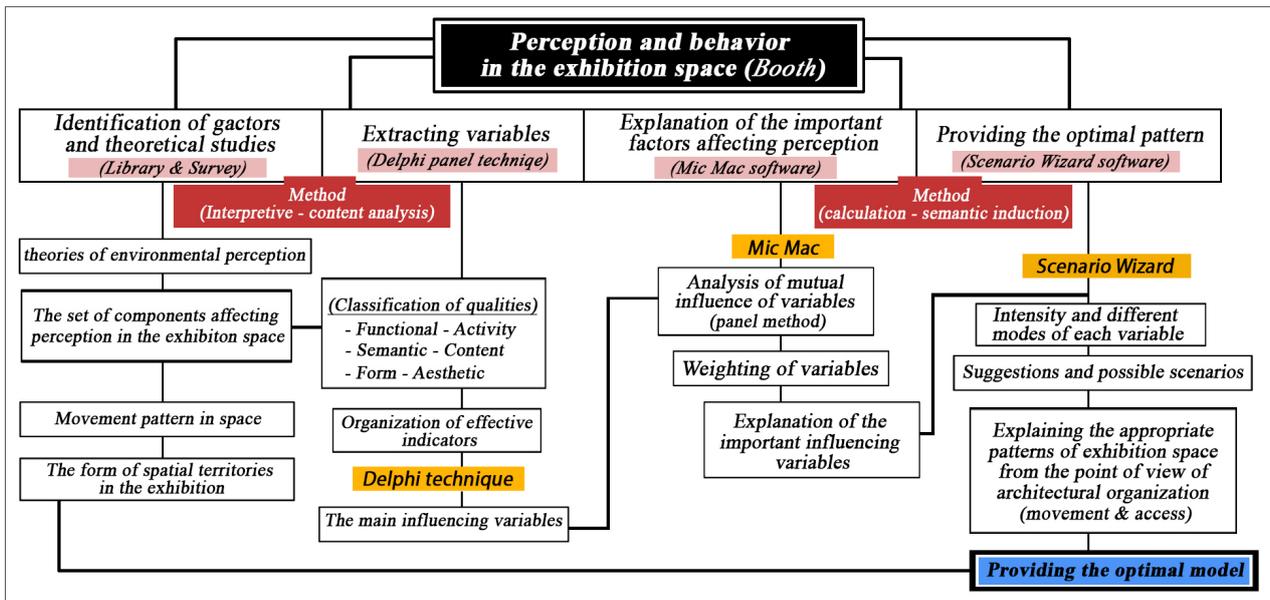


Fig. 3. Research process diagram. Source: Authors.

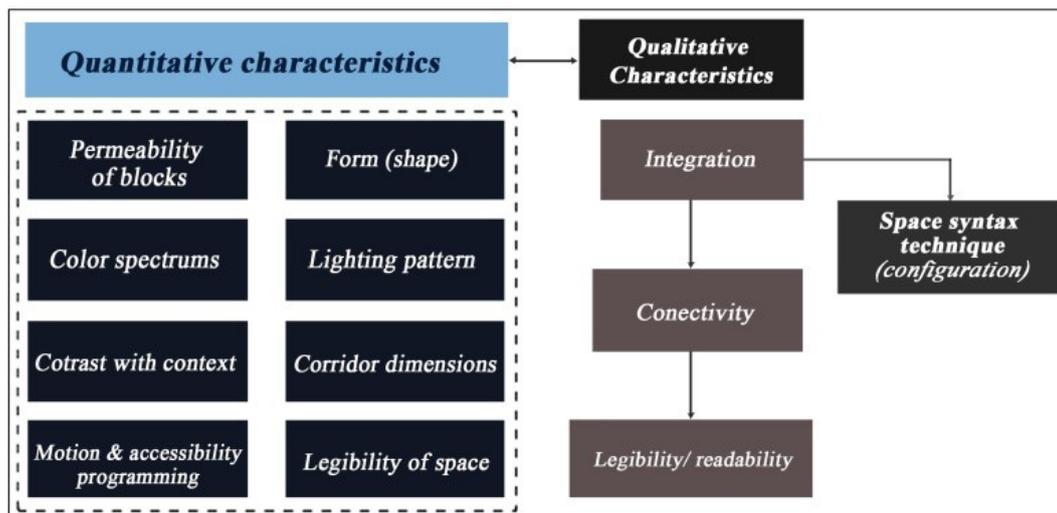


Fig. 4. Quantitative and qualitative components of research. Source: Authors.

are analyzed in the Depth Map software, and after the analysis, new proposals are made.

Semantic induction: Using this method, the prioritization of dependent variables has been done based on the measured software and the obtained data.

