Action 08: Expand the Figure-Ground Relationship

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Why

The fabric, grain and texture of a city reflect its physical dynamics, genesis and potential for future transformation and development. The resulting urban morphology combines social, cultural, economic and climatic aspects of cities into particular patterns. A figure-ground diagram captures the geometric and spatial composition of buildings, blocks and infrastructure, represented as solid figures, and the open void of plazas, streetscapes, parks and waterways, represented as ground. The abstraction of these figure-ground diagrams allows us to quantitatively compare and evaluate the spatial elements of cities. These elements can then be classified into distinctive urban types. In their composition and distribution, these elements are like the fingerprint of a city, as can be seen in the distinct figure-ground patterns of the central areas of Barcelona, Manhattan, Tokyo and Singapore. Figure-ground diagrams imply that cities tend to converge, at least in their mature stage, towards a distinctive static type or stereotype of urban morphology. However, as cities change and become more complex, diverse and dynamic, this is no longer true. With the advancement of city sciences, it is time to move from fingerprinting to something more akin to the DNA sampling of cities.

What

The fabric, grain, texture and morphology to be studied are found in all parts of the urban and peri-urban areas of cities. However, underlying social, cultural, economic, organisational and climatic aspects might differ from one neighbourhood to another, as well as from one city to another. Therefore, a fine-grained, multiscalar and multidimensional approach is needed. Expanding the figure-ground relationship allows us to integrate more aspects into the process that can inform, interfere and question the fabric, grain and texture of cities. This expanded figure-ground challenges preconceived representational models of cities and can lead to new forms of urban cartography.

How

By applying machine learning to satellite images, we can trace changes in urban morphology across large time spans and over extended territories. The resulting maps show gradients of transition that expand the conventional figure-ground relationship, rates of change that replace rigid juxtapositions of built and unbuilt spaces, variable densification and transformation rates that replace static urban compositions, and land-cover dynamics and layered land uses that replace segregated urban zoning. The study of urban morphology—of built and open spaces in terms of scale, extent, configuration and composition—can now be linked to knowledge derived from city sciences. City sciences can help us to interpret emerging spatial configuration and use patterns under changing social, cultural, economic, organisational and climatic aspects. The expanded figure-ground concept can also help bring about more suitable and sustainable spatial configurations of new urban designs using parametric and procedural urban analysis, simulation and design tools.

Evidence

become more supportive of older generations who have naturally occurring cognitive decline and who are more easily disoriented.

From a methodological perspective, while a more interactive planning approach involving older people as co-researchers is beneficial, it requires more resources for the planning team, such as time, money and experimental efforts. In this context, ongoing and long-term collaborations between practitioners and interdisciplinary researchers, using mixed-methods for post-/pre-occupancy evaluation and co-design, can act as a stepping stone. Such collaborations can help translate theory to practice and thereby impact design processes and design outcomes. Collaborations of our team include city planners such as Urban Redevelopment Authority of Singapore, and international design consultants, such as DP Architects, and local organisations, such as Kampung Admiralty and other Active Ageing Hubs. Based on these interactions we plan to continue our outreach activities.

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Create Spaces of Opportunity

Spaces that are not allocated a specific programme at the outset drastically increase the capacity of a project to adapt over time (Gasco 2019a, 496–7; 2019b, 596; Hanakata 2019, 294, 314; Läpple and Hanakata 2019, 42). Determining everything at the conception and planning stage of a project limits a project's capacity to be appropriated by its inhabitants and users. Creating, on the other hand, a porous condition that includes a dynamic leeway and a 'volatile situation' (Christiaanse et al. 2009, 26) provides a space that can respond timely to new opportunities and be activated accordingly at a later stage. Such spaces also increase the possibilities to integrate new uses, people and perspectives while fostering a neighbourhood to be not only adaptive but also inclusive. HafenCity Hamburg GmbH, for example, took its first steps in this direction by deliberately leaving out a certain area (Oberhafen) from the master plan. This area has subsequently evolved into the creative heart of HafenCity (Hanakata 2019, 289). Furthermore, the master plan has only determined the development of different districts over the period of 17 years in several development phases (starting with Am Sandtorkai in the west and ending with Elbbrücken in the east). These districts were further detailed through urban design competitions. Doing so has generated the opportunity to use vacant land in the east for temporary uses, such as a refugee camp for 600 inhabitants, which was built in 2016 and is still in operation today. In the case of the Marina Bay area, the White Site zoning category, introduced by the Urban Redevelopment Authority of Singapore in 1995, has no specific programme allocated to it but rather enables developers to respond to market demands and current trends (Fun and Fassam 2019, 517). In London's King's Cross, plots yet to be developed have been occupied by various community-focused temporary uses, such as community gardens and a swimming pond, some of which have since been relocated to other plots following the development stages of the area (Gasco 2019a, 497).

