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Evaluating Components Affecting Sense of Community in Office Spaces

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ABSTRACT

A sense of community refers to an individual's experience of social life in an environment. Various research has demonstrated that the sense of community has had the highest effects on peoples' participation in environmental functions, including working in a closed office space. The idea of belonging to society has brought about considerable social responsibilities and advantages over the last decade. The sense of community helps people to get together more in a working environment as they are together in the family. It also helps people to demonstrate better conduct and morality in a working environment. This study aimed to use multi-criteria decision-making methods to measure the sense of community indicators and to respond to the study hypotheses. In this regard, the study explored available resources to extract 17 components affecting the sense of community. The views of the population under study were investigated by developing, distributing, and collecting questionnaires. For this purpose, 60 questionnaires were given out to academic professors, experts, and specialists in architecture, while social, environmental, and behavioral components were prioritized. By eliminating incomplete questionnaires, 57 questionnaires were finally analyzed, and in the end, the BWM (Best-Worst method in the multi-criteria decision-making) method was used. Out of social components, environmental components, and behavioral components, the subcomponents of shared connections and social interactions, the subcomponent of using public spaces, and the subcomponent of society were respectively identified as the best components affecting the promotion of the sense of community in office spaces. To promote the sense of community in office spaces, such measures as attention to shared connections, attention to social interactions, and spatial capacities for employee cooperation in space were taken.

Keywords: Office Spaces, Sense of Community, Sense of Community Dimensions, BWM Method.

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1. INTRODUCTION

A sense of community refers to an individual's experience of social life in an environment. Various research has demonstrated that the sense of community has had the highest effects on peoples' participation in environmental functions, including working in a closed office space. The idea of belonging to society has brought about considerable social responsibilities and advantages over the last decade, though the subjects of community performance and membership values in the community have not been fully investigated. The sense of community in place was first explained in rural areas, where people gather based on their kinsmen relations and are connected. This concept generally explains the true way of living and the creation of desirable communities in which people can abandon their privacy and individual needs, and instead look for social ways with others and meet collective needs (Fisher, Sonn, and Bishop 2002, 36). When established in the 16th century, office environments witnessed large-scale changes due to economic and social developments. Currently, despite the rising virtual working environments, physical environments still assume a major and pivotal role in fulfilling tasks, and finally in the sense of community. In general, outside public places and office environments are accessible to all people in the community, help increase inhabitants' interactions, and create opportunities for peoples' to contact and bond in place. Various studies have shown that the sense of community in office environments creates occupational satisfaction, and reduces occupational stress and burnout (Ditzel 2008). The sense of community also helps people to work together and get together as they are at home (Thueson 2002). Few empirical studies have been conducted in public spaces, especially office environments, concerning the sense of community, with most studies have addressed the issue from a theoretical point.

According to various studies, the place is key for social life. This finding is in line with Turnbul's study, which examined the effects of government changes on the Ik tribe in Uganda. The Iks had a collective and simple life, procured their food from hunting, and lived in smaller groups. Small changes in the place of this tribe, however, changed parts of this complicated system and led to the collapse of their social fabric. It is well established that homogeneity and similarity help form a sense of community among people, and the sense of community itself helps unify all members together, while distinct people in a group help form a community (Janowsky 2003). Much research in this regard has demonstrated that the sense of community is a result of individual and collective experience. The sense of community serves as a mental need, and people appear to be focused on a larger group with a greater social context. In general, research in this connection has suggested that the concept of a group is hardly separated from the concept of place. To define the term local community, McMillan and Chavis used Gusfield's theory of the sense of community to define it as a group within a special geographical area that shares some links. In other words, factors of the sense of community refer to groups of people who share a place and are in the adjacency of each other and thus establish collective communications, such as spiritual communications.

This study was innovative because it theoretically used the concept of the sense of community to examine the quality of office spaces concerning individual, group, and environmental variables. Contrary to the widely-used concept of the sense of place, the sense of community does not view the environment as an object, although it can be emotional and human from the angle of human communications and need fulfillment. In the sense of community, there is a commitment to society, i.e., it does not consider group or community simply as a source of fulfilling the needs. A sense of responsibility is part of this concept and coexists in this construct (Boyd et al. 2018). The sense of community is a sense deeper than the sense of place, as people with a sense of community work together not just for being inside an environment but for being part of a society (Garrett, Spreitzer, and Bacevice 2017). As a result, the sense of community can improve peoples' attempts to control the environment and tolerate undesirable environmental conditions. The sense of community has an organizational view and involves a structural approach, and focuses on instrumental functions within a society (Garrett, Spreitzer, and Bacevice 2017). The sense of community includes more time and activities and involves aspects of well-being such as leisure (Lizzo and Liechty 2022), membership, emotional relations, opportunities (Prati 2017), and participation in activities (Boyd et al. 2018).

