URBAN SPACE DESIGN IN HIGH-DENSITY CONTEXTS: PLANNING FOR SUSTAINABLE FUTURE

Zdravko Trivic [1] & Im Sik Cho [2]

Abstract

In the context of rapid urbanisation, increasing density and hybrid conditions, as well as global competitiveness in planning more iconic, yet more sustainable, more environmentally-friendly and healthier cities, the ways urban spaces are traditionally understood and designed are challenged and need to be reconceptualised both quantitatively and qualitatively. Once densities increase urban public space becomes a precious commodity, whose design and performance attributes are yet to be explored in order to fully respond to new citizens' needs and life standards.

In this paper we investigate emerging hybrid urban space typologies and their potential roles in improving conditions of high-density settings and turning them into more vibrant environmentally and socially sustainable spaces. Our main focus is on identifying critical parameters for new urban public space configurations within high-density conditions and led by holistic vision for sustainable urban future. In this paper we outline a tool that would be used to gather, classify, evaluate, analyse, speculate and guide design and planning of urban spaces, and thus ease policy and decision making processes in the context of highly dense Singapore. Drawing from the research by Gehl (1996, 2001, 2010), Carmona (2003), and Shaftoe (2008), among others, a conceptual research framework is developed. The framework recognises three key components that constitute the properties and performances of urban spaces, combining design, use and operational aspects, namely: hardware, software and orgware. As such, it is used as a basis for classifying and evaluating existing urban spaces, as well as speculating on how to generate new hybrid urban space typologies and conditions in high-density contexts. The framework challenges static and prescribed typologies, by proposing sets of positive descriptive and evaluative attributes and criteria that can be combined and compared across different typologies in order to create better urban spaces in high-density contexts.

The research method consists of three major parts, namely: (1) documentation of case studies and literature review, (2) development of classification and evaluation systems for selected cases, and (3) comparative analysis. A total of 48 local (Singaporean) and international cases in high-density contexts, including those from Beijing, Hong Kong, Tokyo, Osaka and New York, are documented, using structured first-person observational techniques, as well as on-site mapping, photography,

[1] Centre for Sustainable Asian Cities (CSAC), National University of Singapore - sdezt@nus.edu.sg
[2] Department of Architecture, School of Design and Environment, National University of Singapore & Principal Investigator, Centre for Sustainable Asian Cities (CSAC), National University of Singapore - akicis@nus.edu.sg

interviewing and secondary sources review. A structured observational checklist - consisting of a number of descriptors and evaluators grouped into five urban space values, namely: nodal, spatial, environmental, use & socio-perceptual and operational value - is used. Selected spaces range from small-scale to large-scale developments, from relatively homogeneous (such as residential) to highly heterogeneous hybrid complexes (such as infrastructural and commercial).

This paper will discuss key findings of comparative analysis, highlighting critical attributes for the performance of particular spatial configurations, as well as their inter-relationships. Additionally, the recommendations of design measures to improve urban spaces in local and international high-density contexts will be proposed. While drawing from existing recent tendencies and transformations in urban space development, this paper aims to trace future trajectories and identify the role of urban space and urban design in future sustainable development.

1. Introduction – High-Density Environment, Urban Space and Sustainability

Due to the rise of urban development and urban population the demands for more environmentally and socially sustainable planning and design are emphasised globally. More than a half of the world's population today live in cities, of which 27% are 19 mega-cities, and 11 of which are located in Asia (Keiner, 2005). Over the last three decades Asian countries experienced the most dramatic urban transformations, which is comparable to what the western world experienced over the last two centuries. From 1900 to 2000, the world's population increased from 220 million to 2.84 billion. It has also been estimated that between 2000 and 2030, Asia's urban population will increase from 1.36 billion to 2.64 billion.[3]

However, in contemporary urban planning and design research and practice, there is a considerable agreement that higher density, compact city and "high intensity urbanism" are desirable and more sustainable urban development strategies (Sabaté Bel, 2011; Chan and Lee, 2007). Such a favourable understanding of high-density conditions is, however, relatively recent. Negative experiences in the nineteenth century's industrial cities, when high concentration of people was associated with poor hygiene, diseases, fire hazards and deaths, led to favouring of low-density urban development. Such a discouragement of high-density urban development has also been justified by sociological and psychological research, which suggested that increasing urban density causes greater physiological and psychological stress, social disorder (increasing violence, crime, suicide rate, and drug addiction), ill health conditions and violation of personal space (Newman and Hogan, 1981). However, such a trend resulted in a number of problems driven by overconsumption of resources, some of which are higher energy consumption, car dependence and higher travelling costs, long daily travelling distances and higher infrastructure costs, as

[3] On the other hand, in spite of such urban population explosion trends, Hidetoshi Ohno (2012) estimates that the cities after 2050 would experience depopulation, especially those in Asian countries with ageing and declining populations.

well as social problems in often ghettoised suburban areas. On the other hand, benefits of higher density and higher intensity may be multiple, yet it is evident that the density of urban environment is not the only and sufficient measure of the good performance, sustainability and quality of urban living.

