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PERCEPTION-BASED EVALUATION OF URBAN PUBLIC SPACES IN DELHI: A MULTI-DIMENSIONAL FRAMEWORK FOR ASSESSING CHALLENGES AND OPPORTUNITIES ACROSS FIVE TYPOLOGICALLY DISTINCT SITES

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ABSTRACT

Urban public spaces are indispensable to social, ecological and cultural life of the city, but their experiential quality is assessed in an inconsistent manner, more so in the quickly growing metropolises like Delhi. Delhi is one of the most densely populated urban conglomerations in the world and the capital of the country, making it a complex city with a variety of public space typologies, socio-spatial dynamics, heritage contexts and user demographics. This study involves the development and validation of a multi-dimensional perception-based evaluation framework of urban public spaces, which is tested in an empirical study of five typologically diverse urban public spaces in Delhi: Sarojini Nagar Market (commercial stretch), Rajiv Chowk (transit hub), Mehrauli Archaeological Park (heritage space), Lodhi Garden (green space), and Connaught Place (civic plaza). The framework is based on user experience (UX) design methods, environmental psychology and urban design theory, and incorporates four evaluative dimensions: (1) Spatial Quality, (2) Accessibility and Inclusivity, (3) Ecological and Environmental Comfort, and (4) Socio-Cultural Vitality. A validated 38 item questionnaire was used to collect data from 500 respondents at all five sites, systematic behavioral observation was conducted using an adapted SOPARC protocol, and GIS based spatial analysis was employed. A 3-D Importance- Performance Analysis (IPA) is a diagnostic tool model identified the critical design gaps that included Accessibility and Inclusivity (mean gap: -2.36) and Ecological Comfort (mean gap: -1.49), and showed high degree of variance across sites and across demographics. The resulting framework provides a replicable diagnostic tool for Indian urban planners, designers and policy makers that can be directly applied to the Smart Cities Mission, AMRUT 2.0, and SDG 11 targets, and is grounded in the context of India.

Keywords: Urban Public Spaces, Delhi, Perception-Based Evaluation, Importance-Performance Analysis, User Experience

1. INTRODUCTION

Markets, transit hubs, green spaces, heritage parks and civic plazas are urban public places that serve as the veins of an urban lifeline. These are places of daily life, cultural expression, economic activity and ecological relief, and impact the daily life of millions of urbanites (Gehl, 2011; Mehta, 2014). With the urban population increasing and cities facing increasing challenges of congestion, inequity and climate change, the quality of public space is increasingly important to human wellbeing, social cohesion and urban resilience (Carmona, 2010; WHO, 2016).

The National Capital Territory of India (NCT) of Delhi is a context that is both uniquely compelling and complex for public space research. Delhi is not just a city of ancient history, it is also a city of rapid modernization, of imperial grandeur, and informal urbanism; of world-class infrastructure and of severe spatial inequity. Its public spaces are similarly complex; colonnaded arcades in Connaught Place; the ruins of Mehrauli, dating back to centuries ago; the vast green space of the Lodhi Garden, the transit concourses of the Rajiv Chowk and the vibrant commercial energy of the Sarojini Nagar, each typology of public life, each serving varied user groups, functions and registers of experience.

However, amidst their diversity and importance in the city context, the public spaces of Delhi have received only a superficial empirical assessment of the quality and nature of the users' experience. Existing planning and design decisions for these areas are more often than not based on engineering standards, heritage conservation requirements or commercial demand, rather than the evidence about the actual experiences, values and behaviours of a variety of users, which would be informed by a structured assessment. This lack of assessments is further significant for the groups that are systematically excluded from planning processes and are always left out of the design of public space in Delhi, namely the marginalised groups -women, elderly people, people with disabilities, children and low-income users (Phadke et al, 2011; Datta, 2016).

To address this, this paper presents a multi-dimensional perception-based evaluation framework for urban public spaces in Delhi, based on primary data gathered from five typologically different spaces. The framework was developed based on a 4-part analytical dimension (Spatial Quality, Accessibility and Inclusivity, Ecological and Environmental Comfort, Socio- Cultural Vitality) and a mixed methods approach to analysis, including a 38-item validated questionnaire, systematic behavioural observation, and GIS-based spatial analysis, with the centre piece being a 3-D Importance-Performance Analysis (IPA) model.

1.1. RESEARCH OBJECTIVES

The study has four objectives which are:

1) To explore and analyses five typologically different urban public spaces of Delhi in a multi-dimensional perception-based manner.
2) To pinpoint issues and opportunities at the design level for various demographic groups on a range of typologies of public space.
3) To create and test a multi-dimensional evaluation system which can be replicated in other cities in Delhi and in other comparable cities in India.
4) To provide typology-specific and cross cutting recommendations to planners, designers and policy makers for enhancing quality of the public space in Delhi.

1.2. SIGNIFICANCE OF THE STUDY

The following are four key contributions to literature found in this research. First, it is the first typology-comparative, perception-based evaluation study of urban public space in Delhi, filling a major gap in Indian urban design research in terms of empirical studies. Secondly, it connects the practice of user experience (UX) design with the field of urban design research by bringing an importance-performance modelling approach and user journey thinking to the physical space context. Third, it foregrounds the voices of marginalized user groups as a main evaluative lens—a vital shift from a city that until now has been planning for elite and mobility-privileged users. Fourth, it generates a truly actionable diagnostic framework readily applicable to the implementation of the Delhi Master Plan 2041, the Smart Cities Mission and AMRUT 2.0 urban infrastructure programming.

2. STUDY CONTEXT: DELHI AND ITS URBAN PUBLIC SPACES

2.1. DELHI AS AN URBAN RESEARCH CONTEXT

The urban morphology of Delhi has been influenced by successive layers of historical settlements, colonial planning, post-independence master planning, and rapid and organic growth. The Delhi Development Authority (DDA) announced the Delhi Master Plan 2041 in 2021 which highlights the importance of enhancing public spaces as a strategic priority in

line with the 15-minute city concept and SDG 11 for inclusive, safe and sustainable urbanisation. However, implementation has been inconsistent, and independent evaluations have consistently identified major accessibility, ecological and safety gaps, especially for women and persons with disabilities (PWD) (Ministry of Housing and Urban Affairs, 2021; DUAC, 2023). This study is further driven by the climate context in Delhi. The city's public spaces face extreme environmental stress, resulting from its location in a semi-arid subtropical climate zone with high temperatures in summer (rising above 45°C during May-June) and heavy rain during the monsoon season (from July to September), as well as thick fog in the dry season (December-January), which significantly affects patterns of use and the experiential quality of outdoor spaces. Thermal comfort and shade provision is not simply a design feature in Delhi, but a factor of the usability of public spaces for vulnerable groups for most of the year. The description of the five study sites follows.

