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Research Paper

Desirability factors of work desk arrangement from the viewpoint of employees by the analysis of space syntax indices

M. Maleki[1], S. M. Mofidi Shemirani[2,*], A. Heidari[3]

[1]*PhD Candidate, School of Architecture and Environmental Design, Iran University of Science and Technology, Tehran, Iran*

[2]*Assistant Professor, School of Architecture and Environmental Design, Iran University of Science and Technology, Tehran, Iran*

[3]*M.A. Student Faculty, Shahid Beheshty University*

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Abstract

Using the results of the assessment of desirability from the viewpoint of employees and the computer analysis of space syntax, the desirability factors of work desk arrangement in office space have been analyzed in the present study. Firstly a pictorial questionnaire was distributed among 113 employees in two offices of Tabriz city to obtain the desirable sitting places in the room (considering the position of the door of room, the angle of the sitting and the position of the desk of colleague). Next, using the space syntax software, the factors which affect the preferences of employees were analyzed. In this regard, indices such as Isovist, integration and distance from the door were studied. The results show the impact of these indices on the preferences of employees. The significance and impact of the indices have not been similar and in some cases, "distance from the door" has had the highest impact and the "isovist" has had more impact than "integration". In relation to the selection of the sitting place, this research has also demonstrated the impact of organizational and cultural factors on the preferences of employees. Such as the difference between the spatial value of various parts of the room in terms of distance from the door and the position of the door in different cultures, the difference between the results obtained from female respondents and the male respondents in relation to the index of "isovist from outside", as well as the difference between the choices of individuals with different occupational ranks.

Keywords: *The desirability of desk arrangement, Office space, Space syntax, Isovist, Distance from door*.

1. INTRODUCTION

The organizations are usually concerned to do the works efficiently and to increase economic profit or work yield, but sometimes this concern accompanies with the lack of attention to the high impact of the environment on the employees. Then, such organizations don't obtain the work environments which they need and deserve. Various studies have represented many solutions in this area, which should finally turn into reliable and usable criteria for designers and employers. However, despite many types of research on the relationship between the work environment and the characteristics of employees, the communications of employees with each other and the office complexes themselves, the results of the studies have been rarely applied functionally in the designs and the design criteria [1]. Designers and managers need reliable documents to show the impact of physical work environments on such issues as job satisfaction, individual work efficiency, absenteeism, duplication and general efficiency of offices.

When there is a lack of such documents, the dimensions of the workspaces are reduced to decrease the overall costs. This shows that the managers still consider the physical work environments as a simple and convenient space where accommodates the employees and they are not aware of the impacts of physical environments. Designers should also pay attention to all aspects of a workspace to decrease physical harm and mental stress endured by the employees; hence, the work is done with maximum efficiency. Additionally, studies which deal with the opinions of users seem necessary in the current time that witnesses many changes. There should be a proper understanding of the society, culture and psychological importance of the workspace to obtain proper solutions. By doing such research, designers can assess the reaction of users to new designs in workspaces and they can also understand how their ideas will affect the behavior, mindset, and lifestyle of the users. Such

** Corresponding author: S_m_mofidi@iust.ac.ir*
Tell: +989123798488; Fax: +989188140345

studies need data collection and research methods related to the spatial behaviors so that they can offer proper policies for design. Various similar studies have been done about the different areas of workspaces ([2] [3] [4]). The results of the studies show mostly the significance of the environmental factors of the workspace. However, none of them have used the method of space syntax to analyze these factors.

The current research tries to find the arrangements of the work desks which are considered by the employees as the desirable ones in relation to the door of room. It also examines especially the factors which affect the desirability of the arrangement of work desks as one of the multiple environmental factors of the workspace. This research tries to answer the following key questions:

- What are the desirable positions of work desk with regard to the room door from the employees' points of view and which are the factors affecting them?
- How can the factors affecting employees' preferences be studied using spatial analysis of space syntax?

Evaluation of environmental factors based on the opinions of the users along with the spatial analysis by the space syntax software forms the basis of this research.