The majority of over 70 definitions of sustainability see economy, environment and social equity as its primary and interdependent components (Boyko et al., 2005). Most common definition describes sustainability as “a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (WCED, 1990). Although sustainability paradigm has recently become mainstream concept in urban planning and architectural research and practice, such research has so far been of relatively poor quality (Mostafavi, 2010). Most of the sustainable practices and mechanisms are being spread globally without taking into consideration the specificities of the particular contexts, which led to a certain level of skepticism towards the concept of sustainability. Moreover, sustainability is often superficially equated to mere technological capabilities and energy performance measured quantitatively, focusing on either (super-)micro-scale of individual buildings or (super-)macro-scale of cities and regions.

As a result, the role and potentials of micro-scale urban spaces, including existing redefining and emerging new hybrid urban developments in high-density contexts have not been fully explored. Yet, the expectations of urban space are high, demanding for such spaces that would be able to accommodate the emerging diverse, dense, intense and flexible conditions. These recent demands brought new interest in urban design as one of the key means for achieving environmental, social and economical sustainability of contemporary cities.[4]

In this research, urban space is seen as a means with potentials to successfully bridge the gap between the micro-scale of individual buildings and the macro-scale of a city and contribute to the overall sustainable living. Furthermore, we understand spatial density as inseparable from intensity of activities and users, as well as in more subjective and experiential terms. Such an approach goes in line with Uytenhaak’s (2008) interpretation of density, which states that density refers to higher diversity and intensity, coming from mutual proximity of urban activities, urban dynamism, efficient land use and ways buildings are arranged and related to one another. It is also supported by research in contemporary urban ecology showing that human perception of urban density defers from the scientific one; it is rather subjective and shaped by particular context (Cheng and Steemers, 2010). Density is indeed more frequently perceived in relation to legibility, intensity of use and information available in space (mess versus order), rather than in terms of spatial density indexes, such as Floor Area Ratio, Gross Density or Weighted Density, among others.

[4] Such a recent shift in understanding the role of urban design in sustainable urban development, that goes beyond beautifying public spaces, Madanipour (2006) calls “new urban revolution”.

According to Gehl (2010), it is only when people, buildings and other objects are in close proximity (within 7 meters) that people can fully use all of their senses, see and experience all details, as well as exchange the most intense feelings. However, this research does not *a priori* favour high-density and hybrid conditions. It rather attempts to respond to challenges that such conditions pose on urban development and urban living today, as well as to investigate the role and capabilities of urban spaces to foster social and environmental sustainability within high-density contexts.

2. Background – Urban Space and Hybrid Environments

As a result of new attention that has recently been given to urban design and role of public space in sustainable development, a number of concepts, tools, guidelines and methodologies have been developed to better understand, evaluate and design urban open spaces (Gehl, 1996, 2004, 2007, 2010; Gehl and Gemzoe, 2001, 2004; Carmona et al., 2003; Project for Public Spaces, 2008; Chan and Lee, 2007; DETR, 2000; Uytenhaak, 2008, etc.). A plethora of measurable and intangible attributes have been identified that shape the performance of an urban space, such as connectivity, accessibility, legibility, user density, demography, space identity, safety and amenities, many of which are interlinked and interdependent. However, the majority of past and contemporary research has been predominantly focused on familiar models of urban space, such as squares, plazas, streets, parks and arcades, without consistent and definite rules in what constitutes good urban space, nonetheless what constitutes good urban space in high-density context.

The ease in which the term 'public space' is commonly used sharply contrasts its growing complexity, including typology, use, ownership and management aspects. Public space is typically defined as an accessible space for all citizens regardless of age, gender, race, ethnicity or socio-economic status with free circulations of people and goods (Carmona et al., 2003; Shaftoe, 2008). It is also described as a space of debate and negotiation, a symbol of democracy and sociability. However, recent critiques also tend to somewhat idealise the notion of public space, emphasising on traditional and nostalgic dialectics which oppose private and public, true and false publicness, space and place, aesthetics and ethics. Major debates revolve around the loss of public space primarily due to commodification and intrusion of private market into the realm of public culture. Accordingly, emerging hybrid urban spaces are characterised as 'quasi-public' (Dovey, 1999, 2010; Pimlott, 2008-9) or even 'non-places' since they have no roots in tradition, history and culture (Augé, 1995). Such a traditional attitude towards the public realm seems to be somewhat problematic and insufficient for understanding the contemporary contexts of emerging new hybrid urbanities and modes of publicness.

As a consequence, we still know too little about the expanding and increasingly hybrid urban space typologies in highly dense contexts emerging today. Instead of adopting classical definitions of public space we use the term 'urban space' which takes into account emerging types of spaces that may not be publicly owned or managed yet increasingly act as public. Such an understanding is closer to the notion of 'collective space', suggested by Spanish architect Manuel de Solà-Morales (1992), where different groups coexist and interact on a competitive basis. For de Solà-Morales, the richness of a contemporary city at the end of the twentieth century should be found in the collective spaces, which are neither public nor private, but rather both simultaneously. They include both public spaces used for private activities and private spaces that allow for collective use. Collective space tends to be more social in nature rather than political, with interactions occurring on experiential rather than communicational level, and as such it is more comparable to the marketplace than to the Greek agora.

