Smart Cities and Circular Economy

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Smart Cities and Circular Economy: The Future of Sustainable Urban Development

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About the Editors

With over 18 years of experience in academia and industry, Dr Vinay Kandpal is a Finance Expert and Educator who teaches and mentors students at Graphic Era University, Dehradun, India. He is a Professor in the Department of Management Studies, Graphic Era University, Dehradun, India, where he imparts his knowledge and insights on diverse topics in finance, management, and education. He holds a D Litt (Post Doc) and a PhD in Finance from Kumaun University, India, and is also a Post Doctorate Scholar of PG Administracao-Paulista University – UNIP, Brazil. Dr Kandpal is also an enthusiastic and prolific researcher and author who has published more than 62 research papers and six books on diverse subjects, such as sustainability, fintech, smart cities, risk management, circular economy and financial inclusion. He has presented his work at prestigious international conferences and institutions and serves on the Editorial and Reviewer Boards of several well-regarded journals. He is a Full-Time Member of the Association of North America Higher Education International (ANAHEI). Dr Kandpal's impressive career highlights his commitment to advancing knowledge and fostering innovation in finance.

Prof Ernesto DR Santibanez-Gonzalez's research is related to the discipline of climate change and management sciences and focuses specifically on the integration of quantitative methods, AI and business models to formulate medium and long-term strategies to mitigate the impacts of climate change and contribute to the sustainable development of the planet. His passion is addressing and solving problems at the interface of climate change and sustainability that arise in many different fields, such as supply chain, energy efficiency, low-carbon economy, carbon capture and storage, smart city, smart manufacturing, sustainable and resilient supply chain, sustainable operations management and sustainable finance. He is included in the 2% of the most influential scientists in the world according to the Stanford University ranking (2023). He has written more than 100 publications in high-impact scientific journals and managed numerous international research projects. He serves as an Associate Editor of the *Journal of Cleaner Production* (Elsevier), *Journal of Intelligent Manufacturing* (Springer), *Modern Supply Chain Research and Applications* (Emerald, new journal), *International Journal of Big Data Mining for Global Warming*, *Heliyon Business and Economics* (Elsevier) and *Sustainability* among others. He is also the Editor-in-Chief and Founder of *Sustainable Operations and Computers*, a new journal sponsored by the Chinese Academy of Sciences and Elsevier and currently

indexed in Scopus. He has been the Guest Editor of several special issues in top-tier journals, such as *European Journal of Operational Research*, *Journal of Cleaner Production*, *International Journal of Production Research*, *Sustainability*, and the Guest Editor of special issues in journals such as *International Journal of Production Economics*, *Computers and Industrial Engineering* and *Science of the Total Environment*. In addition, he served as a Regional Editor of the *International Journal of Physical Distribution and Logistics Management* (Emerald). He has been a reviewer for *Nature*, *EJOR*, *IJPR*, *IJPE* and numerous other top-ranked journals.

Dr Prasenjit Chatterjee is currently a Professor of Mechanical Engineering and the Dean (Research and Consultancy) at MCKV Institute of Engineering, West Bengal, India. He has over 6,250 citations and many research papers in various international journals and peer-reviewed conferences. He has authored and edited several books on intelligent decision-making, fuzzy computing, supply chain management, optimization techniques, risk management and sustainability modelling. He has also been the Guest Editor of several special issues in different SCIE/Scopus/ESCI (Clarivate Analytics) indexed journals. He is the Lead Series Editor of 'Smart and Intelligent Computing in Engineering', Chapman and Hall/CRC Press, Founder and Lead Series Editor of 'Concise Introductions to AI and Data Science', Scrivener – Wiley; AAP Research Notes on Optimization and Decision-Making Theories; Frontiers of Mechanical and Industrial Engineering, Apple Academic Press, co-published with CRC Press, Taylor and Francis Group and 'River Publishers Series in Industrial Manufacturing and Systems Engineering'. Dr Chatterjee is one of the developers of two multiple-criteria decision-making methods called Measurement of Alternatives and Ranking according to Compromise Solution (MARCOS) and Ranking of Alternatives through Functional mapping of criterion sub-intervals into a Single Interval (RAFSI).

