TECHNOLOGY AND TALENT STRATEGIES FOR SUSTAINABLE SMART CITIES

DIGITAL FUTURES

EDITED BY
SUMESH SINGH DADWAL
HAMID JAHANKHANI
GORDON BOWEN
IMAD YASIR NAWAZ

Technology and Talent Strategies for Sustainable Smart Cities – Digital Futures

This page intentionally left blank

Editors

Dr Sumesh Singh Dadwal
Sr Lecturer in strategy, *London South Bank University, UK*. Dadwals@lsbu.ac.uk

Prof. Hamid Jahankhani
Professor and Programme leader, *Northumbria University, UK*. Hamid.jahankhani@northumbria.ac.uk

Dr Gordon Bowen
Associate Professor in Management, *Anglia Ruskin University, UK*. Gordon.bowen@aru.ac.uk

Dr Imad Yasir Nawaz
Sr Lecturer in business, Associate Dean of Business, *Northumbria University, UK*. imad.nawaz@northumbria.ac.uk

Editorial Advisory Board

Dr Arshad Jamal
Northumbria University, UK. arshad.Jamal@northumbria.ac.uk

Dr Anwar Haq
Northumbria University, UK. anwar.haq@northumbria.ac.uk

Dr Bilan Sahidi
University of Sunderland in London, UK. Sahidi.Bilan@sunderland.ac.uk

Dr Farooq Habib
Cranfield University, UK. farooqhabib1969@gmail.com

This page intentionally left blank

Technology and Talent Strategies for Sustainable Smart Cities: Digital Futures

EDITED BY

SUMESH SINGH DADWAL
London South Bank University, UK

HAMID JAHANKHANI
Northumbria University, UK

GORDON BOWEN
Anglia Ruskin University, UK

AND

IMAD YASIR NAWAZ
Northumbria University, UK

United Kingdom – North America – Japan – India – Malaysia – China

Emerald Publishing Limited
Emerald Publishing, Floor 5, Northspring, 21-23 Wellington Street, Leeds LS1 4DL

First edition 2023

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-83753-023-6 (Print)
ISBN: 978-1-83753-022-9 (Online)
ISBN: 978-1-83753-024-3 (Epub)

Contents

This page intentionally left blank

List of Figures and Tables

Chapter 11

Chapter 13

This page intentionally left blank

List of Reviewers

Dr Anil Angrish	*National Institute of Pharmaceutical Education and Research, India*. anil_angrish@yahoo.co.in
Dr Aliar Hossain	*Northumbria University, UK*. aliar.hossain@northumbria.ac.uk
Dr Pawan Kumar	*LPU, India*. thegreatpk@gmail.com
Dr Vipin Nadda	*University of Sunderland, UK*. vipin.nadda@sunderland.ac.uk
Dr Carolina Redolfi	*Northumbria University, UK*. carolina.redolfi@northumbria.ac.uk
Dr Muhammad Saad Khan	*Northumbria University, UK*. m.s.m.khan@northumbria.ac.uk
Dr Janakan Sothinathan	*Northumbria University, UK*. j.sothinathan@northumbria.ac.uk

This page intentionally left blank

About the Editors

Dr Sumesh Dadwal has 23 years of experience in teaching, academic research, eLearning and educational quality management, associated with various UK universities. Currently, he is working as a Senior Lecturer in Strategy with London South Bank University, UK. Previously Dr Dadwal has worked at number of British Universities such as the Northumbria University, University of Glyndwr, UWL, Birkbeck College, University of London, University of Plymouth, University of Falmouth, Ulster University, the University of Roehampton and Bucks New University, UK. He has previously worked as a project engineer in construction projects and quality analyst in the Supply chain. He has also been associated with QAA, UK, the higher education quality assurance agency of the United Kingdom. Sumesh specialises in international strategies, technological strategy and business models, innovation and technology in marketing, digital marketing, entrepreneurship and business in Emerging markets. He is an active researcher undertaking analysis in the service sector, promotional strategies in emerging markets, augmented reality marketing and consumer behaviour and utilising various qualitative and quantitative techniques. He has authored various research papers, recently edited two books, authored many book chapters in other edited books and has led research activities at various levels. His recent publications include many book chapters and journal articles, and he has edited several research books.