Madanipour (2003, 2006) also notes that as much as the private realm influences public, the society is also the realm of the private, pointing out that there is no clear cut separation between public and private. Publicness depends on how people characterise the private, and thus there are many shades of publicity and privacy creating a fluctuating, often tense, semi-public-private or 'neo-public' continuum (Dimmer, Golani Solomon and Klinkers, 2006; ZUS, 2006; Nielsen, 2004). Van Alen Institute's exhibition "OPEN: New Designs for Public Space" held in New York in 2003 well showcased this recent trend of hybrid urban space development across the world, exploring their typological, morphological, infrastructural, programmatic and operational complexities (Gastil and Ryan, 2004).

A number of such recent hybrid developments are investigated in this study. Yet the perennial question remains: can good public space deliberately be created and how? With increasing density and hybrid urban transformations, the ways we traditionally understand, conceptualise, plan, design, re-design and utilise urban space in high-density environment need to be revisited and reconceptualised both quantitatively and qualitatively. Once densities increase space (of any form) becomes a precious commodity, charged with intense competitions, tensions and negotiations between the diverse groups of users over it. Thus, uncovering new ways to create good urban spaces that would fit well in dense urban conditions yet are vibrant and environmentally and socially sustainable would be the main challenge.

3. Objectives

The existing literature and research offers no specific values and criteria that are purposely tailored for high-density environments. The scope of this research includes discerning the relationship between density and quality of urban public spaces based on key criteria that affect the space and their inherent relationship with each other.

The main objectives of this paper are thus: to outline new urban space framework and recommend parameters for emerging new types of urban spaces within the local (Singaporean) and international contexts of high density developments; to discuss key initial findings of comparative analysis, highlighting critical attributes for the performance of particular spatial configurations in high-density contexts, and to propose a tool that would be used to gather, classify, evaluate, analyse, speculate and guide design and planning of urban spaces, and thus ease policy and decision making processes in the context of highly dense and sustainable Singapore.

4. Research Methods and Analysis

The research approach employed in this project is cyclic, non-linear, dynamic and self-investigative. The research process was carried out in three repetitive phases:

(1) Literature Review and Documentation of Case Studies – A number of local (Singaporean) and international case studies of urban spaces have been selected and documented using on-site observational and mapping techniques.

(2) Classification and Evaluation System Development – Based on literature review, a conceptual framework has been developed recognising hardware (design), software (use) and orgware (management) as major conceptual components that shape urban space performance. The framework consists of classification and evaluation systems based on a number of urban space descriptors and evaluators to categorise and evaluate selected urban space typologies, as well as a scoring system and circular chart to visually represent their performances.

(3) Comparative Analysis and Evaluation System Refinement – Comparative analysis of urban space performances primarily involves identifying critical criteria for specific spatial typologies using matching analysis. As synthesis of initial comparative analysis an interactive computational Tool for Urban Space Analysis (TUSA) has been conceptualised, with capabilities to catalogue, classify, evaluate, compare and speculate on hybrid urban space typologies and their performances, by filtering the critical attributes/criteria and design measures, and in such a way guide the initial stage of design process. In order to preserve the objectivity and clarity of proposed criteria, the framework has been tested and refined several times, based on on-site evaluation and comments reported by collaborating teams of architects, urban designers, planners and project managers.

4.1. Documentation of Case Studies

A total of 48 local (Singaporean) and international case studies in high-density contexts, including those from Beijing, Hong Kong, Tokyo, Osaka and New York, have been selected and documented. In selecting the case studies, spaces that are hybrid in form and programme or dense in terms of both spatial density and intensity of use have been prioritised. Case studies range from well-known recreational and residential public spaces to emerging highly hybrid developments and infrastructural spaces. Some of them include: intensified residential developments (such as Shinonome Codan Court in Tokyo; Linked Hybrid and Jianwai Soho in Beijing, etc.), commercial developments (Midtown Tokyo and Roppongi Hills in Tokyo; Sanlitun in Beijing), multi-functional infrastructural spaces (such as railway stations in Tokyo and Osaka) and elevated public spaces (High Line Park in New York; Central Mid-Levels Escalator in Hong Kong; roof-top parks at Pinnacle @ Duxton and Skypark @ Vivocity, Hendeson Wave bridge in Singapore) (Figures 1 and 2).