Dr Manoj Kumar Nallapaneni is a transdisciplinary energy and sustainability engineer with a PhD in Digital Circular Economy and Circular Power System from the School of Energy and Environment, City University of Hong Kong. He has obtained two Master's degrees, one in Renewable Energy Technologies from Karunya University, India, and the other in Environmental Economics from Annamalai University, India. He holds a Bachelor's degree in Electrical and Electronics Engineering from GITAM University. Before joining the CityU, he worked as a Research Fellow at Universiti Malaysia Pahang, Malaysia, on a project which focused on using solar photovoltaics as urban and rural infrastructure. Prior to this, he worked as an Assistant Professor in the Department of Electrical and Electronics Engineering at the Bharat Institute of Engineering and Technology, Hyderabad, India, and Energy Engineer at Atiode Solar Systems Limited, Benin City, Nigeria. Dr Nallapaneni's research works focus on the topics of simulation, experimental, real-time empirical and location, or climate-specific studies mainly focused on building sustainable and resilient systems (decentralized, networked and centralized) across critical infrastructure sectors by adopting nexus thinking and systems innovation with an emphasis on circular business

models and digitalization. He worked on key sustainability challenges that include design, performance modelling and analysis of a wide range of clean energy and environmental systems food–energy–water–waste nexus, industrial symbiosis, waste valorization and material passports, carbon accounting and pricing. He possesses an interdisciplinary skill set that includes performance analytics, techno-economics (spreadsheet and tools), life cycle assessment (emission factor/embodied energy approach and LCA tools), resilience assessment (simple and systemic), leveraging digital innovation (blockchain, IoT, smart contracts and AI), business model innovation and nexus systems design with better conceptualization skills.

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Preface

Amidst the current period of fast urban growth and increased concern for the environment, the idea of smart cities combined with the concepts of a circular economy arises as a promising and innovative solution. The book *Smart Cities and Circular Economy: The Future of Sustainable Urban Development* provides a thorough collection of essays that explore the mutually beneficial connection between smart cities and circular economy. It presents valuable viewpoints and advanced research from a wide array of specialists in this domain.

This edited book showcases a diverse range of concepts, examining the potential for smart technology and circular economic models to bring about a radical transformation in urban surroundings. The individuals who contribute to our work include experienced academics, industry experts and forward-thinking policymakers, resulting in a comprehensive and diverse approach to the subject matter. Each chapter provides insight into the several elements that make up smart, sustainable cities, including energy-efficient infrastructures, waste reduction measures, intelligent transportation systems and sustainable urban design.

As editors, our goal has been to carefully choose and organize content that not only explains the fundamental principles of smart cities and circular economies but also presents real-world examples and case studies from various parts of the world. We want to provide readers with a comprehensive overview of the current situation and encourage creative thinking and proactive measures for the future cities.

In this book, we introduced a collection of 17 chapters that delve into the evolving landscape of urban sustainability. Each chapter, authored by renowned experts, presents a unique perspective on the integration of smart city technologies and circular economy principles. From exploring the human-centric aspects of Industry 4.0 to assessing the impact of smart technologies on urban mobility, the book encapsulates a diverse range of topics. It aims to provide a holistic understanding of how innovative technologies and sustainable practices can transform urban environments, making them more efficient, resilient and conducive to the well-being of their inhabitants. This book serves as a vital resource for academics, policymakers and urban planners, offering insights and strategies to navigate the challenges and opportunities of creating sustainable, smart cities in the circular economy era.

Chapter 1 focuses on the importance of creating work environments in the era of Industry 4.0 that prioritize employee well-being and engagement. It emphasizes the need for human-centric approaches in the technologically advanced

workplace to foster a more satisfied and productive workforce. Chapter 2 provides a comprehensive analysis of existing research at the intersection of smart cities and circular economy. It uses bibliometric methods to map and identify key trends, gaps and the evolution of this interdisciplinary field, highlighting how these two areas are increasingly being integrated in scholarly discourse. Chapter 3 examines the potential and challenges of implementing a circular economy in Ho Chi Minh City. It utilizes a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis, grounded in content analysis, to provide a detailed understanding of the current state and future possibilities for sustainable urban development in this rapidly growing city. Chapter 4 explores how IoT technologies can be pivotal in advancing circular economy practices within smart cities. It discusses the potential of IoT to enhance resource efficiency, waste management and sustainable urban development, providing a critical analysis of the challenges and opportunities in leveraging IoT for circular economy solutions in urban environments. Chapter 5 focuses on identifying and analyzing the various challenges faced in implementing circular economy practices in the context of smart cities. It delves into the complexities and hurdles, such as technological, policy and societal barriers, that impact the successful integration of circular economy concepts in urban development strategies.

