# Complexity and Uncertainty in Contemporary Cities

# Complexity and Uncertainty in Contemporary Cities:

## *Toward a New Conceptual Model*

By

José-Miguel Fernández-Güell

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Complexity and Uncertainty in Contemporary Cities:
Toward a New Conceptual Model

By José-Miguel Fernández-Güell

Originally published in Spanish as “Complejidad e incertidumbre en la ciudad actual: hacia un nuevo modelo conceptual”
© Barcelona: Editorial Reverté, 2022

This book in English version first published 2024

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

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ISBN: 978-1-0364-1435-1
ISBN (Ebook): 978-1-0364-1436-8

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# INTRODUCTION

## The scientific diaspora that promoted systemic thinking

On September 2, 1945, World War II officially ended, leaving behind nearly 60 million dead, the European continent devastated, and the dropping of two atomic bombs on Japan. With the arrival of peace and after five years of war economy, the United States reoriented its budget priorities from the military to the civil field in order to respond to growing social demands in terms of employment, housing and social services. Thus, shortly after the end of the world conflict, a series of military research centers began to close, which during the peak years of the conflict had brought together hundreds of the most brilliant minds of the time to produce all types of military weapons. Research institutions, like all those that participated in the Manhattan Project, which had produced the first atomic bomb, saw the federal funds decrease drastically.

Practically overnight, hundreds of scientists abandoned their positions in military research centers and sought professional accommodation in private companies and universities. In their work diaspora, these scientists not only brought with them their skills in different fields of knowledge, but also disseminated new work methods based on multidisciplinary teams and new forms of project programming that they had learned in the military field. Likewise, these scientists carried with them a seed of intellectual concern about the existence of complex problems and the need to address them with holistic visions from multidisciplinary practice. It was evident that during the first half of the 20th century, Science had progressed at a speed unthinkable in previous times, but these advances had been largely due to the efforts made in different fields of knowledge. To continue progressing, it was necessary to break the boundaries between the various scientific disciplines and move forward with integrative approaches that brought together the different fields of knowledge. In other words, in those years the foundations of what would later be known as systemic thinking were created.

Scientific chronicles say that one of the first steps in the systemic journey was taken in March 1946 when the first Macy Conference on Cybernetics

was held in New York. Months earlier, Lawrence K. Frank and Frank Fremont-Smith, executives of the Macy Foundation, had spoken with neurophysiologist Warren S. McCulloch about the possibility of organizing a series of conferences that would establish the foundations of a general science of the functioning of the human mind. Behind this initial expression of interest, the conferences pursued a more general purpose: to promote meaningful exchanges between various scientific disciplines to restore the unity of science. McCulloch gladly accepted the assignment and brought together a group of very prestigious personalities from various fields of knowledge, who, over ten conferences from 1946 to 1953, laid the foundations of systemic thinking. Among the participants in the Macy Conferences were the psychiatrist William Ross Ashby, the mathematician Claude Shannon, the neurophysiologist Ralph Gerard, the psychologist Kurt Lewin, the anthropologist Margaret Mead, the economist Oskar Morgenstern, the physicist Heinz von Foerster, the mathematicians John von Neumann and Norbert Wiener, and the sociologist Talcott Parsons. These prestigious scientists provided indisputable support to the initiative of promoting exchanges between various disciplines with the aspiration of integrating knowledge in the post-war world.

Beginning with the Macy Conferences, other theoretical and practical initiatives followed uninterruptedly that promoted the study of complexity, the development of cybernetics, and the construction of systemic thinking. To the names of the scientists already mentioned, many others were added who definitively consolidated this field of knowledge in the 50s and 60s. In this way, a very fruitful period for science began in which all kinds of valuable contributions would evolve in findings relevant to the general progress of knowledge.

## Complexity and uncertainty, two closely related concepts

The concepts of complexity and uncertainty have inseparably accompanied the development of human civilization since ancient times. However, the most rigorous and sustained efforts to conceptualize such phenomena and address the challenges they pose took place during the second half of the 20th century. Complexity, basically understood as the difficulty in understanding and accurately replicating the dynamics of complex systems, and uncertainty, succinctly translated as the inability to accurately foresee the future, have been two linked phenomena that feedback on each other. On the one hand, a complex system is usually subject to uncertain behaviors that are difficult to predict, and, on the other hand, the uncertainty of the

environment in which the system operates tends to increase its evolutionary complexity.

Both concepts, complexity and uncertainty, are perfectly transferable to contemporary cities. The city can be assimilated to a complex organism, invented by human societies and built from multiple singular initiatives over time, with a large number of protagonists and connections between them. Likewise, uncertainty is a constant characteristic of cities, which is generated mainly by a complex environment, which disturbs decision-making about their future.

Thus, complexity and uncertainty are two of the main challenges facing contemporary cities and have historically been a handicap for urban planners. Recurrently, complexity and uncertainty have hindered the successful formulation of urban policies. The complexity of analytically defining the values and behavioral patterns of urban society, the multiplicity of actors involved in public decision-making, and the uncertainty of foreseeing the outcomes of each possible alternative have made the task of contemporary urban planning extraordinarily complicated.

Faced with the difficulties that these challenges entail, urban planners are often tempted to abandon long-term planning and focus instead on short-term actions. However, planners should not surrender to short-sighted visions without better understanding both phenomena through creative and comprehensive approaches. Thus, on the one hand, systems thinking can help us unravel the complexity of cities and, on the other hand, future studies can help us manage uncertainty. Given the close relationship between complexity and uncertainty, it would not be a wicked idea to develop approaches that combine systemic thinking and future studies, as proposed in this book.

