The Emerald Handbook of Smart Cities in the Gulf Region

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The Emerald Handbook of Smart Cities in the Gulf Region: Innovation, Development, Transformation, and Prosperity for Vision 2040

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INVESTOR IN PEOPLE

We dedicate this book to the citizens of all ages, with the hope that the added value of smart cities will significantly enhance their quality of life and well-being. May these innovations foster a world where cultures are connected and leveraged for the happiness and prosperity of all.

Miltiadis, Afnan, and Sawsan

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About the Editors

Dr Miltiadis D. Lytras is a world-class expert in advanced computer science and management, an Editor, Lecturer, and Research Consultant with extensive experience in academia and the business sector in Europe and Asia. Dr Lytras is a Visiting Scholar at Effat University, Kingdom of Saudi Arabia. His research focuses on smart cities strategies, cognitive computing, information systems, technology-enabled innovation, and knowledge management. Dr Lytras has co-authored more than 120 high-impact papers in Q1 and Q2 Web of Science and Scopus-indexed journals and has co-edited more than 80 books with international publishers. Dr Lytras's research promotes the utilization of the intersection of computer science and business research toward the promotion of sustainable development goals.

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Dr Wael A. Samad holds the position of Associate Professor of Mechanical Engineering and serves as the Chair of the Department of Mechanical & Industrial Engineering at the Rochester Institute of Technology – Dubai Campus. He obtained his PhD in Mechanical Engineering from the University of Wisconsin – Madison in 2013. Throughout his research endeavors, Dr Samad has delved into areas such as Experimental Solid Mechanics, Material Characterization of 3D Printed Artefacts and Smart Cities. His commitment is demonstrated in the extensive array of over 50 publications he has authored, encompassing peer-reviewed journals, book chapters, and conference proceedings. Among his contributions is an edited volume focused on smart cities in the Gulf. Since setting foot in the UAE almost 10 years ago, Dr Samad has been proactive in forging collaborations with prominent local industries. Notably, his work with Emirates Global Aluminium has played a pivotal role in projects that aim to extend the lifespan of ingot moulds, promoting a more sustainable aluminum production in the Emirates.

João Rodrigues dos Santos holds a PhD in Economics and Management, a Master's degree (with research in the area of Territorial Planning), and a Degree in Geography and Territorial Management (Universidade Nova de Lisboa). He is a Professor at the European University / IADE and he collaborates with the Portuguese Catholic University's Center for Studies and Surveys. His research interests currently are Economics, Political Economy, Political Economy of Communication, Public Policy, Territorial Planning, Environmental Sustainability, Innovation, Information Technology and Communication. He is the author of several articles and book chapters published in national and international journals. He is

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Dr Mustika Sari holds a PhD degree in Civil Engineering. Her primary research interests include infrastructure development and construction management, emphasizing innovations for economic and sustainable development. She is a Senior Researcher at the Center for Sustainable Infrastructure Development (CSID), Faculty of Engineering, Universitas Indonesia, and has been involved in many national and international research activities. She is the Managing Editor of the *CSID Journal of Infrastructure Development (CSID-JID)*. Currently, she is teaching at the Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia.]

Silvana Secinaro, Professor in Business Administration and Accounting at the University of Torino, Department of Management. Chartered accountant and auditor, freelance journalist, and author of numerous publications on public and private accounting and new technologies impact on conservative businesses. Component of National Commission of Italian Ministry of Finance on public accounting. Finally, over the years, she has been the scientific coordinator of multiple European projects, such as H2020 Avangard, to study proper business models for electric mobility in smart cities and an Erasmus + on social entrepreneurship.

Dr Andreea Claudia Şerban is Professor at the Department of Economics and Economic Policies, Faculty of Theoretical and Applied Economics and Director of Doctoral School of Economics I. She holds a PhD in Economics from Bucharest University of Economic Studies and a post-PhD in Economics from Romanian Academy of Science. Her research activity consists in publication of seven books and numerous economic studies in highly ranked journals and participation in many international conferences. She is Associate Editor for *International Journal on Semantic Web and Information Systems* (IJSWIS – WoS indexed journal) and Editor in Chief for *Global Journal of Business, Economics and Management: Current Issues* (journal indexed in many international databases). She is reviewer for prestigious international journals and member in editorial board or organizing committee of many international conferences. She is expert for Lithuania Research Council. Her areas of research interest include: sustainable development, smart development, knowledge economy, labor market, education, demographic issues.

Ravi S. Sharma is Professor of Information Systems & Technology Management at Zayed University, a federal university in the United Arab Emirates. Prior to this he held faculty appointments in New Zealand, Singapore and Canada. He had also spent a decade in industry as an ICT consultant with Deutsche Telekom and IBM Global Services. Ravi received his PhD in Management Sciences from the University of Waterloo, Canada and is a Fellow of the IET and Senior Scholar / Distinguished Member of the AIS. His research interests are in the application of

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Maria José Sousa, Iscte, Portugal. University Professor, with a PhD in Management and a Research Fellow at ISCTE/IUL and of CIEO (Algarve University). Her research interests currently are public policies and political science, innovation, and business management issues. She is a best-seller author in ICT and People Management and has co-authored over 70 articles and book chapters and published in several scientific journals (e.g. *Journal of Business Research, UAIS, Future Generations Computer Systems, Journal of Medical Systems, I. J. of Knowledge, Culture and Change Management, Knowledge Management, Wseas Transactions on Business and Economics, Information Systems Frontiers*, and others), she has organized and peer-reviewed international conferences. She is also External Expert of COST Association – European Cooperation in Science and Technology.

