URBAN SPACE PLANNING
FOR SUSTAINABLE HIGH DENSITY ENVIRONMENTS

RESEARCH PREMISE

The most apparent relationship between urban space and high density is that once density increases space becomes a precious commodity, highly contested and charged with multi-faceted tensions and negotiations occurring between its diverse users and agencies. With the rapid transformations and increased spatial, programmatic and human densification, intensification and hybridization of contemporary urban environments globally, a paradigm of designing more environmentally and socially sustainable environments became an imperative.

Thus, one of the main challenges for dense urban environments would be how to create (and re-create) good urban spaces with the ability to accommodate and respond to diverse, dense, intense and dynamic urban conditions and, thus, foster ecologically and socially sustainable urban development. Consequently, the ways we understand, analyse, design, re-design and utilise urban spaces are once again challenged and require both quantitative and qualitative re-conceptualisations.

Rather than favouring high-density urban conditions, this project challenges the limits of such development up to which the performance and vitality of urban space would remain satisfactory or even improved. This study explores the ways as to how to assure holistic approach to environmental, social and economic sustainability, while not losing one for the other in the process of development, with the reference to specific contexts.

RESEARCH SCOPE AND OBJECTIVES

More precisely, the research scope involves developing an instrument to systematically evaluate and analyse urban space characteristics and performances in high density environments with an aim to guide the decision making, and urban space planning and design processes.

Accordingly, the main research objectives are:
- to recommend parameters for new urban public spaces in local conditions within the context of high density developments;
- to develop design configurations and combinations of design parameters for specific urban space typologies and densities; and
- to develop a tool that would be used to guide the planning and design of a range of urban space configurations to enhance the living and working environment for increased social and community interaction within high density environments.

RESEARCH FRAMEWORK

Drawing from the urban design theories and practices related to sustainability and urban space in high-density environments, as well as the available guidelines for analysing, evaluating and designing liveable and high-quality public spaces, an original and holistic Urban Space Framework was developed.

Urban Space Framework recognises hardware (design value), software (use and social value) and orgware (management and operational value) as three major components that influence and shape urban space performance (Fig. 1).
The framework consists of Classification and Evaluation Systems, which are descriptive mechanisms used to identify key attributes of urban spaces, categorise them and assess their overall performances.

RESEARCH APPROACH AND METHODS

The approach employed is cyclic, non-linear, dynamic and self-investigative. Sub-phases of research were continuously repeated to test and refine the initial framework (Fig. 2).

The research was carried out in two major stages: the primary stage – qualitative study and the additional stage – quantitative study. Research deliverables combine the findings of both phases of investigation.

Primary Stage: Qualitative Study

Qualitative study involved gathering and analysing qualitative and descriptive data, through observations on site and additional comprehensive review of secondary sources. It was carried out in five parallel and/or repetitive sub-phases.

- In phase 1, a total of 53 local (Singaporean) and international case studies of urban spaces in high-density contexts have been selected and documented.

- Phase 2 consisted of extensive literature review of relevant urban theory and research, based on which an original conceptual research framework - Urban Space Framework has been developed.

- In phase 3, the Research Instrument has been established, consisting of the Classification and Evaluation Systems, as well as the scoring system with circular charts to represent the urban space performance.

Classification System

Classification system establishes ways to categorise urban spaces. It consists of a number of descriptors and tags that have neither positive nor negative value. Based on primary use of urban space, five default urban space typologies are created, namely: urban spaces in residential areas, recreational spaces, urban centres, mixed-use developments and infrastructural transit-led spaces. Moreover, the classification system offers flexible means to categorise urban spaces into secondary and hybrid typologies.

Evaluation System

Evaluation System consists of evaluators (47) and criteria (94) that have two-faceted role - to describe and positively evaluate urban spaces. Evaluators are grouped into 13 main attributes, namely: pedestrian accessibility, connectivity, mobility means, legibility and edges, spatial variety, environmentally friendly design and user comfort (hardware); diversity and intensity of use, social activities, identity (software); and provisions, safety and management and regulations (orgware).