2. THE DESIRABILITY OF THE OFFICE FURNITURE ARRANGEMENT

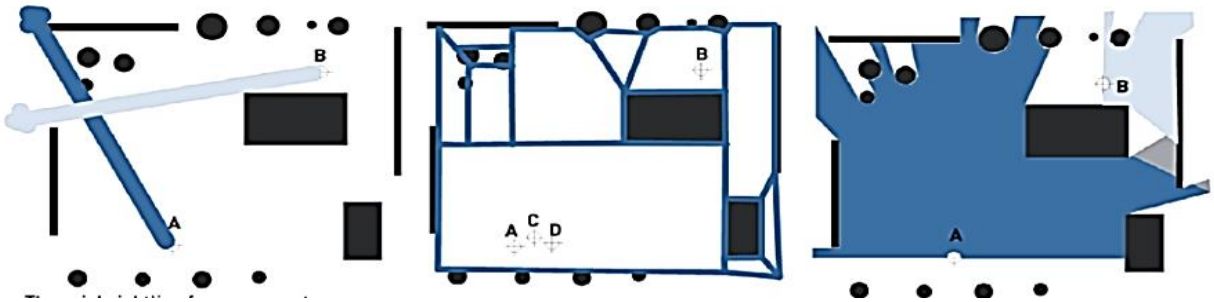
The most important element to define a work is the space wherein the work takes place. Not only space means a room to accommodate luggage and equipment, but also it means a room for other behaviors related to the main work, such as opening the drawers, coming to the desk to welcome the clients, or leaning on the chairs and so on. Space is defined as the most important element of an activity, which has some borders. Space may involve simultaneously or successively different behaviors and its borders may be resistant walls or lines on the carpet ([5], p. 59). Many researchers have consistently demonstrated that the characteristics of the office environment and the furniture arrangement can have a significant effect on the perception, behavior and emotions of people in a room, and the productivity of the workers [6], [7], [8]. Joyner (1976) explained three main qualities that are important to determine the styles of interaction in a room: the position of furniture, the distance between them and the amount of the symbolic decoration used (as cited in [8], p. 241). Such researchers as Sumer (1969) and Cook (1970) conducted some research on the selection of the sitting place. They examined the impact of the communications between the individuals, the position of furniture and the type of work on the preferences of the individuals [8]. On one hand, it is clear that job satisfaction is obtained differently in two different workspaces. Although there is no such thing as a complete and absolute solution, but the opportunity of attaining desirable conditions can be increased by taking into account thoroughly the effective factors in any case [9]. In addition, in all spaces, desirability and individuals' satisfaction are the most important factors for the success of the design. According to sociological and psychological aspects, various factors affect job satisfaction. Such factors as academic education, more work experience, higher organizational rank, and responsibility affect the increase of job satisfaction [10]. But one of the most important factors which affect job satisfaction is the environmental satisfaction of employees. Modeling shows that employees who are more satisfied with their work environments are more satisfied with their jobs and it can be said that the environment plays an effective role in office spaces [1]; [11]; [12], [13], [14], [15]. The studies show that there is a clear relationship between work environment and job satisfaction, and between job satisfaction and the profit and loss of a company. It should be noted that different office plan systems offer different types of furniture arrangement. The most common types of office plan systems include open, closed and combined plans [16]. Various indices in each of the office plan systems and such variables as the organizational rank, gender, culture, and personality have a considerable impact on the selection of the desirable arrangements [16]. In addition, the satisfaction with various workspaces varies according to the type of work and activities done by the employees. For example, office clerks are less satisfied with the closed plans and are more satisfied with the open plans. But managers feel higher satisfaction in closed plans than other types of plans. On the other hand, experts prefer offices with a closed plan or partitioned open plan than offices with an open plan [17]. How the space is arranged depends on physical and psychological conditions in each of the types of office plan systems. For example Hatch (1987) studied such variables as the existence of a door, the degree of being enclosed and the position of the desk (in relation to the entrance door of an office) in open-plan offices [18]. Many studies have explained spatial perception based on the angle and direction of view, visibility, distance from the door and position in the room and the number of desks in the room as the most important psychological factors which affect the determination of the appropriate place for the work desk [19], [7].

3. SPACE SYNTAX

Space syntax is a method to represent spatial indices when it is tried to assess and rearrange the interior spatial structure of complex buildings, including offices, shopping malls, hospitals, museums, railway stations and education buildings is. This paper intends to use this method to analyze desirable arrangements from the viewpoint of employees. The space syntax software is not only a simple modeling tool, but it is a method to understand behavioral patterns in the buildings ([20], p. 32). This method allows the researchers in the field of architecture and urbanization to analyze the relationship between spatial configurations and social structure of space and to identify and analyze the impact of design changes on the mentality and behavior of users [21, 22]. Different variables obtained from graphic analyses and several maps which show the pattern of the distribution of these variables in the building plan are the results of using this method, but these variables are not valuable in themselves and they find meaning by linking the variables and the social qualities of

the environment to each other ([23]p. 528). Space syntax uses a series of computer techniques to model the buildings and cities so that the model created consists of a system which includes geometric elements related to each other and the analysis of the system to understand how the elements composing it are related to each other.

These elements are linear when the subject of research is concerned with the motion, they are convex spaces when the subject of research is the social interaction and they are visible ranges when the subject of research is complex behavioral patterns (Fig. 1) ([20] p. 46).



The axial sightline for movement for person A and B The Convex Space for Interaction The Isovist field for orientation

Fig. 1 Axial sightline, convex space and isovist [24]

In fact, space syntax is an attempt to identify how spatial configurations express a social or cultural meaning [25]. The approach of isovist is the subset of points in space that are visible from a particular vantage point [26]. In other words, the isovist is considered as a set of all points visible from a given vantage point in space and with respect to an environment [27]. The concept of isovist (or view shed) has had a long history in architecture and geography, as well as mathematics. Tandy (1967) appears to have been the originator of the term isovist. He considers isovists as a method to "[take] away from the architectural space a permanent record of what would otherwise be dependent on either memory or upon an unwieldy number of annotated photographs" ([28]: 9). The concept of isovist was discussed initially by Tandy (1967) in relation to landscape architecture. Isovist analysis is a useful tool to understand how individuals perceive a space and act in it. It is often used in space syntax research as a part of a set of techniques that examine users' visibility of space. An isovist is a 2D polygon, taken at a stated height (commonly either floor level or eye height) that represents the visible area from a point (the generating position of the isovist)[29]. Turner et al [30] showed how a set of isovists can be used to generate a graph of mutual visibility between positions. They also demonstrated that this graph can also be constructed without reference to isovists and in fact, they invoked the most general concept of a visibility graph. Using the visibility graph, they extended both isovist and current graph-based analyses of architectural space to form a new methodology for the investigation of configuration relationships.

Lima Sakr et al [31]in a research entitled "Elements of design in a workplace environment, pre and post studies" showed how the selected architectural elements could change behaviors and that different spatial parameters should be tested when designing an office layout. Varoudis and Penn in a research entitled [32] " Visibility, accessibility and beyond: Next generation visibility graph analysis" illustrated how visual-morphological relations beyond accessibility can be encoded programmatically and how they can shape our understanding of space through computational models. In addition, Emo [29] in a paper entitled " Exploring isovists: The egocentric perspective " explored the relevance of first-person isovists that are drawn from what is actually (and not only theoretically) visible in the scene. He evaluated a candidate measure, termed "choice zones". In the research, he argued that for real-world studies examining the social use of space, it may be desirable to complement traditional view shed analyses with ones that take an egocentric perspective.

