Section 1

City Models

DEFINITION

Models describe an abstraction of the real. They are not the real object and should never be confused with it. But they can extract and describe important features of the real object. Good models also describe the interaction between those features and functions of the real object.

Cities in their entirety are the most complex objects humankind has created, and are constantly expanding. The city changes with and through its observation by the people living in it. Therefore, any model of a city must respect the dynamics of the habitat.

In this chapter, we shall look at historical, present and potential future models of the city. This is an open ended search for definition, yet necessary in a similar way as medicine needs a model of the human being, even if it is not perfectly describing the entirety of human.

During the sixth decade of the last century, a young scientist wrote an influential book with the title “A City is not a Tree”. Christopher Alexander, the author, had previously published his “Notes on the Synthesis of Form”. While the first book could be seen more into edition of “form follows function”, “A City is not a Tree” is a strong hint that modeling a city might not be that easy.

The two books are interesting, because they describe positions that were extended to the extremes in both directions. On the one hand, the perception of the city as a mechanism that can be easily explained, measured, and extended, which may result in a single number describing the essence of the city. On the other hand, the perception of the city as the uncontrollable, messy, constantly changing, unpredictable, and in its entirety, indescribable organism made up of people, infrastructure, thoughts, money, water and sewage.

Neither the search for the ideal city nor the virtualisation of the city have led to tangible results that would increase the sustainability of a city. Restricted to plans and spreadsheets as their only instruments, many city governments in developing and emerging countries are struggling to provide the appropriate infrastructures for the growing number of people streaming into the cities. On the other hand, because of the emergence of instruments which take advantage of big data and the increasing capacity of information technology to simulate complex systems, the need for city models is obvious.

Overview

The following is an excerpt from a publication on city modelling by the author.

“Early architecture and urban design examples are based on fundamental geometric shapes: point, line, circle, square and rectangle. Besides the purity of these forms, they have the advantage that they can be constructed easily with simple tools. They could straightforwardly be assembled into grids, thus providing the footprint for the basic organization of urban services and separating public from private areas. For the arrangement of these shapes and infrastructure networks, city planners defined simple rules and instruction sets which, in combination with the shapes, would form a design description that could be easily taught to others.

Gallery 5.1 Changdeokgung Palace in Seoul

Schmitt, G. 2011. *Changdeokgung Palace in Seoul from 1405: geometry as the driving force underlying the design.* [Photograph].

The rule-based approach

With the growing complexity of settlements into urban centers and denser cities, the simple instruction sets became less

Gallery 5.2 Marina Bay Sands complex in Singapore

Schmitt, G. 2011. *The Marina Bay Sands integrated resort complex in Singapore by Architect Moshe Safdie from 2010.* [Photograph].

effective and could in fact diminish the overall performance of the city or hinder it from achieving its defined goals. The definition of those functional goals became priority and geometry had to follow. The geometric pattern of the city was brutally altered accordingly, as the example of the redesign and reconstruction of Paris in the 19th century demonstrates. In this and other cases, geometry was put into the service of other, for example military goals, rather than being the generative driver of city form. Yet the planning intentions and the results of interactions between basic geometry and political or private goals were still visible.

The stocks and flows approach

With growing sophistication of societies, politics, technology and economy, cities changed their geometry again. Linear transportation systems such as freeways, train tracks and suburban private roads gained in importance and reshaped the design of cities. Economics, transportation and the separation between living and working areas became dominant factors. With less limitations in materials and increased freedom in design, driven by a temporary abundance of cheap energy in the 20th century, the geometric expression of the city became increasingly a result of the various stocks and flows that determined city life, leading to sometimes ordered, but sometimes seemingly chaotic conditions of a city's geometry.

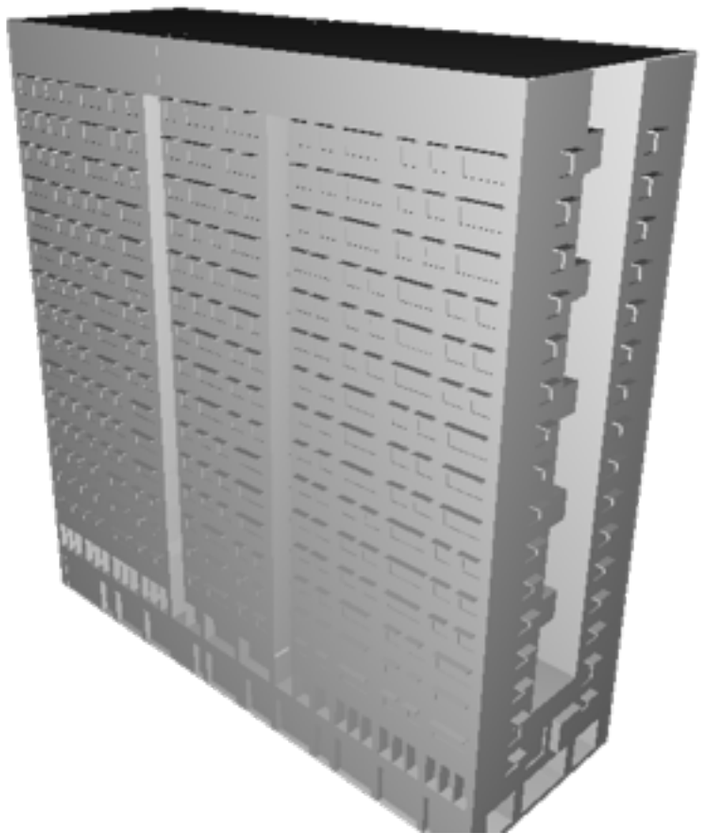
The complex system and quantum city approach

With the beginning of the 21st-century and the globalization of city stocks and flows, the dependence of the city on its direct hinterland decreases, and even national networks of cities for the exchange of goods and services lose their dominance. The forces that cities are exposed to start to shift rapidly, thus making them in their development increasingly the result of changing force fields – force fields in the sense of rules governing the balance of the complex system of the city. This leads to metaphorical analogies with quantum theory and thus to the proclamation of the quantum city, as proposed by Ayssar Arida (1) or Ludger Hovestadt (2). At this stage, geometry takes on a new role, but it still is and will be decisive for the positioning of any physical manifestation of city stocks and flows and force fields."

Geometric Models

Geometric models are the most accessible representation of complex cities, as they create a direct link between visual perception and digital model. In fact, geometric models serve well as the anchor for other properties of a city, which eventually can mostly be pinpointed to a geometric location in space and time.

Interactive 5.1 interactive 3-D model derived from UAV data



Fang, W. 2013. *Graduate student residences at the University Town in Singapore, ETH CREATE.* [3-D model].