



Sustainable Design for Uncertain Futures: Dialogues on Time-based Architecture

Edited by **Joshua D. Lee & Joseph Murray**

WILEY

**SUSTAINABLE
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Dialogues on Time-based Architecture

EDITED BY

JOSHUA D. LEE

JOSEPH MURRAY

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Joshua D. Lee

To my wife, Bridget, for picking up substantial household and parenting duties and to my children, Tivon and Kaia Pax, for their patience and understanding for delayed pick-ups and reduced family time.

Joseph Murray

*For my dear wife Irina and our delightful daughter Maya.
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and for all the pleasant distractions.*

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Editor Biographies

Joshua D. Lee, PhD is an Associate Teaching Professor at Carnegie Mellon Architecture and serves as the Track Chair for the Master of Science and PhD in Architecture–Engineering–Construction Management (AECM) programs. His research interests include sustainable design, adaptable architecture, open building, systems-based architecture, circular construction, public interest design, post-occupancy evaluation, and educational facilities. His 2019 book, *Flexibility and Design: Learning from the School Construction Systems Development (SCSD) Project*, provides a longitudinal evaluation of this innovative and impactful project. Joshua is a registered architect and founder of the Protean Design Collaborative, which in 2022 won the AIA Pittsburgh Honor Award and Social Impact in Design Award for their public interest design work. Joshua is on the AIA Pittsburgh Board of Directors and is Chair of the Design + Research Group. Prior to joining CMU, he served as a Lecturer and Assistant Director of the Restoration Institute at Clemson University and as an architect at SOM-NY, SHW Group Austin (now Stantec), and Davis Wince (now Wellogy) on a wide array of projects. Joshua completed his Master of Architecture, Master of Sustainable Design, and PhD at the University of Texas at Austin.

Joseph Murray is a designer and systems thinker whose projects span user experience, social research, and the built environment. He has worked for architects and engineering firms throughout his career and has developed expertise in building lifecycle management, focusing on long-term change processes at the building and district scales. Expanding on this interdisciplinary approach, Joseph is currently pursuing a PhD in Architecture–Engineering–Construction Management at Carnegie Mellon University. His dissertation investigates adaptable building systems and time-based architectural practices. He holds an MA in Sociology and Social Anthropology from Central European University. Joseph is a board member of the Council on Open Building and is a collaborating researcher at Cornell University’s Just Places Lab. He is a co-editor on a special issue of the journal *Open House International*, titled “Beyond Single Use: Looking Back and Looking Forward at the Open Building Movement”, due to be published in 2026.

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Introduction

The dynamic nature of our world presents unending challenges, and a growing concern and awareness of uncertainties, across multiple scales, is shaping our views of what is desirable, and even what is possible in the field of architecture. This book aims to operationalize new understandings of time, architecture, and the forces of change. Through curated dialogues, an awareness of a thrilling potential becomes apparent: uncertainty can activate new approaches and the time-based strategies discussed in this book can equip us with a means of blending with, rather than working against the forces of change. These forces can range from everyday, relatively minor shifts in preference to global existential threats. Those who create and care for the built environment should plan to accommodate this reality. Unfortunately there is mounting evidence on [construction, renovation, and demolition waste](#)¹ that indicates the discipline of architecture, as it is currently practiced and codified into law, fails to adequately plan for the fourth dimension—time.

The current rate of loss of both resources and cultural heritage is clearly unsustainable on many levels. However, both negative and positive outcomes are implied in our use of the term uncertain futures. While concern over existential threats such as climate change, pandemics, and runaway AI are certainly worthy of consideration, there is also the potential for unexpected positive developments in technology and increasingly equitable forms of decision making.