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Expand the Figure-Ground Relationship

The study of urban fabric, grain and texture, or urban typomorphology, has largely been accepted as a useful method in urban planning and design (Moudon 1994; Lilley 2009). However, over time, these methods lost prominence in the face of criticism, such as the lack of clarity in the validity of the morphological approach in establishing cause-and-effect relationships and the inherent physical determinism in urban morphology studies (Moudon 1997). Recently, there has been a renewed interest in morphological methods as urban decision makers grapple with growing complexity and interdependencies between urban form and processes, with multiple and contradictory goals such as economic vitality, climate-responsiveness, environmental sustainability and social justice. A quantitative vocabulary of urban form eases measurement of success for different goals and aids the decision-making process. It is opportune that this need for systematic definition, classification and quantification of urban form is accompanied by the growing availability of software packages that facilitate analysis of such large data sets. Methods such as space syntax (Space Syntax n.d.), geographic information systems and remote sensing (InterIMAGE 2018), cellular automata (Batty 2007; Koenig and Mueller 2011; Heim et al. 2018) and procedural modelling (Parish and Müller 2001) offer different mechanisms to conduct such analyses (see Figure 08.1).

Data to support the large-scale studies of urban morphology is gradually becoming more available. Supranational research initiatives contribute to high-resolution global land-cover maps (Hansen et al. 2013), standardised global urban growth rate indicators (United Nations DESA 2015) and measuring changes in urban landscapes across time (World Bank 2015). These data sets allow for new forms of cross-comparative and interdisciplinary research, such as the analysis of urban growth and sprawl from remote sensing data (Bhatta 2010), as well as the discovery of new urban typologies by data mining multiple dimensions of urban form (Gil et al. 2012); correlations of natural resources, urban form and infrastructure (see Figure 08.2) (Rode et al. 2017); or the urban morphology informs other disciplines, such as transport planning (Schirmer and Axhausen 2015). The Future Cities Laboratory (FCL) collected open data relevant to the study of urban-rural systems in an open access planning support tool known as 'ur-scape' (UR-Scape 2018). This platform correlates spatial and non-spatial data sets such as food productivity, population density, disaster risk areas, gross domestic product, land cover, soil suitability, nightlight, rainfall and poverty.

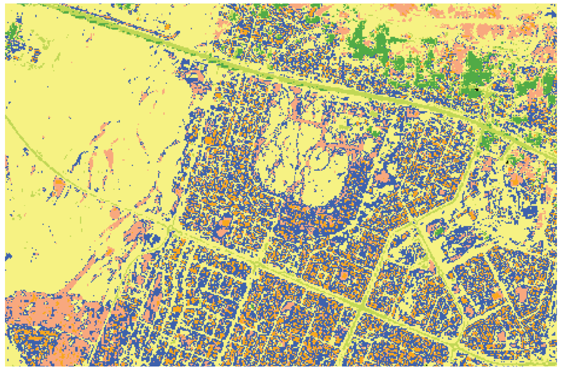
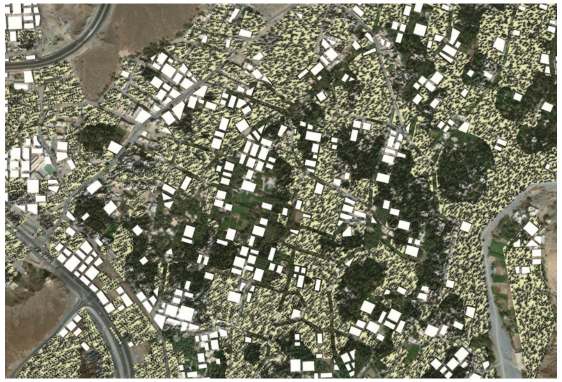


Fig. 08.1 Automatic land-cover classification from satellite images creates an expanded figure-ground map showing built-up and agricultural spaces in various degrees for Muscat Capital Area in Oman.