• **Method of data collection**

The study of library resources: Most of the data used in this research is related to the study of fields related to the subject, which mainly constitutes the literature review section. In this section, the main method of

collecting library information from available sources includes books, magazines, theses, and scientific articles, and the tool of this collection is extracting and summarizing related sources.

Survey Studies: The field methods used are including questionnaires, observation, and photography, which study section of the current research, the way of audience movement in the public exhibition stands of Tehran city, and its optimal visual pattern have been investigated.

• **Statistical population, sampling method, and sample size**

The statistical population of the current research is a collection of experts in the fields of design and architecture in two separate groups who are questioned in a panel format. The sampling method is the selection of 16 people in two groups of specialists and experts in the fields of architecture, interior design, environment graphics, urban planning, urban design, and urban planning. The user and environment preferences section was analyzed by means of semantic differentiation by separate questions. Also, to investigate the state of visual elements and the way of physical and eye movement as well as its effectiveness to attract the audience in the exhibition booths, firstly, to analyze movement (physical) behaviors, the Delphi panel analysis method and screening of the set of variables were used, and then the analysis method was used. The interaction effect and the use of Mic Mac software in a specialized way (opinions of experts and designers) have been used to analyze and extract the most important factors affecting the perception of users of the exhibition space. As a result, the most important factors have been extracted from the Scenario Wizard software using the Mic Mac method, and optimal scenarios have been presented according to the mutual effect method. Of course, it should be stated that the validation of the models was determined based on the analysis stability index in the software. Based on the analysis that the authors have made using the “Scenario Wizard” method in relation to the optimal patterns and based on the key variables affecting the design of the exhibition space; a summary of these factors can be seen in Table 3. What can be discussed

using the software method of spatial syntax analysis in this research are variables such as the shape of the stalls, the standard dimensions of the stalls, the dimensions of the corridors, the permeability of the blocks, spatial contrast, and also the structure of the movement network.

According to the presented variables and the emphasis of the research on the structure of the movement network in the exhibition space, the authors analyzed two types of optimal access (checkered and radial movement) in combination with other factors. The variable of movement network structure between valuing 5 types of access arrangement obtained in theoretical sources and the research process with the emphasis on the optimal proposal of the scenario wizard on radial and checkerboard networks is the aim of this research (Table 4).

Quantitative data analysis has been done using the space syntax technique and “Depth Map” software, and the factors of connection, coherence, and readability are used as variables to evaluate the optimal pattern of spatial arrangement in exhibition booths; The more red and orange the colors are, the higher the level of the measured indicators. Finally, the presentation of the optimal pattern in “Depth Map” was determined by examining the 5 proposed patterns from the two types of motion indicators obtained. The patterns are presented in a general way and can be generalized to the architectural design of exhibition spaces.

Findings and Discussion

The analysis of checkered and radial accesses applied in the configuration and syntax of the exhibition network was done using Depth Map

Table 3. Optimal Scenarios. Source: Authors.

Factors of Optimal Scenarios								
Motion & accessibility programming	Legibility	Contrast	Permeability Of Block dimension	Color spectrums	Dim Corridor	Dim Booth	Vision-Light	Form (shape)
Grid (checkered space) & Radial	Monotonic, Zoning & marking	Function & Form	Length= 40m	-Light Blue - Red - Green	d = 8m & d > 8m	80-100	Artificial Lighting	Regular & Square

Table 4. Types of movement paths in exhibition spaces according to the effective factors of perception. Source: Authors.

Type	Variable
Axial Movement	<u>Motion</u> (Movement in Space)
Spiral Movement	
Movement in checkered grid	
Radial Movement	
Widely Movement	

software. First, it was checked automatically as a map in simple radial and checkerboard grids, which consists of the set of the minimum number of continuous intersecting axial lines and also the longest direct line of sight that can cover the entire space plan. To carry out numerical evaluations, a network map was drawn in radial and grid modes. Then, by adding centrality and creating nodes in the axial lines, each edge was an intersection between them; two other modes of this evaluation were drawn. With this formalization of the derivative, it is possible to calculate the component units in which the continuous nature of space is decomposed and also to evaluate their interrelationships using graph-based methods. In the final mode (the fifth pattern), the optimal accessibility was measured in comparison with all the suggestions as a combination of the stated modes, with the assumption that the path of the contacts tends to go through the most accessible routes. Along with such formalization for the concept of accessibility, it provides the possibility to evaluate the probability of movement in the environment with the method of space syntactic analysis. The difference in the creation of spatial contrast, space openness, or permeability in these models led to different modes of access, and finally, 5 models with checkered and radial access network structures were examined and compared; checkered and simple radial, checkered, and radial access by creating centrality on the axes, as well as the combination of the radial and checkered network (Fig. 5).