Professor Hamid Jahankhani gained his PhD from Queen Mary College, University of London. In 1999 he moved to the University of East London (UEL) to become the first Professor of Information Security and Cyber Criminology at the university in 2010. Hamid's principal research area for several years has been in the field of cyber security, information security and digital forensics. In partnership with the key industrial sectors, he has examined and established several innovative research projects that are of direct relevance to the needs of the UK and European information security, digital forensics industries, Critical National Infrastructure and law enforcement agencies. Professor Jahankhani is the Editor-in-Chief of the International Journal of Electronic Security and Digital Forensics, www.inderscience.com/ijesdf and International Journal of Electronic Democracy, www.inderscience.com/ijed, both published by Inderscience and General Chair of the annual International Conference on Global Security, Safety and Sustainability (ICGS3). Hamid has edited and contributed to over 15 books and has over 150 conference and journal publications together with Various BBC

radio interviews. Hamid has supervised the completion of 13 PhD and professional doctorate students and overseen 67 PhD students progressing. In summer 2017, Hamid was trained as the GCHQ 'cyber is' to train the next generation of cyber security experts through GCHQ CyberFirst initiative.

Gordon Bowen has a Doctorate in Business (University of Hull) and is a Chartered Marketer from the Chartered Institute of Marketing (UK). He is an Associate Professor in Management at Anglia Ruskin University and works as an Associate Lecturer at various universities and higher education institutions, including Warwick University, University of Gloucestershire, Northumbria University, Cumbria University, Regent's University London, Ulster University, University of Hertfordshire, University of Wales Trinity St. David and Grenoble Graduate Business School. His research interests are strategy, marketing, digital marketing and SMEs (Small Medium Enterprises), and he supervise PhD and DBA students in these areas. Gordon has many completions at PhD and DBA. Gordon has reviewed articles for journals and conferences including MDPI Sustainability, European Academy of Management Conference and International Journal of Technology Management. He has published edited books on social media and Cybersecurity and AI (Artificial Intelligence), which are recognised internationally. Educational consultancy is another area of expertise and he works with national and international organisations to develop degree programmes and partnerships. The other aspect of academic work that Gordon is involved in is external examiner (national and international) for doctoral theses. Gordon has held senior positions in the telecommunications industry, including strategy development, business development, technical training and director of sales training. He has also advised SMEs on business matters.

Imad Nawaz is the programme leader for MSc Business with course offered with seven specialist pathways including International Management, Marketing Management, Human Resource Management, Financial Management and Entrepreneurship. He is an experienced Lecturer and management professional who has taught students from diverse social and cultural backgrounds both at undergraduate and postgraduate levels. Imad has worked in various academic, commercial and non-profit organisations in the United Kingdom and abroad. He is a Human Resource Management Practitioner and holds qualifications in the same area. Imad is also a Graduate Member and Associate Member of the Chartered Institute of Personnel Development (CIPD) and associated with many other professional associations and networks in the United Kingdom and abroad. He also delivered various corporate trainings and undertook consultancies in the area of business, management and education in the United Kingdom and Middle Eastern region particularly Qatar and the United Arab Emirates. His interactive teaching style and being an expert in psychometric assessments assist him in understanding students' learning styles and adopting an approach which is comprehensible and relatable by all the students. Imad is also a reviewer for research papers and Journals. Being a practitioner and research active helps Imad to incorporate research and organisational practices in his teachings which not only helps students to stay informed but makes their learning an exciting experience.

About the Contributors

Dr Bindu Aggarwal, is currently an Associate Professor of Marketing in the University School of Business at Chandigarh University, Gharaun, Mohali, Punjab, India. She has teaching experience of 18 years. She completed her PhD in marketing from the Lovely Professional University, Punjab, India, in the year 2021. Her areas of interest include marketing, human resource management, current issues in management and psychology. She is a dedicated researcher and has presented more than 35 research papers related to marketing, human resource management and psychology at conferences/seminars held at national and international levels. She has also published papers in various reputed national and international journals.