Dr Bambang Susantono is the Chairman of Indonesia's Nusantara Capital City Authority (NCCA). He was the Vice-President for Knowledge Management and Sustainable Development of the Asian Development Bank (ADB). He holds a PhD in Infrastructure Planning and has two master's degrees in Transportation Engineering and City and Regional Planning from the University of California, Berkeley. Susantono was the Acting Minister, Vice-Minister of Transportation of Indonesia (2010–2014), and Deputy Minister for Infrastructure and Regional Development at the Office of Coordinating Ministry for Economic Affairs (2007–2010). He chaired several research institutes and taught in universities. He is actively doing research, publishing several books, and writing articles on infrastructure, transportation, urban and regional planning, sustainable development, and climate change.

Dr Hussin A. M. Yahia, Assistant Professor in Transportation Engineering and Traffic Management in the Department of Civil and Mechanical Engineering, Middle East College affiliated with Coventry University. He was the principal investigator of several national and international studies, among which Governing the smart cities, Growth of Green Buildings in the Oman Construction Industry, supported by the (Ministry of Higher Education, Research and Innovation, Oman) and financed with the TRC (The Research Council – Oman). Total amount founded; 18,000 OMR (46,800 USD). His main research interests are focused on issues in smart cities; IoT smart transportation, intelligent transportation systems, road safety, and green technology in buildings and roads.

Preface

The Emerald Handbook of Smart Cities in the Gulf Region delves into the multifaceted development of smart cities across the Gulf, showcasing how technology, innovation, and sustainability converge to transform urban landscapes. The book is structured around contributions from experts who provide comprehensive insights into various aspects of smart city development, ranging from governance frameworks and technological advancements to sustainability initiatives and societal impacts. Through detailed case studies and empirical research, the handbook explores key themes such as smart infrastructure, intelligent transportation systems, renewable energy integration, and digital governance. It also examines the socio-economic benefits of smart city initiatives, including improved quality of life, economic growth, and enhanced public services. By highlighting best practices and emerging trends, the handbook is an essential resource for policymakers, urban planners, and researchers aiming to understand and implement smart city strategies in the Gulf region.

Chapter Summaries:

Chapter 1: A Holistic Framework for Smart Cities Governance in the Gulf Region: From Hype to Sustainable Impact
Authors: Miltiadis D. Lytras, Afnan Alkhaldi, Sawsan Malik, and Andreea Claudia Serban

This chapter introduces a framework for governing smart cities in the Gulf region, focusing on governance, strategy, technology, and infrastructure. The framework aligns with the Sustainable Development Goals (SDGs) to guide smart city initiatives. The authors emphasize the importance of data integrity, regulatory resilience, and civic engagement in ensuring ambitious and sustainable strategic initiatives. This approach provides a robust model for smart city projects, which can be adapted and applied to various urban settings globally.

Chapter 2: Smart City Innovation and Sustainability: A Comparative Study in GCC Countries
Authors: Revenio C. Jalagat, Jr, Edwin C. Du, Neilson D. Bation, and Perfecto Gatbonton Aquino, Jr

This chapter evaluates the benefits and challenges of smart city technologies in the UAE, Saudi Arabia, and Qatar and offers policy recommendations for

sustainable development. The authors conducted a comparative analysis using documentary evidence to identify best practices and areas for improvement. Their work emphasizes the need for collaborative efforts among stakeholders to sustain smart city operations. This chapter provides valuable perspectives on how innovation drives sustainable urban development.

Chapter 3: The Science of Mobile Pedestrianism Through Smart Cities
Authors: Ashok Chopra and Anita Rani Chopra

This chapter explores how walkability and IoT enhance urban living, promoting health, safety, and environmental sustainability through strategic planning. The authors discuss the role of walkable communities and technology integration to support pedestrianism. Their findings suggest that well-planned, walkable cities can significantly improve residents' quality of life. The chapter highlights the importance of designing urban environments prioritizing human mobility and health.

Chapter 4: Innovating Urban Environments: The Impact of Smart City Technologies on Employee Performance, Quality of Life, and Service
Authors: Alice AlAkoum and Elvira Nica

The chapter discusses how smart city technologies improve employee performance, quality of life, and service delivery, emphasizing the need for ongoing innovation and policy support. The authors analyze the interplay between advanced technologies and urban living conditions. Their work illustrates the potential of smart cities to create efficient and sustainable urban environments. This chapter emphasizes the critical role of technology in shaping future workplaces and urban spaces.

Chapter 5: Democratization and Transformation of Higher Education in the Era of Smart Cities
Authors: Kevin A. Jones and Ravi S. Sharma

This chapter explores the shift toward personalized and diversified education modes in smart cities, advocating for adaptable, learner-driven approaches. The authors discuss the impact of digital platforms on higher education and the need for institutions to reimagine their roles. Their analysis reveals the potential of smart city environments to enhance educational accessibility and relevance. The chapter emphasizes the importance of innovation in education for sustainable urban development.

Chapter 6: The Rebirth of Museum Education Echoing of Smart Education
Authors: Yingyilong Hu, Zhengchao Fu, Suwithda Charungkaittikul and Ravee Chudasring

This chapter explores digital platforms in museum education and presents the Danxiashan Geo-Museum case study, illustrating innovative educational approaches through smart technologies. The authors highlight the potential for museums to become dynamic educational environments. Their work suggests

that integrating digital tools can enhance cultural and educational outreach. This chapter demonstrates the transformative power of technology in museum education, aligning with smart city goals.

