

From Bricks to Bytes

ESG Transformation in the
Digital Built Environment

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ESG TRANSFORMATION IN THE DIGITAL BUILT ENVIRONMENT

Nadzirah Zainordin, Dainna Baharuddin, Norshakila
Rawai, & Khoo Sui Lai

From Bricks to Bytes: ESG Transformation in the Digital Built Environment

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ISBN: 9 788793 914315

Printed by International Federation Surveyors (FIG)

DEDICATION

To the visionaries, changemakers, and silent builders—
who believe that cities are not just built with bricks and steel,
but with values, purpose, and imagination.

To the educators and researchers
who shape minds with knowledge and inspire hearts with
curiosity.

To my family and mentors,
whose unwavering support and belief in sustainable futures
continue to light the path forward.

And most of all,
to the next generation of built environment leaders—
may you build not only smarter cities,
but fairer, greener, and more inclusive communities for all.

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FOREWORD

In the face of climate urgency, urban inequality, and digital disruption, the built environment stands at a transformative crossroads. No longer defined solely by physical structures or static assets, our cities and infrastructures are evolving into dynamic systems—driven by data, governed by values, and shaped by an increasing responsibility to future generations.

This timely volume, *From Bricks to Bytes: ESG Transformation in the Digital Built Environment*, captures the spirit of this evolution with clarity and conviction. It boldly reimagines the way we design, procure, finance, and operate the spaces we inhabit—not only through bricks and mortar but through embedded intelligence, ethical governance, and inclusive growth.

Environmental, Social, and Governance (ESG) principles have moved beyond boardrooms and CSR reports. Today, they are fundamental pillars in shaping how we conceive smart, sustainable, and socially responsive cities. Yet, ESG alone is not enough without the transformative power of digitalisation. When fused, ESG and digital innovation offer a powerful framework to build not just resilient infrastructure—but also resilient societies.

This book presents a compelling roadmap for this new paradigm. Through carefully curated chapters, it explores how digital technologies such as artificial intelligence, digital twins, blockchain, and IoT are being harnessed to measure impact, enhance transparency, and drive

long-term value creation. It interrogates critical topics like ESG-linked financing, scenario planning, and sustainable procurement—while never losing sight of the human dimension at the heart of urban development.

Importantly, this work is not confined to theory. It draws on real-world practices, emerging models, and forward-looking reflections that will inspire policymakers, academics, built environment professionals, and students alike. It challenges us to rethink what it means to build—not just stronger cities, but better futures.

As we transition from an era of *bricks* to a future of *bytes*, we are reminded that our greatest responsibility lies in creating environments that are not only smart and efficient, but also just, regenerative, and inclusive. This book is a vital contribution to that mission—and a call to action for all who believe in the power of the built environment to shape a more equitable and sustainable world.

PREFACE

The built environment stands at a crossroads—where tradition meets transformation, and where the convergence of sustainability, governance, and technology is reshaping how we design, build, and live. *From Bricks to Bytes* was born out of this moment of transition.

As a scholar, practitioner, and educator in the field of the built environment, We have witnessed how environmental, social, and governance (ESG) considerations are no longer peripheral, but central to the success and resilience of infrastructure and urban development. At the same time, digital tools—from artificial intelligence to blockchain and digital twins—are empowering us to track, manage, and improve the performance of our cities with unprecedented precision.

This book is an attempt to bridge two powerful forces: the global momentum around ESG accountability and the transformative potential of digital innovation. It explores how quantity surveyors, architects, planners, policymakers, and technologists can work together to embed ESG values into every phase of the building lifecycle—from procurement and finance to operations and community engagement.

Drawing on current research, emerging case studies, and industry trends, the chapters provide a forward-thinking roadmap for future-ready professionals who are committed to building more inclusive, climate-resilient, and digitally connected environments.

We hope this work contributes to meaningful conversations and actionable pathways for students, researchers, and practitioners alike.

More than ever, our challenge is to think systemically, act ethically, and build intentionally—for the generations to come.

INTRODUCTION

“ From Bricks to Bytes: ESG Transformation in the Digital Built Environment “

In an era defined by climate urgency, urban complexity, and digital acceleration, the built environment must evolve beyond its traditional boundaries. No longer is construction solely about physical structures and architectural form—it is now equally about how buildings and infrastructure respond to environmental, social, and governance (ESG) challenges, powered by smart technologies and data-driven decision-making.

This book sets out to explore that very transformation—from bricks to bytes.