Routes are also shown on connectivity analysis and space integration maps. The tendency of most colors to be red and orange in the graph of the results of each pattern shows the priority and higher degree

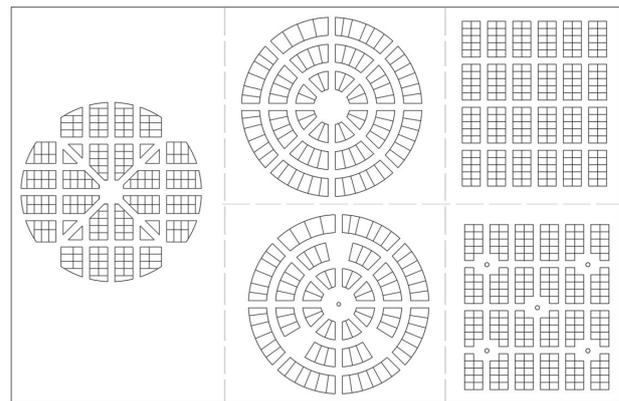


Fig. 5. Drawing types of access with checkered (grid) and radial design of the space in the exhibition. Source: Authors.

of the indicators to be measured. The green color in the maps indicates low values and the yellow color indicates medium values. Also, the tables based on the difference in connectivity and the standard deviation of each of the patterns have been calculated by the software, which compares the balance of the accesses and the connectivity of the movement network in the patterns.

• **Pattern No. 1**

The network of accesses is designed in checkered form and the length of the blocks is 40 meters to have the most favorable level of permeability with what is proposed in the “Scenario Wizard” results. The spaces are undifferentiated and homogeneous, and the centrality of the exhibition space is weak in this model (Fig. 6 and Table 5).

• **Pattern No. 2**

Emphasis on the centrality and the pattern of radial access can be seen in this plan, where the permeability of the blocks is determined with regard to the maximum length of 40 meters. In the design of the shape of the booths, due to the radial axis, it is not possible to have complete order on the sides of the booths (Fig. 7 and Table 6).

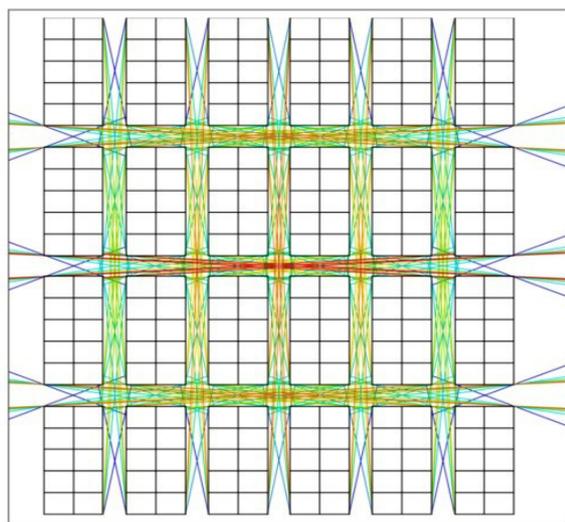


Fig. 6. Checkered (grid) access pattern graph. Source: Authors.

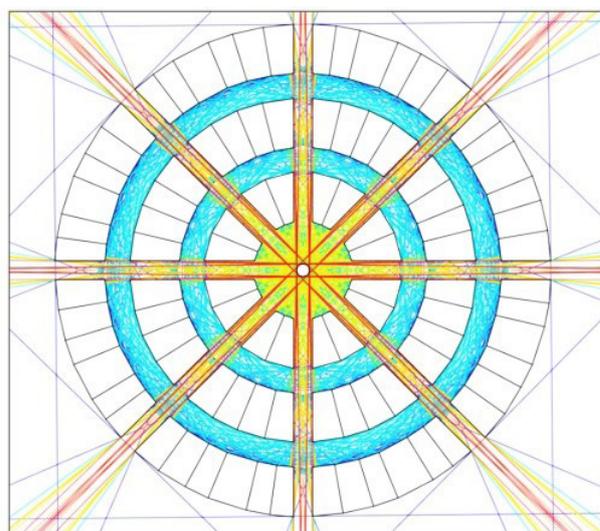


Fig. 7. Radial access pattern graph. Source: Authors.

Table 5. Standard deviation and integration difference of pattern (1) in the examination with Depth Map software. Source: Authors

Pattern No. 1	Min	Average	Max	Integration difference	Standard deviation
				94	38.4442
Spatial communication	27	69.12	121		
Path length	38.72	120.95	288.78		

Table 6. Standard deviation and integration difference of pattern (2) in the examination with Depth Map software. Source: Authors

Pattern No. 2	Min	Average	Max	Integration difference	Standard deviation
Spatial communication	44	173.6	514	470	198.2054
Path length	15.3	75.5	437.79		

• **Pattern No. 3**

In the third proposed model, the defects of the first model have been removed and despite the checkered network of accesses as well as the dimensions of the blocks and permeability, spatial openness has been created to create space contrast, which has also led to zoning and centrality in space (Fig. 8 and Table 7).