Figure 1. Hybrid Developments: Shinonome Codan Court, Tokyo, Japan [left], Midtown Tokyo, Japan [middle], Sanlitun, Beijing, China [right]

Figure 2. Elevated Public Spaces: Henderson Wave, Singapore [left], Pinnacle @ Duxton, Singapore [middle and right]

Documentation of each case study was primarily based on structured first-person observational techniques. It involved on-site recording of spatial typologies and features and intensities of uses through mapping, photography and interviewing as well as comprehensive secondary sources review of the design parameters and planning policies, including measures to enhance sustainability capabilities of the larger urban environment, that were difficult to observe on site. (Figures 3 and 4)

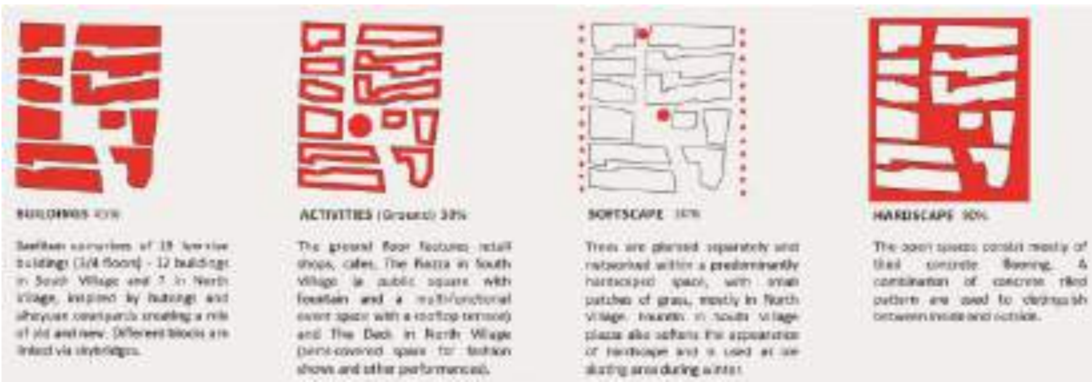

Figure 3. Initial Mapping: Sanlitun, Beijing, China

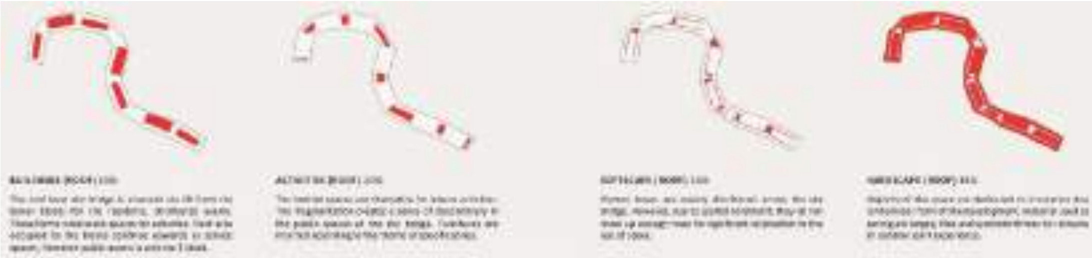

Figure 4. Initial Mapping: Pinnacle @ Duxton, Singapore

Rather than evaluating each selected urban space and recommending design measures to improve its performance, case studies primarily served as a means to test and further refine the research tool, which is the main objective of this project. Such a cycle has been repeated several times, ending with the original urban space framework.

4.2 Research Framework - Classification and Evaluation Systems

Drawing from literature review a conceptual research framework is developed, which recognises three key components that constitute the properties and performances of urban spaces, combining design, use and operational aspects, namely: hardware, software and orgware (Figure 5).

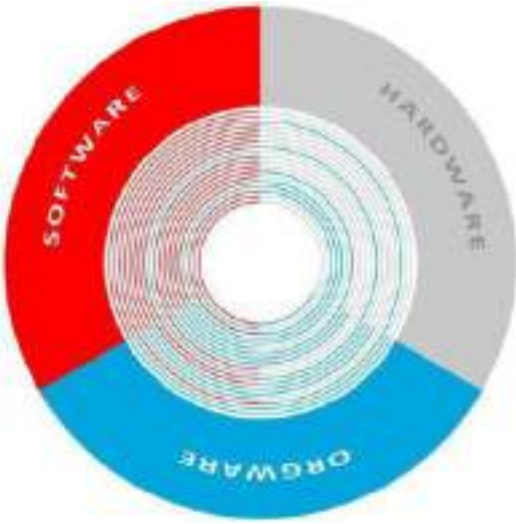

Figure 5. Urban Space Conceptual Framework: Hardware, Software & Orgware

HARDware component refers to physical and geometrical properties of space - design values, such as spatial quality, environmental design, accessibility and users' comfort. SOFTware combines activities, as well as socio-perceptual values of space, such as social interaction, character of space and diversity of uses and users. ORGware refers to operational and management aspects of public space, such as supporting services, security and regulations.

While there is a clear cut between hardware and software components, orgware in certain aspects, such as seating amenities or environmentally friendly strategies, overlaps with both hardware and software. As such, it links the two aspects focusing on how the spaces operate and perform. The research framework consists of Classification and Evaluation Systems.

Classification System

Classification System consists of a number of descriptors and tags that have neither intrinsic positive nor negative value. Their role is to describe urban spaces and classify them into key, secondary and hybrid typologies; to set the basis for in-depth qualitative analysis and comparison between spaces and their components; and to speculate on new hybrid typologies and their properties. All descriptors with their belonging tags are grouped according to hardware, software and orgware categories, some of which are: spatial density indexes, scale, elevation, enclosure (hardware), primary and secondary activities, users' age and gender profiles, subcultures (software), climate context, role, influence, time regulations, and governance (orgware).