Methodologically, this study used the multivariate decision-making method with an internal evaluation mechanism. As a priority, variable weighting was the main subject of the multi-criteria decision-making method, with hierarchical methods being the most dominant and coherent method used in this area (Nadkarni and Puthuvayi 2020). These methods, however, usually use pairwise comparisons, where simple, but highly repeatable methods are used to weight criteria or variables in a way that they are equal to 2(n-1)/2 of the number of variables and criteria. In this situation, reliance on the various comparisons of variables can cause erroneous weighting results, which consequently cause disharmony in data analysis. In other words, respondents simultaneously evaluate the weights of criteria greater or smaller than other criteria. In the BWM method, however, the low computational load in comparison to other multi-criteria decision-making methods allows respondents to maintain the necessary subjective coherence in responses. This method also investigates the validity

of comparisons done, while the method is designed to increase consistency in evaluation and weighting.
The present study aimed to evaluate and prioritize the factors affecting the sense of community in office spaces from the view of experts, and the findings could be used to remove limitations and obstacles and to provide solutions for plans. In the stage of studies and subject explanation, content analysis and logical reasoning methods were used, the findings of which were presented in the study. According to the goal of the study, and to answer the questions, the views of architecture and design experts were used to prioritize the factors affecting the promotion of the sense of community in office spaces. The following diagram presents the overall structure of the study.

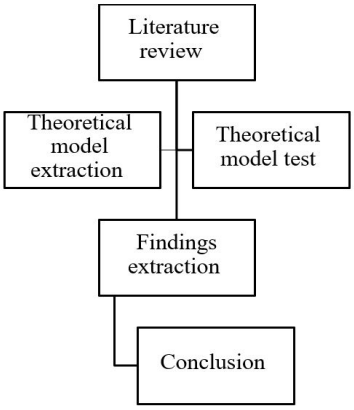

Fig. 1. Article's Analytical Framework

2. SENSE OF COMMUNITY

According to studies in urbanization and early 18th century industrialization developments, many debates were carried out about the sense of community. The sense of community, as suggested by various research, defines the concept of community and the word collective. Preliminary research in the sense of community has addressed such issues as participation in citizenship activities and social developments. In general, the concept of the collective has been considered a place in some studies, while as a social network in some other studies. According to various studies in this regard, the sense of community sometimes refers to an individual phenomenon, and sometimes to a social phenomenon, as literature has placed great emphasis on the sense of community, and the necessity of attention to collective psychology in social sciences (Janowsky 2003). In his doctoral dissertation, Zhu categorized the human-place relationship into four groups given in the table below. This table gives the position of the sense of community in human and place research.

Table 1. Various Levels of Concepts of Place

Human	Place	Area
	Place identity (Proshansky 1978)	Cognitive
	Sense of place (Tuan 1977)	
	Place belonging	Emotional
	Sense of community (Low and Altman 1992)	Communi-cational
	Place satisfaction	Evaluative

(Zhu 2014)

Behavioral sciences scholars interpret cognitive interaction between people, and places in the form of collective psychology and the sense of community (Larsen and Johnson 2012). Geography scholars consider meaning to be within the form of daily life experiences. In humanist approaches, which deal with understanding space, people aim to understand important places and search for the meanings of special places, and generally social places; in other words, they interact with each other, and thus form place. Social sciences scholars aim to gain a new understanding of social interactions and the sense of community in place (Simonsen 2012; Stephenson 2010). In general, research in psychosociology suggests that the concept of the sense of community is dependent on place and should be examined by various methods.
Various studies have indicated that the sense of community involves various social, physical, behavioral, and emotional dimensions (Lizak 2003). A sense of security, collaboration, voting, being a volunteer, and welfare (Davidson and Cotter 1991) are related to a strong sense of community. The sense of community refers to a sense of belonging, a sense of relations between members and groups, and a shared belief between members (McMillan and Chavis 1986). In general, definitions of the sense of community, senses of dependence, and belonging have distinguished this concept from other place structures. For example, attachment to place is an emotional link and a behavioral commitment. Also, attachment to a place depends on activities in a place (Pretty, Chipur, and Bramston 2003). In the sense of place, emphasis is mostly placed on attachment to place, place identity, and place attachment (Jorgensen and Stedman 2001). In recent years, numerous measures were taken to define and interpret place concepts (Mannarini et al. 2006). Over these years, the sense of community has, for some reasons, declined, with the reasons including smaller family networks, suburbanization, long daily commuting, the increased use of social networks and TV, etc. (Freeman 2011). Public spaces, including

