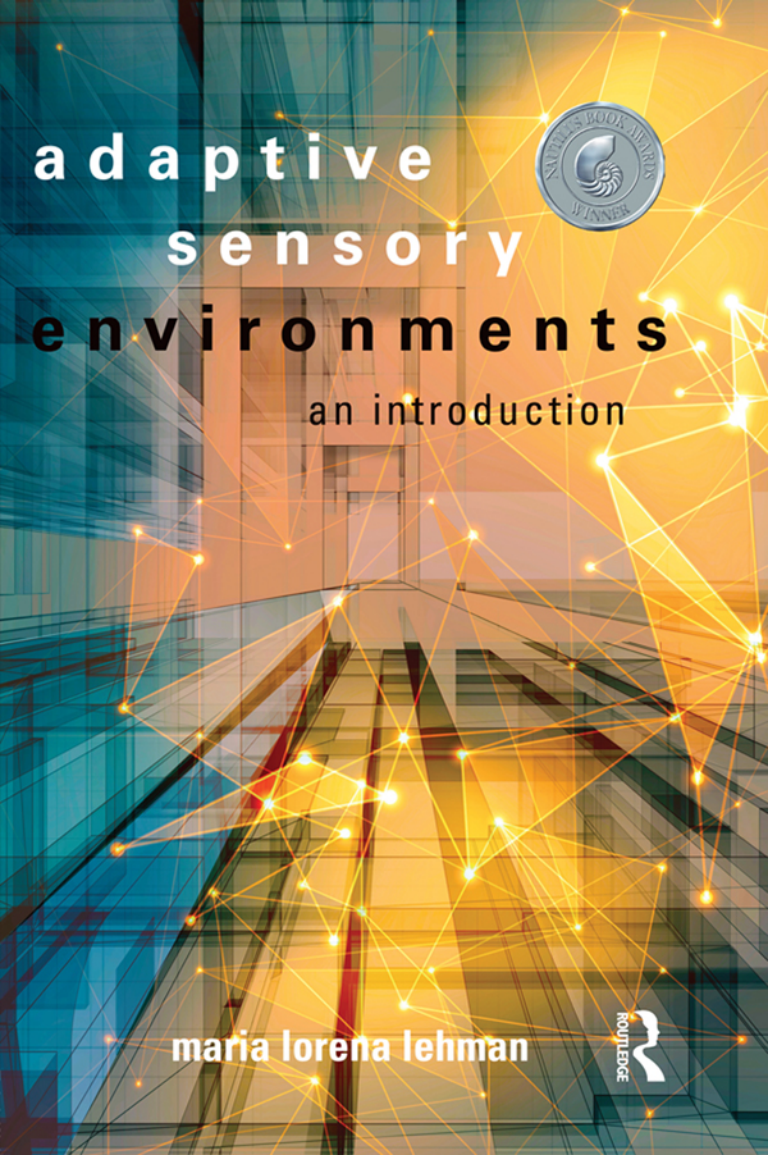
adaptive
sensory
environments
an introduction
NAUTILUS BOOK AWARD
WINNER
maria lorena lehman
ROUTLEDGE

"Maria Lorena Lehman has established a formidable international reputation as a researcher and teacher of multi-sensory design. All her work is devoted to enhancing the human experience when working and living in buildings. This book continues to explore this motive and shows her keen awareness of the lessons from the past and current trends in foreseeing the future for architecture. It is full of creative thought. She examines how technology, nature, learning from other design sectors and many other aspects can harness benefits for occupants and in this way transform architectural design. This is a book students, academics and professionals in practice should embrace and I believe will relish."