2.2. THE FIVE STUDY SITES: TYPOLOGICAL OVERVIEW:

To compare the typologies and also to have a city-wide synthesis, five sites were selected through purposive sampling representing the major typologies of urban public space in the Delhi context. Each site is typologically overviewed in Table 1.

Table 1

Table 1 Typological Overview of Five Study Sites -Delhi Urban Public Spaces

Site	Name	Typology	Location Zone	Approx. Area	Primary Users
S1	Sarojini Nagar Market (Study Stretch)	Commercial / Market	South Delhi	~300m stretch	Shoppers, vendors, commuters
S2	Rajiv Chowk Metro Station Area	Transit Hub	Central Delhi	~2.5 ha plaza	Commuters, youth, tourists
S3	Mehrauli Archaeological Park	Heritage Space	South Delhi	~100 ha	Walkers, tourists, students
S4	Lodhi Garden	Green Space	Central Delhi	~90 ha	Walkers, families, elderly
S5	Connaught Place (Inner Circle)	Civic Plaza / Commercial	Central Delhi	~3 ha Inner Circle	Shoppers, office workers, tourists

Figure 1

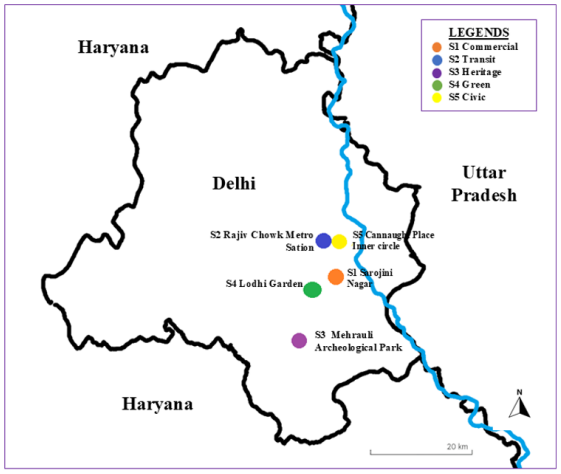

Figure 1 Study Site Location Map Showing the Five Typologically Distinct Public Spaces Selected Across Delhi NCT. Source: Author's GIS Analysis using OpenStreetMap Base Data.

2.2.1. SITE S1 -SAROJINI NAGAR MARKET (COMMERCIAL TYPOLOGY)

Sarojini Nagar is a retail market in Delhi, located in the residential and institutional area of South Delhi, which is one of the most iconic and densely used retail markets of Delhi. The study is based on a particular section of the main market lane, and the surrounding public domain that includes pedestrian walkways, vendor stalls, seating points, and the public space interaction between indoor shops and outdoor circulation space. The market is used by an estimated 50,000 people each day, ranging from those with high incomes to those with low incomes. The study stretch was chosen as a

representative sample of the conditions of public space in the market, in order to be able to observe and survey systematically and without trying to cover the whole area of the market, which is spread across several kilo meters.

2.2.2. SITE S2 -RAJIV CHOWK (TRANSIT HUB TYPOLOGY)

The busiest metro station in the Delhi Metro Rail Corporation (DMRC) network is Rajiv Chowk which is situated beneath the Connaught Place under the Blue and Yellow Line at the junction of the two lines. Its above-ground plaza, pedestrian underpasses, bus interchange areas and street-level public spaces are one of the most heavily-used transit public spaces in South Asia, serving over 300,000 passengers daily. The study is dedicated to the above-ground public realm, defined as the plaza level, pedestrian approaches, the informal seating and gathering areas, and the connection between the metro station and the road network and Connaught Place. A public space with high activity, where many different groups of people use the space and where there is a complicated multi-modal interaction.

2.2.3. SITE S3 -MEHRAULI ARCHAEOLOGICAL PARK (HERITAGE TYPOLOGY)

Mehrauli Archaeological Park is a 100 ha. protected archaeological park in South Delhi managed by the Archaeological Survey of India (ASI) and the Delhi Government. The park houses more than 100 listed monuments from six centuries of Delhi history such as the tombs of the Jamal and Kamali, the tomb of Balban, and many other Lodi-period monuments set in the midst of semi-naturalistic landscape of scrub woodland and rocky terrain. The park is a heritage public space that has a diverse range of users such as heritage tourists, educational groups, morning walkers and local residents, and that is significantly influenced by its location in the urban-rural fringe, and its status as a partly maintained and partly informal landscape.

2.2.4. SITE S4 -LODHI GARDEN (GREEN SPACE TYPOLOGY)

Lodhi Garden is a formal green space of about 90 hectares in the Lodhi Colony area of Central Delhi under the management of Archaeological Survey of India and New Delhi Municipal Council (NDMC). The garden was originally planned as a public garden by the colonial government in 1936 around existing tombs of the Lodi and Sayyid periods and consists of well-lawned fields, mature trees, stone footpaths and a dense collection of historic monuments. It is one of the most visited urban parks in Delhi with an average of 10,000 to 15,000 users per day during the week, and much more during the weekend.

2.2.5. SITE S5 -CONNAUGHT PLACE (CIVIC PLAZA / COMMERCIAL TYPOLOGY)

The heart of Lutyens' Delhi is Connaught Place (now known as Rajiv Chowk), designed as a colonnaded circular marketplace by Robert Tor Russell in the 1930s. The Inner Circle, Central Park (the inner grass lawn), and the surrounding colonnade represent a typology of civic plazas, with a high architectural scale, heritage value (Grade I listed by INTACH), high commercial density and a high tourist and office footfall. The study is centered on the Inner Circle public realm which consists of the lawn of Central Park, the colonnade pedestrian space and the connection with the metro access at the Rajiv Chowk. The renovation and pedestrianization of Connaught Place, 2016-2018, has created a context for before-after perception analysis of a recent design intervention.

3. LITERATURE REVIEW

3.1. EVALUATION FRAMEWORKS FOR URBAN PUBLIC SPACE QUALITY

The theoretical basis for assessing the quality of public space includes 50 years of empirical urban design research. William H. Whyte's (1980) careful behavioral analysis of New York plazas set the standard for looking at human activity in determining the success of public space, and showed that seating areas, sunlight, food service, and social interaction were the most important factors in establishing the vitality and use of public space. Jan Gehl (2011) formalized this understanding in his widely used 12 Quality Criteria framework, which outlines public space attributes in a hierarchy, starting with protection, followed by comfort, and then enjoyment, with higher levels of human activity being dependent on each preceding level. Project for Public Spaces (PPS) then further defined this concept by considering it within the

context of its four attribute Place Evaluation framework: sociability, uses and activities, comfort and image, and access and linkages, which has been used in hundreds of evaluation studies around the world. Later additions have attempted to expand these models to include aspects of sustainability, inclusivity and psychological wellbeing not well understood by previous models. The multi-layered public space framework of Carmona's (2010) is a combination of physical, social, temporal, and managerial. Dane et al. (2024) proposed a participatory co-design method, showing that the adoption of immersive VR technology in design process leads to more satisfaction and ownership of the resulting designs. The four-dimensional perception framework -service, spatial, cultural, and aesthetic -was adopted in Wuhan by Zhang et al. (2024) with the 3-D IPA model, which provided action points for sustainable landscape design. Overall, these contributions highlight the importance of multi-dimensional, user-centered evaluation methods, which can encompass all aspects of the public space experience.