parks and office spaces, as well as other environment models constructed by increasing interactions among people, could help increase the sense of community. Well-designed public spaces should be accessible to all groups intended, provide freedom of activity for all, and involve peoples' ownership (Carr 1992). In the sense of community, people look for communications through shared connections and shared experiences through belonging to collective groups. In recent years, urban designers and architects have performed many studies on the relationship between public spaces, including office environments and the sense of community (Carr 1992; Francis 2003, 58). Carr maintains that a well-constructed and successful public space is characterized by supportive and meaningful features, in a way that meets human needs, such as convenience and active participation. Recent literature has demonstrated that using public spaces could affect the sense of community (Halpern 36, 1995; Huo et al. 1998; Leyden 2003). In this way, face-to-face contact and the rising levels and length of contacts are seen as major factors in developing friendships and amicable relations between people. The level of using public spaces affects peoples' random encounters. Recent studies in the sense of community and public spaces have largely emphasized the characteristics of public spaces, including proximity to the house accessibility, and land use diversity (Lund 2002; Plas and Lewis 1996; Wood, Frank, and Giles-Corti 2010). In essence, a well-designed and high-quality public space tends to attract a larger number of users, and include a broader spectrum of necessary activities, so that people have a sense of community there. High-quality places serve as a factor in developing a sense of community among people (Gehl 2006, 124). In general, the sense of community in various places helps form people's subjective health, creates physical well-being, collaboration, satisfaction with public services and social control, and strengthens connections between people; consequently, resulting in peoples' loyalty to the group and society as a whole (Brodsky et al. 2002). Researchers consider components of the sense of community to include a physical environment, people, and a collective process (Kim 2001).

Various studies have found that the characteristics of public spaces (office environments), including such hotspots as art statues, coffee shops, intersections, and sitting places (Bedimo-Rung, Mowen, and Cohen 2005; Evans 2003; Semenza 2003; Coley, Sullivan, and Kuo 1997; Kuo et al. 1998), building, and attractive landscapes (Butterworth 2000; Lund 2002; Nasar 1994), and security affect the sense of community in public spaces, with people in places with higher senses of community feeling a greater sense of offenses. Other studies have suggested that the factors of services offered, quality, and the cleanliness of the environment help improve the sense of community in the environment (Bellenger, Robertson, and Greenberg 1977). Green spaces in the environment help people escape subjective fatigue and mental behaviors (Kaplan 1995; Ulrich et al. 1991), since they have desirable effects on the sense of community indicators, including friendship and interactions.

Kim and Kaplan found similar results concerning the effects of green spaces on the sense of community. Comparing two traditional and modern urbanization models, they concluded that the higher sense of community in modern urbanization models was due to more green spaces and shared spaces in urban models, and the people living close to green spaces were found to be more socially active and tended to recognize their neighbors more (Kim and Kaplan 2004). As well, participation in neighborhood activities and office places was found to increase the sense of community, which involved an expansion of social networks and amicable relations (Coleman and Iso-Ahola 1993). Again, participation in neighborhood organizations could produce more sense of community, as a higher sense of community created more engagement in neighborhood activities (Warde, Tampubolon, and Savage 2005). In the book "Language of Model", Alexander gives characterizes the sense of community as follows.

Table 2. Sense of Community from Alexander's Views

Characteristics	Design Response
Random Encounters	- Wide corridors: Wide corridors for people to commute and communicate with each other; - Sequence of sitting spaces: Organizing groups in a way people are placed in a pathway to the corridor; - Low-higher wall: A semi-constructed wall to allow people to visually communicate with each other; - Advertising spaces: To advertise and post journals.
Reduced Separation	- People live by each other in a way they are not separated; - Collective activity space: Activity space should be in a way that people engage in activities together.

Characteristics	Design Response
Social Networks	- Gathering places; - Shred dining places; - Heigh diversity in ceiling ; - Place to show local and regional crafts.
Membership	- A shared symbolic system for people to have a sense of place.
Virtual Interactions	-
Social Organizations	- Meeting space.
Collective Identity	- Distinct buildings.
Personalization	- Space to exhibit artworks.
Walking	- Building on a human scale.
Opportunity for Recreation and Leisure	- Inviting and open spaces; - Circular sitting spaces to arrange commuting paths around the space; - Height diversity in the ceiling: Low-height ceiling could create more intimacy - Comfortable furniture; - Exhibition space.