The indices which can be calculated by the space syntax software include: area and perimeter (where the viewer can see large areas, a feeling of spaciousness can be provided), compactness (shows how enclosed the viewer feels himself in the environment and how much he is affected by the environment), the occlusivity or circularity of spaces (which defines the path and fluctuates much) [33]. In other words, the occlusivity index is a part of isovist tool that represents hidden or ambiguous parts of a building - a feature which has a close relationship with the mystery and deals less with the amount of complexity [34]. According to the available empirical background, human, environmental and functional factors affect the sociability of space and the social interactions. The present research has considered all items in the space, isovist, motion factor, the orientation of the subjects in the space, readability of the space for the subjects and the social interaction between the subjects. Integration and depth are variables of space syntax which have helped researchers to analyze the above-mentioned concepts.

4. METHODOLOGY

In this study, a combined method has been used. The main purpose of the research is to achieve specific criteria by using space syntax and considering priorities of people (Figure 2). So, the present study is an applied research.

4.1. Question Survey

Previous studies which have been concerned with the impact of the perception of office physical environment on the preferences of the employees have indicated that a series of main factors have been more important in this area. This study examines the amount of the impact and evaluates numerically the relationship of the factors with each other by the questionnaire and computer simulation. However, the absence of commonly-used, reliable, standardized tools to measure employees' ratings of the work environment is one of the problems of research in this area. Stokols and Scharf [35] set out four criteria for standardized research instruments addressing the physical work environment. First, the questionnaire should be streamlined in length and wording so participants can complete the protocols in a straightforward manner. Second, the scope of the content should be sufficiently broad so that important aspects of facility design are not neglected. Third, in addition to characteristics of the physical work environment, other variables that should be included are participants' biographic characteristics, job status or category, and ratings of job or work satisfaction. Fourth, survey items should be directly relevant to organizational problem-solving strategies ([1]). For this purpose, by evaluating and studying previous research that have been done in this area, a questionnaire was prepared that involved: 1) general information about the person (age, occupation, work experience, gender, etc.) and the characteristics of workspace (including the number of personnel in the room, the approximate dimensions of the room and the amount of the clients referring), 2) the priority of the selection of sitting place according to the position of the second desk and the door of the room (in the form of pictorial questionnaires with four arrangements of the door in the room and four arrangements of the second desk).

4.2. Participants

The statistical population of this study was the employees of both East Azerbaijan governor's office and Tabriz gubernatorial office and it took about 3 work months to collect the questionnaires. After collecting the questionnaires, in addition to other analyses, the accuracy of responses was assured by interviewing the employees. Of the questionnaires distributed, 113 reliable questionnaires were used as the basis for this study (Table 1). Most of the participants were male (74%) and expert (55%).

Table 1 the statistical population studied in the research

The number of reliable questionnaires			Education level			The type of office work			
total	male	female	Masters' degree and higher	Bachelor's degree	Associate's degree & lower	manager	Clerical employee	expert	Service and others
113	84	29	48	47	18	6	31	63	13

4.3. Materials and Workflow

To analyze the results of the questionnaires, the indices of space syntax based on software ability were used. The priorities of employees which have been obtained based on the pictorial questions, were measured by numerical analysis of space syntax to infer the main criteria. In this section, results were compared and logical reasoning was used. The results have been represented in tables 3 to 14. The indices of distance from the door, isovist (employees' and clients') and spatial integration were used to assess priorities obtained from questionnaires (Fig. 2).

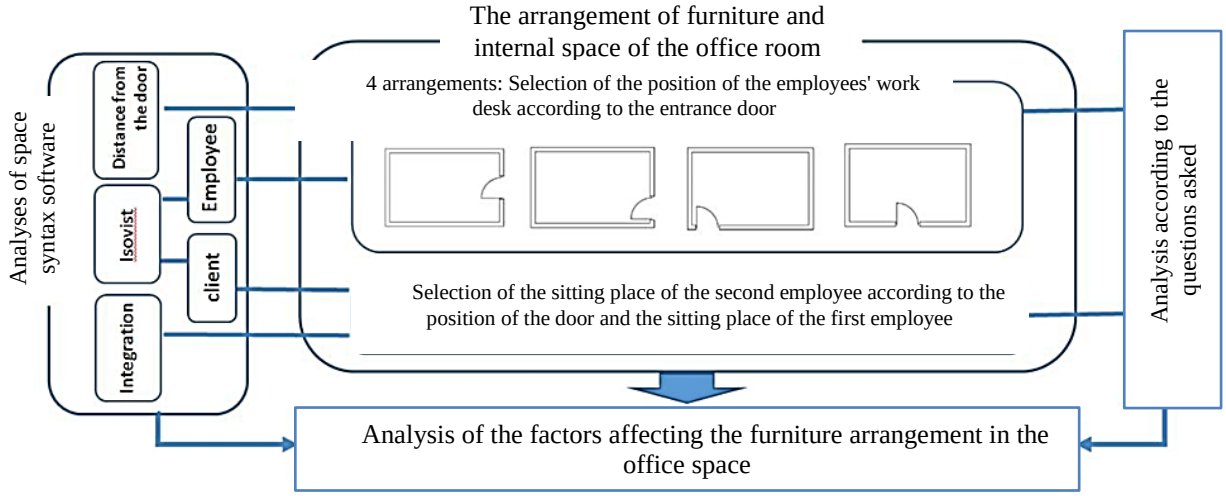
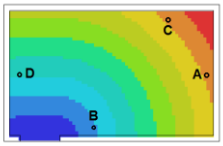
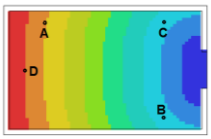
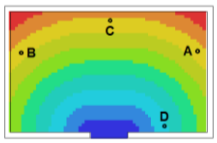
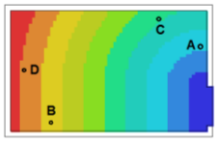


Fig. 2 The structure of the research

In the earlier similar studies, the index of Isovist has mostly been used in relation to the analysis of urban spaces or successive views to the internal spaces of a building. In this study, according to the importance of the visibility and private spaces as factors affecting the selection of the sitting place, the index has been used in relation to a fixed point, namely the sitting place of the employee, the direction and angle of his view, and the client's view to the room. Regarding the isovist of the employee, different values obtained for the indices in different arrangements have been due to the change of the position of employee and his angle of view. Regarding the client's angle of view, similar values obtained for each of the door arrangements. However, since the wooden door and the employee's work desk were considered as visual barriers, the impact of the direction of the door opening and how much the employee is visible by an external viewer were assessed. Three indices of integration, connection and space depth were used to analyze data. In addition, the index of distance from the entrance door (table 2) and then its impact on the privacy of employees were measured by the step depth in the UCL Depth map software as below.