3.2. IMPORTANCE-PERFORMANCE ANALYSIS (IPA) IN URBAN SPACE RESEARCH

Importance-Performance Analysis (IPA) is a diagnostic tool initially created in marketing and later applied across a variety of service quality evaluation applications (Martilla and James, 1977). The application of IPA in urban space research has been used to evaluate park quality (Xiao et al., 2024), waterfront design (Chen et al., 2022), and cultural heritage sites (Kim et al., 2021). The method's great strength is its capacity to simplify multi-attribute evaluation information into visually simple, actionable quadrant maps which can directly reach the attention of non-specialist planners and policymakers. The three-dimensional extension of IPA, which adds gap scores or willingness-to-pay as a third dimension, further enriches this prioritisation by separating the attributes that are all performing poorly from those with the largest gap between user expectations and delivery (Xiao et al., 2024). There is no previous study that has used 3-D IPA across different typologies of public spaces within the same city in India which makes it difficult to make conclusions on the priorities of design. This work fills this void directly and allows a site specific and comparative typological analysis to be conducted within a common analytical framework.

3.3. PUBLIC SPACES IN DELHI: EXISTING RESEARCH

The study of public spaces in Delhi has increased substantially in the last ten years, and has begun to focus on the concepts of gender and security (Phadke et al., 2011; Datta, 2016), heritage conservation (Gupta, 2015) and post-colonial urban memory (Legg, 2007). Srivastava (2014) studied the social production of space in Delhi's markets, and concluded that the informal commercial activity is an integral part of public space vitality which is not recognized in formal planning frameworks. Dupont (2011) reported the systematic design, management and policing practices which excluded lower income or informal users from the premium public spaces in Delhi. While these contributions create a rich sense of context to the dynamics of public space in Delhi, they do not provide frameworks for systematic multi-attribute quantitative evaluation that are applicable to planning and design practice. The lack of empirical and survey based multi-dimensional evaluation studies focusing on the user experience quality in various public space typologies in Delhi is the main research gap this study addresses.

3.4. UNIVERSAL DESIGN AND INCLUSIVITY IN INDIAN PUBLIC SPACES

The question of Universal Design which is the design of environments usable by all people without specialized adaptation (Story et al., 1998) is a commitment of the Indian legislation as well as implementation failure in Indian urban public spaces. The Rights of Persons with Disabilities Act (2016) and the Harmonized Guidelines for Accessibility by the Ministry of Housing and Urban Affairs (2021) prescribe barrier free environments in all public buildings and spaces under the jurisdiction of the central government. However, independent audits, such as those conducted by the ASI's own assessments of the accessibility of Delhi's heritage sites and the NDMC compliance reports, continue to highlight widespread non-compliance with basic accessibility standards across public spaces in Delhi (Ministry of Housing, 2021). The lack of ramps, tactile paths, disability friendly seats and bathroom facilities is not just a design error, but a rights violation, denying millions of Delhiites a chance to enjoy public life on an equal footing.

4. THEORETICAL FRAMEWORK

This analytical framework brings together user experience (UX) design methodology, urban design theory, and environmental psychology and is presented as a four-dimensional evaluation model. Each dimension is based on sound theoretical foundations and is expressed in terms of measurable user-rated attributes of the dimension.

Table 2

Table 2 Four-Dimensional Evaluation Framework -Dimensions, Attributes, and Theoretical Basis

#	Dimension	Focus	Core Attributes	Theoretical Basis
1	**Spatial Quality**	Physical form & legibility	Layout clarity, wayfinding, seating, maintenance, cleanliness, surface quality, aesthetics	Gehl (2011); Carmona (2010); Whyte (1980)
2	**Accessibility & Inclusivity**	Equitable access for all	Ramps, tactile paths, accessible restrooms, multi-ability seating, gender- sensitive facilities, economic inclusivity	Steinfeld & Maisel (2012); RPWD Act -2016
3	**Ecological & Environmental Comfort**	Thermal, sonic, visual comfort	Shade, greenery, noise, air quality, lighting, water features, biodiversity, microclimate	Kaplan & Kaplan (1989); Ulrich (1983)
4	**Socio-Cultural Vitality**	Social life, safety, culture	Social interaction, cultural expression, safety perception, gender sensitivity, belonging, diversity	Mehta (2014); Low & Smith (2006)

Figure 2

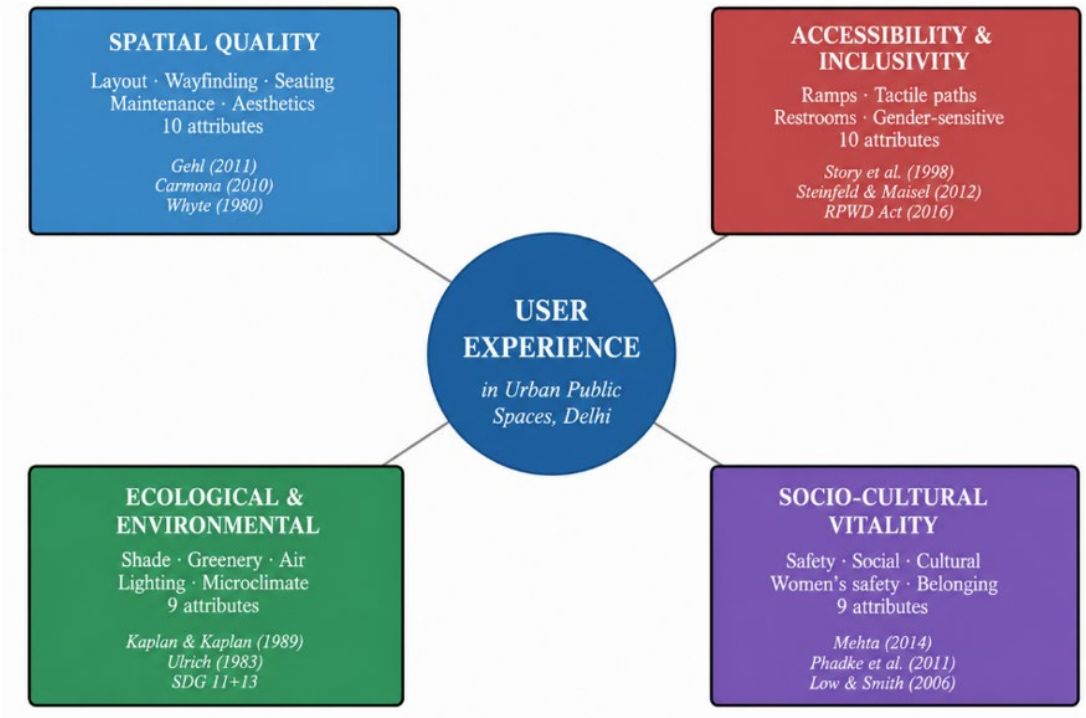

Figure 2 The Four-Dimensional Evaluation Framework Integrating Universal Design, Sustainability, and User Experience Theory. Each Dimension Comprises 9–10 Measurable Attributes Grounded in Established Literature

The 3-D IPA model operationalizes this framework by measuring, for each attribute: (a) Importance (how important is the attribute to the overall space experience); (b) Performance (how well does the current space perform on the attribute); and (c) Gap Score (P - I) (how much under- or over-delivery on the attribute is occurring relative to user expectations). High importance and low performance (Quadrant 2) are design attributes that are critical to solve right now.