Sonn and Fisher's research about a group of people in Africa have shown that the people's cultural, social, and historical backgrounds and their shared identities were key for social lives and relations. For these researchers, inter-group relations require creating a group identity. Denvi's research also suggests that a higher sense of community requires users to be placed in smaller environments, as it is dependent on people's personality characteristics. Meanwhile, people who have many commonalities have a stronger sense of community; for this, people look for living environments where there are neighbors of the same economic, ethnic, and religious backgrounds. This uniformity can be both religious and occupational, which would lead to better and stronger social connections. In essence, the sense of community in a social environment is higher than that in a physical environment (Sonn and Fisher 1996). Long and Perkins (2003) considered three factors of social relation, shared concerns, and collective values as factors affecting the sense of community.

Stevenson (2011) considered the Ecological Model three criteria of social relations (macrosystem), social connection (microsystem), and individual importance (mesosystem) as criteria to evaluate the sense of community (Stevens, Jason, and Ferrari 2011). In Stevenson's definition, the macrosystem relates to group characteristics, including shared values and shared goals, as the microsystem pertains to membership (members' relationships with each other), while shared emotional connection falls under the mesosystem level. In his doctoral dissertation, Flage (1999) investigated the sense of community among the rural inhabitants of the State of Dakota and concluded that out of the 84 factors affecting the sense of community among residents of various characteristics, the majority of them were 40-70 years old and owned their residence, and were living there for around 10 years. The following open and closed-ended questions in this study were used to investigate the factors mentioned in the items:

- Membership: I belong to this group. I am comfortable in this environment and feel at home. I know the majority of people here. People in this place have a sense of care and friendship.
- Emotional connection: It matters for me to be part of this community. I am proud of the people who are in this community and live there.
- Need fulfillment: I know everyone in this place and take care of others.
- Influence and satisfaction: Most people influence each other and offer help, if necessary. If there is a problem, people can provide each other with assistance and help resolve it. People here are volunteers for leadership.

The results of this dissertation indicated that physical, social, and subjective-mental components were regarded as major components to measure the sense of community. The results also indicated that collective places where collective activities were occurring could create social capital, as a sense of community could be seen in those places. In general, the items in the study led him to identify the final criteria of the sense of belonging, security, social connections, activity, and the richness of place (ownership). However, besides these criteria, he adds the component of residence

duration, which required at least five years, and the place scale- a small place strengthens the sense of security, the sense of amicability, and the formation of the family- to the above components.

Janowsky (2003) also examined the sense of community in his doctoral dissertation that studied 404 mothers at shopping malls. Here, he used McMillan and Chavis's theoretical model to measure the sense of community among the studied subjects. In this study, he used 35-minute interview and observation methods, and 46-item questionnaires. In general, the study was theoretically founded on McMillan and Chavis's Sense of Community definition. In this dissertation, the sense of community was defined based on economic, social, and cultural connections between people, belonging to a place, shared faith, and views that help people come together. However, these commonalities can vary by time and place.

In the study's case studies, the shops that represented desired spatial definitions of shop spaces were chosen. Local shops are places where shop salespeople are somehow engaged with children, work with them, and involve them in necessary activities. In these shops, children are provided with some training and social services that help them escape from diseases. These studies have indicated that a sense of community leads to collaboration and cooperation among people. The mentioned criteria to measure the sense of community include membership, influence, needs fulfillment, and shared emotional connections.

According to Janowsky's findings, the sense of community varies from one place to another and across different periods, as with changes in the quality of an environment, the sense of community could also change. Results indicated that 1. because mothers at these shops had good sales, they were satisfied with the environment and could enjoy the sense of belonging and being in those settings, thus resulting in a sense of community; 2. also, smaller shops with low density could create more sense of community for customers as they provided more access to cleaner and more organized resources and facilities; this also helped increase peoples' collaboration in the environment; 3. mothers' familiarity with each other due to the number of hours they had to spend together, and the views of people who communicated with the, could also create the sense of community. Findings suggested that residents with higher income could perceive more sense of community than others; 4. satisfaction with the place and problems arising in the neighborhood could increase participation in the place. In the meantime, satisfaction with the place and perceived problems were regarded as distinct indicators correlated with participation and could have many effects on the sense of community. In reality, active mothers reported more problems. When faced with problems in place, mothers needed to connect with others and participate in place affairs so that they could strengthen their sense of community.

In general, the shops with higher social connections had a higher sense of community. The findings also revealed that the highest sense of community occurred when members had more influence on the environment, which would turn the sense of community into individual and collective development. This study also aimed to answer the following two questions:

- To what extent do you have a sense of community with other people in the environment?
- How important is the sense of community for you in the environment?