Table 2 Access to the entrance door and proximity to it

cm	Point			cm	Point		
360	A		**III**	440	A		**I**
90	B			210	B		
360	C			210	C		
180	D			480	D		
270	A		**IV**	90	A		**II**
270	B			330	B		
270	C			260	C		
110	D			500	D		

A, B, C, D: position of work desks in the questionnaire - Colors: points with the equal distance from the door

5. RESULTS

Firstly, the questionnaires completed by the participants were analyzed to determine priorities of employees in each of the cases. Then, the arrangements included in the questionnaires were analyzed by space syntax software, and the results of both parts were compared with each other. The following results have been obtained for each arrangement.

5.1. Selection of the Position of the Work Desk with Respect to the Position of the Door

The results of the analysis and comparison of the arrangements to determine the priority of the position of the work desk with regard to the door are as follows:

– Arrangement I: the door in the middle of the small side of the room (Tables 3 and 4)

Option D was considered as the best option, and the study of the indices of area and perimeter in this option indicates the largest possible space that the viewer can see and dominate it. Hence, when the employee is placed in the option D, he as the viewer can have the highest dominance on the workspace. As well, the high value of the index of compactness in this option indicates that the viewer feels himself among the workspace and is affected by the environment. The index of occlusivity has the lowest value in the option D which indicates fewer hidden or ambiguous parts in this position. This option has the highest dominance on the door of the room.

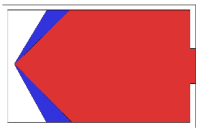
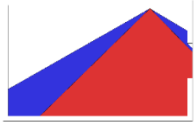
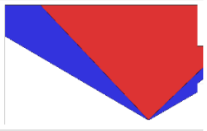
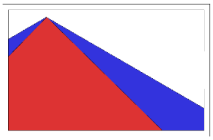
In Table 3, two view fields of the employee have been examined: the main view field (red color) as the first field and the view field provided by a little rotation of the head as the second field (blue color). In option A, the door of the room is not in any of these two view fields, accordingly, this option has less dominance on the door. The desirability of the option A has been 7/3%. Although option A has had the second rank (88% of employees selected it as the second option), it has been far from being selected as the best option due to the less value of the indices of area, isovist, compactness and dominance on the door in this position. The highest value obtained in the option A has been related to the index of distance from the door which makes the option better than the other two options.

In the options B and C, relatively similar values were obtained for the indices, which have been less than the values obtained in two other options (D and A). In terms of being close to the door, these two options have similar conditions, but the option B was considered as the worst option (51%) by the employees because the work desk remained behind the door when the door was opened.

– Arrangement II: the door in the corner of the small side of the room (Tables 5 and 6)

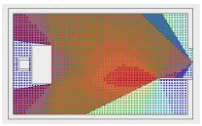
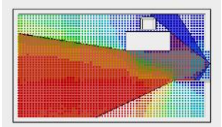
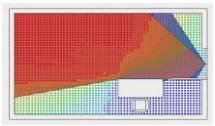
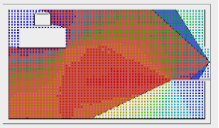
Similar to the results from the arrangement I, option D was also considered as the best option in this arrangement. After the option D, option A involved the second highest value of the index of isovist. However, due to the excessive proximity of option A to the entrance door and the lack of dominance on the door, as well as the visibility of the private sections of employee from the outside of the room (table 5), this option was considered as the worst option (70 % of participants considered it as the worst option). This clearly shows the importance of the indices of distance from the door and dominance on the door. Option B has been selected by 80% of participants as the second option. In this option, there was no dominance on the door because it was out of the view field of the employee.

Table 3 Analysis of employee priorities for seating position using Isovist indices. Employee view area (arrangement I)

positions	D	C	B	A
Arrangement I				
Isovist area	141530	87029.3	95846.2	95207.5
Isovist compactness	0.8858	0.7427	0.7867	0.7538
Isovist drift angle	358.87	291.92	106.125	249.16
Isovist occlusivity	320.038	502.607	515.231	523.83
Isovist perimeter	1419.17	1215.55	1239.2	1260.97
Priority	- PF:90% ****	**	- PL:51% *	***

****:First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

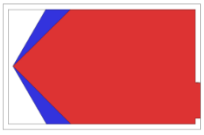
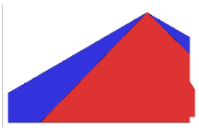
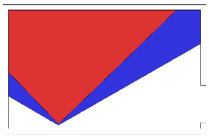
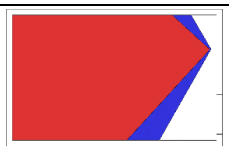
Table 4 Analysis of employee priorities for seating position using indices view from outside and integration (arrangement I)

positions	D	C	B	A
Arrangement I				
Integration	76.023	70.62	66.36	95.29
Mean Depth	1.174	1.201	1.211	1.153
Isovist Area	120033	97515.7	107839	121294
Isovist Compactness	0.540	0.526	0.685	0.596
Isovist Drift Angle	178.15	185.95	171.93	180.83
Isovist Occlusivity	702.809	772.37	544.24	564.80
Isovist Perimeter	1670.28	1533.67	1406.44	1598.47
Priority	- PF:90% ****	**	- PL:51% *	***

****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

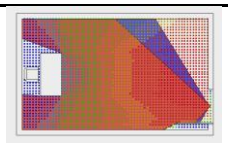
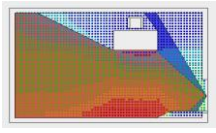
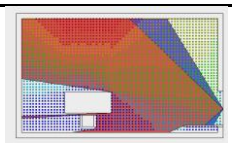
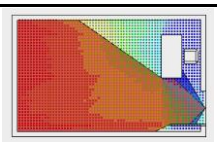
Comparison of the spatial integration between the two arrangements I and II show the impact of the position of the door on the value of integration in similar arrangements. A door in the corner of the room provides a better integration in the space. In these arrangements, options A and D provide the highest integration with other parts of the room (Tables 3 and 5). Then, the impact of the integration on the priorities is recognized, but it should be noted that other indices such as distance from the door, dominance on the workspace and visibility from an external viewer are also more important in this area.