• **Pattern No. 4**

In the fourth model, like the third model, the openness of the space was created in a balanced way in parts of the exhibition space with an emphasis on the radial grid. Also, the maximum length of the blocks is 40 meters (Fig. 9 and Table 8).

• **Pattern No. 5**

The last model is a combination design of both radial and checkerboard grids in the accesses and corridors of the exhibition, in which the spatial contrast, shape, and dimensions of the booths are equal to the table of optimal results of the wizard scenario (Fig. 10 and Table 9).

To infer behavioral characteristics in spatial settings, topological measurements were performed with raster and radial map diagram-based representations. While focusing on the movement patterns of the audience, the integration index was determined based on the scale of the exhibition environment. In

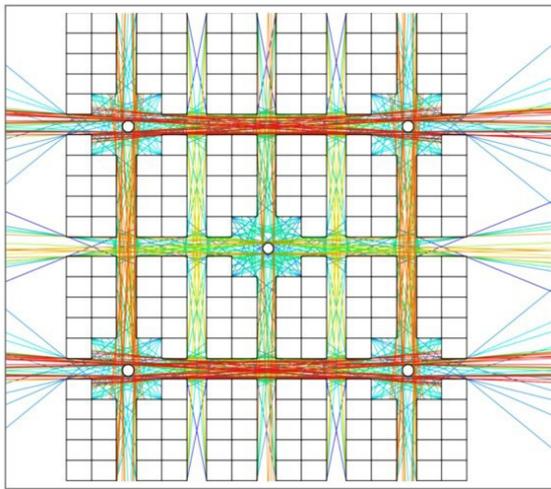


Fig. 8. Spatial openness in checkered (grid) pattern graph. Source: Authors.

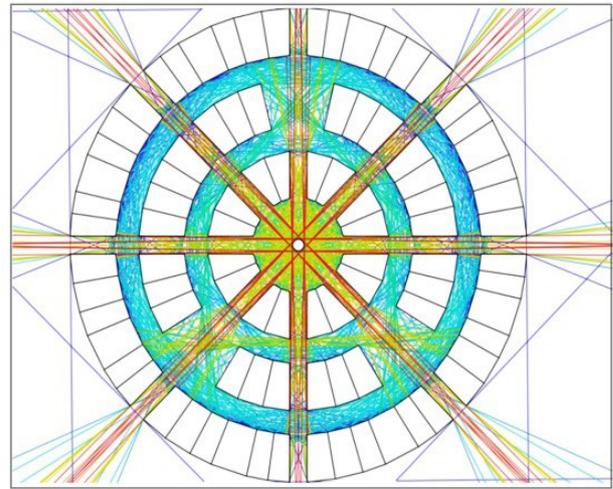


Fig. 9. Spatial openness in radial pattern graph. Source: Authors.

Table 7. Standard deviation and integration difference of pattern (3) in the examination with Depth Map software. Source: Authors.

Pattern No. 3	Min	Average	Max	Integration difference	Standard deviation
Spatial communication	53	132.4	223	170	69.4524
Path length	31.1	118.15	288.78		

Table 8. Standard deviation and integration difference of pattern (4) in the examination with Depth Map software. Source: Authors.

Pattern No. 4	Min	Average	Max	Integration difference	Standard deviation
Spatial communication	45	194.79	533	488	204.1152
Path length	15.3	81.22	437.79		

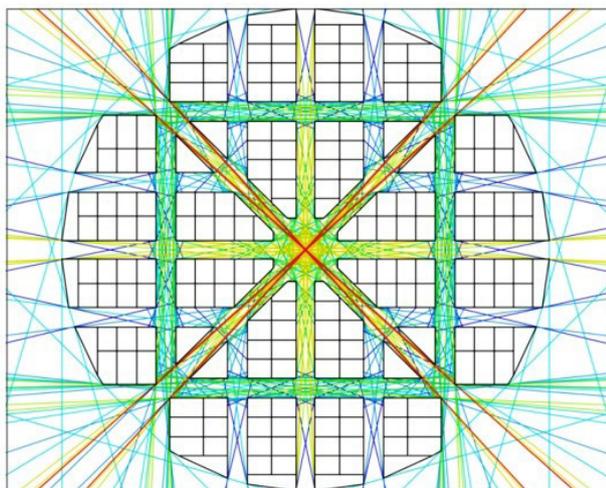


Fig. 10. Combined design of radial and checkered grids. Source: Authors.

the integration map, the green color represents the lowest value of integration and increases towards red and orange for the highest. Likewise, regions of high integration are defined as integrated, while

regions of low integration are termed segregated. Creating centrality in the access routes to connect different spaces creates spatial unity and coherence. According to the indicators of visual communication and integration in the analysis of the space syntax, the checkered access space has been assigned the highest score by creating centers. On the other hand, the geometric arrangement of the booths and their spatial communication have led to a legible architectural design and easy circulation while maintaining the integration and unity of the existing elements. Integration, as the most important factor in the arrangement, indicates spatial coherence. In other words, the greater degree of integration of the space indicates the greater coherence of that space with other spaces and the totality of the spatial organization. Therefore, the lower values of visual chaos indicators and greater transparency

Table 9. Standard deviation and integration difference of pattern (5) in the examination with Depth Map software. Source: Authors.