5. METHODOLOGY

Figure 3

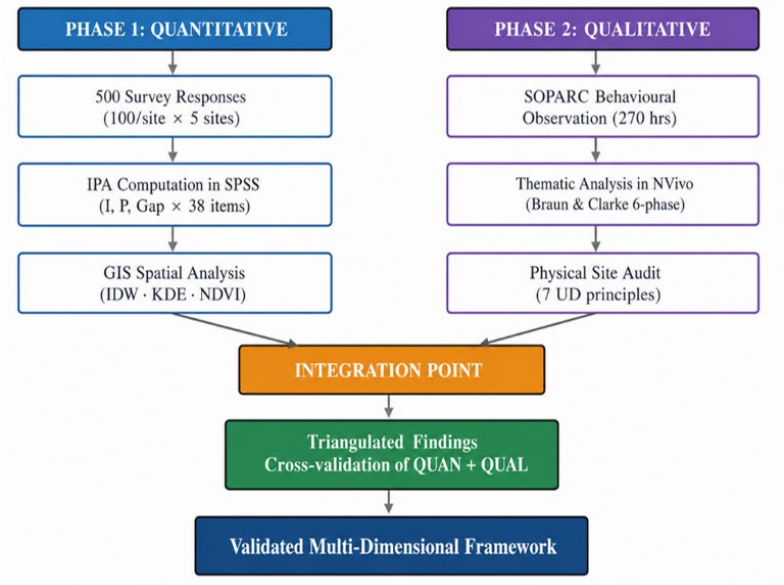

Figure 3 Sequential explanatory mixed-methods research design showing quantitative and qualitative data collection streams, analytical procedures, and integration points.

5.1. RESEARCH DESIGN

The research design of this study is mixed methods, multi-site comparative. Structured questionnaires and GIS spatial analysis provide quantitative data, while behavioral observation and open-ended survey questions provide qualitative data; findings from both types of data are triangulated. The comparative typological design allows site-specific diagnostic conclusions as well as typology-level generalizations that can be applied throughout Delhi and similar Indian metropolitan settings, with respect to commercial, transit, heritage, green and civic plaza typologies.

5.2. SITE SELECTION RATIONALE

Selected through purposive sampling to maximize typological diversity but also to ensure that all sites are: (a) publicly accessible; and (b) under government jurisdiction (spaces managed by the government). The other four parameters for the selection of the surveys were: (b) significant daily footfall so that adequate recruitment can be made in the surveys; (c) located within the National capital territory of Delhi; and (d) representative of typologies commonly found. In other metropolitan cities of India, making sure of the transferability of the framework. Located across three administrative zones (South Delhi, Central Delhi and Lutyens' Delhi), the sites encompass recently renovated (Connaught Place, 2018) and unrenovated spaces, thus allowing the examination of design vintage impact on user perception.

5.3. DATA COLLECTION

5.3.1. STRUCTURED SURVEY INSTRUMENT

The authors used a 38-item validated questionnaire (see Appendix A) that was distributed to users in five of the sites (100 users per site) to get a cross-section of the population. For all the items, both Importance (1 = Not at all important to 5 = Extremely important) and Performance (1 = Very poor / Absent to 5 = Excellent) were rated on a 5-point Likert scale. To provide some time of day variation, surveys were administered in the morning (7-10 AM), afternoon (12-3 PM), and evening (5-8 PM) on four weekdays and two weekend days at each site. The instrument was translated in Hindi and subsequently administered in Hindi and English to make the instrument accessible to the non-English speaking respondents. Pilot testing achieved reliability (Cronbach's $\alpha = 0.897$, Appendix B) with 30 participants.

5.3.2. BEHAVIORAL OBSERVATION

A modified SOPARC (System for Observing Play and Recreation in Communities) protocol (McKenzie et al., 2006) was used to conduct systematic behavioral observation at all five sites, which was adapted for Indian urban context to incorporate informal commercial activities, gender-segregated behaviors and cultural/ceremonial use patterns (see Appendix D). Observations were taken at 30 minute intervals throughout all time periods, plotted on scaled base maps and then mapped in QGIS to produce activity density heat maps for each site.

5.3.3. GIS SPATIAL ANALYSIS

Ten spatial layers of data were used for GIS analysis, including physical accessibility features, green cover (from Sentinel-2 NDVI), shade distribution, lighting infrastructure, CCTV coverage and spatially interpolated user perception scores (IDW method). Pearson r analysis was performed to determine the spatial correlation between perception dimension scores and physical design attributes (see Appendix E for complete GIS layer register).

5.4. ANALYTICAL APPROACH

The 3-D IPA model was used at three different levels of analysis: (1) site-level (including comparisons of distributions of IPA quadrants for the five typologies); (2) dimension-level (including comparisons of gap scores across the four evaluation dimensions within and between sites); and (3) demographic subgroup level (including disaggregation by gender, age group, and disability status). One way ANOVA with post-hoc Tukey HSD tests ($p < 0.05$) were used for cross-site statistical comparison. Qualitative data were analyzed using Thematic analysis by Braun and Clarke (2006) was used for the analysis of the open-ended answers from the survey.

6. RESULTS

6.1. RESPONDENT PROFILE

There were 47.2% male, 48.8% female, and 4.0% that identified as neither male nor female or preferred not to answer. Age distribution: below 18 (6%), 18–30 (31%), 31–45 (26%), 46–60 (23%), above 60 (14%). The sample included 9.2% persons with disabilities. Most respondents at S4 (Lodhi Garden) and S3 (Mehrauli) visited more than three times a week, while the respondents at S2 (Rajiv Chowk) were mainly transiting and had less frequent recreational visits to the space.

