Determining Attributes of Spatial Organization in Public Open Space

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Abstract: Spatial organization can be attributed to diverse physical factors in Public open space. The spatial organization act as one of the major factors for describing the identity of the architecture of a particular space and builds a relationship between architecture spaces with culture and their application. Therefore, this research explores the factors of spatial organization for making effectual public open space in Indian context. The research has been unfolded into two steps. Firstly, literature review has been done followed by questionnaire survey. Three different Public open spaces of New Delhi, India including New Friends colony, Saket, Nehru Place has been taken as site study over which questionnaire survey has been performed. The questionnaire design is based on the 'Likert scale' ranging from 1 to 5 i.e. from 'strongly disagree' to 'strongly agree'. Each factor is divided into different construct having five to seven items which is analysed through Cronbach's alpha in order to evaluate the authenticity of response by users. Further, exploratory factor analysis using IBM SPSS software has been employed to explore the factors of spatial organization in Indian Public open space. The factors are further confirmed through confirmatory factor analysis using Amos software. Furthermore, the research findings confirm accessibility and linkages, uses and activities, facilities and microclimate are the major factors of spatial organization of public open spaces in Indian context.

Keywords: Spatial Organisation, Public Open Space, Indian context

Introduction

The public open space is certainly a predominant component of public life. Lofland (1998) explained term public spaces as an area which covers a diverse connection between people and space. (Garau, 2016) stressed that design and organization of spaces of public open space explicates the function of the space, building or a city. Therefore, while designing Public open space, spatial organization and design should be in perpetuation of the context of a city and mutate according to the users need. However, Zakariya et al. (2016), identifies, spatial organization as one of the predominant factor of Public open space, to enhance the social interaction. The aim of the research paper is to determine the factors of spatial organization of a Public open space successful in Indian context. The results of the study will provide comprehensive understanding in context of spatial organization in Public open space which eventually further helps in making effective Public open space. The objective of the study will be achieved by conducting case study in three different Public open space of New Delhi India.

Literature Review

Spatial Organisation

Goffman (1963) reported the spatial organisation has a major impact people's behaviour and their level of interaction in public open space. Zakariya et al. (2016) asserted that spatial organisation and elements in Public open space is highly linked to social interaction as desired spatial organisation, attracts people for a longer duration which further helps in enhancing the productiveness of public open space. Zakariya et al. (2016) further mentioned that, organisation of spaces produces association between spaces as well as provide possibilities for sociability.

Factors of Spatial organization for social sustainability (Thwaites 2005)	Factors of Spatial organization (Parsaee, Parva et al. 2015)	Factors of public open spaces	Derived factors of spatial organization
Directional space			
Deflective facades		Linkage	
Façade continuity		Access	
Rhythm of boundary treatment		Urban elements/ Amenities (Facilities)	
Linearity of floorscape		Access	
Views and focal points		Linkage	
Transitional space			
Thresholds: boundaries between spaces marked by change in: material, texture, color, form/shape, direction, level	Type of spatial organization	Urban elements/ Amenities (Facilities)	
Segments: spaces that break linearity and provide 'softness' through: porticos, arcades, colonnades, shelters, low fencing, stoops, porches and landings etc.	Type of circulation system	Access & Mobility	
Corridors and Tunnels: narrow routes between buildings enabling access to interior courtyards or through routes to neighboring spaces.	Type of circulation system	Access	
Ephemeral: transient effects of sun and shade patterns, seasonal change in vegetation, sounds, smells etc.		Microclimate	
Locational space			
Separation from Distraction	Private and public zones	Urban elements/ Amenities (Facilities)	
Provision of Access		Access	
Provision for Comfort		Comfort	
Opportunities for Interaction with the Environment		Urban elements/ Amenities/uses and activities	
Place attachment		Place attachment	
Features of interest	functional areas	Urban elements/ Amenities (Facilities)	
Opportunities for social interaction		uses and activities	

Derived factors of spatial organization

Access and linkages

Microclimate

Uses and Activities

Facilities

Figure 1 showing attributes of spatial organization of public open space derived from literature review

Figure 2 Derived factors of spatial organization in Public open space

Nezhad et al. (2003) elucidates that spatial organisation involves the design and layout of spaces, as to accomplish few consideration which construct the rate and type of relation between elements. Further, Nezhad et al. (2003) added that the order, sequence and position of spaces administrates the organisation. Moreover, every organisation has a distinct influence on semantic relationships between spaces. Each place needs different semantic relationship and spatial organisation as they possess different cultures and context. According to Melik (2008), to attain successful public open space, spatial organisation and design of space should be in a relation of social life of place. While, Whyte (1980), identified flexible design, public amenities, signages, circulation, shades, sit outs as major components of spatial organisation as it has immense impact on social life and encourages in generating effective public open space.