In his doctoral dissertation, Waxman (2004) investigated the social and physical characteristics of coffee shops in Florida, measuring the sense of community among the visitors of these coffee shops via place capacities. In this study, he used behavioral mapping techniques, interviews, and questionnaires to collect data. In this study, activities performed during the day in the coffee shops were observed, and fifteen 15-30-minute interviews were conducted with the managers, waiters, and three permanent customers of the coffee shops. The interviews were aimed to reveal the attitudes and views about the coffee shop environments. Also, 94 questionnaires were distributed among visitors to express their feelings about social life in these places. In general, the results of the interviews and questionnaires suggested that from the perspectives of the subjects, special and physical characteristics deemed suitable for the sense of community were 1. maintenance and care of the environment: in fact, each coffee shop has a unique physical environment that creates a sense of belonging, and this is, by itself, appropriate for the sense of community; 2. the view of the nature to have a reviewing effect, satisfaction, and happiness with presence in such an environment, originating from the view of the nature, could leave desirable effects on the sense of community; 3. comfortable furniture to be easily displaced so that space has the necessary flexibility to involve a sense of community and social; interaction; 4. good lighting; 5. public spaces, and 6. hospitality and social characteristics that will affect the sense of community.

In the last stage, the results of interviews and observation analyses suggested that restaurants' waiters and workers demonstrated higher social and mental support compared to the customers who were present in and visited such environments most of the time; for example, it was stated that the workers would help customers repair their cars, and people were generally willing to come to the coffee shops and stay there for a longer period, resulting in the greater sense of community among the visitors. Also, in coffee shops with longer and larger tables, people were free to do different activities such as reading books, communicate with others longer, and thus had a strong sense of belonging to such places. As well, larger tables in these coffee shops helped people

spend more time there and feel a sense of community. The findings also revealed that the number of public spaces was a factor in peoples' sociability. In essence, a place must have the capability to gather people to strengthen their sense of community and lead to social capital, and finally, help the promotion of the sense of community. In the end, social criteria, including the presence of familiar people with social characters, social support or hospitality, and physical criteria, including the number of public spaces, special furniture (convenient and large furniture), etc. could provide an opportunity for the individual and social development of people. Good lighting, a view of nature, and care for the environment, which resulted in a sense of belonging, were identified as the final criteria for the sense of community. Other studies also categorized the factors of the sense of community and the relevant characteristics in the following table.

Table 3. Comparing the Indicators of a Sense of Community and their Characteristics

Indicators of Sense of Community from the View of McMillan and Chavis	Characteristics
Membership	Emotional security, boundaries, sense of belonging, identity, shared symbols, sense of acceptance, recognition, devotion, personal investment
Influence	The individual's influence on the community, management, the community's influence on the individual, similarity, participation, support, shared responsibility
Needs Fulfilment	Shared values, needs and priorities, fulfilling the needs of others, support, security, internal dependence, communication and shared goal, collective success and competition.
Shared Emotional Connections	Shared history, interactions and the quality of interactions, shared events, people valuation, spiritual connection, amicable and face-to-face relations.
Demographics	Age, gender, education

(Shafik and El Bayar 2013)

Many researchers, including Brick, Driskel, and Breuer, argue that people with similar economic, social, and personality backgrounds in the environment will enjoy stronger social connections, and as a result a better sense of community due to the similarities between environment users an (Cadieux 2002). Research in urban areas in Italy showed that the sense of community and satisfaction with smaller cities and environments were greater, and if people were to be placed on larger cities, they should reside in smaller neighborhoods. Social and economic facilities across individual and collective levels could also have many effects on the sense of community. In a study to measure the sense of community among prisoners using interview and questionnaire methods, various questions about the sense of community were asked from users. These questions were performed through open-ended formats and via interviews (Fisher et al. 2002).

- How do you perceive this place? Explain your perception of this place.
- Do you have a sense of belonging to this place and the people in this place? Please explain.
- How would you feel if you wanted to leave this place?
- How can you establish communications with the external environment and people in this place?

To Alexander, there should be a shared area in spaces to connect people. This will naturally strengthen the sense of membership in the community, because a part of the space and resources, which serves as the center of the territory, is shared between them (Lawson 2001, 146). In sum, he argued that shared facilities should be provided in two distinct levels. Community refers to a group of people who interact in a shared place. For places to be successful in attracting people, their situation should be focused attention (Alexander, Ishikawa, and Silverstein 1977).

Janowsky did a study on the relationship between the sense of community and participation in treatment centers among mothers. For him, the criteria of the sense of belonging, satisfaction, and pleasure with activities help people to have a presence in the environment, and to form a sense of community among the environment users. He argues that participation in social activities and places helps improve the sense of community in the environment. In his dissertation, he used Vandersmen and Chavis to examine the general process of the sense of community and activity in the environment.