As a basis of discourse we have adopted a [pragmatic, discursive, and pluralistic approach](#)² to thinking about sustainability and we remain hopeful that we can move towards the ambitious goal set forth decades ago to build in such a way that we “meet the needs of the present without compromising the ability of future generations to meet their own needs” (Our Common Future 1987). We see great potential in the growing number of architectural strategies that deal in one way or another with possible futures, in an effort to add adaptive capacity. We call these strategies time-based because they address the forces of change, often working across multiple time scales and in consideration of evolving needs. The 14 strategies we engage in dialogue in this book provide a wide range of embedded values that offer both theoretical and practical guidance to address aspects of the polycrisis we face today and the unknown crises we will face in the future. They include *Mass Customization* (Avi Friedman & Naomi Keena) ↔ *Computationally Responsive Environments* (Michael Fox), *Adaptive Reuse* (Bie Plevoets) ↔ *Open Building* (John Dale), *Metabolism* (Aki Ishida) ↔ *Persistence* (Michelle Laboy), *Circular Economy* (Felix Heisel) ↔ *Preservation* (Jenni Minner), *Repair* (Kim Trogal) ↔ *Design for Disassembly & Reuse* (Brad Guy), *Inclusive Design* (Sarah Wigglesworth) ↔ *Resilience* (Irena Bauman), and *Smart Materials* (Doris Sung) ↔ *Bio Design* (Mitchell Joachim). Each of these strategies address time in their own way, with their own terminology, and with varying levels of success and acceptance. What is common among them is a willingness to consider specific forces of change. See the matrix of these forces in Figure 0.1, which shows an example of a multi-family residence and a partial listing of the forces of change acting upon such a structure across multiple categories of change across scales. The central premise of this book is that by engaging in dialogue across time-based strategies we can develop innovative approaches to addressing our current needs and manage long term uncertainties by designing adaptive capacities while honoring the efforts of previous generations.

To operationalize the strategies in combination we have aligned the strategies to the building lifecycle according to six time signatures as illustrated in Figure 0.2. The potential

¹[construction, renovation, and demolition waste](#). See the US EPA’s Construction and Demolition Debris website, the EU’s Construction and Demolition Waste website, and the United Nations Sustainable Debris Management website for the latest statistics. While disruptive events like natural disasters are certainly impactful, so too are the everyday choices to modify or replace buildings to meet current needs.

²[pragmatic, discursive, and pluralistic](#). See Moore, S. 2010. *Pragmatic Sustainability: Theoretical and Practical Tools*. Routledge This book asserts that despite the staggering array of ways sustainability has been operationalized for the built environment (LEED, the UN’s Sustainable Development Goals, Passivhaus, Living Building Challenge, Cradle to Cradle, etc.), no single approach is sufficient and the collective effort of all these situated efforts has successfully moved us in a positive direction.