Md Hussin Alam, is an academician, researcher and entrepreneur. He has completed his MSc in International Business from Canterbury Christ Church University, Canterbury, Kent, UK. He was awarded two times the best students rector scholarship from the university of Wroclaw, 2019–2020 and 2020–2021. He was PhD student in political science at the Institute of Political Science, University of Wroclaw, Poland. He has presented research papers at over 30 international conferences. Hussin Alam received the young star entrepreneur award from Television reporters' unity of Bangladesh (Europe) in 2023. He received this for unexceptional contribution education sector in Bangladesh and Poland. He is the only Bangladeshi who founded the British Graduate college in Wroclaw, Poland.

Dr Anil Kumar Angrish, is an Associate Professor (Finance and Accounting) in the Department of Pharmaceutical Management, NIPER SAS Nagar (Mohali). He has teaching and research experience of more than 20 years. He has authored/co-authored 85 publications in reputable journals, newspapers, magazines and books. He has conducted studies for organisations like the WTO Cell, Union Ministry of Health and Family Welfare, Government of India, the Competition Commission of India (CCI), and the Department of Pharmaceuticals. In the last 20 years, he has served as a member of more than 70 institutional and outside Committees such as the Investment Committee, Patent Licencing Committee, IPR Committee and Agreement Handling Committee, to name a few. As organiser/co-organiser, he has coordinated about 10 seminars/conferences/symposiums/workshops. He has been invited as a speaker by more than 100 institutions/organisations. He has guided more than 150 MBA/MBA (Pharm.) students for their major research projects.

Mr Ali Katouzian Bolourforoush, has an excess of 10 years of experience in technical support and customer success management. As part of his effort to have manifested a solid foundation and understanding of cyber security that was directly related to the sector he was employed at, he embarked on Northumbria's part time master's programme. That then paved the way for him to exceed and be promoted at work. He is currently working as an account Manager dealing with large international enterprises.

Richard Bowen, has worked at some of the largest and fastest growing technology companies and startups, including Amazon, Microsoft, Facebook and Instacart. He now plies his trade at Chime after working at Robomart, a Silicon Valley startup, as Interim Chief Operating Officer and now Board Member. Rich is also an early-stage startup advisor and mentor, investor, board member, research author and visiting Lecturer, with over 15 years of industry diverse operations experience, with a balance of business experience and academia. Rich holds a first class, with honours BA in Business and Management and is a doctoral candidate. Rich was recently nominated to attend Stanford University Executive Education Programme, focused on the Emergence of Chief Operating Officers.

Deidre Bowen, holds a master's in applied management (Henley Business School) with distinction, is a qualified solicitor and completed her degree at Oxford University. She is currently the Director of Delivery at Mental Health, UK, responsible for leading and developing all UK-wide programmes. Her research interests are strategy, organisational culture, SMEs sustainability and leadership. More recently, Deidre has explored the impact of the pandemic on the mental health of both young people and adults. Deidre plays an active role in promoting women and leadership in business and she was a key-note speaker at an event held at Sheffield University.

Mr Usman Javed Butt, has extensive industry and academic experience. He worked in the industry as a Network Engineer and Systems Administrator and has hands on experience of managing and configuring Windows/Unix servers and Cisco devices. He is a Certified Ethical Hacker (CEH), Certified Information Security Management (CISMP) awarded by British Computer Society (BCS), trained on Certified Information Systems Security Professional (CISSP) both GCHQ certified courses and also trained on CompTIA Security+. He is currently managing the portfolio of MSc. Cyber Security technologies and Web and Mobile programmes and involve in delivering Network Security, Ethical Hacking and Web Application Security modules. He also holds a Fellowship from the Higher Education Academy (FHEA) and is currently doing a PhD in Cyber Security. He is also research active and has an interest in penetration testing, Ransomware and BlockChain technologies.

Mohammad Raziuddin Chowdhury, completed his master's in data science from Jahangirnagar University, Bangladesh, in 2022. His bachelor's degree was in Electrical and Electronics Engineering from American International University, Bangladesh. He has worked in multiple electronics manufacturing units. He is an

aspiring researcher hoping to make his mark in Artificial Intelligence (AI) and Machine Learning research.