Finally, a Scoring System and Circular Urban Space Value Charts (Fig. 3) are devised to ease visual communication, assessment, comparison and identification of strengths and weakness of a particular urban space. The circular charts consist of three segments with respect to key urban space components: hardware, software and orgware. Segments are divided into stripes, each representing one criterion. Coloured stripes represent criteria that are met by the investigated urban space and the sum of all coloured stripes creates the overall Urban Space Value. In such a way, the Urban Space Value diagrams enable general and specific comparisons across all case studies, while highlighting the strengths and weakness of the space evaluated and thus suggesting areas for improvement in a straightforward manner.
Phase 4 involved identifying the hierarchy of criteria for specific urban space typologies using statistical consistency analysis. Hierarchy of Criteria establishes criteria that are ‘Basic/Necessary’, ‘Value Add’, ‘High Value Add’, ‘Good to Have’ and ‘Desired’ for each urban space type/condition. Being an instrument to highlight criteria that are critical for urban space performance, while prioritising the design actions for particular urban space enhancement, hierarchy of criteria helps in decision making in various stages of design process. The main focus of analysis is on ‘Basic’ and ‘High Value Add’ criteria, which are recognised as either the most feasible to meet or having the highest corrective potentials to improve the overall urban space performance respectively. In other words, the Hierarchy of Criteria prompts the designer to fulfil ‘basic’ and ‘high value add criteria’ first, rather than focusing on meeting ‘desired’ criteria, which are most difficult to achieve.

Finally, in phase 5, as synthesis of the initial comparative analysis, an interactive computational Tool for Urban Space Analysis (TUSA) has been conceptualised to facilitate cataloguing, classifying, assessing, comparing and speculating on hybrid urban space typologies and their performances.

Additional Stage: Quantitative Study
In addition to primary qualitative research, quantitative data analysis was conducted in order to further test and refine the research framework, improve TUSA, as well as to strengthen the interpretations and design recommendations in terms of quantitative design measures. The analysis of quantitative data gathered and/or calculated consists of two main phases, namely: Mean and Standard Deviation statistical analysis and Linear Regression (correlation) analysis. By combining the two methods, a benchmarking mechanism and reference to design measures are proposed.

SYNTHESIS OF THE KEY FINDINGS
Urban space performance is a result of dynamic and synergetic interactions between three key components, namely: hardware (design values), software (use and socio-perceptual values) and orgware (operational values). Integrated qualitative and quantitative findings of this research reveal numerous positive and, sometimes, negative, or rather conflicting, correlations between certain design measures and criteria related to key components. Key findings indicate six critical aspects in designing quality urban spaces and their correlations to other hardware, software and orgware performances and measures, for which qualitative design principles and quantitative design measures are recommended. They are:

- **Scale and Built Density** (hardware);
- **Accessibility** (hardware + orgware);
- **Programme** (software + orgware);
- **Landscape** (hardware);
- **Shade** (hardware);
- **Seating** (software).

The design principles and recommendations apply globally, with exceptions of those related to shade and seating, which are measured and tailored specifically for the local Singaporean context.

SCALE AND BUILT DENSITY

![Fig. 4: Public space in large-scale high-density developments; Jianwei SOHO, Beijing, China (left); Pinnacle@Duxton, Singapore (right)](image)

Scale and built density are the major factors that shape the emerging complex and hybrid urban space configurations. Besides provision of open space, elevation, level of enclosure and porosity, shade conditions, pedestrian access and provision of amenities are some spatial characteristics that are directly and substantially affected by the scale and density of the development. Key qualitative and quantitative results do not reveal many direct strong correlations between scales, built densities and urban space performance. Yet some valuable conclusions can be made:
In general, the larger the urban spaces, the better they are designed.

Higher built density in extra-large scale residential areas seems to positively affect hardware performance.

Larger local urban spaces lack in shading means. Within the sample of 27 local case studies, by increasing the floor area of usable urban space, the percentage of shaded area during the noon time decreases. Such shade is not casted by the surrounding buildings, but the additional means, canopies and tall trees.

ACCESSIBILITY

Accessibility is considered one of the most important components of good urban form and, together with connectivity, it is a prerequisite for a space to function well, as it frames the interaction between space and its surroundings and between users and space. As such, accessibility considerably affects socio-perceptual and operational performances of urban space. When designing for good pedestrian accessibility one should consider: physical access (both formal and informal, horizontal and vertical), visual access (porosity), universal access (Fig. 5), diversity of access, interconnectivity and legibility, security measures, regulation strategies, time management and access to free or affordable facilities (including entrance fee). While urban space should ideally be accessible by all means of transportation, including vehicular, design that fosters walking, cycling and use of public transport should be prioritised.