Chapter 7: The Synergy Between Advanced Innovative Water Management and Smart Cities Development: Enhancing Sustainability and Quality of Life
Authors: Dr Hend Sameh Hafez Hassan, Dr Ahmed Abdelkader, and Dr Oualid Abidi

The chapter outlines a framework for adopting ICTs to support sustainable water management in smart cities, emphasizing citizen engagement and interdisciplinary collaboration. The authors present case studies from the GCC region to illustrate best practices. Their findings highlight the critical role of technology in managing urban water systems sustainably. This chapter contributes to the discourse on how smart cities can address environmental challenges effectively.

Chapter 8: AI's Role in the Development and Transformation of Smart Cities
Authors: Andreia De Bem Machado, Gabriel Osório De Barros, João Rodrigues dos Santos, Silvana Secinaro, Davide Calandra, Maria José Sousa

This chapter maps AI applications in public safety, transportation, energy, and more, emphasizing AI's role in enhancing urban living conditions and supporting Vision 2040 initiatives. The authors use qualitative narrative analysis to explore AI's impact. Their research highlights AI's potential to revolutionize smart city services. This chapter underscores integrating AI into urban planning for innovative and sustainable growth.

Chapter 9: The Impact of Innovation & Sustainable Development in Smart Cities
Author: Khider Hamid Khider

This chapter focuses on the integration of IoT, AI, and smart grids and discusses how innovation and sustainable practices address urban challenges and improve quality of life. The author analyzes the role of advanced technologies in fostering sustainable urban environments. The findings suggest that continuous innovation is essential for maintaining urban resilience. This chapter highlights the need for strategic planning and investment in sustainable technologies.

Chapter 10: Digital Intersections: Synergies Between the Gig Economy and Evolution of the Smart City
Authors: Sawsan Malik, Afnan Alkhaldi, Jarrah Fahad Al-Mansour, and Miltiadis D. Lytras

The chapter explores how the gig economy integrates with smart city frameworks, enhancing urban living through technology-mediated work arrangements. The authors provide case studies from global and regional examples. Their analysis reveals the potential for digital platforms to create efficient urban ecosystems. This chapter emphasizes the importance of digital literacy and inclusivity in leveraging the benefits of the gig economy for smart city development.

Chapter 11: Enhancing Prosperity through Smart Tourism: A Competitive Analysis of Gulf Cities Using STCCI
Authors: Hyunae Lee and Namho Chung

Introducing the STCCI, this chapter evaluates Gulf cities' smart tourism capabilities, providing strategic insights for fostering innovation and development. The authors benchmark cities like Dubai, Abu Dhabi, and Doha using the index. Their findings highlight the strengths and areas for improvement in each city. This chapter emphasizes the role of strategic enhancements in driving smart tourism and urban development.

Chapter 12: Innovative Digital Transformation of Issuing Final Clearance Certificates for Infrastructure Projects in Dubai
Authors: Anmar AlObaidi and Wael A. Samad

This chapter presents a case study on digitizing clearance processes for infrastructure projects, highlighting the eNOC portal's role in enhancing efficiency and transparency. The authors analyze the process using the DMAIC methodology, demonstrating how digital transformation can streamline application submissions and improve project management. Their findings emphasize the importance of technological innovation for regulatory compliance and customer satisfaction, offering valuable insights for smart city administrators aiming to optimize urban infrastructure projects.

Chapter 13: Innovating Urban Policy Development: Lusail Smart City's Role in Qatar's Transition to a Knowledge-Based Economy
Author: Dr Ahmed Badran

The chapter discusses Lusail Smart City's contributions to Qatar's knowledge-based economy, emphasizing strategic initiatives for innovation and sustainable urban planning. By presenting a detailed case study of Lusail City, the author illustrates how smart infrastructure, and advanced technologies can foster urban living and economic growth. The analysis highlights the need for policy support and stakeholder engagement, providing a model for other cities aiming to achieve similar transformational goals.

Chapter 14: The Role of Government in Ensuring Sustainability in Smart Urban Development: A Case Study of Kuwait
Authors: Afnan Alkhaldi, Sawsan Malik, Salah Alhammadi and Miltiadis D. Lytras

Using Kuwait as a case study, this chapter explores the government's role in promoting sustainability through strategic initiatives and policy support. The authors highlight successful models from the GCC and beyond, demonstrating effective combinations of technology, infrastructure, and sustainable practices. Their findings illustrate the importance of public-private partnerships and robust legislative frameworks in achieving sustainability goals, significantly contributing to smart city research and practice.

Chapter 15: Innovating Sustainable Urban Development: Evaluating the Social Acceptance of Residential Solar Integration for the Prosperity of Abu Dhabi
Authors: Hamed M. Hussain and Dr Khalil Rahi

This chapter analyzes the potential for residential solar integration, highlighting the importance of public awareness and supportive policies for sustainable energy adoption. The authors present survey results from Abu Dhabi residents, revealing a high interest in solar energy and a preference for government financial support. Their findings emphasize the need for comprehensive public awareness campaigns and strategic incentives, contributing valuable insights into promoting renewable energy in smart cities.

Chapter 16: Strategic Planning for the Development of Smart Cities in Oman
Authors: Hussin A. M Yahia, Azzan Majid Al-Shukaili , Ram Kishore Manchiryal, Taleb Eissa, and Ali Ahmed Mohammed

Focusing on Muscat, this chapter discusses strategies for transitioning traditional cities into smart urban areas, emphasizing legislative support and community engagement. The authors outline principles of sustainable development and urban policy formulation, presenting practical solutions for integrating advanced technologies. Their findings suggest that strategic planning is essential for successful smart city implementation, highlighting the importance of aligning urban development with national visions like Oman Vision 2040.