Pattern No. 5	Min	Average	Max	Integration difference	Standard deviation
Spatial communication	32	93.41	215	183	76.0441
Path length	30.62	146.53	423.55		

and visibility in the analysis of the space syntax can confirm the attention to these issues in the access architecture of the exhibition space. Spatial chaos is a qualitative quantity that does not mean chaos in dimensions and size but in the way of choosing access and visibility paths in each space. Bill Hillier believes that clarity and visual vision are directly related to the concept of shaping the whole space in the mind and putting these pieces together (Bemanian, Jalvani & Arjmandi, 2016). According to the characteristics of this index, its score in the exhibition and exhibition booths can reflect the readability, simplicity, and flow of movement. The average value is a key value in space syntax studies. Because it largely expresses the general situation of the desired parameter. In the analysis of space arrangement, the difference between the highest and lowest integration is also an indicator (Alibadi & Mahmoudi, 2018). The greater the difference, it means that the movement spaces in that model are not used in the same way, and some areas of the proposed model will be isolated. Isolated spaces benefit less from the economic benefits of movement, and in this case, as movement spaces of the exhibition, such spaces are less interested in the audience of the exhibition, based on which the lowest degree of integration means that that area is less subject to social surveillance or movement. By analyzing the charts and graphs extracted from the "Depth Map" software, it can be concluded that the fourth pattern has the highest level of correlation and the lowest level for the first pattern (Table 10 & Fig. 11).

According to the achievements of the field studies, which also played a significant role in the proposed process of the five presented models, the discussion and analysis of the research topic will be done by

selecting some concrete and practical examples of the layout of the exhibition plan. Of course, it should be mentioned that the obtained plans are all of checkered type (same as pattern 1), which may have minor differences in changing the dimensions, sizes, or cohabitations.

Examples of access network arrangements in international exhibitions in Tehran and Shahr Aftab: By examining the different layout plans of the booths in the different halls of the above exhibitions, most of the spatial divisions of the halls show how they are arranged based on a simple checkerboard pattern (pattern no. 1), a pattern that has led to spatial discontinuities in the multiplicity regardless of the factor of openness and centrality in the movement paths. Of course, through the indicators of visual communication and the length of the path, it is possible to create unity in the way of space to some extent, but unity in the whole space and movement paths must have balance for movement behaviors. The objective expression of the effective criteria identified in the internal layout of the exhibition architecture is a simple checkerboard compared to the other four proposed models, which have the lowest coefficient of spatial connection and the highest difference in connectivity in explaining accessibility. The criteria of this research are to reach the optimal pattern in the movement network as one of the main factors in organizing the architecture of exhibition spaces. By presenting some examples of similar patterns (field research) in the layout of the plan and the architectural structure of the movement in such spaces, it is possible to understand the importance of these research results by making small changes and paying enough attention to factors such as openness, creating centrality, the way of communication, and the average of the connections,

Table 10. Comparison of standard deviation and Integration difference between patterns. Source: Authors.

Pattern	Spatial communication	Average	Integration difference	Standard deviation
Number 1	27	69.12	94	38.4442
Number 2	44	173.6	470	198.2054
Number 3	53	132.4	170	69.4524
Number 4	45	194.79	488	204.1152
Number 5	32	93.41	183	76.0441