## What is and how useful is the systemic approach for cities?

Nowadays it is fashionable to talk, both in the media and in scientific forums, about the science of complexity. This science emerged during the 1950s in the fields of Physics, Biology, Mathematics and Computer Science, later finding receptivity in the Social Sciences. This new scientific domain relies on systems theory to study various complex phenomena such as climate, natural ecosystems, the economy, social systems or cities. These phenomena are characterized by having a very large number of elements,

which maintain a high number of non-linear interactions among themselves and which observe a great self-organizing capacity to adapt to changes in the environment.

While these concepts will be explained more parsimoniously in later chapters, this preamble raises more questions than clarifications about systems theory. Is this theory simply an abstraction of reality or can we expect concrete applications of it? Is it a theory that works only on the basis of certainties or does it also incorporate uncertainty in its reasoning? In what form do systems exist in the real world of cities? Is systems theory applicable to urban planning and if so, what kind of advantages does it present? Is it a theory restricted to the capabilities of scientists or is it accessible enough for local actors to understand and apply its principles?

Throughout this work we will try to answer these and other questions that arise about systemic approaches applied to cities. It is clear that if we were able to unequivocally demonstrate the usefulness of systems theory to address the challenges of contemporary cities, no one would hesitate to make a continued effort to achieve its effective application. However, we are still far from verifying its practical usefulness. This endorsement will occur the day we can accurately recognize urban problems, reliably model urban reality and anticipate urban dynamics. In the meantime, we will content ourselves with continuing to test the principles of systems thinking in cities with the aim of achieving incremental results that support the development of future contributions.

## Author's professional and intellectual drift towards systemic thinking

My landing in the field of systemic thinking occurred after a long pilgrimage through other areas of knowledge. At the end of my Architecture studies at Universidad Politécnica de Madrid, a great interest in the conflicts and opportunities that were generated in cities was awakened in me. This interest pushed me in 1981 to study urban planning at Texas A&M University, in the United States, thanks to a scholarship from the Fulbright Commission. My stay in Texas convinced me that urban planning brought together a large number of disciplines that explained the urban phenomenon from very different perspectives. There, I realized that urban challenges went beyond the capabilities of spatial planners and that the construction of a comprehensive vision of the city required the help of many specialists.

After returning to my country at the end of 1984, I observed how the young Spanish democracy launched a new generation of urban plans with incipient citizen participation. Those plans were drafted by multidisciplinary teams, but their leadership rested mainly on architects-urban planners. That is to say, the collaborative space had been opened to other professional profiles, but in practice the execution of Urban Planning was still controlled by spatial planners, who maintained distrustful relationships with other sectors, such as Economy and Business.

In 1988 I joined an American consulting company that intended to launch a new product that had been well accepted in the United States: strategic city planning. Basically, this product consisted of adapting and applying the methodology of strategic business plans to cities. This professional experience reinforced my intuitions about the limitations of strictly spatial approaches and the need to open urban planning processes to diverse local actors. The result of these concerns was the book titled "Strategic City Planning", which had a first version in 1997 and a second expanded version in 2006. Both versions were widely disseminated in Spain and Latin America.

With the beginning of the new century, I began a new professional and academic journey in the field of foresight. While working on strategic city plans, I had been always concerned about formulating future visions in the most systematic and rigorous way possible, avoiding unfounded speculation. For this reason, I began my collaboration with the Spanish Industrial Technological Prospective Observatory (OPTI). There, I experimented with the benefits of incorporating local actors in foresight exercises and verified that, in most cases, they made very enriching contributions. Once again, the complexity of the challenges facing contemporary societies and the permanent uncertainty when anticipating the future were revealed to me.

In both my strategic planning and foresight related work, the topic of the complexity of urban phenomena appeared recurrently. At the beginning of the new century, it had become fashionable among urban planners to make constant references to urban complexity as one of the main barriers to achieving an accurate understanding of urban dynamics. The need to assimilate the city into a complex functional system was a persistent topic at that time; however, there were hardly any real cases where this theory was applied in any detail. In fact, most publications dealt with the issue of

complexity from a dialectical point of view, merely speculating on the benefits of the systemic approach but without really going into the matter.

Thus, around 2016 I began to investigate thoroughly urban complexity and uncertainty. As soon as I began to investigate the general background of systemic thinking, I realized that I had a task that far exceeded my abilities and energies. The task was additionally complicated due to the scarce documentation on the intermittent feedback between Urban Planning and Complexity Sciences. At this point, I considered that my humble contribution to the urban systemic community would be to develop a friendly conceptual tool that would allow urban planners to work collaboratively with local actors. Even though these actors did not know the principles of complex systems, they could positively offer integrative visions of urban phenomena. In short, at the beginning of 2020, taking advantage of the general confinement that occurred as a result of covid19, I began to write the book that readers currently have in their hands.

## Book objectives

The main objectives of this book are basically three. Firstly, the desire to present in the most informative and critical way possible, but without excluding critical evaluation, the historical evolution of both systemic thinking and futures studies. Since the pioneering initiatives that took place in the urban planning field in the 60s and 70s, we have experienced successive crises and resurrections that maintain interest in these matters among planning professionals. When reviewing these historical journeys, I have grouped the main contributions into large time periods, avoiding a narrative structured around a simple linear time scale. This has allowed me to venture possible flows and connections between schools of ideas over time. However, the history of knowledge does not usually focus on rigid historical compartments or pigeonholing into predetermined schools. Thus, throughout the book we will observe how some protagonists of our topic move naturally from one period to another and even from one school of thought to another.

A second explicit objective of the book is to propose and deploy a conceptual model that explains the systemic functioning of the city, avoiding quantitative models full of mathematical algorithms. There is no doubt that this propositional part invites both a frontal criticism of the model and a debate that generates new advances on the model. One of the clearest criticisms that can be made at the outset of the conceptual model proposed