Dr Farooq Habib, currently teaches Strategic Procurement, Industrial Negotiation and Commercial Contract Management, Inventory and Operations Management, Lean Six Sigma and Supply Network Resilience at Cranfield University (UK and Oman Campus). Farooq holds or has held Visiting Faculty positions at business schools in Birkbeck College, University of London (UK), University of Buckingham (UK) and University of Bedfordshire (UK and Vietnam Campus). Prior to these roles, he held senior management positions for more than 15 years in export-oriented organisations operating globally within the textiles, food and beverage sectors. Farooq has co-authored various academic papers, book chapters and project reports. He regularly engages in high-quality research, evidenced by publications in leading academic and practitioner journals and conferences in the arena of logistics, procurement and supply chain management. Farooq is a member of review boards of leading academic journals.

Dr Firas Hazzaa, received his PhD in Cyber security from Anglia Ruskin university in Cambridge/United Kingdom in 2019. He works as a Lecturer in the ministry of the higher education in Iraq. He is associated fellow of the UK higher education Academy. His research interest includes IoT security and cryptography. He has published many papers in this field and collaborates with different researchers and industry in cyber security to develop new ideas and research. He is an expert, consultant and researcher in areas of cyber Security, cryptography, power management, wireless networks, etc.

Professor Amin Hosseinian-Far, is a Professor of Systems Thinking in the Department of Business Systems and Operations at the University of Northampton. He is Chair of the research Centre for Sustainable Business Practices (CSBP) at the University. His research interests are at the intersections of systems thinking (mainly hard systems thinking), information systems, analytics and modelling, with applications in various fields. Over the years, Amin has contributed to more than 100 peer-reviewed publications.

Md Aminul Islam, Data Science, University of Gloucestershire, talukder.rana.13@gmail.com. Md Aminul Islam, an engineer, teacher and researcher, studied several domains, including business, social science, education and computer science holds BSc and MSc in Computer Science and is currently doing research in AI. Aminul has certification in education and training, networking, blockchain and cloud and wrote eight books for college students in Bangla. He won a few gold awards in leadership, research and extracurricular activities. He has a membership of IEEE, the British Computer Society, the Royal Statistical Society and STEMResearchAI. As a philanthropist through charities like Rotary International holding leadership positions from club president, DRR and MDIO Secretary is continuing to contribute to the development of the community. His focus of research is AI, ML and Edtech. Currently, he is going through Deep Learning Projects at University of Gloucestershire, UK.

Dr Arshad Jamal, is a Dean QAHE at Northumbria University London. He holds a PhD Degree in Information Systems and Computing from Brunel University, UK. He received his MSc Degree in Interactive Systems Engineering from Royal Institute of Technology, Sweden; MSc Degree in Software Engineering from the National University of Sciences and Technology, Pakistan; an MA Economics from the University of the Punjab, Pakistan; and a Postgraduate Certificate in Professional Studies in Education from Kingston University, UK. His research articles have been published in various peer-reviewed journals including the Journal of Knowledge Management. His research interests include knowledge management, social media, social media marketing, digital marketing, information privacy and human-computer interaction. He has reviewed papers in journals, namely, IJIM and JEIM and conferences including ICIS 2011, AMCIS 2009-2010, EMCIS 2012 and ECIS 2012.

Mr Murtaza Farooq Khan, is an aspiring barrister, with a particular interest in company, revenue and IT law. He holds an LLB Single Honours from SOAS University of London and is presently taking the Bar Professional Training Course at the University of Law, London. In pursuit of his career at the Bar, Murtaza holds two major scholarships, from the Middle Temple and the University of Law. He is also involved in blockchain technology – having produced a White Paper, a self-balancing index and a variety of research reports for organisations involved in the private sector.

Dr Pawan Kumar, is a Doctor of Philosophy from Punjabi University, Patiala, with specialisation in the field of Marketing and currently working as a Professor in Mittal School of Business, Lovely Professional University, Phagwara, Punjab. He has 16 years of experience in business academic research. His areas of interest in research include sustainability, entrepreneurship, e-commerce, consumer behaviour, marketing research, etc. He has more than 40 publications in the reputed Journals particularly in Q1 and Q2 Journals to his credit in various research papers in Scopus indexed journals namely: The TQM (Total Quality Management) Journal from Emerald, Visions: Journal of Business Perspectives from Sage, International Journal of Business and Globalisation, International Journal of Business Information Systems from Inderscience and other national/international journals of repute.