Classification system establishes 5 default typologies defined by primary uses of space, namely: residential, recreational, urban centres, integrated mixed developments and infrastructural transit-led spaces. The default sub-typologies are further defined based on forms of urban footprint, which refer to geometry and role of urban space in urban fabric, such as: housing precincts, squares, parks, streets, promenades or bridges (Figure 6).

While the main analysis involves default types of urban spaces, classification system also provides ways to establish secondary typologies and/or their hybrids by selecting descriptors other than primary use and urban footprint. As such, it defies static conventional typologies, in response to emerging more dynamic and transformative new hybrid urban spaces, and provides basis to speculate on new urban space properties and performances.

Figure 6. Default Classification of Urban Space Typologies and Sub-Typologies

Evaluation System

Evaluation System consists of sets of evaluators and criteria that have intrinsic positive value. Their role is two-faceted - to describe and positively evaluate urban spaces. Evaluative Framework is organized hierarchically and consists of: (1) key urban space components (hardware, software & orgware); (2) components consist of 5 urban values, namely: nodal, spatial, environmental, use and socio-perceptual and operational value; (3) each urban value consists of 2 or 3 attributes (13 in total); (4) attributes are further defined by 2-5 Evaluators (46 in total); finally, each evaluator has 2 positive criteria, which makes it 92 in total (Figure 7).

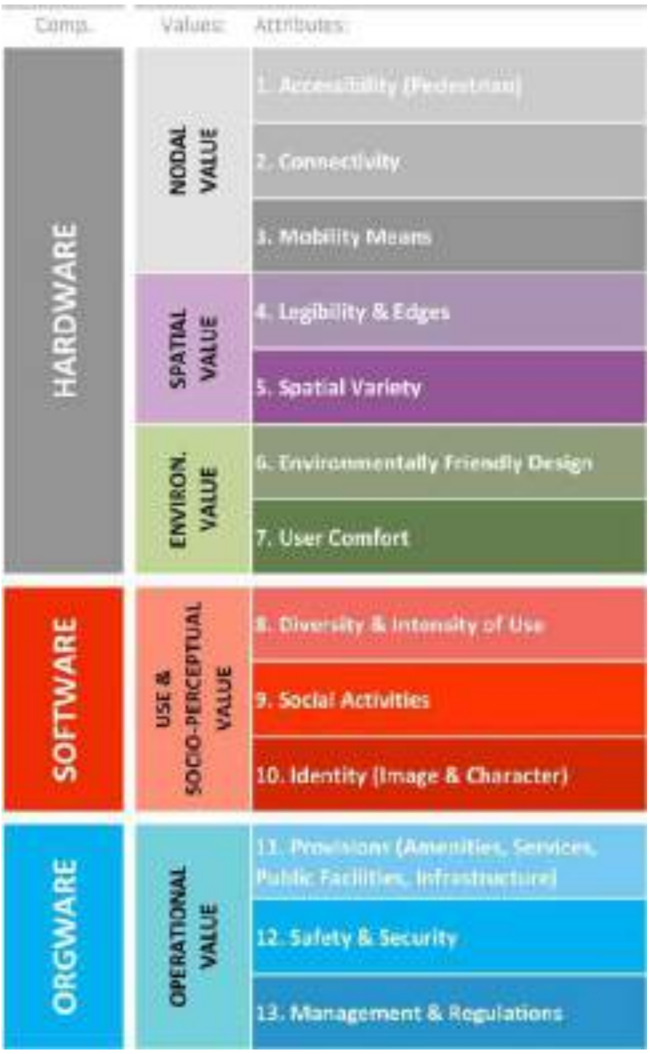

Figure 7. Evaluation Framework – Components, Values and Attributes

Some of the evaluators set by the evaluation system within hardware component are: physical accessibility, number and type of universal access, movement patterns, node connectivity, sightlines and wayfinding, cycling and public transport (nodal value); layout, landmarks, permeability, spatial variety and adaptability (spatial value); greenery and water features, bio-diversity, use of alternative energy, weather protection, shade and sunlight, air quality and noise control (environmental value). Software component and use and socio-perceptual value consist of: number and diversity of activities, number, type and condition of seating amenities, interactivity, privacy, imageability and space character. Some evaluators within orgware component and operational value are hygiene facilities, lighting and informational facilities, community services, safety and security, rules, regulations, and management.

Scoring System

Urban spaces are scored using structured evaluation check-list, which includes all criteria proposed in evaluation system. Space scores 0 if it fails to meet both positive criteria; it scores 1 if it meets one criterion; it scores 2 if it meets 2 criteria. Final scores are cumulative (sum of all met criteria) and form the overall Urban Space Value, which represents the overall performance of space shown in percentage. However, such an overall value is basic and serves for quick comparison only. Along with scoring, additional information on specific design measures that are used to meet particular criteria are also documented to provide the basis for design recommendations.