Chapter 17: Toward Kuwait Seaport's Sustainability 2040: The Implication of Digital Twins Technology on Terminal Containers' Transformation
Authors: Zeinab Gamal, Ahmed Aboualam, and Munther Abbas Alkandari

The chapter explores digital twins' technology in enhancing Kuwait's seaport sustainability, providing a framework for managing logistics operations and future demands. The authors discuss the role of digital twins in improving efficiency and reducing environmental impact. Their analysis highlights the correlation between population growth and logistics needs, emphasizing the importance of advanced technologies in managing urban infrastructure. This chapter underscores the potential of digital technologies in transforming seaport operations for sustainable development.

Chapter 18: Shifting Toward Digitalization and Smart Cities: Evidence from Kuwait
Author: Dr Rashed Alhaimer

This chapter examines Kuwait's strategic investment in digital infrastructure, exploring its impact across various sectors, including political campaigns, public health, and corporate innovation. The author highlights Kuwait's $10 billion commitment to enhancing its digital capabilities, demonstrating how digitalization fosters innovation and economic growth. The findings emphasize the transformative role of social media and digital platforms in shaping urban development, contributing to Kuwait's Vision 2035 and the broader smart city agenda.

Chapter 19: United Arab Emirates: Integration of Smart Technology – An Innovative Solution for Climate Change Mitigation
Authors: Prisilla Jayanthi Gandam, Xi Chen, Muralikrishna Iyyanki, Utku Kose, and Valentina Emilia Balas

The chapter highlights UAE's initiatives in using smart technologies for climate change mitigation, showcasing AI, IoT, and digital twins in sustainable urban development. The authors present case studies from Abu Dhabi, illustrating how smart systems enhance energy efficiency, public health, and environmental monitoring. Their analysis illustrates the UAE's digital transformation leadership and commitment to achieving net zero emissions by 2050. This chapter provides valuable insights into the role of smart technologies in addressing global environmental challenges.

Chapter 20: The Social, Economic, and Sustainability Agenda of Smart Cities in the Kingdom of Bahrain
Author: Omer Hag Hamid

This chapter presents a comprehensive framework for advancing smart cities in Bahrain. It focuses on integrating technological advancements with sustainable practices to enhance societal well-being, economic growth, and overall development. The author aligns the framework with Bahrain's 2030 Vision, emphasizing social impact, healthcare access, and renewable energy projects. The analysis highlights initiatives such as smart parks and community centers that foster social cohesion. This chapter underscores the importance of a holistic approach to creating inclusive, prosperous, and sustainable smart cities.

Chapter 21: Transforming Ecological Footprint Through Circular Economy Innovation toward Sustainable Well-Being in the Development of (Islamic) Smart Cities in GCC Countries
Author: Khairunnisa Musari

The chapter explores how Islamic Smart Cities can leverage circular economy innovations to mitigate environmental impacts and foster sustainable development in the GCC region. The author discusses the high ecological footprint of high HDI countries, and the potential of circular economy principles supported by technology and community engagement. The analysis highlights the strategic role of Islamic Smart Cities in global green transitions, emphasizing their capacity to set an example for sustainable urban development. This chapter contributes to understanding how cultural and technological integration can drive environmental sustainability.

Chapter 22: Understanding and Optimizing Hydrogen Transport Technologies for 21st Century Smart Cities: Innovation for Morocco's Green Interconnections in Hydrogen, Ammonia, and Kerosene Production
Author: Ayat-Allah Bouramdane

This chapter evaluates hydrogen transport methods, using the Analytic Hierarchy Process (AHP) tool to optimize technologies for sustainable energy solutions in

Morocco's smart city initiatives. The author explores various hydrogen transport methods, assessing their advantages and process equations. The analysis identifies barriers and opportunities for hydrogen transport, providing strategic insights into optimizing these technologies. This chapter aligns with Morocco's vision for sustainable development, highlighting the potential of hydrogen transport in reducing carbon emissions and enhancing energy security.

Chapter 23: Smart City Framework for Nusantara Capital City Development
Authors: Bambang Susantono, Mohammed Ali Berawi, and Mustika Sari

The chapter outlines a comprehensive framework for developing Nusantara, Indonesia's new capital city, as a smart city. The authors integrate advanced technologies across six key domains: governance, transportation, living, resources, industry, and infrastructure. Their detailed insights into strategic planning and implementation processes highlight the importance of technological innovation and sustainability. This chapter provides a model for future urban development, emphasizing the need for community engagement and environmental preservation in building world-class smart cities.

Chapter 24: Artificial Intelligence for Smart City Vision 2040 in Gulf Region
Authors: Miltiadis D. Lytras, Afnan Alkhaldi, Sawsan Malik, and Andreea Claudia Serban

This concluding chapter explores the transformative role of AI in smart city development, emphasizing its integration with governance, strategy, and infrastructure. The authors discuss strategic areas such as LLMs, AI-driven social network analysis, and predictive analytics, showcasing how AI can enhance smart city services and foster new markets. Their holistic approach ensures that AI improves the quality of life and economic prosperity and positions the Gulf Region as a global leader in smart city innovation. This chapter calls for leveraging AI's potential to transform urban development sustainably.