Furthermore, Torabi and Brahman (2013) linked architecture spaces with the culture of a place, moreover, defines spatial organisation as essential attribute for illustrating the identity of the architecture of a particular space. Whilst, Fichter (2013) comments that every person or a group have a contrasting outlook on exploring a public space. A spatial organisation of Public open space should be such that a person should be able to develop sense of belonging.

Factors of Spatial Organisation in Public open space

Thwaites (2005) described different types of spaces and some features of spatial organization towards social sustainability in public open spaces. Therefore, in this study factors of spatial organization have been extracted from the determinants of public open space on the basis of literature review (figure 1). The extracted parameters are Access and linkages, uses and activities, facilities and microclimate.

Accessibility and linkages

Whyte (1980) describe, access as a visible reach of the space, while Tibbalds (1992) mentioned accessibility as a physical and visual approach of a space which have an immense impact on the user's perception. Tabassum and Sharmin (2013) states that open spaces with better accessibility encourages social cohesion and interaction. While, Taghipour et al. (2015) defined linkages as a connection between spaces, inner and outer circulation.

Uses and activities

Taghipour et al. (2015) described uses and activities as one of the essential factors to rejuvenate the Public open space in different time and season. According to Gehl (1996), in public space, people are attracted by people and

activities gets attracted by activities. Therefore, it is important to put uses and activities as it generates social interaction and captivates public for longer duration.

Facilities

Facilities include urban elements and maintenance and security. Carmona (2008) stated that the quality and organization of urban elements is directly related to the quality of public space. While, Whyte (1980) considered, installation of small visually pleasing urban elements like sit outs, installations, cascades attract users. Carmona (2008) mentioned that at different time of a day i.e. day and night, users perceive place differently. Therefore, public space should have the security provision of both day and night. Rimanova (2010) safety and maintain are the two essential factors for the success of Public open space.

*Figure 3 Public open space, New Friends colony ,
New Delhi*

Figure 4 Public open space, Saket, New Delhi

Microclimate

Gehl (1996); Mehta (2014) describes microclimate as a climate at micro level, comprises temperature, sunlight, shade and shadow, wind, humidity and a sense of comfort which compliments outdoor activities in Public open space. Thus, this factor is further divided into two parameters including comfort and landscape. Stephen et al. (1992) defines comfort is one of the necessary components of Public open space as it has strong impact on people's satisfaction. While Gehl (1996) asserts that, Comfort and user's activities in Public open space are in relation to each other. Therefore, it is essential to create comfortable environment for users. Further, Kaplan and Kaplan (1989) also describe physiological comfort as one of the perquisites for generating social interaction in Public open space. While, landscape includes components like sitting area, water bodies, fountain, cascade, green areas, encourages users to stay for longer duration. According to Spooner (2014) social interaction in Public open space is highly depend on the physical quality. Moreover, landscape is one of an attribute of a physical quality which compliments the social connects between an individual or a group (Spooner, 2014).

Methods

Description of Study Area

The study adopted three different Public open space of New Delhi, so that the context and the size of the site should be different, while character of the city does not change. Adding to this, design spaces are different of each Public open space, in order to get contrasting responses from the users. Thus, according to specified

parameters, Public open space of Saket, Nehru Place and New Friends Colony are considered for the case study. These Public open spaces are the part of District centre which includes varied land uses like commercial areas, offices, Hotels, restaurants, etc. Therefore, the selected site caters to different users.

Data Collection

For data collection, research has adopted quantitative method. A set of questionnaires is designed to find out the factors of spatial organization in Indian context. Thus, 26 questions were framed, which inquiries about users satisfaction level regarding present factors of spatial organization in Public open space. The questionnaire is based on the Likert scale ranging from 1 to 5 "highly disagree to highly agree," containing four different factors with 26 items. Prior to survey, pilot study with 19 samples has been done in order to validate the questionnaire. The results of data collection specify the satisfaction level of users in terms of spatial organization of Public open space in selected study area.