Circular Charts

To represent the evaluation process and urban space performances, a circular chart is crafted. It is an integrated device that can serve both as an evaluation sheet and a scoring chart. Circular chart is divided into three segments: hardware, software and orgware. The three segments are divided into stripes, each representing one criterion. Coloured stripes are criteria that are met by investigated space. Space’s overall performance corresponds to a percentage of coloured stripe area, which is also summarised by the size and percentage of the central black circle (Figure 8).

To enhance visual communication and comparison of space hardware, software and orgware qualitative performances, another circular pie-chart is also crafted. It consists of 2 circles. Outer circle shows performance of space (in %) for each urban space value component. Inner circle (pie chart) shows to what extent each of the components take part in creation of overall Urban Space Value (Figure 8).

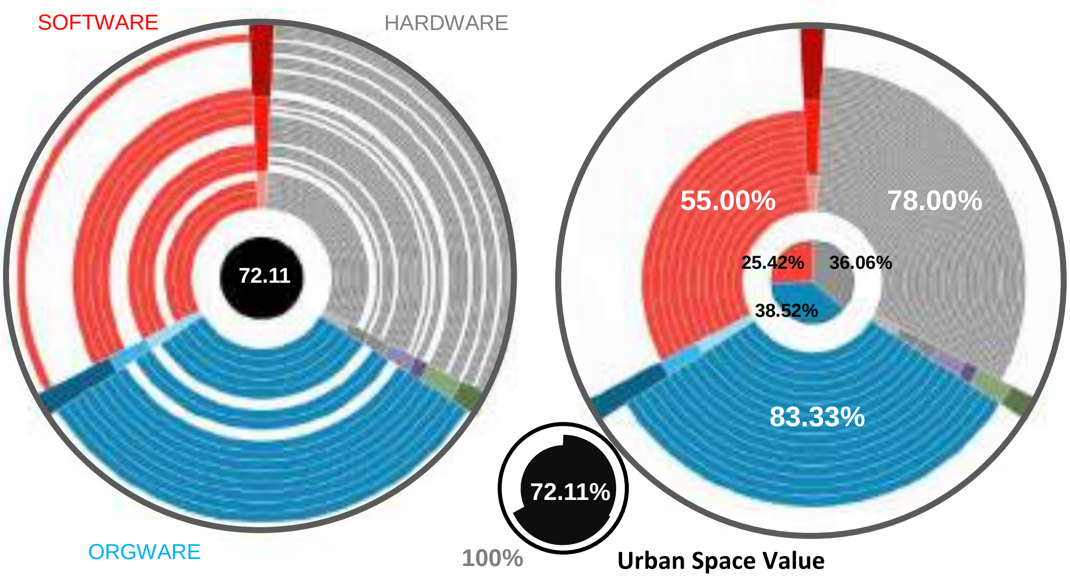

Figure 8. Examples of Circular Chart [left] and Circular Pie-Chart [right]

4.3 Comparative Analysis and Synthesis

After all selected spaces were classified and evaluated, a consistency or matching analysis has been conducted across all types of urban spaces in order to investigate the critical attributes that shape their performance. Based on such analysis a hierarchy of criteria has been established for each type of urban space. It recognises: basic, critical, desired and difficult sets of criteria.

The criteria most consistently met by all urban spaces of the same default type are considered basic or necessary criteria. Those criteria that are never met by all spaces of the same type are considered difficult criteria. Our main focus is on criteria that are most inconsistently met by the majority of spaces of the same default type. We assume that these criteria have the highest corrective factor in terms of overall space performance. The desired criteria are those which are inconsistently but often met by the majority of spaces of the same type. Accordingly, the recommendations for improvement rely primarily on critical and desired criteria, since they are the most feasible to meet by a particular type of urban space, rather than on difficult criteria.

While focusing on spaces that belong to the same default urban space typology, i.e. of the same primary uses, the matching analysis also involves spaces from other default typologies if their secondary uses correspond to that of investigated type of urban spaces. For example, when performing the analysis of primarily residential spaces, the analysis also involves spaces that are not primarily residential yet possess considerable residential activities closely linked to public spaces investigated.

5. Initial Findings – Areas for Improvement

The initial findings show that majority of investigated spaces score highest for hardware component, while software and orgware components seem to be generally weak and leave room for improvements. Yet hardware component can be the most feasibly achieved and thus the criteria belonging to design aspect also play an important role in recommending space improvements. Moreover, more hybrid environments in terms of both spatial complexity and programmes tend to gain higher scores in comparison to more spatially and programmatically homogeneous urban spaces.

Based on matching analysis and critical criteria the initial areas for improving urban space performance have been filtered for each default type of urban spaces. Schematic representation of findings across all default urban space typologies are shown in Figure 9.

Criteria and recommendations that have shown to be the most critical for most of the types of urban spaces are summarised below and illustrated drawing from good examples in data base of case studies. These examples are not limited to only one urban space typology, considering the assumption that with higher densities and intensified uses urban spaces would become more and more hybrid, less distinguishable and would have to provide more functions for a greater number of diverse user groups.