Concluding Remark:

This book serves as an essential reference point and a comprehensive guide to the groundbreaking Smart Cities initiatives and projects that are shaping the future of the Gulf region. The transformation occurring within these cities and countries is a testament to the region's vision and ambition, offering a unique perspective on economic and social development. Through a deep exploration of the smart city concept, this volume showcases the incredible potential for positive change and the profound social footprint that can be achieved.

The academic community, policymakers, government officials, and citizens will find valuable insights and knowledge within these pages. It highlights the dedicated work and contributions of academics, practitioners, and students who strive for a world of peace, prosperity, and mutual respect. Their collective efforts are leading us toward sustainable and inclusive urban environments, and their impact will be felt for generations.

This book not only celebrates their dedication but also invites further collaboration and innovation. It is a call to action for continued progress, inspiring all readers to embrace the potential of smart cities and the positive impact they can have on our world. We believe this volume will spark new ideas, foster cooperation, and drive the vision of smart cities forward, creating a better future for all.

Miltiadis D. Lytras, Afnan Alkhaldi, and Sawsan Malik

Organization in Sections

Section 1: Governance and Strategic Frameworks
This section focuses on the foundational frameworks, governance strategies, and policy implications for developing and sustaining smart cities. It covers holistic frameworks, the role of government, and strategic planning necessary for smart city initiatives.

Chapter Number	Chapter Title
1	A Holistic Framework for Smart Cities Governance in the Gulf Region: From Hype to Sustainable Impact
2	Smart City Innovation and Sustainability: A Comparative Study in GCC Countries
3	The Science of Mobile Pedestrianism through Smart Cities
4	Innovating Urban Environments: The Impact of Smart City Technologies on Employee Performance, Quality of Life, and Service
13	Innovating Urban Policy Development: Lusail Smart City's Role in Qatar
14	The Role of Government in Ensuring Sustainability in Smart Urban Development: A Case Study of Kuwait
16	Strategic Planning for the Development of Smart Cities in Oman
18	Shifting Toward Digitalization and Smart Cities: Evidence from Kuwait

Section 2: Technological Innovations and Digital Transformation
This section delves into the technological advancements driving smart city development, including AI, IoT, digital twins, and other innovations. It highlights the transformative impact of these technologies on various urban sectors.

Chapter Number	Chapter Title
5	Democratization and Transformation of Higher Education in the Era of Smart Cities
6	The Rebirth of Museum Education Echoing of Smart Education
7	The Synergy between Advanced Innovative Water Management and Smart Cities Development: Enhancing Sustainability and Quality of Life
8	AI's Role in the Development and Transformation of Smart Cities
9	The Impact of Innovation & Sustainable development in Smart Cities
10	Digital Intersections: Synergies between the Gig Economy and evolution of the Smart City
12	Innovative Digital Transformation of Issuing Final Clearance Certificates for Infrastructure Projects in Dubai
22	Understanding and Optimizing Hydrogen Transport Technologies for 21st Century Smart Cities: Innovation for Morocco's Green Interconnections in Hydrogen, Ammonia, and Kerosene Production

Section 3: Sustainability and Environmental Impact
Description: This section addresses the environmental aspects of smart city development, focusing on sustainability practices, renewable energy integration, and climate change mitigation. It includes case studies and strategic approaches for sustainable urban living.

Chapter Number	Chapter Title
11	Enhancing Prosperity through Smart Tourism: A Competitive Analysis of Gulf Cities Using STCCI
15	Innovating Sustainable Urban Development: Evaluating the Social Acceptance of Residential Solar Integration for the Prosperity of Abu Dhabi
17	Toward Kuwait Seaport's Sustainability 2040: The Implication of Digital Twins Technology on Terminal Containers' Transformation
19	United Arab Emirates: Integration of Smart Technology – An Innovative Solution for Climate Change Mitigation
20	The Social, Economic, and Sustainability Agenda of Smart Cities in the Kingdom of Bahrain
21	Transforming Ecological Footprint through Circular Economy Innovation toward Sustainable Well-Being in the Development of (Islamic) Smart Cities in GCC Countries

Section 4: Case Studies and Regional Insights
Description: This section compiles specific case studies and regional analyses, offering insights into smart city implementations across different Gulf countries. It includes discussions on strategic urban projects, regional frameworks, and localized smart city solutions.

Chapter Number	Chapter Title
13	Innovating Urban Policy Development: Lusail Smart City's Role in Qatar's Transition to a Knowledge-based Economy
14	The Role of Government in Ensuring Sustainability in Smart Urban Development: A Case Study of Kuwait
16	Strategic Planning for the Development of Smart Cities in Oman
18	Shifting Toward Digitalization and Smart Cities: Evidence from Kuwait
23	Smart City Framework for Nusantara Capital City Development
24	Artificial intelligence for smart city vision 2040 in gulf region

Recommended Reading

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Chapter 1

A Holistic Framework for Smart Cities Governance in the Gulf Region: From Hype to Sustainable Impact

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Abstract

This introductory chapter lays the foundation for a Holistic Smart City framework organized around five pillars namely: Smart City Governance – Strategy – Utilization – Technology – Infrastructure (GSUTI) model. Smart cities governance establishes the overarching structure for effective management, emphasizing data integrity, regulatory resilience, and civic engagement. The strategy pillar integrates vision, mission, and strategic initiatives aligned with sustainable development goals, ensuring resource allocation and innovation resilience. The Utilization Framework encompasses diverse domains like transportation, energy, and healthcare, thus prioritizing initiatives and monitoring impact, enabling technologies that drive smart city innovation, leveraging artificial intelligence (AI) (Chui et al., 2018), Internet of Things, blockchain, and cybersecurity to enhance efficiency and service delivery. Infrastructures and capabilities encompass physical and data ecosystems, from buildings and transportation hubs to big data streams and social media content. The chapter sets the context for the scientific discussion, offering practical insights into strategic consultation, performance monitoring, technology management, and data governance. It outlines directions for smart city development in the Gulf Region, including bold visions, megaprojects, national-level initiatives, data-driven

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services, and AI-driven excellence. This holistic framework provides a roadmap for smart city development, fostering sustainability, innovation, and societal well-being across the Gulf Region and beyond.