PROGRAMME

Activities and events are crucial elements of good public spaces that promote use, human contact and social activities. The quality of design is crucial for quality and intensity of activities occurring in urban spaces. Findings reveal qualitative and quantitative aspects of space performance, namely: provision of activities within and around urban space, diversity and intensity of activities and users, including formal and informal, passive and active, short-term and long-term, regular and occasional activities (Figs. 6, 7, 8). These are closely related to programme and time management and regulations, safety and surveillance, spatial flexibility and adaptability, interactivity, connectivity, provision of services and amenities, community participation and social inclusion.

LANDSCAPING – GREENERY AND WATER FEATURES

Good landscaping improves all components of urban space performance. Critical aspects include: provision of greenery and water as part of environmental strategy to improve microclimate conditions (shade) and support biodiversity, access to green and water features to
programming that positively correlate to urban foster interaction and community bonding (Fig. 9), diversity of greenery forms and patterns to enhance spatial variety and identity. The size of softscape area, provision of trees and spatial adaptability seem to particularly improve orgware performance of urban space.

SHADE

Sufficient shade is one of the most important conditions for successful urban public spaces, which is often neglected by designers and planners. Designing for good shade and weather protection is particularly important in the local Singaporean context due to its tropical climate characterised by high air temperature, high sun exposure, and high humidity and rainfall levels.

Fig. 9: Interaction with greenery and water elements; Punggol Central, Singapore (left); Skypark at VivoCity, Singapore (right)

Shade contributes to comfort, use and socio-perceptual performance of urban space. Provision of covered walkways, and larger covered area (Fig. 10), 'hard' and 'soft' shading means and flexible and adjustable shading means (Fig. 11) considerably affect longer dwelling, social interaction, boost sense of control and ownership, as well as foster development of community.

Fig. 10: Covered walkways and larger covered areas; The Place, Beijing, China (left); Skypark at VivoCity, Singapore (right)

Fig. 11: Flexible shading means; Times Square, New York, USA (left); Albert Mall, Singapore (right)

SEATING

Seating considerably improves socio-perceptual performance (software) of urban space. These aspects particularly include seating provision, capacity and type (Figs. 12 and 13), as indicated through quantitative analysis. Apart from these, qualitative analysis showed particular importance of informal seating (Fig. 14), seating arrangements and conditions for creation of interactive, adaptable, safe, comfortable and memorable social spaces.

Fig. 12: Diversity of seating types, arrangements and conditions; Raffles Place Park, Singapore

Fig. 13: Diversity of seating types (laying, flexible seating and amphitheater); Highline Park, New York, USA

Fig. 14: Informal seating; ION Orchard, Singapore (left); Bryant Park, New York, USA (right)
**SPECIFIC RESEARCH DELIVERABLES**

**Tool for Urban Space Analysis (TUSA)**
The team has developed TUSA (Tool for Urban Space Analysis), an integrated computational application with capacities to catalogue, classify, evaluate, analyse and speculate on hybrid and complex urban space typologies and their performances (Fig. 15). As such, TUSA provides means of guiding various stages of design process, including: design brief development, pre-evaluation of design proposals, post-evaluation and strategic intervention, benchmarking and speculation, with reference to digital library of best practice case studies. TUSA is primarily based on qualitative and descriptive assessment of urban spaces, fully reflecting the research process employed in this study. It has also been developed from the start to be flexible and to accommodate changes in the future.

![Fig. 15: Snapshot of TUSA](image)

**Urban Space Guideline**
Urban Space Guideline proposes a set of qualitative and quantitative actions and design measures to improve the performance of urban spaces of particular typologies or in specific high density conditions (Fig. 16). The Guideline should be used as a reference to design recommendations, rather than prescriptions.

**Urban Spaces Catalogue**
Urban Spaces Catalogue (Fig. 17) summarises key information about each documented urban space, including: classification (typology), quantitative measures (size, density measures, etc.), maps (spatial analysis), photographs, performance charts (evaluation), and textual information, including comprehensive information from site observation and secondary sources, with the section commenting on lessons learned through this investigation (“Strengths and Weaknesses” for local and “How Does It Fit to Singapore?” for international spaces).

![Fig. 16: An excerpt from Urban Space Guideline](image)

![Fig. 17: An excerpt from Urban Space Catalogue](image)

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