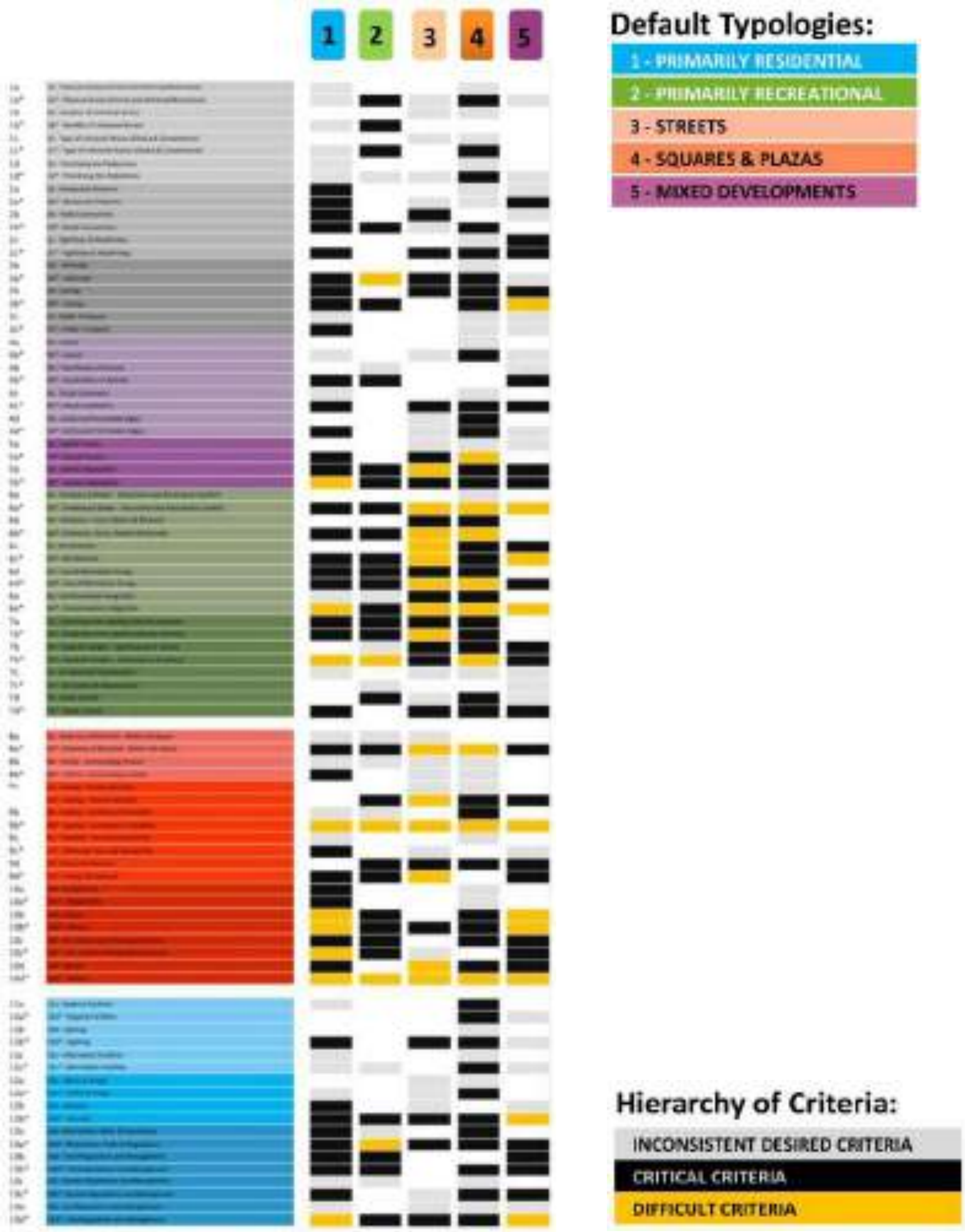

Figure 9. Critical Criteria across Different Default Urban Space Typologies

Spatial Adaptability (hardware)

One of the arias for improvement that has emerged from the analysis and applies to all types of urban spaces, is spatial adaptability within spatial value of hardware component, which refers to an ability of space to adjust to a number of different activities, to be flexible and dynamic in terms of both structure and functional programme in order to increase users' comfort and choice. The examples from New York and Tokyo include flexible and movable seating arrangements, adjustable means of shading and multi-functional spaces (Figure 10). Benefits of achieving structural and programmatic flexibility are multiple, ranging from increment of social interaction, sense of belonging and privacy to increased comfort level regardless the weather conditions, which all refer to strong links between hardware and software components.

Figure 10. Spatial Adaptability – flexible seating and multi-functional spaces: Times Square, NY, US [left], Bryant Park, NY, US [middle], Roppongi Hills, Tokyo, Japan [right]

Greenery and Water (hardware)

Another criterion critical for all default types of urban space is amount and diversity of greenery & water elements within environmentally friendly design attribute. Spaces that well integrate natural elements into physical environment provide better relationship and interaction with and within space, as well as means for users' participation, while also benefiting in better micro-climate, sensory comfort, healing environment, formal and informal community activities, and providing means for education on environmental awareness. Community gardens on the roof-top of Roppongi Hills in Tokyo and interactive water fountains are some of the good examples (Figure 11).