Table 5 Analysis of employee priorities for seating position using Isovist indices. Employee view area (arrangement II)

position	**D**	**C**	**B**	**A**
Arrangement II				
Isovist area	143682	97049.4	97836.2	138315
Isovist compactness	0.8842	0.7690	0.7926	0.8646
Isovist drift angle	359.46	252.1	72.22	192.57
Isovist occlusivity	335.066	535.233	511.94	335.09
Isovist perimeter	1431.23	1259.61	1245.18	1418.99
Priority	- PF:90% ****	**	***	- PL:70% *

****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

Table 6 Analysis of employee priorities for seating position using indices view from outside and integration (arrangement II)

position	D	C	B	A
Arrangement II				
Integration	113.45	63.97	76.79	109.27
Mean depth	1.136	1.209	1.183	1.140
Isovist area	122848	120131	114400	124212
Isovist compactness	0.552	0.613	0.339	0.7005
Isovist drift angle	164.55	168.86	159.63	167.96
Isovist occlusivity	562.42	582.44	1083.65	488.16
Isovist perimeter	1670.85	1584.14	2056.64	1494.21
Priority	- PF:90% ****	**	***	- PL:70% *

****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

- Arrangement III: the door in the corner of the large side of room (Tables 7 and 8)

The study of the given indices in this arrangement shows that the option A was considered as the best option (75% of participants). After the option A, option D involved the second highest value of the index of isovist. However, due to the excessive proximity of option D to the entrance door and the lack of dominance on the door, this option was considered as the worst option. Like the arrangement II, this also demonstrates the importance of distance from the door (which affects the spatial dominance).

Option D provides the best conditions in terms of the spatial integration. But like the option B, it provides the worst conditions in terms of distance from the door and visibility from the outside. However, the number of people who considered the option D as the worst option has been more than option B (57% vs. 43%). The only index which justifies this subject is the visibility from the outside of the room.

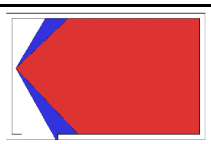
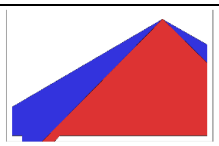
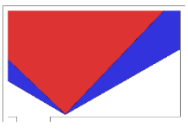
After the option B, option C involved lower value than other options in terms of the index of integration. However, in terms of other indices and especially distance from the door, it was considered as a suitable position. In option C, the door is out of the view field of the employee. This shows that the people prefer to have dominance on the door when the room is for one person.

– Arrangement IV: the door in the middle of the large side of the room (Tables 9 and 10).

In this arrangement, the study of the indices of area and perimeter shows the largest possible space which the viewer can see and dominate it. Hence, according to the maximum value of the indices of area and perimeter, option A indicates the highest dominance of the viewer on the workspace. Regarding option D, similar values were obtained for these indices, but being behind the door affected the choices of employees.

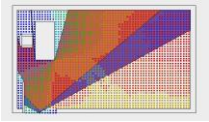
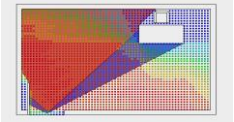
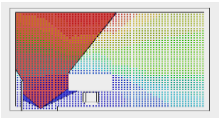
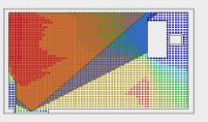
The high value of the index of compactness in options A and D shows that the viewer felt himself among the space and was affected by the environment. The index of occlusivity had the lowest value in the options A and D, which indicates less hidden and ambiguous parts in these two options. It should be noted that the option D was selected by 32% of participants as the first priority. But the number of people who selected this option as the worst option was much more (42%). This has been due to the angle of the door opening and the placement of the work desk behind the door. Option B was considered as the worst option, while it was selected by 35% of participants. This option was not selected by any of the employees as the first priority. So, this option was considered as the worst one. The proximity to the door and the lack of dominance on the door can be considered as the most important reasons for it.

Table 7 Analysis of employee priorities for seating position using Isovist indices. Employee view area (arrangement III)

position	D	C	B	A
Arangment III				
Isovist area	142753	94927.1	102869	144110
Isovist compactness	0.877	0.740	0.835	0.881
Isovist drift angle	355.935	250.44	78.545	186.43
Isovist occlusivity	343.707	536.51	510.92	357.46
Isovist perimeter	343.70	536.512	1243.21	1435.65
Priority	- PL:57% *	***	**	- PF:75% ****

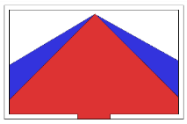
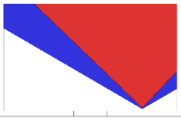
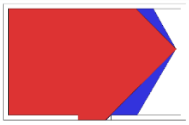
****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

Table 8 Analysis of employee priorities for seating position using indices view from outside and integration (arrangement III)

position	D	C	B	A
Arrangement III				
Integration	115.5	91.80	62.71	105.80
Mean depth	1.131	1.159	1.215	1.142
Isovist area	75001.1	80592.2	56212.7	84894.9
Isovist Compactness	0.37	0.65	0. 67	0.7
Isovist drift Angle	55.44	68.78	80.198	65.95
Isovist Occlusivity	924.25	529.57	432.17	512.96
Isovist perimeter	1579.37	1249.5	1027.58	1231.07
Priority	- PL:57% *	***	**	- PF:75% ****