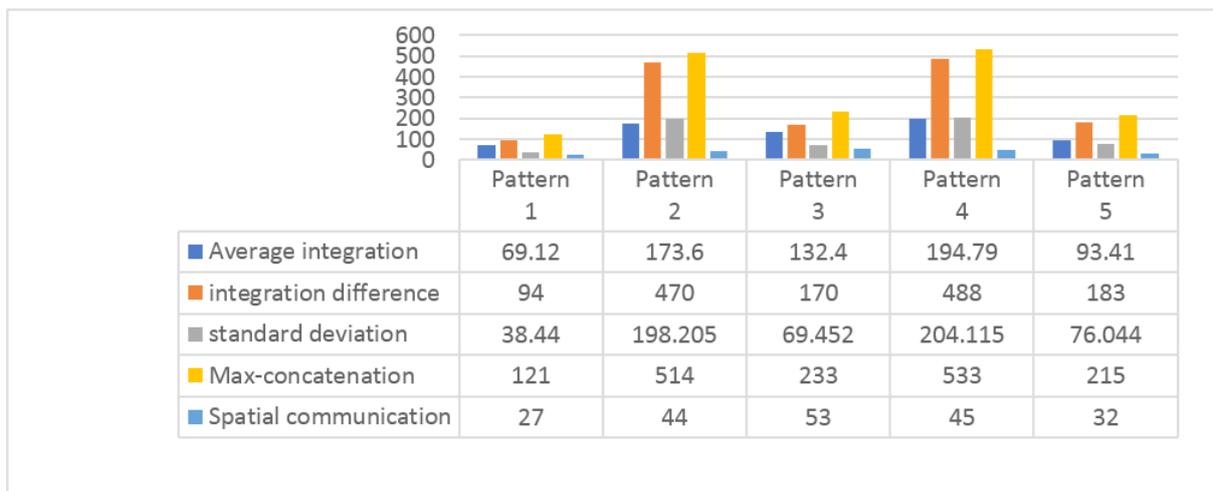


Fig. 11. Bar chart comparing the variables in the respective patterns. Source: Authors.

which cause a reduction in the standard deviation and an increase in the balance factor in the spatial relations. Hereby, we discuss three selected examples of similar layout plans in different exhibitions in Tehran.

The first example: It is an example of the layout of the plan and the way to access the A⁵ hall of the Aftab city fair, named the car exhibition, which is formed in a simple checkerboard pattern, and the blocks are the same length to improve the level of permeability. The homogeneity and inconsistency of the layout of the plan have led to weaknesses in creating the centrality of the exhibition space. Of course, it is necessary to pay attention to the dimensions and how to present the products and productions in each exhibition, the organization of the booths, the way of movement, and how to access the audience to the booths, besides the importance of the length of the route, which is

also done through the way of physical or visual communication (Fig. 12).

Second example: Another example of how to access and arrange the plan in checkerboard style in Hall A 5 of the Shahr Aftab Exhibition, entitled Stationery Exhibition, where the length of the blocks and the number of accesses are somewhat variable and arranged in three different sections. The degree of permeability, homogeneity, the contrast in the layout of the dimensions of the booths, and the way of access are also homogeneous, although differences have been tried to form in general. The creation of space contrast with different zoning without creating centrality or changing the dimensions of movement paths has led to uniformity in the space network, which has a low degree of spatial connection due to the lack of focal points and openness. This can lead to spatial chaos when

choosing access routes and visibility in space (Fig. 13).

Analysis of the third sample by presenting the optimal proposal after the process of this research: an example of the layout of halls 8 and 9 of the Tehran International Exhibition, Paint and Resin Exhibition, which is a simple grid. According to the structural form of the hall, the fifth model can be used in this research. The combination of radial and checkered grids in the structure of this hall, by creating centrality and openness in the accesses, leads to balance and desirability in the indicators of interconnectedness, communication, and spatial coherence, which create more optimal access and visibility paths for clients (Fig. 14).

Conclusion

Since it was mentioned in the findings, the analysis of the spatial syntax pattern of the exhibition stands based on four indicators of the difference in the degree of connection of accesses: the length of accesses, the standard deviation, and the coefficient of spatial connection, it can be

concluded that the third and fifth patterns are the most optimal layout design patterns. Exhibition booths are communication spaces, which include harmony, balance, access, and connection. Since the length of the route, the difference of integration, and the standard deviation are close to each other in the third and fifth desirable patterns, the spatial connection in the third pattern is significantly higher due to the different nodes in the space and the location of the connections of the main axes; this shows the third model is more desirable. In the first checkered pattern, due to the uniformity in the network of spaces and the lack of focal points, openness, or spatial contrast, this pattern has a low degree of spatial connection compared to other designs, and there is no balance in access to the exhibition stands. In the second and fourth patterns, due to the radially of the main axes perpendicular to the concentric circles around the centrality of the exhibition space, a relatively favorable spatial connection can be observed, but due to the very high degree of difference in integration, they cannot be a



Fig. 12. Analysis of the layout and accessibility of the Auto Show exhibition in Hall A5 - Shahr Aftab. Source: Authors.



Fig. 13. Analysis of the layout and accessibility of the PENEX International Exhibition in Hall A5 - Shahr Aftab. Source: Authors.