Figure 4

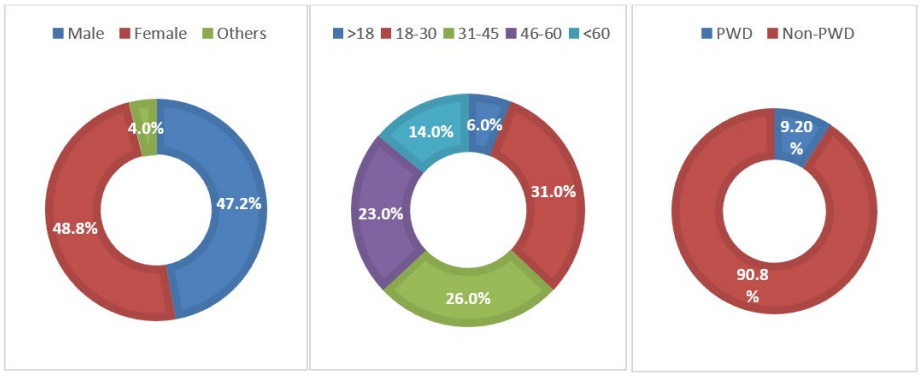

Figure 4 Three donut charts illustrating the demographic distribution of survey participants across gender, age groups, and disability status.

6.2. CROSS-SITE DIMENSION-LEVEL IPA RESULTS

Table 3 shows the mean Importance, Performance and Gap Scores for the four dimensions for all five sites combined and by site typology.

Table 3

Table 3 Gap Scores (P - I) by Dimension and Site. Negative values indicate underperformance relative to importance. S1 = Sarojini Nagar; S2 = Rajiv Chowk; S3 = Mehrauli Archaeological Park; S4 = Lodhi Garden; S5 = Connaught Place.

	All Sites Gap	S1	S2	S3	S4	S5 CP		p- value
Dimension		**Sar. Gap**	**Raj. Gap**	**Meh. Gap**	**Lodhi Gap**	**Gap**	**F-stat**	
Spatial Quality	-0.77	-1.12	-1.44	-0.54	-0.31	-0.88	11.2	< .001
Accessibility & Inclusivity	-2.36	-2.44	-2.71	-2.88	-1.62	-2.18	8.77	< .001
Ecological & Environmental Comfort	-1.49	-1.88	-1.77	-1.22	-0.61	-2.11	14.3	< .001
Socio-Cultural Vitality	-1.02	-0.88	-1.34	-0.71	-0.44	-1.22	9.14	< .001

Figure 5

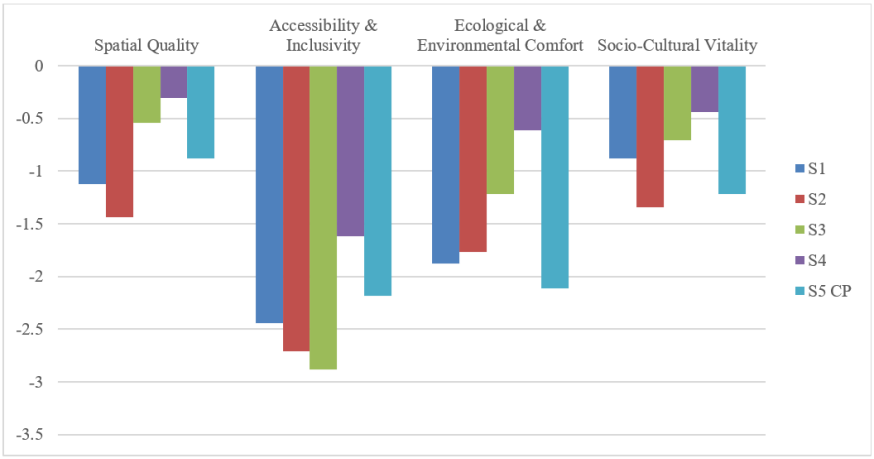

Figure 5 Cross-Site Gap Scores (Performance - Importance) by Evaluation Dimension Across Five Typologically Distinct Public Spaces in Delhi.

Figure 6

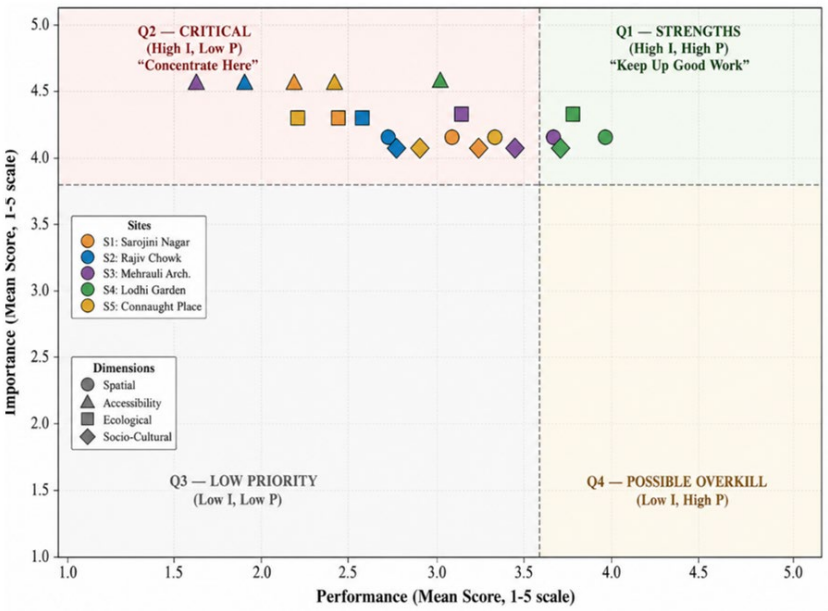

Figure 6 Three-Dimensional Importance-Performance Analysis Showing Dimension-Level Positioning of All Four Evaluation Dimensions Across the Five Study Sites. Quadrant 2 (High Importance, Low Performance) Represents Critical Design Priorities.

6.3. SITE-SPECIFIC FINDINGS

Sarojini Nagar Market had significant problems in spatial quality and ecological comfort with overcrowded walkways, inadequate restroom facilities and poor pedestrian access. Although there were these restrictions, the market was socially active and culturally active, which affected their user experience in a positive way. Women, however, reported far lower levels of safety, especially due to the lack of space, lighting and back lanes. Rajiv Chowk, as a major transit hub, had the highest accessibility and spatial quality gaps due to confusing wayfinding systems, the lack of seating, thermal discomfort, and a lack of facilities for persons with disability. Likewise, night time safety perception was also very low, as lighting was inadequate and public space poorly monitored. Mehrauli Archaeological Park faced the most difficult accessibility problems, due to unpaved paths, lack of inclusive infrastructure and no accessible facilities. However, its high ecological value and the presence of natural environment and dense tree canopy was highly valued by the users. The overall best performing site was Lodhi Garden with its green space, cleanliness, and well-maintained landscape (notwithstanding the issues with access and evening safety). However, despite recent renovations, Connaught Place had the most heat island, traffic noise and lack of shade issues and the highest ecological discomfort. While improvements were made in access (ramps, parking), users with disabilities found challenges at pedestrian interfaces and circulation zones.