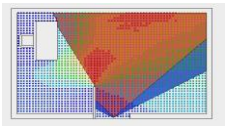
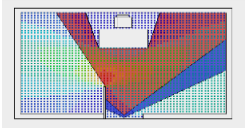
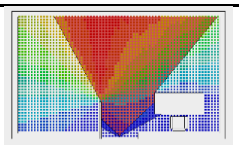
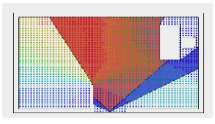
****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

Table 9 Analysis of employee priorities for seating position using Isovist indices. Employee view area (arrangement IV)

position	D	C	B	A
Arrangement IV				
Isovist area	142823	108305	93363.6	141978
Isovist compactness	0.860	0.835	0.749	0.879
Isovist drift angle	350.4	269.7	112.13	186.988
Isovist occlusivity	351.93	520.114	512.22	345.96
Isovist perimeter	1445.42	1275.86	1250.7	1425.98
Priority	- PL:42% (PF:32%)*	***	**- PL:٣٥%	- PF:53% ****

****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

Table 10 Analysis of employee priorities for seating position using indices view from outside and integration (arrangement IV)

position	D	C	B	A
Arrangement IV				
Integration	76.81	34.73	90.154	73.60
Mean depth	1.19	1.30	1.18	1.20
Isovist area	88811.8	70432.9	71747.9	73340.7
Isovist Compactness	0.751	0.458	0.626	0.64
Isovist drift angle	75.556	69.458	82.313	83.155
Isovist occlusivity	597.86	840.24	677.71	619.74
Isovist perimeter	1218.06	1387.26	1200.73	1210.89
Priority	- PL:42% (PF:32%)*	***	**- PL:35%	- PF:53% ****

****: First priority," best choice" - ***: second priority- **: third priority- *: fourth priority," the worst choice".
(PF: the percentage of selection as the first priority – PL: the percentage of selection as the last priority)

5.2. The Selection of the Position of the Second Desk According to the Position of the First Desk and the Door

After the analysis of the priorities of employees with regard to the place of sitting, a questionnaire was completed by the employees, in which they were asked to draw the desirable position of a desk for the second employee according to various positions of the door (Figure 3).

By examining the responses, the best options were identified. Then, influential factors were analyzed by the use of the space syntax software and the study of the space syntax indices. The results of analyses and comparison of the results in different arrangements are as follows:

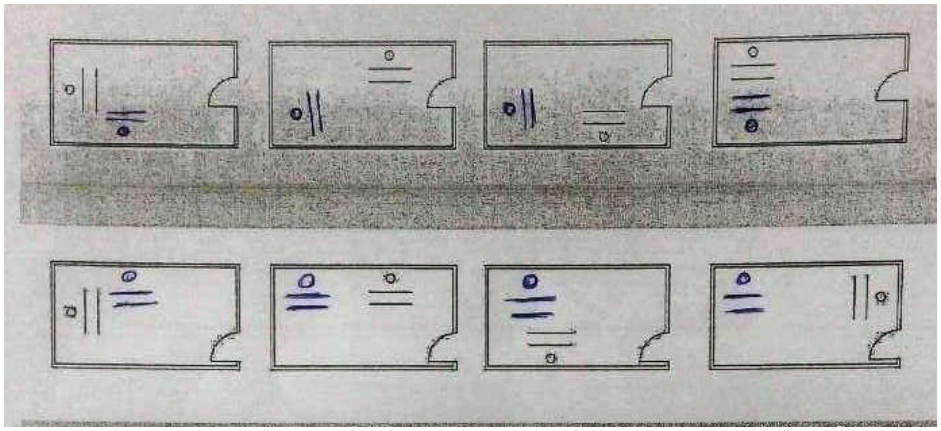
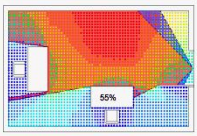
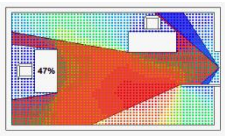
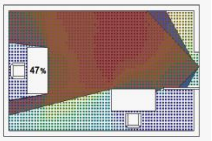
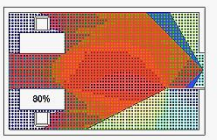


Fig. 3 A part of the questionnaire completed by the participants (Arrangement I & II, Options A, B, C and D of First desk. In each option the best position of the second desk has been questioned.)

– Arrangement I: the door in the middle of the small side of the room (Table 11).

In this arrangement, the results of the research show the high importance of the distance from the door, or in other words being placed at the opposite side of the door. In all four options (A to D), the employees preferred the second desk to be placed at the end part of the room to fill there. In option D, the desk fills the end part of the room. This option was considered as the best option when there was one person in the room. In this condition, the employees preferred the desk to be placed in the middle of the room, while being perpendicular to the length of the room (54%). It should be noted that the best option for the placement of two employees in a room was the option A, while the best place for the second desk was exactly the opposite side of the first desk and the end part of the room (80%). This option has been the most common state of arrangement in two given offices and can be seen in rooms with two employees. The relatively equal conditions of both desks in terms of the indices of dominance on the door, distance from the door, isovist and spatial integration can be the main reason for the priority of this option. At the same time, regarding the overall arrangement of the room, the opposite part of the door is fully occupied in this option.