Chapter 6 discusses strategies for effectively incorporating circular economy models into smart cities. It addresses the various challenges in this integration and outlines potential pathways to overcome these obstacles, thereby facilitating sustainable urban development through innovative and efficient resource management within smart city frameworks. Chapter 7 examines the integration of artificial intelligence (AI) in managing circular economies within smart cities. It highlights the role of AI in optimizing resource use and waste reduction, providing an in-depth analysis of how AI technologies can enhance sustainability and efficiency in urban settings. Chapter 8 delves into how data analytics and AI can be leveraged to enhance resource efficiency in smart cities. It explores the potential of these technologies in optimizing the use of resources, thereby contributing to the sustainability and effectiveness of urban environments within the framework of smart city development. Chapter 9 focuses on the impact of Environmental, Social and Governance (ESG) performance disclosure by firms on sustainable development. It examines how transparency in ESG reporting can influence corporate strategies towards sustainability, particularly in the context of smart cities and the circular economy.

Chapter 10 investigates the capabilities and barriers associated with implementing IoT technologies for circular economy practices in smart cities. It provides insights into how IoT can facilitate sustainable urban development while also addressing the challenges that need to be overcome for its effective integration. Chapter 11 presents an in-depth analysis of the current research trends in the field of circular economy within smart cities. It focuses on identifying the barriers and challenges that impede the implementation of circular economy practices in urban settings, providing a critical overview of the existing research landscape in this area. Chapter 12 explores the relationship between the development of smart cities and the enhancement of sustainable mobility. It discusses how smart city

initiatives can improve the quality of life by fostering more sustainable, efficient and user-friendly transportation systems, thereby contributing significantly to the overall sustainability and livability of urban environments. Chapter 13 discusses the potential of hydrogen fuel cell vehicles as a sustainable solution for urban mobility. It explores the advantages and challenges of hydrogen-powered transportation and its role in reducing emissions and promoting sustainable urban mobility within the context of smart cities.

Chapter 14 examines how smart city technologies influence sustainable urban mobility in developing economies. It evaluates the effects of these technologies on transportation systems, addressing challenges and opportunities to enhance mobility while considering the unique contexts of developing nations. Chapter 15 delves into the difficulties and obstacles associated with integrating AI to enhance circular economy initiatives in smart urban environments. It scrutinizes the complexities and limitations in deploying AI for optimizing resource use and waste reduction within the circular economy framework, offering valuable insights into addressing these challenges. Chapter 16 delves into the difficulties and obstacles associated with integrating AI to enhance circular economy initiatives in smart urban environments. It scrutinizes the complexities and limitations in deploying AI for optimizing resource use and waste reduction within the circular economy framework, offering valuable insights into addressing these challenges. Chapter 17 discusses the intersection of the metaverse, urban living and sustainable mobility. It explores how technological advancements and sustainable transportation solutions can bridge the gap between virtual and physical worlds, enhancing urban living experiences within the context of smart cities and the metaverse.

In the current juncture of human existence, where critical issues such as climate change and limited resources pose imminent threats, the concepts and methodologies deliberated about in this book hold heightened significance. We aspire that *Smart Cities and Circular Economy: The Future of Sustainable Urban Development* would not only enhance scholarly discussions but also catalyze tangible transformations towards more sustainable, efficient and resilient urban ecosystems.

Join us as we explore the intersection of technology and sustainability, redefining urban landscapes through innovation and discovery.

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At the heart of this book on smart cities lies a tapestry woven by the dedication, intellect and innovative spirit of numerous individuals and groups, to whom we extend our deepest gratitude.

Firstly, we recognize the urban planners, urban geographers, policymakers and decision-makers whose diligent work in exploring the complexities, challenges and vast potential of smart cities has been the cornerstone of inspiration for this publication. Their relentless pursuit of knowledge and practical solutions in the urban landscape has illuminated the path for this book's creation.

We are immensely thankful to the community of researchers and working professionals whose substantial contributions have breathed life into this book. Their expertise, insights and unwavering commitment to advancing the field of smart urban planning have been instrumental in shaping the content and quality of this work.

Our appreciation extends to the anonymous reviewers whose keen eyes and thoughtful commentary have significantly enhanced the quality and depth of this book. Their expertise and constructive critiques have been invaluable in refining our perspectives and arguments.

We extend special thanks to our publisher Emerald and the publishing editor for their unwavering support and belief in this project. Their guidance and assistance have been pivotal in navigating the publishing landscape, ensuring that this book reaches its audience effectively. This book is not just a product of our efforts but a collective achievement that reflects the dedication and support of many. It is with profound gratitude that we acknowledge the contributions of each individual and organization involved in this endeavour. Without them, our vision for a smarter, more sustainable urban future would remain unrealized.