6.3.1. S1 -SAROJINI NAGAR MARKET (COMMERCIAL)

Among commercial typologies, Sarojini Nagar had the second highest Spatial Quality gap (-1.12) and the highest Ecological Comfort gap (-1.88). Severely congested footpaths (often obstructed by vendor stalls) and inadequate and non-functional public restrooms were the two most common spatial quality complaints that were made repeatedly in qualitative responses. Even with these weaknesses, the highest performance scores for this dimension were obtained at this site (gap: -0.88), which indicates that the social vitality and cultural dynamism of the marketplace is a great compensating virtue. However, the women respondents rated their perception of safety significantly lower than the men ($t = 8.44$, $p < 0.001$) and cited overcrowding, poor provision of restrooms, and poor lighting in the rear lanes as key issues of safety.

6.3.2. S2 -RAJIV CHOWK (TRANSIT HUB)

The highest Accessibility gap was at Rajiv Chowk (-2.71), where the above-ground wayfinding system for non-metro users was found to be faulty, seating was not provided in the Plaza zone, the thermal stress was high in the unshaded above ground area and provision for persons with disabilities for navigating the complex multi-modal interchange was found to be inadequate. The Spatial Quality gap (-1.44) was also the most extreme for all sites, with wayfinding clarity being perceived as particularly poor, which is consistent with the complex above ground geometry of this site and the visual competition between commercial signage and wayfinding. This site was rated lowest for all five indices of night-time safety perception (mean P = 1.89), indicating that the site was poorly lit, lacked street-level surveillance, and had a high proportion of unsheltered users in poorly designed marginal spaces.

6.3.3. S3 -MEHRAULI ARCHAEOLOGICAL PARK (HERITAGE)

Mehrauli Archaeological Park had the highest Accessibility gap of all sites (-2.88), where no accessible path network can be found on the generally unpaved heritage landscape, no signage for sight impaired viewers and no disability-accessible restroom facilities in the Park itself. Though the site failed in some aspects, it achieved the lowest Ecological Comfort gap (-1.22) compared to the site average (-1.49) due to the well-developed tree canopy, relatively clean air (because it is located at the urban fringe of South Delhi), and naturalistic environment, which were highly appreciated by the users. Lack of formal interpretation and heritage information was the major Socio-Cultural Vitality gap identified and many respondents were not aware of the importance of monuments they visited.

6.3.4. S4 -LODHI GARDEN (GREEN SPACE)

The gap scores of the sites were the lowest in the case of Lodhi Garden with the Ecological Comfort being the highest in all the sites (gap: -0.61). It was consistently described as the best aspects of the site was its mature tree canopy, the well kept lawns, clean air and birdsong environment. At this highest performing site, though, the figures for Accessibility and Inclusivity were still quite low (gap: -1.62), and wheelchair accessibility on unpaved paths (gap: -0.5) was also low. Lack of accessible restrooms, and lack of tactile path systems identified as persistent barriers. Gender disaggregated data from Lodhi Garden indicated that the safety level was significantly lower during the evening times than in the daytime ($t = 6.21$, $p < 0.001$), with the female respondents reporting poorer lighting on inner paths and absence of CCTV coverage in secluded areas.

6.3.5. S5 -CONNAUGHT PLACE (CIVIC PLAZA / COMMERCIAL)

The highest Ecological and Environmental Comfort gap across the five sites was at Connaught Place (-2.11) where the exposed lawn of the Inner Circle was extremely thermally uncomfortable, and the paved colonnade and road network of Connaught Place created the heat island effect. Although the site has been renovated in 2018, it still scores low for thermal comfort, shade and acoustic comfort (noise from surrounding traffic). The Spatial Quality gap (-0.88) is due to the continuing problems associated with wayfinding in the complex concentric ring design, surface maintenance of the Central Park grass, and seating. The accessibility at Connaught Place was rated much better than S2 and S3 (gap: -2.18 vs. -2.71 and -2.88) due to the post-renovation installation of ramps and accessible parking, however, users with disabilities identified significant barriers at the colonnade-road interfaces.

This includes all sites with priorities listed in Quadrant 2. All sit es in Quadrant 2 have priorities listed.

6.4. CRITICAL IMPROVEMENT PRIORITIES (QUADRANT 2) -ALL SITES

In Quadrant 2 (high importance, low performance), across all five sites there were 16 of 38 attributes Concentrate Here). The top 5 most important attributes, based on average gap score across all sites, were:

- Provision of accessible ramps and level changes (mean I = 4.81; mean P = 1.77; Gap = -3.04)
- Availability of shade structures and tree canopy (mean I = 4.74; mean P = 2.14; Gap = -2.60)
- Accessible and clean restroom facilities (mean I = 4.71; mean P = 1.91; Gap = -2.80) Tactile paving and wayfinding for the visually impaired (mean I = 4.62; mean P = 1.71; Gap = -2.91)
- Night-time safety and lighting adequacy (mean I = 4.58; mean P = 2.11; Gap = -2.47) Gap = -2.47)

Figure 7

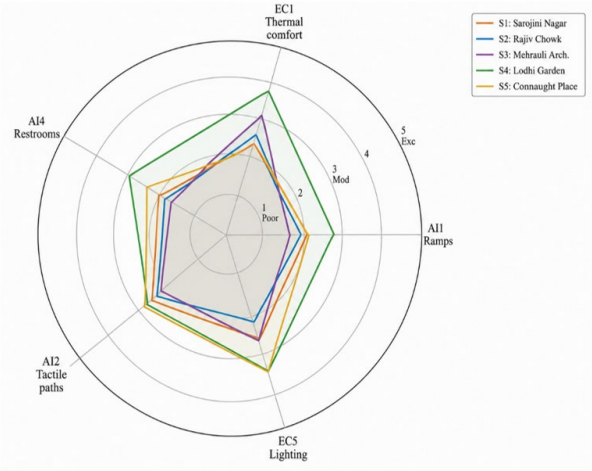

Figure 7 Radar chart showing relative performance of all 5 sites on the top 5 critical (Q2) attributes identified in cross-site analysis.

7. DISCUSSION

7.1. ACCESSIBILITY: DELHI'S MOST CRITICAL PUBLIC SPACE FAILURE

The uniformity for critical accessibility gaps across all five sites irrespective of typology, location, management body and design vintage suggests a systemic failure in planning and provision of accessible public spaces in Delhi. Rajiv Chowk, under the management of DMRC and under the accessibility requirements of the central government, had the largest accessibility gap of any site (-2.71), highlighting that legislative requirements and accountability for management are not enough. By themselves without any embedded user centred design thinking. The high accessibility gap (-2.88) at the Mehrauli is indicative of a larger conflict between heritage conservation goals and the universal design mandate: the notion that heritage value conflicts with accessible design is not only wrong, it is a violation of rights, and it excludes the very diverse communities whose history these sites represent.