Table 11 Analysis of employee priorities for second seating position using indices view from outside and integration (arrangement I)

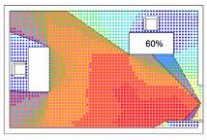
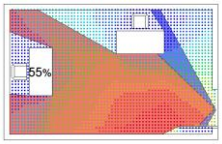
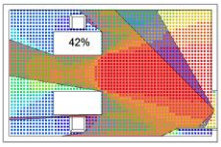
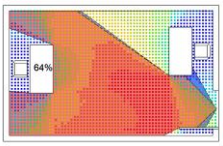
Position of the first desk	D	C	B	A
Arrangement I and the best position of second desk according to questionaire				
Integration	29.63	31.15	33.16	45.81
Mean depth	1.38	1.36	1.35	1.27
Isovist area	89674	80868.9	95196.4	105335
Isovist compactness	0.43	0.30	0.46	0.45
Isovist drift angle	168.81	186.37	171.74	177.3
Isovist occlusivity	777.35	1092.58	760.34	667.22
Isovist perimeter	1615.08	1817.11	1605.85	1716.94
Priority	PF: 55%	PF: 47%	PF: 47%	PF: 80%

PF: The percentage of the selection of the best position of the second desk by the respondents

– Arrangement II: the door in the corner of the small side of room (Table 12).

Results obtained from options A to D confirm completely the results from arrangement I. The impact of the position of the door on the desirability of the position of two desks is noteworthy, so that the option D with the placement of the second desk in the middle of the room and perpendicular to the length of the room was considered more desirable than the arrangement I (60%). It's main reasons can be the increased dominance of the second desk on the door, and the decreased visibility from the outside of the room than the arrangement I. The highest variation in responses was related to the option B, which seems to be due to the fact that the position of the first desk was considered largely undesirable in this option.

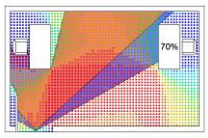
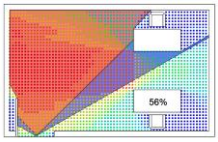
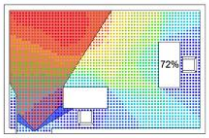
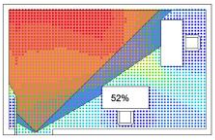
Table 12 Analysis of employee priorities for second seating position using indices view from outside and integration (arrangement II)

Position of the first desk	D	C	B	A
Arrangement II and the best position of second desk according to questionaire				
Integration	38.10	34.90	27.39	45.63
Mean depth	1.31	1.33	1.39	1.27
Isovist area	109061	103546	88557.9	108032
Isovist compactness	0.49	0.42	0.23	0.48
Isovist drift angle	167.75	168.43	161.67	168.34
Isovist occlusivity	621.07	747.74	1272.66	651.95
Isovist perimeter	1660.62	1767.31	2180.87	1677.7
Priority	PF: 60%	PF: 55%	PF: 42%	PF: 64%

PF: the percentage of the selection of the best position of the second desk by the respondents

- Arrangement III :the door in the corner of the large side of room (Table 13). In this arrangement, the main index is also the distance from the door. More variety can be seen in the responses than two other arrangements, which can indicate that there was less certainty on the desirable options. However, in all cases where a position far from the door can be selected, a larger percentage of people (between 52 to 72 percent) selected it. Option A was considered as the best option when there was one person in the room. In the case of the existence of two desks in a room, option A involved a considerable desirability (52%) when the second desk was in the middle of the room and back to the wall which was at the opposite side of the door. The next desirable option when there were two desks in the room was the option C (56%) while the second desk was placed exactly at the opposite side of the first desk. In both options (A and C), the best place for the second desk was out of the view field of the external viewer and the integration for both desks in the room was better than other options. Generally, the options in which the desks were back to the wall that was at the opposite side of the door were selected more than other options in the room (30%). In these options, the indices of dominance on the door and the visibility from the external viewer were evaluated more desirable.

Table 13 Analysis of employee priorities for second seating position using indices view from outside and integration (arrangement III)

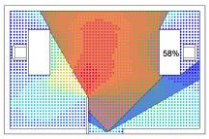
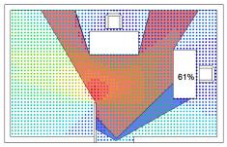
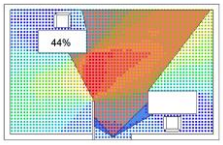
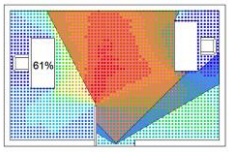
Position of the first desk	D	C	B	A
Arrangement III and the best position of second desk according to questionaire				
Integration	53.55	38.99	33.10	35.37
Mean depth	1.24	1.32	1.35	1.33
Isovist area	71172	82711.6	56152.5	82947.3
Isovist compactness	0.44	0.60	0.67	0.69
Isovist drift angle	57.78	68.11	80.25	67.41
Isovist occlusivity	789.154	613.831	433.64	511.79
Isovist perimeter	1417.29	1344.38	1028.22	1221.84
priority	PF: 70%	PF: 56%	PF: 72%	PF: 52%

PF: the percentage of the selection of the best position of the second desk by the respondents

- Arrangement IV: the door in the middle of the large side of the room (Table 14)

In this arrangement, various options were considered as desirable options by the participants. Regarding options A and D, the best position selected for the second desk was exactly the opposite side of the first desk, which was back to the opposite wall (61% and 58% respectively). This indicates that most of the participants preferred to fill both sides of the room with regard to the door. In option C, the best place was the right side which was back to the wall (61%). The indices of visibility from the outside and dominance on the door were important in this option and it was preferred to being placed behind the entrance door. The spatial integration was also much more in option C than the other options. Nobody located the second desk beside the first one. The position of the first desk in the middle of the room causes the second desk to be placed particularly in an unequal position in terms of indices of space syntax. Regarding option B, most of the positions selected by the people were at the opposite side of the door and back to the wall. The best position of the desk was back to the wall at the opposite side of the door and in the corner of that side (44%), which can be due to the tendency of people to fill both sides of the room and use a larger area of the room.