Keywords: Smart cities; artificial intelligence; digital transformation; smart cities governance; Gulf Region; Gulf Cooperation Council Countries; Vision 2040

1. Introduction: A Holistic Framework for Smart Cities Governance and Strategy

The debate on smart cities research and its utilization in the Gulf Region, requires the introduction of a "holistic" context for the discussion and analyses of the diverse value layers of smart city concept.

In our *Emerald Handbook on Smart Cities Research in the Gulf Region*, we decided in our introductory chapter to provide a quite abstract and concurrently integrative context. For this purpose, in Fig. 1, we summarize our Smart City Governance – Strategy – Utilization – Technology – Infrastructure (GSUTI) framework. The basic logic of this abstraction is to provide at a glance the critical pillars of a holistic smart city strategy. In our approach, we decided to include in our framework five pillars or dimensions of unique smart city-value proposition namely: smart city governance, smart city strategy, smart city utilization framework, enabling smart city technologies, and enabling infrastructures & capabilities.

Smart Cities Governance: This is the overarching layer of the entire smart city value proposition. In this context, a high-level smart city governance framework is needed which will provide a thorough description and identification of roles and responsibilities, and integral data and processes management need to be secured

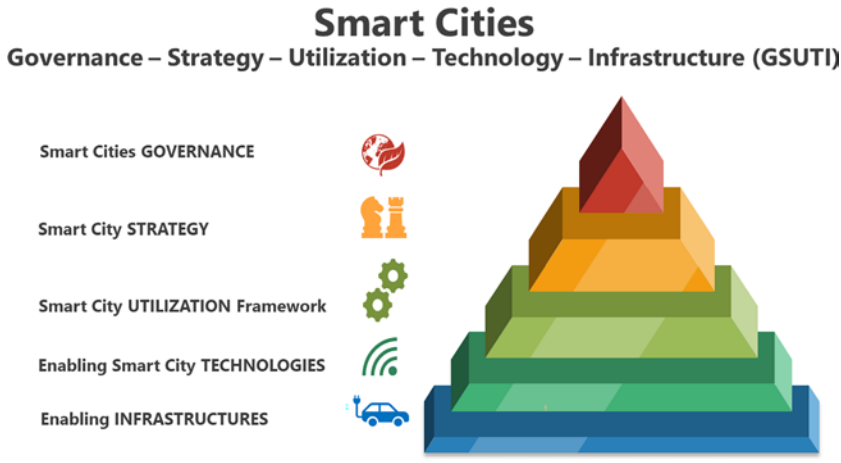

Fig. 1. Smart City GSUTI Framework. (*Source*: The Authors).

toward the fulfillment of all smart city objectives and vision (Nikiforova et al., 2023). It is also necessary at this level to build bold, resilient, and sustainable regulatory frameworks and also civic engagement platforms that will multiply the impact and the social and economic values of the smart city governance (Lytras, 2023e; Lytras, Visvizi, Chopdar, et al., 2021; Visvizi & Lytras, 2019a). Critical actions are also required at this level in relevance to risk management strategies and also overarching privacy, security, and ethics governance aiming to offer a fully trusted, and a secured smart city ecosystem for the benefit of the people and their well-being.

Smart Cities Strategy: The detailed design of smart city strategy is a bold effort toward the specification of vision and mission to be accomplished by the utilization of the diverse value components of smart city. It incorporates also the prioritization, selection, and implementation of strategic initiatives and projects, within a robust roadmap and execution plans that need also to be clarified and supported fully by resources (Lytras & Visvizi 2018; Lytras, Visvizi, Chopdar, et al., 2021; Lytras, Visvizi, & Jussila, 2020; Lytras, Visvizi, Sarirete, et al. 2021; Lytras, Visvizi, Torres-Ruiz, et al. 2020; Visvizi et al., 2018). smart city strategy has also to be anchored and aligned to sustainable development goals (SDGs) of United Nations, with reference to well-defined KPIs and analytics. For this purpose, a complementary resources allocation framework and a resilient innovation, research and development strategy have to be documented and disseminated. In the same context, capacity-building initiatives are also critical and crucial for the success of the smart city strategy.

Smart City Utilization Framework: The utilization framework is a comprehensive abstraction that covers the diverse and complementary aspects of smart city agenda (Alkhaldi et al., 2024; Lytras, Visvizi, Sarirete, et al., 2021). In our GSUTI model, we list these areas of smart city utilization but it is true that many other domains can be identified and integrated: smart transportation, smart energy (Serban & Lytras, 2020), smart education, smart environment, smart waste management, smart economy, smart governance/E-Governance (Lytras & Şerban, 2020), smart resilience, smart healthcare (Lytras & Alsaywid, 2023), smart social inclusion, smart civic engagement, smart public safety (Visvizi & Lytras, 2020), smart waste management, and smart infrastructure. For each of these areas, a systematic effort to prioritize initiatives, projects, impact and cost is required. The overarching monitoring of the execution of the diverse initiatives is a critical task for this layer and has to be supported by innovative managerial and monitoring applications, that will have also the capacity to measure the social and the economic impact of the utilization.