Derek Clements-Croome, Professor Emeritus,
School of the Built Environment, Reading University, UK

ADAPTIVE SENSORY ENVIRONMENTS

Adaptive Sensory Environments: An introduction presents a cutting-edge methodology for adaptive sensory design by fostering an inter-disciplinary approach in which aspects of neuroscience, biophilia, captology, nanotechnology, kinetics, and sensemaking all play critical roles in helping adaptive architecture "tune" to occupants. Furthermore, the book illustrates how adaptive sensory environments transform and uplift quality of life in entirely new ways, by strategically unlocking the potential that technological innovations bring. By teaching scholars, researchers, practitioners, specialists, and consultants how to design architecture that guides what emerging interactive technology can do, it allows them to see deeper into an architectural design, to extend beyond interaction and, ultimately, to build environments that adapt by changing and growing with their occupants' immediate needs and long-term goals.

Maria Lorena Lehman is the Founder of the Sensing Architecture ® Academy. She is recipient of the Harvard University Digital Design Prize, and holds degrees from both Virginia Polytechnic Institute, US and the Harvard University Graduate School of Design, US. Lehman is internationally published and in numerous periodicals, including *Architect Magazine* and *Forbes*. Learn more at SensingArchitecture.com.

ADAPTIVE SENSORY ENVIRONMENTS

An introduction

Maria Lorena Lehman

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For my loving family, who brighten my life with beauty every day.

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INTRODUCTION

The synergy lens

Imagine an environment that predicts and responds to occupant need with such harmony, that occupants thrive not only physically, but also mentally and spiritually. This is an environment in perfect synergy, manifest through the relationships between its parts that come together to yield transformational occupant experience. This book delves into this next evolution of architectural design, where adaptive sensory environments go beyond comfort to help occupants achieve not only short-term needs, but also longer-term milestones, goals and ultimate fulfillment. These are environments where health, safety and happiness abound because they stem from *the synergy lens*.

To innovate the future of architectural design is to create a new synergy. By bringing together seemingly disparate parts through synergistic design, it becomes possible to shift paradigms to yield life-changing opportunities. Synergy occurs when parts work together to create much more than they could have ever accomplished if separated. Thus, it is in the relationship between segments that benefits are born, and where change-making occurs.

To design from a "lens" of synergy calls for a heightened awareness that unfolds the two-way dialogues that occur between entities. An example of this can be seen in the evolution of engagement between an adaptive architecture and its occupant, as they help each other to improve with each interaction between them. Designers must seek such opportunities that allow for two-way dialogues to deepen over time. And it is in the "sensing of synergy" that this all becomes possible.

The renewal of connection between humans and nature is synergistic and evolutionary. As people evolve, so too, does the way they engage with their natural environment. With each new innovation, relationships change – they expand, contract, grow and deepen. Thus, emerging breakthroughs with technology and

important discoveries in fields like neuroscience are pointing environmental designers toward the need for advancing occupant-centered design. After all, such innovations are making real-time engagement faster, cheaper and smarter.

Occupant-centered design must be brought to the next level, where designers create environments that feed the senses for both the occupant *and the building*. By creating a feedback loop, adaptive sensory architecture brings occupant-centered design into new realms where it becomes possible to meet real-time occupant need and long-term occupant goals. Adaptive sensory environments do not just house function and aesthetic, they proactively *foster* function and aesthetic through real-time evolution by sensing and actuating synergies during occupant journeys. This is a change-making architecture that allows designers to author environments that empower occupants in entirely new ways.

Real-time synchronization bridge

Findings in neuroscience shed light on how space impacts physiology, perception, cognition and behavior. This is particularly important as technological advancements continue to emerge. As the internet of things, wearable technologies, nanotechnologies and ubiquitous computing proliferate into environments, building occupants are again evolving in the way they relate to their surrounding contexts. Such technological developments are changing the landscape of built environments, while neuroscientists are uncovering insights into the impact of these changes. Thus, the time is ripe for designers to extract and create beneficial next steps for the advancement of architectural design. Architecture is poised to reach beyond interaction – to transcend into the realm of adaptability, where synergy can reach its optimal potential.

