

**Towards (R)evolving Cities**  
**Urban Fragilities and Prospects in the 21<sup>st</sup> century**

FEDERICO CINQUEPALMI



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DIDA**  
DIPARTIMENTO DI  
ARCHITETTURA

AUTORE CAPITOLO

This volume is the result of thirty years of studies and research on policies and technologies applied to the environmental, energy and building sectors, with particular focus on processes and phenomena related to urban systems: research and studies carried out in some of the main academic centers in Italy and abroad, namely the IUAV university of architecture in Venice, the National Research Council (Consiglio Nazionale delle Ricerche - CNR), the Sapienza University of Rome, the National Agency for New Technologies, Energy and Sustainable Economic Development (Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile - ENEA), the National Institute for Environmental Protection and Research (Istituto Superiore per la Protezione e la Ricerca Ambientale - ISPRA), and the US National Oceanic and Atmospheric Administration (NOAA), as well as United Nations Educational, Scientific and Cultural Organization (UNESCO), Food and Agriculture Organization (FAO), Organization for Economic Co-operation and Development (OECD), the University of Massachusetts (Boston) and Cambridge University. The research and studies have found concrete applications in the policies of the Italian Ministry of the Environment and Protection of Land and Sea, and the Ministry of Universities and Research, from 1999 until today.

This publication has been subject to an acceptance and qualitative peer review procedure, based on a *blind review* evaluation by the Scientific Committee of the DIDA Department of Architecture. All DIDA publications are web *open access*, allowing an effective open evaluation by the international scientific community.

The English text has been elaborated and verified under the supervision of Prof. Ann Katherine Isaacs (University of Pisa).

Cover: Leonardo da Vinci (1452 - 1519), Atlantic Code (Codex Atlanticus), folio 199 (reverse). Plan of the city of Milan with indication of city gates (top) and bird's eye view of the city of Milan (bottom).

©Veneranda Biblioteca Ambrosiana/Mondadori Portfolio



All written material is available under the Creative Common Attribution-Noncommercial-Share alike 4.0 license.

*progetto grafico*

**didacommunicationlab**

Dipartimento di Architettura  
Università degli Studi di Firenze

Susanna Cerri  
Federica Giulivo



**didapress**

Dipartimento di Architettura  
Università degli Studi di Firenze  
via della Mattonaia, 8 Firenze 50121

Stampato su carta Fedrigoni  
FreeLife Vellum

ELEMENTAL  
CHLORINE  
**FREE**  
GUARANTEED



LONG-LIFE  
ISO 9706

HEAVY METAL  
**ABSENCE**  
CE 128143

© 2021  
ISBN 978-88-3338-137-4

---

## TABLE OF CONTENTS

---

<b>Urban fragilities in the 21st century</b>	<b>13</b>
Saverio Mecca	
<b>Urban metabolism</b>	<b>25</b>
Metabolic approaches to the urban context	26
The urban ecological footprint	32
Life Cycle Assessment (LCA)	40
Circular economy	43
The wellbeing economy and urban systems	46
<b>Elements of the demographic, socio-cultural and historical evolution of human settlements</b>	<b>53</b>
Demography of the city	55
From a grain of wheat: the birth of the urban idea	61
The land of the two rivers: Mesopotamia	69
The land of two kingdoms: the Nile Valley	73
Civilisations far from the Mediterranean: Asia, the Americas, the Indian subcontinent and sub-Saharan Africa	77
The culture of urban design	86
<i>Hellas</i>	87
Euclid's dream: Hippodamus of Miletus	89
The dream of a god king: Alexandria	91
<i>Ab urbe condita</i>	93

The birth of the modern city and the idea of the capital	98
The Tsar's dream: Saint Petersburg	100
The Bonaparte's dream: Paris during the Empire	104
The Federal dream: Washington	109
A Saint's dream: Brasilia	112
Understanding the city	117
<b>Urban fragilities</b>	<b>127</b>
Extreme climate events	128
The demographic issue and the challenge of Ageing society	142
The challenge of migrations	154
The challenges of pandemics in urban societies	164
Resilience and adaptation of urban systems	178
Resilient cities and communities	190
<b>Technological systems, digital tools, and smart grids serving urban communities</b>	<b>195</b>
Smart grids and microgeneration	197
Sustainable mobility technologies	203
Information management systems for teleworking, e-teaching and e-learning and telemedicine	207
Internet of Things (IoT), home automation and Artificial Intelligence (AI)	219
Managing urban environments with Digital Twin	227
European cities from space: the EU Copernicus programme	235
Risk management and insurance tools for urban resilience	245

<b>Conclusions</b>	<b>253</b>
<b>Insights</b>	<b>263</b>
Brussels and Paris: the application of the metabolic approach <i>Carlo Pisano</i>	265
Micro-scale analysis of the urban territory according to the 'sustainable cells' methodology <i>Elisa Pennacchia</i>	277
Integrated digital systems for building and urban processes: the integration of advanced digital technologies <i>Elisa Pennacchia</i>	285
Cognitive Digital Twin for Building Management systems: a case study in Rome <i>Sofia Agostinelli</i>	293
Evolutionary cities. From theory to practice <i>Riccardo Maria Pulselli</i>	307
<b>Author</b>	<b>320</b>
<b>Contributors</b>	<b>321</b>
<b>Bibliography</b>	<b>326</b>