

Self-Organization and the City

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An ever increasing number of scientific disciplines deal with complex systems. These are systems that are composed of many parts which interact with one another in a more or less complicated manner. One of the most striking features of many such systems is their ability to spontaneously form spatial or temporal structures. A great variety of these structures are found, in both the inanimate and the living world. In the inanimate world of physics and chemistry, examples include the growth of crystals, coherent oscillations of laser light, and the spiral structures formed in fluids and chemical reactions. In biology we encounter the growth of plants and animals (morphogenesis) and the evolution of species. In medicine we observe, for instance, the electromagnetic activity of the brain with its pronounced spatio-temporal structures. Psychology deals with characteristic features of human behavior ranging from simple pattern recognition tasks to complex patterns of social behavior. Examples from sociology include the formation of public opinion and cooperation or competition between social groups.

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Juval Portugali

Self-Organization and the City

With a Foreword by Hermann Haken

Includes chapters in collaboration
with I. Benenson, I. Omer and N. Alfasi

Two special chapters on “Synergetic Cities”
with Hermann Haken

With 120 Figures



Springer

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Foreword

Cities first came into existence more than five thousand years ago. How to deal with these partly fascinating, partly frightening creatures of mankind, both practically and intellectually, concerns all of us and, in particular, presents a real challenge to city planners. Each historical epoch has had its own particular attitudes associated with the “Zeitgeist”. Accordingly, the planning and steering of cities were based on quite different criteria. But in spite of these differences, the concept of planning and steering was, and still is, the cornerstone of our dealing with cities. Nevertheless, the planner’s dilemma is becoming more and more visible: cities and megacities seem to be unplannable.

In this book, Juval Portugali introduces a new idea: Cities are self-organizing systems. To substantiate his revolutionary concept, he uses several interlinked methods. On the one hand, and to my own delight, he employs in his arguments theoretical tools developed in the interdisciplinary field of synergetics. On the other hand, jointly with his co-workers, he has performed detailed model calculations on cellular nets. It has been a great pleasure and a wonderful experience for me to discuss these concepts with Juval Portugali over a number of years. I was repeatedly and deeply impressed by the way he established profound and often surprising links to other fields of science. Reading this book has fascinated me and I am sure that this fascination will also be felt by both professionals and laymen. Indeed, the text will provide the reader with new and deep insights. I am convinced that this book by my friend Juval Portugali will become a deserved success.

Stuttgart
April 1999

Hermann Haken

Preface

Cities are *par excellence* complex systems. This property of cities was always recognized and the study of cities and urbanism was from the start an interdisciplinary endeavor that involved disciplines such as geography, architecture, town-planning, engineering, economics, sociology, psychology, anthropology, archaeology, and more. Given the disciplinary diversity of the field, a major issue was to find a common language allowing discourse, co-operation and exchange of ideas between the many domains involved. For some time, during the 1950s and 1960s, it was thought that such a common ground could be found in a conjunction between the scientific method, as elaborated mainly in the economically oriented human geography, and the then newly emerging *General System Theory*. Very soon, however, this whole positivistic approach came under a strong Structuralist–Marxist and Humanistic–phenomenological criticism, and as a result the field of cities and urbanism has split into two, disconnected, parallel currents: one quantitative and positivist, often termed *regional science*, and the other qualitative–hermeneutic, which we'll call here *social theory of the city*.

Self-organization is the central property of, and a theory about, complex systems. Soon after its origin, during the 1960s, in physics and the exact sciences, it became a leading paradigm in the study of complex systems in general. Given the complexity of cities, it was not surprising that specialists in self-organization (mostly physicists) have found cities a fruitful field to apply their models, and that regional scientists have welcomed the new theory and made it the forefront of their research domain.

The central thesis of this book is that self-organization theories have much more to offer to the study of cities than being simply the modeling engine of regional science. The language and conceptual framework of self-organization resembles much of the language and conceptual framework of the non-quantitative social theory of the city. As such, it has the potential to provide a common language that will unite the two, currently split, urban currents.

Self-Organization and the City makes a first step in this direction and illustrates how the notion of self-organization can provide a common language and a conceptual and methodological framework for the study of cities and urbanism. The book is intended, therefore, for students of self-organization in

general, and for students of cities and urbanism of all convictions: for regional scientists working with mathematical models of self-organizing cities and for urbanists in a variety of disciplines working within the frame of social theory: in social geography, architecture, urban and regional planning, economics, sociology, and so on.

I would like to close this preface with some acknowledgments. First and foremost I acknowledge Professor Hermann Haken, a great scientist, a marvelous person, a friend and a colleague: for his theory of synergetics and for our many conversations which have greatly inspired my work; for his encouragement and support in publishing this book, and for collaborating in the writing of the two special chapters on 'synergetic cities'. As an enthusiastic student of synergetics I very strongly believe in scientific co-operation and teamwork, that is to say, that the output of a good team can exceed the input of its members. This book is indeed the fruit of a synergistic team which includes Itzhak Benenson, who came all the way from Sverdlovsk to Tel-Aviv in order to construct and shape our FACS models and give them mathematical precision, Itzhak Omer, who was the first to suggest the usefulness of cellular automata as heuristic city models, and Nurit Alfasi, who joined the team just in time to elaborate on the implications of self-organization to urban and regional planning. Several chapters of the book were co-authored with them, and two special chapters (Chaps. 13 and 14) with Professor Hermann Haken. And while I bear full responsibility for any faults that might be found in the text, I would like to emphasize that without their collaboration and support the project of writing this book would not have been possible. I would also like to thank Y. Dorfman and O. Reuven-Safrir for doing several of the drawings.

Chapters 5, 6, and 7 of the book are based on research conducted, from 1992 to 1994, within the frame of an Israeli Academy of Science research grant (No. 891-171), on *The metropolitan space as a self-organizing system*, while Chaps. 8 and 14, are part of an on-going GIF (German-Israeli Foundation) research project (Grant No. I-458.224.07/95) on *Synergetics, interrepresentation and cognitive mapping*. We are grateful to both research foundations. Since the early 1990s, as the study developed, several of its issues have been published in scientific journals. These papers provide some of the foundations for this book and are integrated in the following chapters. Chapters 1, 2 draw on my 'Notions concerning the nature of world urbanization', *Progress in Planning* **46**(3), 1996, 141-194; Chap. 3 on my 'Self-organizing cities', *Futures* **29**, (4/5), 1997, 353-380; Chap. 5 on my paper with Benenson and Omer on 'Socio-spatial residential dynamics: stability and instability within a self-Organizing city', *Geographical Analysis*, **26**(4), 1994, 321-340; Chaps. 6, 12 on my paper with Benenson on 'Artificial planning experience by means of a heuristic cell-space model: simulating international migration in the urban process', *Environment and Planning A*, **27**, 1994, 1647-1665; Chap. 7 on my article with Benenson and Omer, 'Spatial cognitive disso-

nance and sociospatial emergence in a self-organizing city', *Environment and Planning B*, **24**, 1997, 263–285; and Chap. 13 on Haken and my article 'A synergetic approach to the self-organization of cities and settlements', *Environment and Planning B: Planning and Design* **22**, 1995, 35–46.

Tel-Aviv
April 1999

Juval Portugali

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