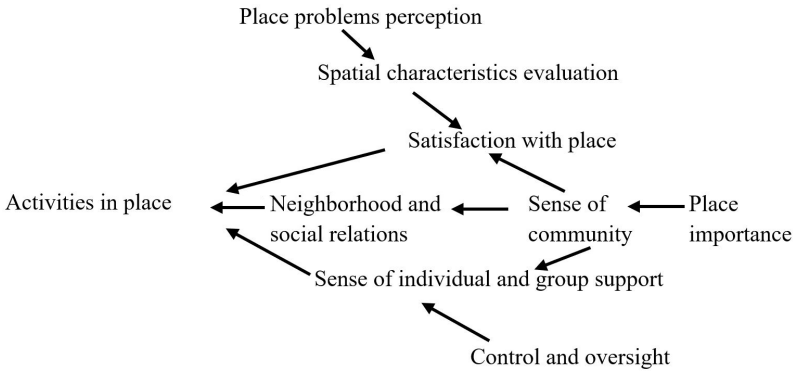

Fig. 2. General Model of the Sense of Community and Activity Dimensions

Reviews led to identifying various factors of the sense of community; here, three environmental, social, and behavioral components were found to be effective in the promotion of the social sense, as listed in the following table.

Table 4. Components Affecting the Sense of Community from the Views of Different Scholars

Environmental Component	Social Component	Behavioral Component
The quality of public spaces, the level of using public spaces, readability, relation with green spaces, shared spaces, and shared facilities	The level of participation in social activities; social interactions; shared connections and participation	sense of belonging; sense of identity; social support; security; trust; membership in social network; commitment to group members

3. STUDY METHOD

To evaluate the views of architectural (office spaces) experts about factors extracted from the literature review, the first subject was examined by using the Delphi technique and a researcher-made questionnaire (hierarchical analysis questionnaire), which was distributed to five architecture professors. After their validities were determined, 60 questionnaires were distributed to professors through face-to-face presence. These scales determined the effects and priorities of the environmental, social, and behavioral components, which were measured by the experts. Out of this number, 58 questionnaires were finally gathered, which were evaluated by the BWM method (multi-criteria decision-making method).

4. RESULTS AND DISCUSSION

This study used the BWM (multi-criteria decision-making) method, which uses a generalized method of hierarchical analyses, proposed by Rezaei (2015). This method mainly suggests that instead of the pairwise comparison of all criteria, only the pairwise comparison of the criteria using the best and worst decision-making criteria should be used. In this state, experts can perform the pairwise comparison with more consistency, because when criteria vary, then the pairwise comparison of all criteria with each other could yield greater inconsistency, which is due to the subjective inability of the experts to analyze various criteria. The stages of performing this method are as follows:

1. Show performance indicators with C1, C2, ….Cn.
2. Determine the most and least important performance indicators based on decision-makers' views,
3. Pairwise compare the best performance indicator with other indicators.
4. Pairwise compare the best performance indicator with other indicators. This comparison is performed on a scale of 1-9, where 1 is the equally important and 9 is the absolutely important performance of the best performance indicator relative to the performance indicator under study. The results of this vector comparison are in the form of $A_B = (a_{B1}, a_{B2}, ..., a_{Bn})$, where a_{Bj} indicates the preference of the best performance indicator over the jth performance indicator.
5. Pairwise compare other performance indicators with the least important performance indicators. Here, a scale of 1-9 is used, where 1 is the equally important and 9 is the absolutely important performance of other performance indicators relative to the least important performance indicators. The results of the comparison are shown in the vector $A_W = (a_{1W}, a_{2W}, ..., a_{nW})$ where a_{jW} is the preference of the jth performance indicator over the least important performance indicator.
6. Determine the weight of importance of each performance indicator in the form of $(w^*_1, w^*_2, ..., w^*_n)$. This vector should be so determined that for each k performance

indicators, the relations $w_B / w_j = a_{Bj}$ and $w_j / w_W = a_{jW}$ should be met. Therefore, to meet the mentioned conditions, the relations $\left|\frac{w_B}{w_j} - a_{Bj}\right|$ and $\left|\frac{w_j}{w_W} - a_{jW}\right|$ should involve the least values. Also, by considering the non-negative assumption of the weights of importance and the sum of the indicator equaling to 1, the following mathematical planning problem is solved.

(1) --->

$$\min \varepsilon$$

$$s.t.$$

$$\varepsilon \geq \left|\frac{w_B}{w_j} - a_{Bj}\right|; \quad \varepsilon \geq \left|\frac{w_j}{w_W} - a_{jW}\right| \qquad \forall j$$

$$\sum_{j=1}^{n} w_j = 1; \quad w_j \geq 0 \qquad \forall j$$

By solving the above mathematical problem, the optimal ε^* value is determined (Rezaei. 2015). In Rezaei's article, by solving an equation, the consistency indicator for various $a_{best,worst}$ values is determined as consistent t with Table 5.