Across the globe, cities are under pressure to become more resilient, equitable, and intelligent. The traditional model of development, often focused on cost-efficiency and short-term delivery, is increasingly insufficient to meet the demands of a world facing rising temperatures, rapid urbanisation, and widening social gaps. At the same time, innovations in digital technologies—such as Internet of Things (IoT), Building Information Modelling (BIM), blockchain, and digital twins—are revolutionising the way we design, monitor, and manage the life cycle of the built environment.

The convergence of ESG and digitalisation is no longer a distant ideal. It is an emerging reality that offers a new blueprint for sustainable

urban development. ESG principles help ensure that buildings are environmentally responsible, socially inclusive, and governed with transparency. Digital tools enable real-time tracking of performance, predictive maintenance, transparent procurement, and participatory governance.

This book is structured around key themes that address how this transformation unfolds in practice:

- How ESG-linked financing and procurement models are changing infrastructure investment
- How smart technologies enable healthier, safer, and more inclusive built environments
- How governance, ethics, and community participation are being redefined through digital platforms
- How professionals in architecture, construction, and urban planning can lead this change with purpose and precision

It draws from real-world case studies, global frameworks, and interdisciplinary insights to guide practitioners, policymakers, students, and scholars toward more responsible and future-proof built environments.

Ultimately, this is a book about change. It is about reimagining the built environment not just as structures we live and work in, but as dynamic systems that shape—and are shaped by—our collective values. As we shift from bricks to bytes, we must also shift our mindsets: from profit to purpose, from isolation to integration, and from short-term fixes to long-term foresight.

Welcome to the journey of ESG transformation in the digital built environment.

The Authors

Ts. Sr Dr. Nadzirah Hj. Zainordin is a professional surveyor with a strong academic and research background. She obtained her Master's degree from Heriot-Watt University, UK, a Ph.D. from UTM, and completed her Post-Doctorate at UTHM. She has published over 200 research papers, received more than 150 national and international awards, and led or co-led over 50 research projects. Her achievements include being listed as one of "The Most Successful People in Malaysia" (2021), receiving the Young Surveyor of the Year award from RISM, and the Excellence Award for Inspirational Leadership from BQSM. She been awarded as Southeast Emerging Surveyor of the Year from The Royal Institution of Chartered Surveyors UK (RICS). Her research focuses on sustainable and resilient development in higher education and the construction industry, and she actively contributes to professional bodies locally and internationally.



Sr Dainna Baharuddin is a Chartered Quantity Surveyor with over 30 years of experience in advancing the built environment at national and international levels. She has worked in Malaysia, the United Kingdom, the Republic of Ireland, and Bangladesh, gaining broad global exposure that informs her professional practice and leadership. She graduated from Northumbria University (formerly Newcastle Upon Tyne Polytechnic) and returned to Malaysia to strengthen local consultancy practice. Since 2010, she has served as the second-generation Director of Basar & Harun Sdn Bhd. She is also appointed as a Specialist Expert Witness at the Construction High Court of Malaysia. She served as the 59th President of the Royal Institution of Surveyors Malaysia (RISM) and has contributed extensively to the Board of Quantity Surveyors Malaysia (BQSM) and the Royal Institution of Chartered Surveyors (RICS), supporting professional standards and regional collaboration. She is currently pursuing postgraduate research in ESG, reflecting her continued commitment to shaping the future of the profession.



Dr Shakila Rawai is a Lecturer and Researcher specializing in construction management, sustainable construction, digitalization, and the decarbonization of construction projects. She pursued a Ph.D. directly after completing a first degree under a Fast Track Program at UTM, Malaysia. She has over 12 years of research experience and currently serves as a Lecturer and Researcher, Praxis, Industry and Community Engagement Coordinator, and SDG Coordinator at the Top 3 private University in Malaysia. her research focuses on sustainable construction management, with good knowledge in digitalization and decarbonization of construction projects. Passionate about transforming the construction industry, her focuses on integrating innovative technologies, green building practices, SDG and ESG principles to reduce environmental impact while improving efficiency.



Ts. Sr Khoo Sui Lai graduated with a Bachelor of Building in Construction Economics from the University of Technology Sydney (UTS) and is currently pursuing his Ph.D. (Engineering) at Universiti Tunku Abdul Rahman (UTAR). He is a Consultant Quantity Surveyor (CQS) registered with the Board of Quantity Surveyors Malaysia (BQSM), a Fellow of the Royal Institution of Surveyors Malaysia (RISM), and a Chartered Surveyor with the Royal Institution of Chartered Surveyors (RICS). He is also a Professional Technologist (Ts) registered with the Malaysia Board of Technologists (MBOT). He is actively involved in research, has published academic papers, won local and international invention awards, and led or co-led several research grants. His research interests include digital construction, construction economics, and sustainable development in the construction industry. He also actively contributes to professional bodies at both national and international levels.



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