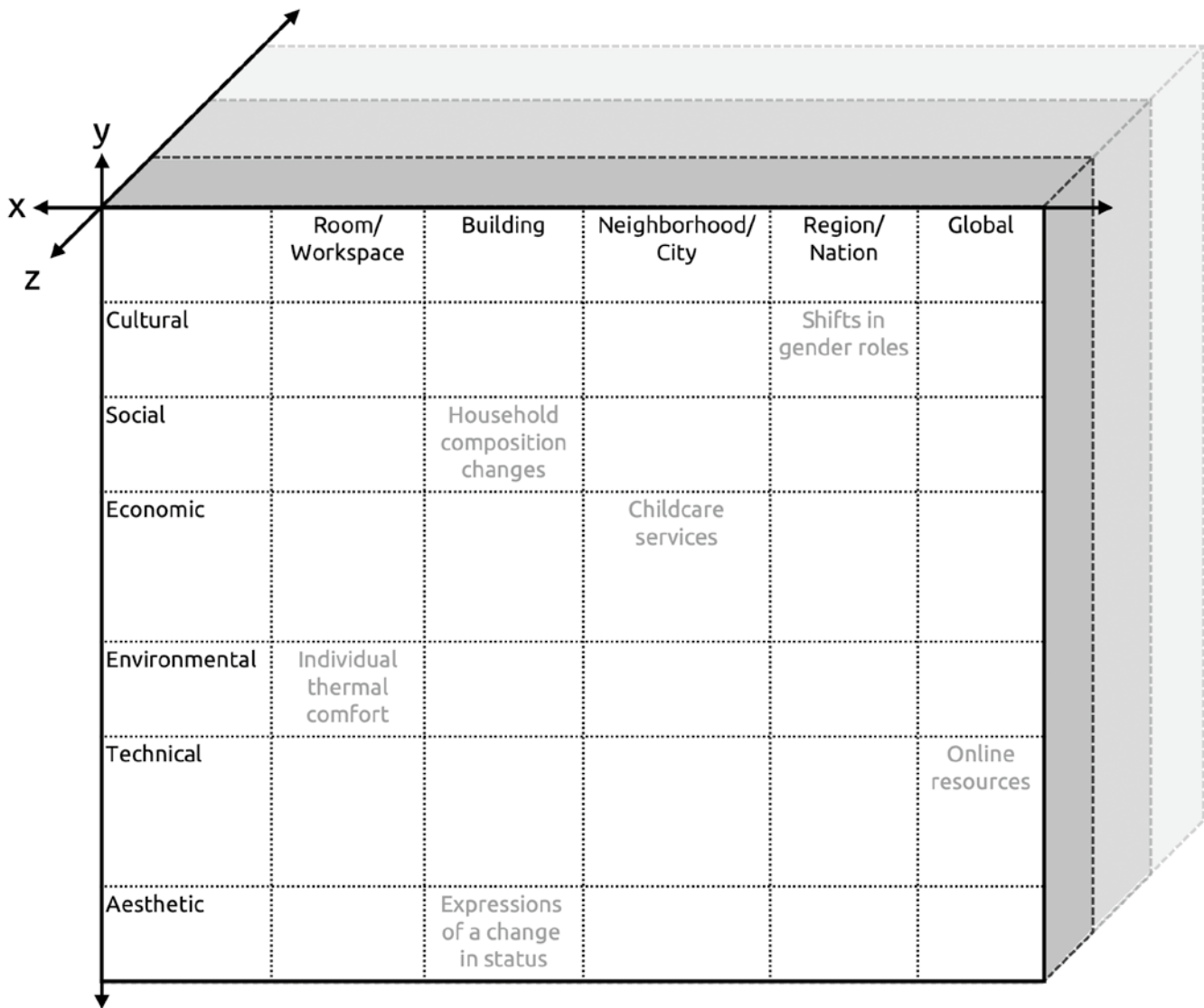


Figure 0.1 Forces and Scales of Change Matrix. This example is for a multi-family residence. The y-axis provides a variety of categories of change and the x-axis relates these to a continuum of scales. The z-axis indicates time, which recedes into greater uncertainty. The forces and scales of change rarely fit neatly in a single cell, but attempting to map these can be helpful when planning for the future, uncertain as it is.

for secondary time signatures will be explored as the strategic understandings broaden through the dialogues. *Mass Customization* is closely associated with the **Planning & Design** phase because it provides many options and choices that designers and clients can make throughout the pre-built phase. *Inclusive Design* embraces the needs of diverse users through the design process. *Computationally Responsive Environments* and *Smart Materials* are linked to **Immediate Change**, which occur in real time in frequent cycles. For example, *Computationally Responsive Environments* can open or close a window or blinds within seconds of a specific gesture. Some *Smart Materials* can change their shape as the temperature or humidity changes.