Table 5. Consistency Indicator in the BWM Method

9	8	7	6	5	4	3	2	1	$a_{best,worst}$
5.23	4.47	3.73	3.00	2.30	1.63	1.00	0.44	0.00	$CI(\max \delta)$

Now, assuming the optimal answer of Model (1), i.e., ε^*, equation (2) is used to calculate the consistency rate.

$$consistency\ \ ratio = \frac{\varepsilon^*}{CI} \qquad (2)$$

If the consistency rate was less than 0.1, the experts evaluated it to be consistent; otherwise, the responses should be reviewed. The BWM method identified the best and the worst criteria at each level of decision-making. Decision-making levels included the main and secondary criteria related to the main criteria. To determine the best and worst criteria, the experts were asked to determine the best and worst criteria and to make their views the basis to choose the best and the worst criteria. Table 6 gives decision-making levels and the best and the worst criteria at each level.

Table 6. Decision-Making Levels and the Best and the Worst Criteria at each Level

First Level	Second Level
Physical Components (the worst criterion)	Public space quality
	Public space quality
	Using public space (the best criterion)
	Readability and territory determination
	Relation to green space
Social Component (the best criterion)	Shared space
	Shared facilities
	Participation in social activities (the best criterion)
	Social interactions
Behavioral Component	Shared connections (the best criterion)
	Participation
	Sense of belonging
	Sense of identity
	Shared interests between people
	Social support
	Security (the best criterion)
	Trust
	Membership in social networks (the best criterion)

In the second stage, the BWM method was used to identify the weight of importance of the main criteria. By solving model (1) in GAMS software, which is used to solve mathematical planning models, the ε^* value was calculated to be 0.041. By considering $a_{best,worst}$ it to be equal to 2 in Table 5 and using Equation (2), the maximum rate of consistency was 0.093. Because this rate was less than 0.1, the experts' evaluated it to be consistent, and the validity of the results was confirmed. In Table 7, the geometric average intended by the experts was provided concerning the best and worst criteria with other criteria. As well, this table gives the results of the weights of importance of the main criteria in the BWM method. Table 7 also identifies the criterion of the social component as the most important criterion with a weight of importance of 0.453, followed by behavioral and physical components.

Table 7. Pairwise Comparison of the best and the Worst Main Criterion with other Criteria

i \ j	Social Component	Physical Component	Behavioral Component
The Best Criterion (social component)	1	2.402	1.229
The Worst Criterion (physical component)	0.416	1	0.554
$\min w_j$	0.453	0.192	0.355
$\max w_j$	0.453	0.192	0.353
w_j	0.453	0.192	0.355
Ranks	1	3	2

Tables 8-10 give the geometric average of the experts to compare the best and the worst criterion in the secondary criteria of the main criteria of the social, physical, and behavioral components.

These tables also give the weights of importance of the secondary sub-criteria by solving mathematical models. Table 11 also gives the results of solving Model (1) to identify the ε^* value, the $a_{best,worst}$ value, the consistency indicator, as given by Table 5, and the consistency rate in the pairwise comparison of the secondary sub-criteria of each of the main criteria. Because the consistency rate was less than 0.1 in all cases, it was concluded that expert responses enjoyed sufficient consistency.

Table 8. Pairwise Comparison of the Best and the Worst Sub-Criterion in the Main Criterion of the Social Component with other Sub-Criteria

i \ j	Participation in Social Activities	Social Interactions	Hared Connections	Participation
The Best Criterion (shared connections)	2.237	1.133	1	1.8
The Worst Criterion (participation in social activities)	1	0.536	0.447	0.517
$\min w_j$	0.138	0.318	0.336	0.208
$\max w_j$	0.138	0.318	0.336	0.208
w_i	0.138	0.318	0.336	0.208
Ranks	4	2	1	3

Table 9. Pairwise Comparison of the Best and the Worst Sub-Criterion in the Main Criterion of the Physical Component with other Sub-Criteria

i \ j	Public Space Quality	Using Public Space	Readability and Territory Determination	Relation to Green Spaces	Shared Space	Shared Facilities
The Best Criterion (Using public spaces)	3.44	1	1.9	1.03	1.47	1.41
The Worst Criterion (Public space quality)	1	0.29	0.467	0.56	0.43	0.427
$\min w_j$	0.0809	0.186	0.111	0.0967	0.139	0.146
$\max w_j$	0.0951	0.258	0.198	0.109	0.281	0.3
w_j	0.088	0.222	0.1545	1.02	0.21	0.203
Ranks	6	1	4	5	2	3