Enabling Smart City Technologies: In the current evolution in the technology ecosystem, diverse technologies have proved their capacity to enable strategic initiatives and to promote multi-dimensional digital transformation. In the context of smart cities, the following list represents just a sample of the diverse pool of technologies that can be utilized and integrated: artificial intelligence (AI) and machine learning (ML), cloud computing, the Internet of Things (IoT), sensors (Balfaqih et al., 2023), analytics and dashboards, open and free source technologies, social networks, the metaverse and augmented reality, blockchain, digital twins, cybersecurity, edge computing and real-time data processing, biometric identification systems, smart grids for energy distribution, and 5G and 6G networks (Lytras, Alsaywid, et al., 2023; Lytras & Housawi, 2023; Lytras, Housawi, et al., 2023; Sarirete et al., 2022).

Enabling Infrastructures & Capabilities: The enabling infrastructures refer to both the physical spaces and data-processes ecosystems that are constituting the context of smart city context. In our models, we summarized items such are buildings, public infrastructures, schools, urban areas, hospitals and healthcare facilities, transportation hubs (such as airports and train stations), parks and recreational areas, community centers and cultural institutions, government offices and administrative buildings, utilities infrastructure (water treatment plants, sewage systems, etc.), commercial and industrial zones, housing areas. For sure are part of the infrastructure that can be expanded to items such as: roads and highways, bridges and tunnels, railways and metro systems, ports and harbors, airports and airstrips, waterways and canals, traffic signals and streetlights, parking facilities and garages, telecommunication networks including fiber optics and cellular towers, waste management facilities such as landfills and recycling centers, water supply and distribution systems, sewage and wastewater treatment plants, electrical grids and power distribution networks, gas pipelines and distribution systems, green spaces and urban parks. One of the most significant aspects of the infrastructure is also related to data and big data streams (Wu et al., 2018), social media clickstreams, and huge data lakes that complement structured data warehouses within the context of the smart city. In this really complicated environment, the following data examples are few of the cases that have to be utilized in the entire smart city governance framework: personal data including identification information and preferences, location data from GPS and geolocation services, health data from wearable devices and medical records, transportation data such as traffic conditions and public transit schedules, environmental data including air quality and weather forecasts, energy consumption data from smart meters and appliances, financial data for transactions and payments, social media data related to citizens opinions and ideas (Lytras, Visvizi, & Jussila, 2020), educational data for learning and skill development, public safety data, government data for accessing public services and information, urban planning data for infrastructure development, community engagement data for citizen feedback and participation.

In the next section, we elaborate further on the key determinants of our framework and provide ideas on how this can be exploited on real-world smart city projects at national, international, municipality, and local contexts.

2. Translation of the GSUTI Smart City Framework: Enabling Smart City Efficiency and Performance for Social and Economic Value

In a fast-advancing area, like the Gulf Region, where the innovations are embraced and enhanced, it is also critical to understand that such Smart City GSUTI Framework, has to take into consideration micro, meso, and macro levels and also has to support all the diverse contexts of interoperability, operation, and exploitation including smart city strategies at cross-national, international, national, municipality, and local levels. This is though something that goes beyond the scope of this chapter, and we will discuss it in another volume.

In Fig. 2, we provide an abstraction of the expanded Smart City GSUTI framework. In the next paragraphs, we elaborate further on the aspects of the model that can guide the development of a holistic smart city governance strategy in mega-projects of smart cities in the Gulf Region and globally (Visvizi & Lytras, 2018b). These aspects can also support any strategic consultation on national, municipal, and local projects.

Our model can be exploited in diverse directions:

- Strategic Consultation: The five pillars and the diverse dimensions integrated into each pillar can serve as a reference master document for drafting detailed strategies for smart city management in national and local contexts.
- Priority Matrixes: Our model can be also utilized for the identification of smart cities initiatives and their prioritization within the strategic and philosophical directions of our model.
- Performance Monitoring: Our model has also the capacity to serve as a holistic performance and efficiency monitoring tool, with the deployment of additional guides and resources.
- Sophisticated Technology Management: In another strategic direction, our model can be utilized for the detailed mapping of technologies, infrastructures, and smart city applications and services that are implemented and used.
- Integral Data Governance and Management: Our model can also be exploited for the integrated data governance and management of all smart city applications that fall under the capacity of the smart city governance and strategy pillars. It is one of the really important parts of the usability of the framework to enable smart city owners and stakeholders to deploy a full understanding and exploitation of the smart city data ecosystem.

Given the high-level items that are included in our framework, it is rather difficult within a single chapter to discuss all its aspects and components. For this reason, in the next paragraphs, we elaborate on some indicative areas of interest,

Fig. 2. *The Expanded Smart City GSUTI Framework.* (*Source*: The Authors).

that significant effort has to be allocated. We will present selectively a few items from each of the five pillars below:

Pillar 1: Smart Cities Governance

- Governance Framework: The governance framework is a masterplan for the holistic management of all the resources utilized within the smart city context.
- Integral Data and Processes Management: One of the most important aspects of the governance pillar is the integrated management of data and processes. It requires enormous effort and systematic business processes and data governance modeling tools and methodologies.
- Orchestration with Stakeholders and Partners: The smart city governance offers guidelines, procedures, and services for the systematic dissemination of the diverse policies, strategies, and regulations. From this perspective, the governance layer provides all the overarching mechanisms that secure an integral, unified, and global approach to smart city that has also significant social and economic impacts.
- Regulatory Frameworks: These should cover a wide range of significant aspects of the smart city model including data privacy and protection AI and ML utilization, taxation, sustainability, environmental, social, and governance (ESG) aspects, SDGs compliance, etc.
- Civic Engagement Platforms: The smart city governance has also the pivotal role on the provision of platforms for civic engagement. These promote the co-design and the co-responsibility of the smart city services. They have also to exploit a unified data ecosystem that meets all the standards for high-value quality information.