Table 14 Analysis of employee priorities for second seating position using indices view from outside and integration (arrangement IV)

Position of the first desk	D	C	B	A
Arrangement IV and the best position of second desk according to questionaire				
Integration	34.34	23.46	32.73	35.46
Mean depth	1.34	1.43	1.35	1.34
Isovist area	73998.4	55912.9	64214.4	73336.5
Isovist compactness	0.63	0.38	0.61	0.63
Isovist drift angle	85.04	82.14	78.27	82.39
Isovist occlusivity	633.32	851.39	605.02	621.66
Isovist perimeter	1224.25	1352.61	1143.44	1214.03
Priority	PF: 58%	PF: 61%	PF: 44%	PF: 61%

PF: the percentage of the selection of the best position of the second desk by the respondents

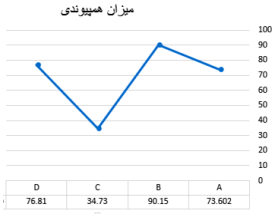
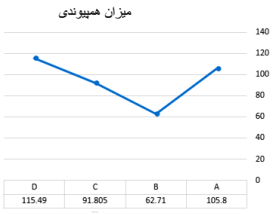
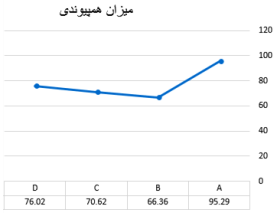
6. DISCUSSION

Analysis of the results from the present research demonstrates that many factors are important to determine the priorities of employees. The results can be further extended and justified by taking into account other factors such as culture, organizational structures, etc. One of the significant results has been the importance and the impact of the distance from the door. In most of the options, where the greatest distance from the door was possible was selected as a place for sitting. This can be attributed to the tendency of people to fill a part of the room which is at the opposite side of the door. When employees were interviewed, most of them acknowledged that the best place inside a room is a place that is called in Iranian culture as "Balaye-Otagh". This term means "the most valuable part of room" where has usually the greatest distance from the door and is at the opposite side of the door. Even when the first work desk was in this part of the room, it was also preferred that the second work desk was placed in this part as much as possible.

On the other hand, the results from the research emphasize the impact of other indices of space syntax on the selection of desirable positions. The indices of isovist and integration have had high importance. But in cases where the position of the desk was so that the participant was obliged to prioritize the given indices, these indices were not similarly worthy. This means that the distance from the door has had more priority in most cases than the index of isovist, and the isovist has had a far greater impact on the choice of people than integration. Of course, one of the intervening variables in this area has been the amount of client's referring to the room. In a part of the given questionnaire, the amount of the clients' referring to the room was measured by the 5 options, ranging from "never" to "very high". The high or very high referring of the client to the room increased significantly the importance of the isovist of viewer. Very low or no referring of the client leads to significant differences in priorities of people. Another influential variable has been the gender of respondents. The index of isovist had more impacts on the priorities of female employees compared to the male employees (72% of female employees considered it as the main factor). The most important reason for it can be cultural issues which dominate the psychological space of the office. After an interview with the employees, it became clear that visibility from the outside of the room was considered as an important issue by most female employees. The index of dominance on the room was more important for the majority of male employees.

Education level had no significant impact on the selection of desirable place for sitting. But the job rank and job type e had specific impacts on the priorities of people. One of the impacts of job type was related to the amount of the client's referring, which has previously discussed. But a greater percentage of managers compared to experts (86% vs. 60%) considered the distance from the door as the most influential factor. In relation to the selection of the position of the second work desk in the room, it was largely tried to provide a balance and equality between two employees in terms of the given indices. Employees who had many clients selected a condition in which two desks were placed beside each other and back to the wall (68%) and the experts with fewer clients preferred a condition in which two desks were placed opposite to each other at a part of the room which is called "Balaye-Otagh" (74%). It should be noted that in all cases, none of the participants drew the desk facing the wall. This shows the importance of isovist for people.

Table 15 The index o connectivity in different arrangements and different positions of work desk (The amount of connectivity)

Arrangement IV	Arrangement III	Arrangement II	Arrangement I	
				Graph of connectivity index
The amount of connectivity	The amount of connectivity	The amount of connectivity	The amount of connectivity	

7. CONCLUSION

1. To achieve the desirability factors of the office space arrangement, the priorities of employees in this area should be considered. Various variables can affect these priorities. However, the previous studies have not assessed enough the environmental perception of employees by the numerical computation of the spatial factors of the workspace. By analyzing some indices of space syntax which play a significant role in the interior spaces, the present study has tried to provide a method to predict the desirable position of work desk in an office room based on the priorities of the employees with regard to various positions of the door, and also the desirable position of the second work desk with regard to the position of the first work desk. The comparison of different values resulted from the analysis of the indices of space syntax demonstrates the impact of each of the indices. revised The results make it clear that the indices of distance from the door, dominance on the room (the feel of spaciousness), dominance on the door, visibility from the outside of the room and spatial integration have impacts on the determination of the desirable positions of work desk in the room. However, the importance of these indices is different. The index of distance from the door has been recognized as the most effective factor and on the other hand, the indices of isovist and angle of view have had higher priorities in choosing the desired options by employees than the spatial integration. Comparison of the results has shown the influence of some cultural and organizational factors. Some cultural approaches to the spatial value of different parts of the room, as well as the impact of gender and job rank on the priorities, all confirm this issue. A part of the room where is far from the door has been considered by the employees as more valuable position and there is a higher tendency to fill this part. Women are more sensitive than men to be visible from the outside of the room and men prefer to have more dominance on the room.

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CONFLICT OF INTEREST

The author declares that there are no conflicts of interest regarding the publication of this manuscript.

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AUTHOR (S) BIOSKETCHES

Maleki, M., *PhD Candidate, School of Architecture and Environmental Design, Iran University of Science and Technology, Tehran, Iran*
Email*: mmaleki@IUST.ac.ir*

Mofidi Shemirani, S. M., *Assistant Professor, School of Architecture and Environmental Design, Iran University of Science and Technology, Tehran, Iran*
Email*: S_m_mofidi@iust.ac.ir*

Heidari, A., *M.A. Student Faculty, Shahid Beheshty University*
Email*: heidari74@gmail.com*

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