Table 10. Pairwise Comparison of the Best and the Worst Sub-Criterion in the Main Criterion of the Behavioral Component with other Sub-Criteria

j / i	Sense of Belonging	Sense of Identity	Shared Interests Between People	Social Support	Security	Trust	Membership in Social Network	Commitment to the Group's People
The Best Criterion (security)	3.98	4.79	4.643	1.695	1	1.475	4.993	1.552
The Worst Criterion (membership in social networks)	0.275	0.423	0.427	0.29	0.2	0.252	1	0.3
$\min w_j$	0.084	0.039	0.039	0.085	0.226	0.105	0.036	0.087
$\max w_j$	0.124	0.092	0.096	0.222	0.335	0.246	0.053	0.217
w_j	0.104	0.066	0.068	0.153	0.28	0.176	0.045	0.152
Ranks	5	7	6	3	1	2	8	4

Table 11. The Results of the Consistency of the Experts' Judgements over the Pairwise Comparison of the Sub-Criteria of each of the Main Criteria

Mian Criterion	ε^*	$a_{best,worst}$	Consistency Indicator	Consistency Rate
Social Component	0.0188	2	0.44	0.042
Physical Component	0.0679	3	1	0.0679
Behavioral Component	0.129	4	1.63	0.079

5. CONCLUSION

This study was aimed at identifying the factors affecting the strengthening of the sense of community in office spaces from the views of architecture and design experts. In the end, the factors affecting the sense of community were identified. For this, some studies on the sense of community and its formation were carried out. The results concluded that the promotion of the sense of community had some environmental, behavioral, and social indicators, with the coefficient of the importance of social criteria being higher than those f others, as it was recognized as the best criterion. The weight of importance of this criterion was reported to be 0.453. Also, the physical criterion ranked last, and its weight of importance was 0.192.

On the other hand, the prioritization of all sub-indicators revealed that the sub-indicators of shared connections of the social criterion, and the sub-indicators of social interactions of the social criterion held the highest coefficients of importance compared t other sub-indicators. Considering the weight of importance of these criteria, the sub-indicator of shared connections had a higher priority, as the coefficients of the importance of 0.336 and 0.318 suggested that the consistency rate (0.042) was lower than 0.1; as a result, experts' responses were consistent, and that should facilitate employees' shared connections. This finding was consistent with Coleman, Cohen, and Jew's research. As regards the behavioral component, the security indicator was recognized as the best indicator, whose weight of importance was 0.28. In the physical component, the level of using public spaces should be provided to allow for public participation so that people can have convenient access to these spaces, and have a sense of community feeling. The relevant weight of importance was 0.222, suggesting a consistency rate of 0.042.

The study hypothesis stated the direct or indirect effects of individual and environmental factors on the social process in office spaces, and finally on the formation of the sense of community as qualitative and functional evaluation indicators of public spaces. The sense of community is a social concept; however, in most studies, such as those by Stewart and Townley (2020), this concept has been used as an indicator to evaluate well-being. The most important approach to the sense of community is the one based on performance or efficiency. The performance-based approach, especially in its initial form, studied the individual as the main unit of study and the goal of the intervention. Efficiency-based approaches directly prioritized individual and behavioral as well as individual control factors (Kwon et al. 2019). Other researchers also studied other more subjective criteria (Ru et al. 2019) and sensory factors (Zhang, Qu, and Kang 2021).

As a human-centered rotation and by considering the importance of human force well-being, integrated approaches that combine employee efficiency and well-being replaced initial selfish approaches. These studies take into account qualitative issues in

the working place; these studies include Sadik and Kamaradin (2022) who investigated the effects of the relationship between nature and employee well-being. However, the approach concerning the study of office environments was based on individuals.

The second rotation included methodology and distancing from quantitative measures, together with changing the definition of the environment against quantitative theories in method and goals. In quantitative approaches, control stands against trust, criteria against values, and organization against a communication network (Kingman 2019). In the new approach to work, space serves activities, with interaction taking precedence.

Thus, considering the most important factors affecting the promotion of the level of the sense of community in office spaces by focusing on communication in the context of environmental facilities, the following two concepts are suggested:

- Shared connection: A context for providing employees in office spaces with the opportunity to have shared connections and to have interactions. This context is both performance and perceptual and can be part of facilities.
- Level of using public spaces: A context should be provided to help people have convenient access to spaces, perform activities, and finally feel a sense of community. The level of using public spaces can help create an opportunity for the context for a sense of community.

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