Through biophilia and biomimicry, designers are harmonizing and learning from nature. And through design computation advancements, architects are using tools that allow them to more deeply understand their own designs. Thus, important trends are gaining momentum, and it is up to environmental designers to unlock their capabilities once merged. Such a convergence leads to an architecture that acts as a "synchronization bridge" where built form filters in the benefits between entities, and filters out what hinders. This is an architecture which adapts in real time as it finds synergies. It creates empowering experience for occupants by making smarter design decisions through its real-time adaptation. This is an adaptive sensory environment, designed to pull from the best of what neuroscience, technology, and nature have to offer – leading the advancement of occupant-centered design.

The rise of engagement

It is important to understand how more engagement with the built environment impacts occupants. After all, flex design is giving way to interactive design, which is giving way to adaptive design. Thus, the question is not whether technology is

advancing, but rather, what to do with it as it advances. Architects need to consider not just how designs should engage with occupants, but also when, why and where. Engagement is no longer a one-size-fits-all solution, but rather, a means by which to further personalize architectural experience. Through engagement, synergy between architecture and occupant is heightened, and this brings added benefits for each.

As technology makes more engagement possible, and is evolving at increasingly faster rates, designers can use these trends to their advantage by using technology to better understand the consequences of their design solutions. In this way, an adaptive architecture is not built to be used and then torn down; but rather, to be built, used and tweaked optimally for improvement over time. With adaptation, refinements can occur that improve the way a built environment engages with its occupants. In other words, architecture can grow and change as its occupants grow and change. Architecture is no longer static. It is transient and fluid in its behavior.

Guiding technology

The future role of technology in design is to support the human reach for a higher level of consciousness – to become more self-aware. In this way, occupants become better citizens for the good of planetary needs, societal needs and their own needs. Architectural technology should support human fulfillment, where through environments it can prompt, guide, remind, educate, listen, learn and even inspire. By entering into a synergy with built form, technology can unite occupants with their surroundings anew – for example, experiencing nature in a way never experienced before. Technology can serve to make the impossible, possible.

As new technologies surface, architecture gains layered capabilities that designers must understand. The impact of such capabilities can be profoundly felt by occupants; thus, it is imperative that technology not be used simply because it can be used. Emerging technologies must be *guided* into environments by designers, to meet needs or to create new opportunities. Technologies should not be integrated as a "default" by which to strengthen a poor design. Instead, designers should think synergistically about technology, so they can see how it fits into the *entire* context. After all, technology is only one part of the equation.

Advancing occupant-centered design

The intent of this book is to guide the environmental design profession toward advancing what occupant-centered design can do for occupants. Through the innovation of architectural experience, environments can uplift quality of life in entirely new ways. For this reason, the chapters ahead point to the design of adaptive sensory environments – where real-time architecture becomes change-maker. By advancing occupant-centered design, architects can create environments that do more than meet occupant needs as they surface. Such environments can also be strategically designed to forecast needs, plan growth paths and support goal

attainment. These become next level environments centered on the occupant, always adapting to support their safety, health and happiness for ultimate fulfillment.

Advancement begins by exposing the problems and challenges which today's emerging technology brings. By better understanding such design limitations, architectural designers can more readily bridge the gap between where built form is today, and where it should be tomorrow. This book carves a path toward the innovation of architecture and the advancement of occupant-centered design – where adaptive sensory environments are used strategically to empower the occupants they serve.

Throughout this book, architectural technology design is taught through the lens of synergy. By strategically converging technology with other critical leading-edge trends, it becomes possible to turn technology from that which detracts, to that which supports. With a perspective toward progress and innovation, this book encourages a humanistic advancement of technological evolution within design. To do this well, designers must strategically extract from technology's potential. This book provides the "recipe."