Fig. 14. Analysis and proposal of how to arrange and access the network in the IPPC exhibition in Tehran. Hall 8 and 9. Source: Authors.

suitable pattern in the direction of balance and equal access for the exhibition space. The third model, with a general outline of a design idea that can be generalized to the design of exhibition spaces (a space with a strong and distinct centrality and satellite centralities in the spatial comparison as well as the peripheral areas of the exhibition with an emphasis on the checkered pattern), has the most desirable indicators mentioned regarding the optimal model of spatial syntax with regard to the access network. The dynamics of movement are greater in this type of access, which has a positive environmental perception. The average amount of integration, as well as the social dimension of the space, is also on the rise. This research is designed to test and compare the similarity of different quantitative and qualitative methods for measuring the quality of radial and checkered accesses in the exhibition space according to the scenario presented, which ultimately leads to the optimal model for improving the interaction between man and space in the architecture of the exhibition. According to the topics raised and the results of this research on the direct impact and important role of access and movement routes in exhibition spaces, the ways of communication and access between micro spaces and booths with different dimensions and specifications can be investigated in future research. Achieving successful and comprehensive models in the field of arranging the space governing most exhibitions can be suggested as one of the important issues for the researchers who continue this way.

Reference list

- Aliabadi, Z. & Mohammadi, M (2018). Spatial isolation of urban areas and simulate the movement pattern pedestrian By using Space Syntax method (Case study: City of Zanjan). *GEOGRAPHIC SPACE*, 18(64), 99-120.
- Abbas Zadegan, M. (2002). The method of space syntax in the process of urban design, with a look at the city of Yazd. *Urban Management*, 3(9), 35-43.
- Arab loodaricheh, M., Shahivandi, A. & Moradi Chadgani, D. (2021). Identification of key variables affecting on infill development in inefficient fabrics of inner city by using futures study (case study: Shahshahan neighborhood of Isfahan). *Urban Planning Quarterly*, 12(46), 82-83.
- Ahmadi, Y. (2012). *Facade design guide*. Esfahan: Daneshpazhohan.
- Bahraini, S., & Taghabon, S. (2012). Application Testing of Space Arrangement Method in Design of Traditional Urban Spaces. *Honar-Ha-Ye-Ziba*, (48(3),5-18). [In Persian].
- Banister, D. & Stead, D. (2004). Impact of Information and Communications Technology on Transport. *Transport Reviews*, 24, 611-632.
- Bazai, M., Ghasemi Sichani, M., Shojaei, A. & Madahi, M. (2020). Syntactic reading of continuity and change in the spatial configuration of native houses in Shiraz, from the Zandieh era until now using quantitative data of “ucl depth” software map. *Islamic Art Studies*, 16(37), 50.
- Behmanesh, A. (2018). *Pattern of Exhibit Stand Design Process*. Tehran: Zibasazi.
- Bemanian, M, R., Jalvani, M. & Arjmandi, S. (2016). A Study of the Relationship between Spatial Configuration and Wisdom in Islamic Architecture of Isfahan School Mosques. *Iranian Architectural Studies*, 5(9), 141-157.
- Bibri, S. E. (2018). Backcasting in futures studies: a synthesized scholarly and planning approach to strategic