User journey mapping, one of the most basic UX design techniques, is being transferred into the space domain, providing a practical approach to more systematic accessibility planning. Planners can then identify specific spatial obstacles in the experiential trajectory of wheelchair users, the visually impaired and elderly users from their point of first approach to their final destination by mapping the experience of each of the five sites. Planners can then understand the specific spatial blocks in the experiential trajectory of wheelchair users, the visually impaired and elderly users from their point of first approach to their final destination, which conventional audit checklists are unable to capture. This methodological recommendation is an actionable output of the UX-urban design interface that has been developed in this study.

7.2. THERMAL COMFORT: THE INVISIBLE EQUITY CRISIS IN DELHI'S PUBLIC SPACES

The Ecological Comfort dimension showed the greatest typological disparity in the data set: Lodhi Garden had the highest ecological performance scores of any site, gap: Connaught Place's open civic plaza recorded the worst (gap: -2.11) whereas the shade and thermal comfort at its more open civic plaza contributed to the high (gap: -0.61). The provision of shade is not just a design amenity, it is a health equity imperative, in a city where summer temperatures frequently exceed 40°C, and where heat-related illness is a documented public health emergency (NDMA, 2022).

The study has shown that thermal discomfort significantly affects afternoon use, with a disproportionate impact on the use of Sarojini Nagar by those who find it difficult to operate or come to work indoors during the hottest part of the day, which include lower income vendors, shoppers, and informal workers. The use of bioclimatic design interventions such as strategic tree planting (species-specific to the Delhi climate - Peepal, Neem, Jamun), tensile shade canopies at strategic gathering nodes, reflective paving surfaces and passive evaporative cooling at transit waiting areas, are high impact, low cost solutions that can enhance the ecological comfort and equity of public spaces in Delhi.

7.3. GENDER SAFETY: A PERSISTENT AND TYPOLOGY-SPECIFIC CHALLENGE

Gender disaggregated analysis showed that there is a statistically significant difference ($p < 0.001$ in all cases) between the mean of safety perception scores for males and females at all five sites; the largest difference was at Rajiv Chowk (difference: 1.44 points) and Sarojini Nagar (difference: 1.37 points). The results corroborate and build on previous qualitative studies of women's experience of public spaces in Delhi (Phadke et al., 2011; Datta, 2016) by providing quantitative site-specific evidence. Most importantly, the data show that the differences in perception of safety are not consistent across typologies: Although formally managed, Lodhi Garden had substantial gender safety gaps at night because of the inadequate path lighting and lack of surveillance on internal trails, thus indicating that spatial isolation, not only crowding, is a factor in driving concern for safety.

Figure 8

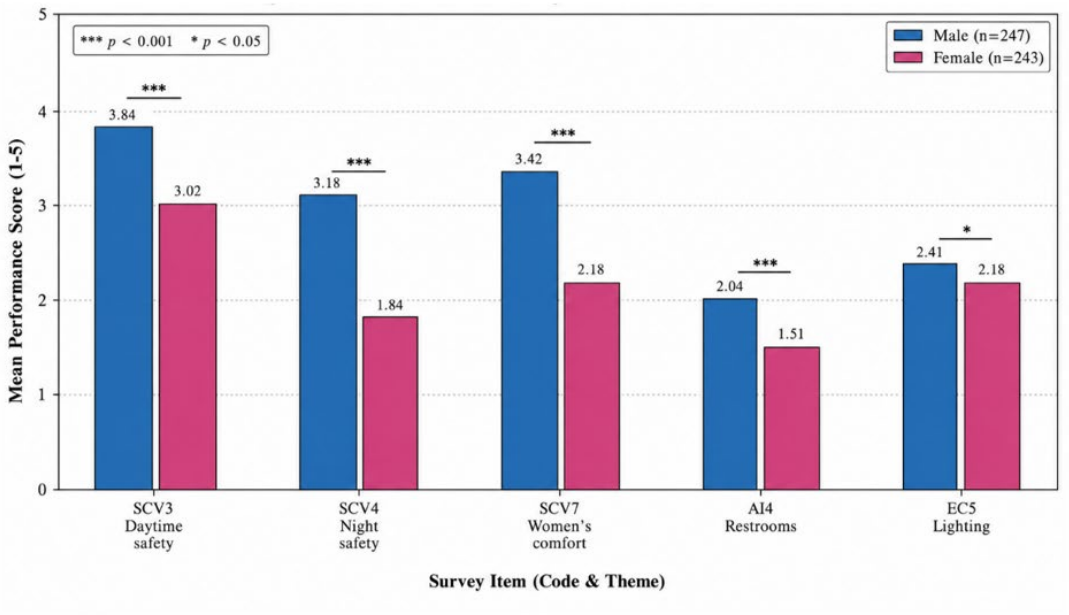

Figure 8 Gender disaggregated safety perception across all 5 study sites. Statistically significant differences (p<0.001) observed at all sites with consistently lower scores reported by female respondents.

7.4. TYPOLOGY-SPECIFIC INSIGHTS FOR DESIGN PRACTICE

The most practically valuable aspect of the study may just be the typology-specific design priorities, which vary systematically from site to site across the five sites. The need for urgent capital expenditure is felt on the transit space (Rajiv Chowk), where the need of the hour is for wayfinding, seating and above-ground thermal comfort infrastructure. Enforcement of footpath width, provision of shade, and provision of safe, clean, accessible restroom facilities are priority interventions for commercial spaces (Sarojini Nagar). For such heritage spaces (Mehrauli), a phased universal design access plan is needed which takes into account the conservation considerations, but also allows for dignified access for persons with disabilities and elderly visitors. Green spaces (Lodhi Garden) will most benefit from better lighting and surveillance of inner paths, as well as better accessible path surfaces and restroom facilities. The urgent needs for civic plazas (Connaught Place) are to invest in shade infrastructure and to manage acoustics to minimize traffic noise intrusion.