Environment as linchpin

Adaptive sensory environments act as a "bridge" that connects occupants with their surrounding contexts in real time. For example, such environments can do this to varying degrees as they dynamically filter nature into occupant experience. To form such connections, the design of adaptive sensory environments is critical. Such an environment becomes the linchpin that allows for new synergies between nature and occupant. This designed "bridge" synchronizes between the two, as it uses its adaptable behavior to optimize how, when, where and why the two engage.

An adaptive environment adjusts to support its occupant. Through architect-embedded rules and occupant control points, this architecture ultimately helps occupants with decision-making. That is, it does not make decisions for them but rather it helps occupants to make informed, healthy and fulfilling decisions that have impact at micro and macro scales. Adaptive sensory environments impact individuals, collectives and institutions, from the scale of a room, to the scale of a city, to the scale of a system, like healthcare or education. Environmental design can solve challenges experienced by the individual and the collective through a sequence of solutions or one milestone solution. In either case, adaptive environments dynamically adjust to find the best path to help occupants overcome such challenges.

The environment is at the nexus. Through time it has been sensed by its contexts, and over time it will increasingly be able to sense its contexts. This shift allows for renewed connection between occupants and their surroundings. Adaptive sensory environments bridge weather systems, data systems and even urban systems. It becomes a real-time linchpin – a synergistic lens through which occupants experience.

Pathfinder architecture

As the future unfolds, architecture is becoming increasingly dynamic, and less static. It is able to interact with its contexts in new ways, and at deeper levels. By transcending interaction, and embodying adaptability, this transient architecture calls for renewed design thinking, conceptualization processes and integrated capabilities. Authors of adaptive sensory environments must be aware of the impact of their designs, as transience yields deeper levels of occupant engagement. And this calls for renewed design tools that allow designers to understand their creations more deeply.

This book guides the design profession to build "pathfinder" environments that help occupants to journey through the challenges they seek to overcome and the goals they seek to achieve. Adaptive sensory environments are linchpins that mirror and extend occupant efforts to meet needs and reach goals. The role of adaptive sensory environments is to leave occupants better off than before their experience with the architecture. Such environments become an "invisible skin" that simultaneously protects and exposes in order to unveil transformative opportunities for occupants. This architecture is a guide, like a "live map" that travels with an explorer, helping them to get to where they want to go. If a wrong turn is made, the architecture adjusts. And with each self-correction, the environment learns to improve in the way it supports and empowers its occupants.

Similarly, this book is to serve as pathfinder to guide environmental designers toward a renewed self-awareness, where design with technology is more strategic as it enriches and renews occupant experience through the architecture. This book carves a path toward a better tomorrow that integrates technology into environments to fuel occupant growth and potential. It all begins with the advancement of occupant-centered design that reaches new levels of refinement by designing for synergy.

Sensemaking opportunities

As design synergy takes effect through adaptive environments, it is in the *sensing* that deeper engagement unfolds. Sensing allows for perception by both occupants and architecture that fosters a mutually beneficial relationship between the two through "sensemaking." The pages ahead propose new ways for this relationship to evolve, with the goal of innovating capabilities for occupant growth and fulfillment.

Through sensemaking, understanding is reached by both environment and occupant. Language is formed and processed into behavior over time. Such engagement forms character within both building and occupant, and personality is the thumbprint that runs through each. The design of adaptive sensory environments renews and innovates experience for occupants; in turn, adaptive sensory architecture is renewed and innovated by its experience with occupants. Each impacts the other, and leaves a mark from which evolution progresses.

Architecture today must be understood for all of its strengths and weaknesses. From there the path grows, the future unfolds and life changes and is uplifted. Expanding what design can do means seeing through a more focused lens that captures the capabilities of synergetic design. This sets the foundation for adaptive sensory environments which exude synergy, moment-by-moment, to help occupants thrive.

Adaptive sensory environments are catalysts that turn change and challenge into growth opportunity, and its designers are the fuel by which to spark such beneficial transformations. This book aims to carve the path toward this realization.