Pillar 2: Smart Cities Strategy

- Vision and Mission: The smart city strategy has to be reflected in a compact, high-level, abstract strategy house with reference to vision and mission reflecting the intended social, economic, and sustainable impact.
- Strategic Priorities: The same strategy house should also integrate meaningful strategic objectives and priorities that are also directly linked to the smart city utilization areas (e.g., energy, mobility, education, economy, governance, environment, healthcare, waste management, civic engagement, public security, etc.).
- Roles & Responsibilities: The design and execution of smart city governance and Strategy also requires a modern organo-diagram, to reflect an efficient management and organizational structure with clear roles and responsibilities.
- Strategic Initiatives and Projects: It is crucial for smart city governance at the national level to maintain a robust framework to manage effectively the identification and execution of strategic initiatives and projects. This will provide a sufficient mechanism for the continuous monitoring of efficiency and performance and also will serve as a key managerial instrument.

- Roadmap and Execution Plan: The road mapping process is another high-level component of the smart city strategy. The attachment of milestones, deadlines, priorities, and deliverables in the execution of the smart city governance and Strategy is crucial.

Pillar 3: Smart City Utilization Framework

The smart city concept serves as an umbrella mechanism for diverse, complementary, and integrated domains of human and urban and rural space co-existence. It is important though to understand that the utilization of technologies in order to design and implement socio-technical systems has the ultimate objective to add value to the society and to promote the well-being and the quality of life for people. The following list of sub-domains of smart city applications is indicative. For each of these areas, there are numerous processes and workflows that can be enhanced, supported, or re-invented with the deployment of modern technologies. In the concluding chapter of this volume, we discuss how artificial technology as a disruptive technology can provide new unforeseen opportunities for systems, services, and applications within these domains:

- Smart Transportation
- Smart Energy
- Smart Education
- Smart Environment
- Smart Waste management
- Smart Economy
- Smart Governance/E-Governance
- Smart Resilience
- Smart Healthcare
- Smart Social Inclusion
- Smart Civic Engagement
- Smart Public Safety
- Smart Waste Management
- Smart Infrastructure

Pillar 4: Enabling Smart City Technologies

- AI and ML
- Cloud Computing
- IoT and Sensors
- Analytics and Dashboards
- Open and Free Source Technologies
- Social Networks
- Metaverse and Augmented Reality
- Blockchain
- Digital Twins
- Cybersecurity

- Edge Computing & Real-time Data Processing
- Biometric Identification Systems
- Smart Grids for Energy Distribution
- 5G and 6G Networks

3. Bold Smart City Strategic Directions in the Gulf Region

The current investments in the Gulf Region in the current period, are huge and have the potential to transform the business, economic, and cultural environments, with diverse services and benefits for individuals, businesses, and the countries. They lead also the region in the frontend of innovation, and leadership in the areas of Smart cities. In our volume, different chapters discuss big projects and initiatives. In this section (Lytras et al., 2022), we just comment on the type of smart cities strategic directions in the Gulf Region. These could be for sure titles for future volumes.

In this short section, we decided to comment in only five characteristic directions:

1. **Bold Visions for each country integrating smart city aspects**: In this context, the smart city vision is materialized in bold visions, where smart city pillars are integrated in diverse strategic distinct directions of the visions including areas such as vibrant society, enhanced quality of healthcare and quality of life for all, smart transportation and various others.
2. **Smart cities megaprojects**: All the countries in the Region, have designed and implemented huge megaprojects aiming to transform the entire region. These megaprojects serve also as flagships of the economic development and the leadership of the nations in the region. The required know-how, and the deployment of local and international resources, serve as huge knowledge dissemination and knowledge transfer best practices. The utilization of these mega projects has also to take into consideration the impact effect of these on the societies and the economies. In our volume, various contributors discuss these projects, in the next chapter. Saudi Arabia for example is investing multibillion budgets to move forward ambitious smart city megaprojects such as the Neom (https://www.neom.com/en-us) and the Line (https://www.neom.com/en-us/regions/theline). In the same context, Masdar City, Abu Dhabi, UAE (https://masdarcity.ae/), the city of tomorrow, the King Abdullah Economic City (KAEC), in Saudi Arabia (https://www.kaec.net/), the Lusail City in Qatar (https://www.lusail.com/), the Smart Muscat in Oman are few examples of visionary, big transformational smart city megaprojects.
3. **Smart cities projects at national level promoting digital transformation**: The quest for digital transformation in diverse aspects of the society, economy, and life promotes in the region significant projects related to smart cities agenda (Lytras & Alsawid, 2023; Lytras & Housawi, 2023). Projects such as the South Saad Al-Abdullah City in Kuwait (https://southsaadkw.com/), the XZero Smart city, that represents Kuwait's model for a sustainable smart city, the Dubai Blockchain Strategy (https://www.digitaldubai.ae/initiatives/blockchain). Other initiatives in the same context include projects like Tasmu