Chapter 7
Application of Complexity Theory in Representation of the City

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ABSTRACT

The objective of this chapter is to show how chaos and complexity theory can be applied to understanding of the dynamics of a city. At first, the changes in the theoretical and practical knowledge that occurred in contemporary philosophical and scientific thought from the end of the nineteenth century, which led to the formulation of the chaos and complexity theory are discussed. The new vision of the world emerging from chaos and complexity theory allows a rapprochement between the two complementary ways of analysis and action: the analytical method, born from the Cartesian method, and the systemic approach, derived from cybernetics and systems theory. Then the characteristics of a complex system are analyzed by referring to the definitions of the main exponents of the discipline, in order to understand if a city can be identified as a complex system. A review of the main theories about complexity of the city is included in order to demonstrate that a city can be considered as a "system" defined by the elements (the various activities and urban functions) and from the interactions and relations between its various components (tangible and intangible communications) that produces hardly detectable effects on all parts of the city. Finally, the systems currently used for the description and the representation of components and relationships of a city intended as a complex system are presented.

INTRODUCTION

The objective of this chapter is to show how chaos and complexity theory can be applied to understand the dynamics of a city, and represent it showing the relations between tangible and intangible elements that contribute do define it.

If planning and design are based upon representation, intended as a graphical reproduction of the knowledge acquired on the case study, it is necessary to inquire the identity of the contemporary city, and find the tools to communicate the complexity of relationships that characterize it.

In the cities of the past it is easy to understand the evidence of the way in which a society was planning and organizing their own way of life, and also the representations of the time are consistent and give a fair idea of the role and identity attributed to the city.

In the Middle Ages, for example, the urban space was an interior space, completely separate from the countryside, very compact, defended by walls that marked the boundaries and protected the city, in which were instituted the different functions of social life. The representations of the time show this characteristic of closing, sometimes deliberately accentuating the impressiveness of the walls of protection.

The conception of the Renaissance city is instead linked to the myth of the ideal city: a perfect, orderly and rational city, constructed with ruler and compass, with a rigorously geometrical plan and a chilly architectural precision. A city, which frequently appears in the treatises of the time, from Leon Battista Alberti to Filarete and Francesco di Giorgio Martini, up to the great architects of the sixteenth century, and which finds its expression more in graphical representations than in the real urban form in both intellectual and theoretical form.

In the era immediately following the Renaissance, new astronomical knowledge due to the Treaty of Copernicus (1543) and especially to the *Nuncius sidereus* of Galileo (1619) brought down the traditional beliefs and discovered the new dimension of infinite space, in which the design of architecture and city had to find a new place. The idea of infinity is recognizable in the space of the city that spreads, as well as in the maps of some topographers which make the idea of the infinite space precise. (Benevolo, 1994).

In the contemporary city, boundaries have gradually faded. There are no longer massive walls, bastions, deep ditches or imposing fronts of the harbor, which in turn defined the social bonds between citizens and other residents. The urban shape has taken the form of a meta-city without borders, a "city beyond the city", an urban world wrapped in a complex maze of visible and invisible networks, material and immaterial relations, that the representation, to be effective, should be able to understand and communicate using completely new instruments.

To understand what might be the most suitable instruments for this purpose, it is necessary to place as a starting point the idea that the contemporary city is configured as a complex system.

FROM THE ANALYTIC METHOD TO THE SYSTEMIC APPROACH

The history of contemporary scientific and philosophical thought is marked, as early as the end of the nineteenth century, by the gradual awareness of a slow but inexorable vanishing of the certainties of theoretical and practical knowledge. The categories of the scientific and philosophical thought and action, and in particular ideas and concepts considered immutable as time, space, relationship between cause and effect, have been progressively challenged.

Complexity theory is the best response given from the 70s to the need to understand apparently accidental scientific phenomena, until then generally categorized as "chaos", Greek word to denote the void, the absence, the unknowable.

The new vision of the world emerged from chaos and complexity theory allows a rapprochement between the two complementary ways of analysis and action: the analytical method, born from the Cartesian method, and the systemic approach, derived from cybernetics and systems theory.

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