Figure 9

Domain	Survey Item (Code)	Study Sites S1 Sarojini	S2 Rajiv	S3 Mehrauli	S4 Lodhi	S5 CP	Overall Mean
Spatial Quality (SQ1–SQ10)	SQ1 Layout clarity	2.88	2.56	3.46	4.12	2.95	3.19
	SQ2 Spatial openness	2.72	2.28	3.22	4.01	2.63	2.97
	SQ3 Wayfinding	2.64	2.10	3.08	3.71	2.55	2.82
	SQ4 Seating	2.48	1.82	2.91	3.86	2.40	2.69
	SQ5 Street furniture	2.76	2.20	3.12	3.84	2.68	2.92
	SQ6 Cleanliness	2.32	1.88	2.76	3.58	2.26	2.56
	SQ7 Surface safety	2.60	1.97	2.82	3.63	2.44	2.69
	SQ8 Aesthetic	2.98	2.56	3.41	4.23	2.89	3.21
	SQ9 Activity zones	2.68	2.26	3.11	3.87	2.62	2.91
	SQ10 Boundaries	2.80	2.18	3.05	3.78	2.64	2.89
Accessibility (A11–A19)	A11 Ramps	1.84	1.52	1.63	2.81	1.71	1.90
	A12 Tactile paths	1.76	1.41	1.54	2.63	1.66	1.80
	A13 Disability seating	1.69	1.35	1.48	2.49	1.59	1.72
	A14 Restrooms	1.61	1.28	1.44	2.39	1.53	1.65
	A15 Child-friendly	1.92	1.61	1.74	2.81	1.75	1.97
	A16 Barrier-free access	1.70	1.39	1.52	2.61	1.61	1.77
	A17 Sensory info	1.58	1.28	1.41	2.44	1.48	1.64
	A18 Economic inclusion	1.98	1.67	1.82	2.92	1.78	2.03
	A19 Gender-sensitive	1.76	1.48	1.63	2.70	1.64	1.84
Ecological Comfort (EC1–EC8)	EC1 Shade	2.55	2.11	2.86	3.78	2.32	2.72
	EC2 Greenery	2.62	2.22	3.12	4.06	2.48	2.90
	EC3 Noise	2.36	1.96	2.48	3.16	2.10	2.41
	EC4 Air quality	2.28	1.92	2.61	3.18	2.18	2.43
	EC5 Lighting	2.41	1.88	2.53	3.31	2.11	2.45
	EC6 Water features	2.84	2.38	2.97	3.89	2.69	2.95
	EC7 Drainage	2.62	2.14	2.76	3.54	2.35	2.68
	EC8 Biodiversity	2.66	2.21	2.87	3.66	2.46	2.77
Socio-Cultural Vitality (SCV1–SCV9)	SCV1 Social interaction	2.68	2.32	3.06	3.81	2.51	2.88
	SCV2 Cultural events	2.56	2.18	2.94	3.72	2.40	2.76
	SCV3 Daytime safety	2.74	2.36	3.18	3.92	2.58	2.96
	SCV4 Night safety	2.34	1.93	2.61	3.34	2.12	2.47
	SCV5 Cultural identity	2.82	2.40	2.24	4.02	2.62	3.02
	SCV6 Informal economy	2.46	2.06	2.72	3.41	2.22	2.57
	SCV7 Women's safety	2.18	1.78	2.28	3.01	1.97	2.24
	SCV8 Belonging	2.62	2.16	2.93	3.71	2.36	2.76
	SCV9 Diversity	2.72	2.22	2.96	3.79	2.49	2.84

Note: Scores range from 1 (very poor) to 5 (excellent). Overall mean is the average across 5 sites.

Figure 9 Typology-specific design priority matrix displaying mean gap scores (Performance - Importance) for all four evaluation dimensions across the five study sites.

8. THE VALIDATED FRAMEWORK: STRUCTURE AND APPLICATION

The empirical results confirm and strengthen the four-stage assessment model suggested for the evaluation of the urban public space in Delhi and other similar metropolitan cities in India. The framework is intended to be usable by urban local bodies, design professionals and community organizations, with technical infrastructure beyond that of the typical GIS and survey capacity. The initial stage involves site profiling and typological classification.

Figure 10

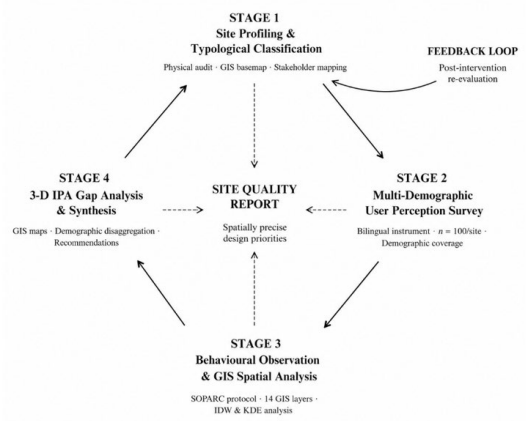

Figure 10 Four-stage validated framework for perception-based evaluation of urban public spaces, developed and empirically tested across five typologically distinct sites in Delhi.

Stage 1: Site Profiling and Typological Classification

The first stage is "site profiling and typological classification". Set the contextual baseline by conducting a physical site audit (based on the Universal Design Compliance Checklist found in Appendix C), spatial mapping, typological classification and identification of stakeholders. GIS base mapping is recommended as a basis for subsequent spatial analysis, with geophysical features.

Stage 2: Multi-Demographic User Perception Survey

Conduct validated 38-item questionnaire (Appendix A) to a demographically representative sample of at least 100 users per site, purposively oversampling women, elderly, and lower income users as well as differently abled users. Indian cities are recommended to be administered in bilingual (Hindi and regional language).

Stage 3: Behavioral Observation and GIS Spatial Analysis

Simultaneously conduct SOPARC-adapted behavioral observation (Appendix D) during the survey period. Run spatial analysis in GIS based on 10-layer register (Appendix E) to generate activity heatmaps and spatial correlation between physical attributes and perception scores.

Stage 4: 3-D IPA Gap Analysis and Site Quality Report

Use the IPA model to determine the critical priorities (attributes in Quadrant 2) at site-wide and demographic subgroup levels. Break down by typology to create typology specific design recommendations. Create a Site Quality Report that integrates the results into a spatially accurate, actionable report for planners and policymakers.

9. CONCLUSIONS

The study has designed and empirically tested an evaluation framework for urban public spaces based on multi-dimensional perception, which was then applied on five typologically different urban public spaces in Delhi (Sarojini Nagar Market, Rajiv Chowk, Mehrauli Archaeological Park, Lodhi Garden and Connaught Place), with the help of 500 responses from users, systematic behavioral observation and GIS based spatial analysis. The results show that there are important and consistent gaps in Accessibility and Inclusivity, Ecological Comfort, and there is significant variation in Spatial Quality and Socio-Cultural Vitality across the sites that requires typology-specific solutions. The key contributions

of the study are: (a) A validated four-dimensional assessment framework calibrated for the city of Delhi and applicable to other metropolitan cities in India; (b) For the first time, a dataset of user perceptions of public space, which utilizes multi- typology, comparative, and IPA-based assessments; (c) Empirical findings of systemic gender safety and disability accessibility failures across the most prominent public spaces in the city of Delhi; and (d) typology-specific design recommendations based on user centred evidence, not supply-side assumptions. These contributions have direct relevance with regard to the Delhi Master Plan 2041, Smart Cities Mission, AMRUT 2.0, and implementation of SDG 11 targets for inclusive, safe and sustainable cities. Research could be further extended by including a larger range of public spaces in the city of Delhi and other major cities in India, and further explore the ways in which longitudinal user feedback systems, such as mobile apps and participatory GIS, could be introduced to allow for continuous, adaptive public space management to respond to evolving user needs.

CONFLICT OF INTERESTS

None.

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None.

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