Fig. 08.2 Expanded figure-ground maps combine land-use, density and micro-climatic information during the 2019 Advanced Studies in Urban Design (AS-UD) course.



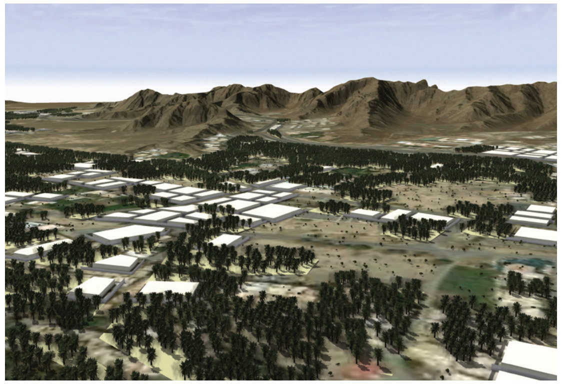


Fig. 08.3 Automatic land-cover classification maps drive three-dimensional figure-ground models of built-up and agricultural spaces in Nizwa, Oman, for further morphological investigation.

Fig. 08.4 Evaluating urban typomorphologies for case studies in Singapore using CityEngine during the 2018 Advanced Studies in Urban Design (AS-UD) course.

The ur-scape platform has been piloted in several cities in South East Asia, including Bandung under the Asian Development Bank's Future Cities initiative (Cairns et al. 2018). Then, the large data sets were linked to parametric and procedural urban modelling techniques to explore large-scale urban form. The 'Urban Elements' method (von Richthofen 2018) served to link conceptual urban design intents, urban science and procedural modelling with typomorphology to further engage in urban planning and analysis in Singapore (see Figures 08.3–4).

Stakeholders

The one-year Advanced Studies in Urban Design (AS-UD) course offered a platform to develop a new urban design curriculum with the Urban Redevelopment Authority of Singapore (URA) from 2017 to 2019. Apart from testing the applicability, transferability and teachability of research conducted at FCL, the course also hybridised and expanded urban morphology and typomorphology in particular. The effectiveness of using CityEngine for urban design workflows was tested in the second and third years of the AS-UD course in 2018 and 2019, which was offered to young professionals at URA and affiliated planning agencies. Knowledge acquired from the course facilitates a better understanding of how CityEngine can bridge the gap between urban design practice and typomorphological analysis.

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Mitigate Urban Heat

Hygiene and the quest for well-lit and ventilated spaces transformed urban design and planning in the twentieth century (Banham 1984). Recently, the urban microclimate has been conceptualised as an 'artefact' (Roesler 2017), and architects, landscape architects and urban designers increasingly design microclimates (von Richthofen 2018; Philippe Rahm architectes 2018) based on novel digital microclimate sensing and modelling (Ruefenacht et al. 2020; Bauer et al. 2015). As demonstrated in the case of Singapore, the urban microclimate is subject not only to the global warming effects of climate change, but also to local heat absorbed and captured in the urban fabric resulting from urban configuration and use (Kayanan et al. 2019). The trending cooling strategy, for example, green façades, have a cooling effect only at close proximity (Acero et al. 2019).

The measurement of the climatic condition of an urban space could help to validate the effectiveness of potential cooling strategies. For example in Singapore, measurements in the elevation of a building podium provides higher air movement at street level. Remote sensing could provide information about the surface temperature of horizontal surfaces (pavements, roofs, green areas). Indeed, satellite maps from Singapore have shown that dense vegetation and water bodies are the coolest surfaces during daytime (Philipp 2019; Nevat et al. 2020). Furthermore, survey campaigns could reveal insights into people's perceptions, awareness, beliefs and attitudes towards the environment that surrounds them. For instance, a survey conducted in Singapore