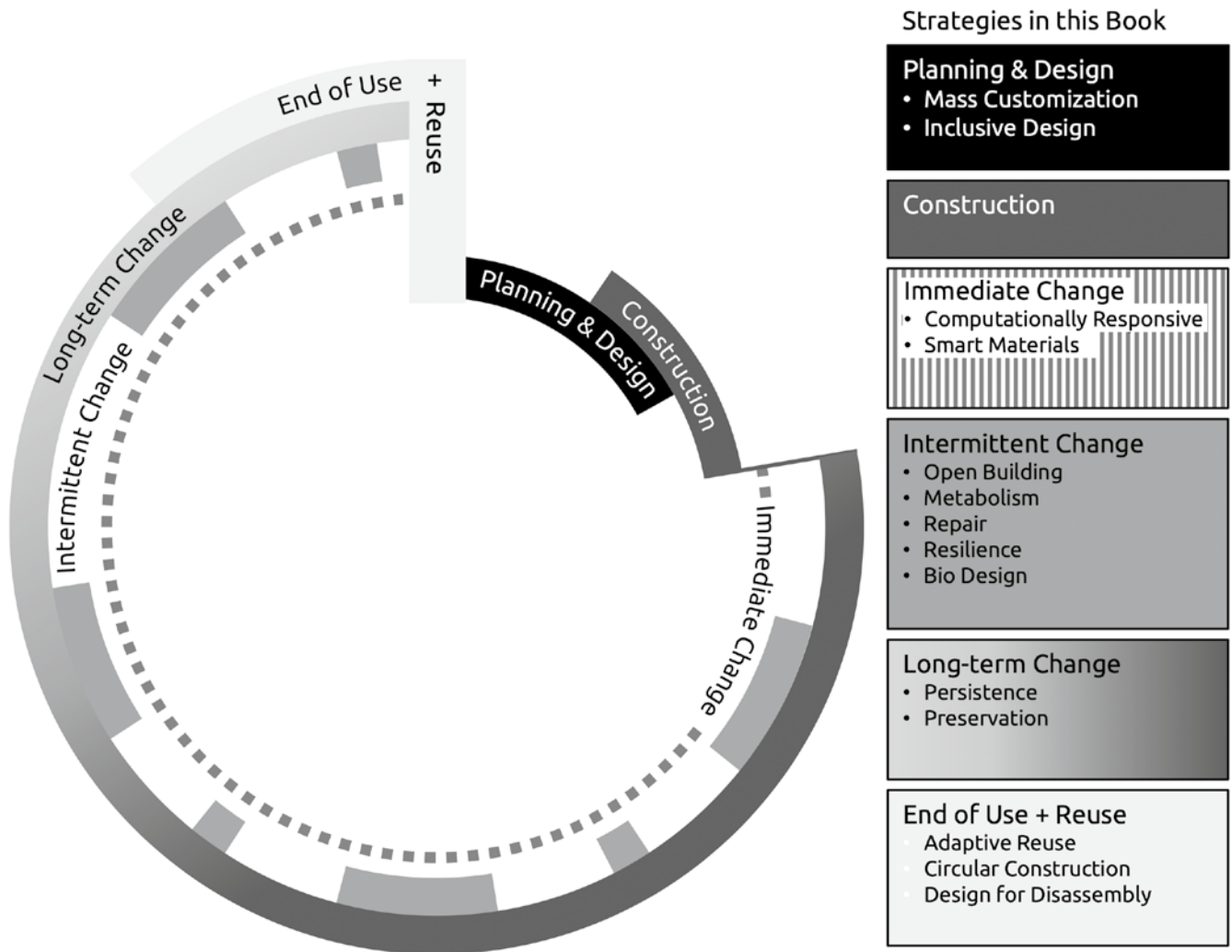


Figure 0.2 Time Signatures.

Intermittent Changes occur at irregular intervals and are aligned with *Open Building*, *Metabolism*, *Repair*, *Resilience*, and *Bio Design*. *Open Building* provides infill components such as demountable partitions that can respond to occupant spatial needs such as a change in household composition. *Metabolism* favors relocatable pods that can be moved from one core structure to another. *Repair* also requires consistent dedication to keeping structures in good, and possibly improving condition, over many years. *Resilience* offers a variety of ways to recover from human-made and natural disasters. *Bio Design* occurs through activities like pruning and grafting that work in concert with natural growth cycles.

Long-term Change occurs slowly over a long span of time and includes strategies like *Persistence*, and *Preservation*. *Persistence* is most evident after many decades or centuries. *Preservation* is typically supported for structures that are more than 50 years old and gain significance through meaningful events occurring in or around them over time.

The final phase is the **End of Use & Reuse**, which includes *Adaptive Reuse*, *Circular Construction*, and *Design for Disassembly & Adaptability*. Here we are distinguishing between the end of a specific use and end of life. End of use recognizes the potential for substantial reuse whereas end of life suggests a linear process leading to the landfill. In the case of