Figure 11. Greenery and Water – interactivity: Skypark @ Vivocity, Singapore [left], Pungol Central housing precinct, Singapore [middle], Roppongi Hills, Tokyo, Japan [right]

Image of Space (software)

Image of space is also critical attribute that seems to be important for the performance of all urban space typologies. Density is more frequently perceived on a subjective level, in terms of legibility, density of information and intensity of use (mess versus order), which can strongly contribute to character of urban space. The examples show ways to improve space character in reference to arts and culture, visual landmarks and interactivity, that have potential to incite creative use of space, users' participation, social interaction, environmental awareness, legibility and wayfinding (Figure 12).

Figure 12. Image of Space – arts and urban furniture: Sculpture Park, Singapore [left and middle], Roppongi Hills, Tokyo, Japan [right]

(Ambient) Lighting (orgware)

Finally, through better night signage and innovative use of self-producing or low-energy-consuming lighting, space may become more inviting and safe environment, with increased legibility and wayfinding, as well as more extensively used during night. This criterion is thus most critical for residential areas and urban centres. Also, this may be particularly interesting for the local context, since Singaporeans seem to use open spaces more intensively once the sun goes down, due to hot and humid tropical climate (Figure 13).

Figure 13. Ambient Lighting: Shinonome Codan Court, Tokyo, Japan [left and middle], Skypark @ Vivocity, Singapore [right]

6. Tool for Urban Space Analysis (TUSA) - Conclusion

As a result of the synthesis and integration of the documentation, evaluation and classification of urban space based on HARD-SOFT-ORG-ware conceptual framework as well as Circular Chart visualisations, an integrated computational tool is conceptualised. The Tool for Urban Space Analysis (TUSA) integrates classification and evaluation systems and has capacities to catalogue, classify, evaluate, compare and speculate on hybrid urban space typologies, their conditions and performances. The visual interface of TUSA consists of four rings, as shown in Figure 14.

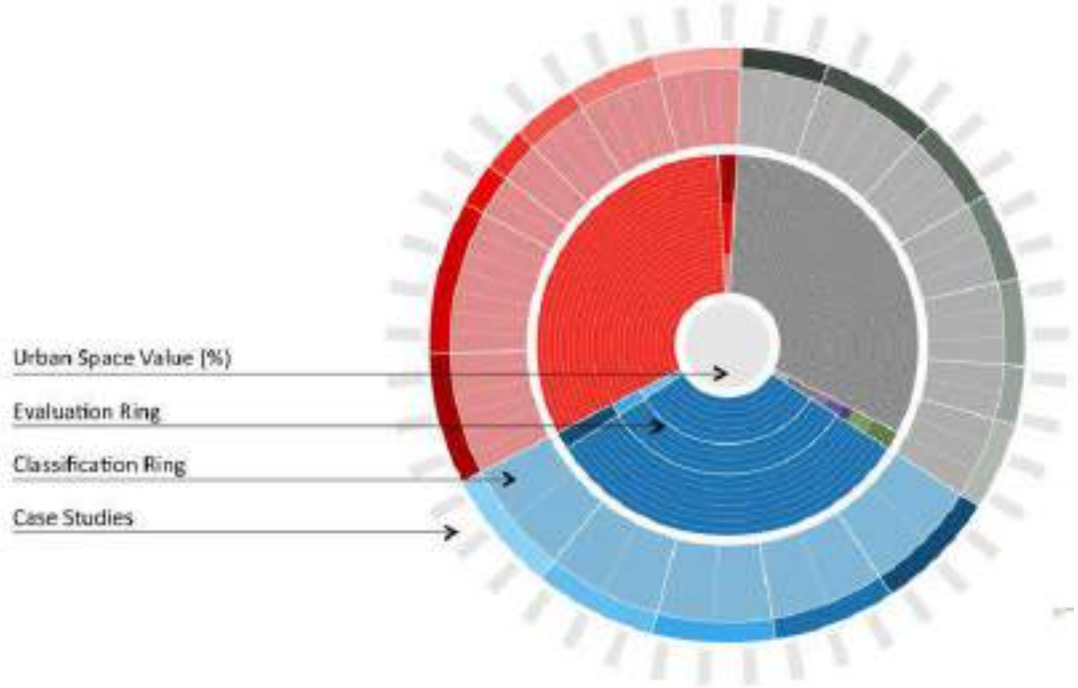

Figure 14. Tool for Urban Space Analysis (TUSA) – visual interface

While the Design Tool integrates an interactive catalogue, classification and evaluation processes, its primary role is in processes of comparison and analysis of urban space performances (as well as generating performance charts), self-evaluation (testing relations between descriptors and evaluators) and speculation on hybrid types of urban spaces and their performances. The tool would thus be helpful in both analysis and guiding the planning and design of urban spaces, drawing from the key attributes of successful urban spaces gathered by the team.

TUSA reflects the research process and analysis employed in this study of urban spaces and is self-evaluative. Additionally, it provides flexible, innovative and intuitive ways of design communication, where any user can define ways of search and analysis. With such capabilities, TUSA is a useful new tool for the study and evaluation of contemporary urban spaces in high density environments.

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