Sample size

Table 1 showing exploratory factor analysis of attributes of spatial organization of public open space

Construct	No. of items	Indicators	Factor loading	Cronbach's Alpha
Access and linkages	6	Entrance is good	0.778	0.940
		Clear entry and exit	0.775	
		Easy to get parking space	0.737	
		Pedestrian entrance is good	0.749	
		Walkable distance from bus, metro to public open space	0.787	
		Size and condition of walkways are good	0.798	
Uses and activities	5	Spaces are attractive	0.776	0.928
		Activities are sufficient to spend time	0.787	
		Diversity in activities	0.781	
		Activities for less abled, senior citizens	0.767	
		Sufficient area for shopping, relaxing	0.785	
Facilities	6	Diversity\in physical form	0.755	0.937
		Spaces with proper sit-outs	0.788	
		Toilets, drink water and first aid available	0.781	
		Street furniture and street lightings are available	0.788	
		Night lighting and security camera are properly installed	0.788	
		Spaces are clean and well maintained	0.744	
Microclimate	8	Shade protect the play areas from climatic condition	0.798	0.958
		Sitting with proper shades (temporary/trees)	0.800	
		Well maintained and shaded pathways	0.788	
		No noise/smell in surrounding	0.818	
		Open space layout design & elements are captivating	0.780	

Water fountain/Statues/sculpture are attractive	0.803
Green areas are provided for shade and relaxing	0.801
Sufficient hardscape is provided (walking/jogging	0.805

The Delhi City has a finite population of 2,733,752 (2011 census). Israel (1992) sample formula for finite population has been used as for sample size calculation. Thus, according to the Israel (1992), 400 samples for the population more than 100,000, assuming $\pm 5\%$ precision level has been taken.

Thus, the sample size is 461 which is collected from three different Public open space of New Delhi i. e., from each site around 154 samples are collected. Moreover, systematic sampling is used in which, every fourth visitor is counted and requested to answer the question. Through observation, spots are finalised. Further, in order to construct reliable samples, time-interval technique is used by conducting survey in first 10 minutes of every hours.

The combination of these two techniques are used by (Akari, 2014) to assess the public open space as well as (Ja'afar and Bina, 2009) supported for these techniques for the similar research. The samples collected are almost equal in terms of gender and age as to avoid imbalance in reviews from one gender.

Data Analysis

The data analysis has been performed in three different stages. In first stage, Cronbach's alpha value of each factor has been checked for ensuring the reliability of data. Prior to this, data screening has been done, which includes finding missing values, checking outliers and normality using IBM SPSS. As recommended by Cronbach (1951), alpha value above 0.7 is consider as reliable. Through table 1, it can be assessed that all the items are above the required 0.7 value of Cronbach's alpha. In stage two, Exploratory factor analysis using Varimax rotation on IBM SPSS has been performed to validate the items of each construct through factor loading of each item. According to Hurley et al.(1997), items having factor loading less than 0.5 are identified and deleted from the construct. Thus, out of 28 items, 2 items are identified and removed from the construct as it showing less than 0.5 factor loading value. At last, to examine the successful factors of spatial organization in Public open space, confirmatory factor analysis has been performed on IBM Amos in order to find out the correlation between each factor as well as factor loading of each item and construct

Figure 5 showing results of confirmatory factor analysis of spatial organization attributes

Confirmatory factor analysis

Table 2 Model fitness indices of spatial organization of public open space

Goodness of fit measures	X2 test statistics/df	GFI	CFI	NFI	AGFI	RMSEA	RMR
Recommended value	≤ 3.00 a	≥ 0.90 b	≥ 0.90 b	≥ 0.90 b	≥ 0.90 b	≤ 0.08 c	≤ 0.1 c
Structural model	1.363	0.939	0.992	0.971	0.926	0.028	0.021

Note: N = 461; GFI = Goodness-of-Fit Index; AGFI = Adjusted Goodness-of-Fit Index; CFI = Comparative Fit Index; NFI = Normed Fit Index; RMSEA = Root Mean Square Error of Approximation; RMR = Root Mean Square Residual Source: a (Jöreskog and Sörbom 1986), b (Bagozzi and Yi 1988), c (Anderson and Gerbing 1988), d (Browne and Cudeck 1993)

Holtzman and Vezzu (2011), confirmatory factor analysis is a part of structural equation modelling which investigates the relationship between latent variable of a design model and confirms model fitness concerning data. According to Child (1990) Bryne (2016), confirmatory factor analysis inquires the relationship between latent, observed, unobserved variables and constructs. While Holtzman and Vezzu (2011) added that, confirmatory factor analysis comprises exogenous (independent) and endogenous (dependent) variable with indirect and direct effects of one variable on other.