- smart sustainable city development. *Eur J Futures Res*, (6), 13.
- Buchanan, R. (2005). 'Design as inquiry: The common, future and current ground of design'. In Redmond, J., Durling, D. & de Bono, A. (Eds.), *Futureground Conference*. V. 2. Melbourne: Monash University.
 - Chatterjee, K & Gordon, A. (2006). Planning for an unpredictable future: transport in Great Britain in 2030. *Transp Policy*, 13(2006), 254–264.
 - Dettlaff, W. (2014). Space syntax analysis – methodology of understanding the space. *PhD Interdisciplinary Journal*, (2), 284-291.
 - Hamedani Golshan, H. (2015). Rethinking the theory of "space syntax", an approach in architecture and urban design; Case study: Boroujerdi House, Kashan. *Journal of Fine 89 Creative city design*, 4(3), 20-21.
 - Hamedani Golshan, H. (2015). Space Syntax, a Brief Review on its Origins and Methods in Architecture and Urban Design Case Study: Brojerdiha Mansion, Kashan, IRAN. *Honar-Ha-Ye-Ziba*, 20(2), 92-85.
 - Heydari, A. & Farhadi, M. (2019). Analysis of the relationship between the computer modeling the space syntax software and the cognitive maps in recognition of sociability behavioral camps (Faculty of Architecture at the University of Bu Ali Sina and Shahid Beheshti University). *Honar-Ha-Ye-Ziba*, 23(2), 17-30.
 - Hosseini Golkar, M., Ghazi Nouri, S., Thaghafi, F. & Ayouzi, A. R. (2017). Comparative study of Shell and Prospective schools of scenario planning. *Iranian Journal of Public Policy*, (4), 153-177.
 - Hillier, B. (2007). *Space Is The Machine: A Configurational Theory Of Architecture*. Cambridge: Cambridge University Press.
 - Hillier, B., Penn, A., Hanson, J., Grajewski, T. and Xu, J. (1993). Natural movement: Or configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design*, (20), 2029–2066.
 - Hillier, B. & Vaughan, L. (2007). The City as One Thing. *Progress in Planning*, 67(3), 205-230.
 - Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: Or, configuration and attraction in urban pedestrian movement. *Environment and Planning B. Planning and Design*, (20), 10-65.
 - Jabari, M. K., Homeland, N., Mohammadi, M. & Kalantari, M. (2018). Analyzing the relationship between spatial structure and the occurrence of urban crimes using the space layout method (case study: theft crimes in Tehran). *New attitudes in human geography*, 11(1), 1-18.
 - Kalantari, S., Ekhlesi, A., Andaji Garmaroudi, A. & Khalilbeigi Khamene, A. (2019). Analysis of the relationship between spatial structure and motivation behaviors of users by space syntax (Case study: Central Campus of Tehran University). *Quarterly Journal of Environmental Based Territorial Planning*, 11(43), 215-234..
 - Kiaee, M., Peyvastehgar, Y. & Heidari, A. A. (2020). Feasibility Study of Developing Space Syntax Components in the Analysis of Traditional Houses. *Armanshahr Architecture & Urban Development Journal*, 13(31), 101-113.
 - Kiaee, M., Soltanzadeh, H. & Heidari, A. A. (2019). Measure the flexibility of spatial system using space syntax (case Study: Houses in Qazvin). *Bagh-e Nazar*, 16 (71), 65-82.
 - Lake-Hammond, A. (2006). *Interpretive design: An exploration of exhibition design through theory and practice*. MCApSc thesis, University of Otago, Dunedin.
 - Lake-Hammond, A. & Noel, W. (2017). Exhibition Design: Bridging the Knowledge Gap. *The Design Journal*, 13 (1), 77–98.
 - Lay, M. C. D., Reis, A., Dreux, V., Becker, D. & Ambrosini, V. (2005). *Spatial Configuration, Spatial cognition and Spatial behavior: syntactic and perceptual analysis of the market station area in Porto Alegre*. In Proceedings from EDRA35, Vancouver, Canada.
 - Mohammadiyan, E., Safari, A. & Karam, A. (2019). The Syntax Logic of Settlement in Khuzestan Plain. *Geography and Territorial Spatial Arrangement*, 9 (33), 147-160.
 - Najjari Nabi, R. & Mahdinezhad, J. (2020). Evaluating the Role of Physical and Functional Factors in the Socialization of Traditional Iranian Markets Using Space Syntax Technique. *Bagh-e Nazar*, 17(85), 75-92.
 - Ou, Y., Wang, X. C., You, Z. W., Tao, C. J., & Liu, J. (2017). Exhibition Space Design Research Based on Service Design Thinking: Viewing the Beijing Rehabilitation Technical Aids for Aging Exhibition Hall as an Exemplar. *Art and Design Review*, (5), 152-161.
 - Puusepp, R. (2011). *Generating circulation diagrams for architecture and urban design using multi-agent systems*. University of East London ed. London: A thesis submitted in partial fulfillment of the requirements of the School of Architecture and Visual Arts, University of East London for the degree of Doctor of Philosophy.
 - Pedram, A. (2018). Futures Studies: Western Knowledge. *Strategic Management & Futures Studies*, 1(1), 43-79.
 - Rajabi, F., Zare, L. & Bagher Hosseini, S. (2022). A Technical Synergy of Cognitive Maps and Space Syntax

in Recognition and Analysis of the Sociability of Physical Space Influenced by Spatial Territories (Case Study: Ekbatan Town). *Bagh-e Nazar*, 19(108), 5-18.

- Rismanchian, O. & Bell, S. (2011). A study over spatial segregation of deprived areas in spatial structure of Tehran by using space syntax technique. *Bagh-e Nazar*, 8(17), 69-80.
- Tobchi Thani, A., Mohammadi, M., & Khazaei, S. (2020). Towards planning in the new era; A comparative study of urban and regional planning with future studies. *Quarterly Journal of Geography and Regional Planning*, 1(3), 93-110.
- Toker, U., Baran, P.K. & Mull, M. (2005). *Sub-Urban evolution: A Cross-temporal analysis of spatial*

configuration in an American town (1989 – 2002). 5th International Space Syntax Symposium, Delft.

- Van Nes, A. & Yamu, C. (2021). Introduction to Space Syntax in Urban Studies. Cham: Springer.
- Van Nes, A. & Yamu, C. (2014). *Space syntax in theory and practice*. In D. J. Lee, E. Dias & H. J. Scholten (Eds.), *Geodesign by integrating design and geospatial sciences* (Vol.111, 237-257). Cham: Springer.
- Vaughan, L (2007). The spatial syntax of urban segregation. *Progress in Planning*, (67), 205-290.
- Wineman, J, D. & Peponis, J. (2010). Constructing Spatial Meaning: Spatial Affordances in Museum Design. *Environment and Behavior*, (42), 86-109.

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