Validity and Reliability

The validity and reliability of a model can be check through the model fitness. There are few indices which testify the goodness of fit of a model. This includes CMIN (likelihood ratio of chi square), GFI (goodness of fit index), CFI (comparative fit index), NFI (Normed Fit Index), AGFI (Adjusted Goodness-of-Fit Index), RMSEA (Root Mean Square Error of Approximation), RMR (Root Mean Square Residual).

According to Joreskog and Sorbom (1986), the value of CMIN should be less than 5, while Bagozzi and Yi (1988); Anderson and Gerbing (1988) recommended values of GFI, CFI, NFI, AGFI ≥ 0.90 . Further, Browne and Cudeck (1992) commend values of RMSEA ≤ 0.08 and RMR ≤ 0.1 . (Rasidi et al., 2012) explained that the CFI and NFI explains descriptive fitness and demonstrate the part of development of overall fit model depend on independent model, while CFI is independent from sample size. Further, Rasidi et al. (2012) mentioned that RMSEA depends on degree of freedom as well as indicates the badness of fit index

Main Results

Before performing exploratory factor analysis, outliers are identified and deleted from the dataset. Bollen-Stine bootstrap has been carried out for multivariate normality, showing significant result (p value = 0.257 bootstrap),

which is above the required value of 0.05. Thus, this demonstrate that the dataset is normally distributed (Byrne, 2016).

The collected data consist total 461 respondents including 219 female (49.6%) and 224 males (50.6%). While, the age groups are unevenly distributed following 0-18 (15.8%), 18-30 (44.2%), 31-50 (29.1%) and 50 above (10.8%). The majority of the visitors from age group 18-30 years. While, it has been tried to get equal number of samples from each group.

Moreover, table 1 demonstrating, exploratory factor analysis results demonstrates that values of each item are significantly positive results, which is about 0.7 value as recommended by (Hurley et al., 1997). The factor loading of accessibility and linkage is are 0.778, 0.775, 0.737, 0.749, 0.787 and 0.798, while uses and activities have 0.776, 0.787, 0.781, 0.767 and 0.785. On the other hand, Facilities factor loading includes 0.755, 0.788, 0.781, 0.788, 0.788 and 0.774, whereas,

Microclimate factor loadings are 0.798, 0.800, 0.788, 0.818, 0.780, 0.803, 0.801, 0.805.

Furthermore, results of confirmatory factor analysis shown in figure 1, that all the factors have significantly high correlation with each other which proves that all the assumed factors of spatial organization are fit in Indian context. The relation of accessibility and linkages with uses and activities is 0.93, with facilities is 0.93 and with microclimate is 0.91. Further, uses and activities with facilities is 0.98, with microclimate is 0.96. Furthermore, facilities with microclimate is 0.97.

Validity and Reliability of factors of spatial organization model

The measurement model of spatial organisation shown in table 2, produced the goodness-of-fit indices which are as follows: chi-square value (χ^2/df) of 1.363, GFI = 0.939, AGFI = 0.926, SRMR = 0.021, NFI = 0.943, CFI = 0.992 and RMSEA = 0.028. The goodness-of-fit indices showing significant results including GFI, NFI and CFI, which is more than 0.9 (Jöreskog and Sörbom, 1986, Schreiber et al., 2006, Lei and Wu, 2007) . This signifies that collected data set is good fit. Therefore, the result reveal that all the mentioned determinants of spatial organization of Public open space are highly essential in Indian context.

Conclusion

This study has distinctly tried to define the attributes of spatial organization of Indian Public open space. The results of the study comprehensively explain the outputs acquired from the survey dataset. The outputs explain that uses and activities and facilities are the two main factors which mainly defines the spatial organization with a factor Loading of 0.99 as well as showing high correlation also. While, microclimate should be kept as one of the essential factors followed by the accessibility and linkages. Thus, it can be defined as uses and activities, facilities, microclimate and accessibility and linkages are the most significant attributes of spatial organization in Indian Public open space.

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