Dr Ebenezer Laryea, Ebenezer is an Associate Professor in International Sustainable Development Law at the University of Northampton and Director of the Systems, Analytics and Business Intelligence research group. Ebenezer's research activities focus primarily on how stakeholders can be supported, using a systems theoretical approach, to pivot towards more sustainable commercial practices which do not impact the environment negatively and protect human rights.

Dr Rebecca Natrajan, is a passionate Lecturer, researcher and a personal branding facilitator. Currently she is working as a Programme Leader at Northumbria University London campus for MSC business with students in the Faculty of Business and Law. Various roles played by her include SFHEA (Senior Fellow of the Higher Education Academy) mentor, Dissertation supervisor and

Senior Lecturer. Her success stories include facilitating the first QAHE's student magazine, which was highly appreciated by the students. She also created the Global business club and Personal branding club out of which seven students started their business successfully. Rebecca enjoys people building and community engagement activities and she was invited by British High commissioner for Mauritius in the year 2019 where she delivered Master class to all business delegates in the Blockchain Fintech conference. Her interests are Blockchain, six sigma, marketing, women and social entrepreneurship, learning and teaching.

Judy Njuguna is an emerging researcher whose work focuses on emerging technologies and their security considerations. With a master's degree in Business Analytics and a background in Accounting, Judy brings a fresh perspective to the Information Technology field that makes her contribution a promising addition.

Mr Amaechi Okoro, He is currently an Associate Lecturer at Anglia Ruskin University, Chelmsford, UK, as he was contracted to teach Microelectronics and Robotics. He was the Innovation leader at the SHELL-ECO MARATHON competition held in South Africa 2018, sponsored by SHELL, where each participating schools are to design and produce an energy-efficient prototype vehicle that can run miles with minimum amount of fuel. He was the Technical Director at the Nigerian Institute of Electrical and Electronics Engineer (NIEEE), Federal University of Petroleum Resources chapter 2018 teaching fellow students how to bridge the gap between theory and practical with basic electronics and how to build circuits. His work history and passion for innovation make him more efficient and enhanced in achieving and setting high standards in the field of the electronics industry as evidenced by his awards as the most innovative student of the year during his undergraduate study in 2018.

Yaneal Patel, has Master of Science (MSc) Accounting and Finance from University of Roehampton. He is a Senior Lecturer and Associate Dean with QAHE (affiliated to Middlesex university, UK). He has wide experience in teaching, industry and research.

Dr Akram Qashou, gained his PhD in Electrical and Electronic Engineering from Anglia Ruskin University. His technical skills in electrical products are related to power generation, power distribution and power back up. Akram's Knowledge is in electrical power system analysis, preparation of single line diagram, short circuit calculation/fault, system stability, motor starting and voltage drop calculations, extending the electricity all house using the method pipe, and extending basic the electric is panels and risers, fire system, medium voltage substation, extending the condition electric, extending the electric ground and surfaces that connect from the panel electric.

Dr Dilshad Sarwar is an Associate Professor and Head of Business Systems and Operations in the Faculty of Business and Law at the University of Northampton. She is also actively involved in the research Centre for Sustainable Business Practice (CSBP) at the University.

Mr Atul Sethi, has extensive experience in business and academia, with a total of 28 years in business and lecturing in education. His qualifications include BA Hons (Business Studies, Sussex University), MCIP (Masters in Chartered Institute of Personnel and Development, Sussex University), PGCE (Postgraduate Certificate in Education, Greenwich University), MA (Marketing, London Metropolitan University). Atul is a visiting Lecturer for Strategy, Marketing and Business Research. His portfolio of clients includes Thames Valley University, Surrey University, Sussex University, London Metropolitan University, Ulster University (London Campus) and Roehampton University Business School.

Zhenyu Shan, is undertaking is master's degree from Cranfield University, UK. He is an expert in technology and international supply chain management.

Dr Archana Shankar, completed doctorate in the area of Organisational Behaviour from Faculty of Management Studies (FMS), University of Delhi, New Delhi, India, 2015. She also holds a BE Computer Science Engineering (2006, Anna University, Chennai, India) and an MBA in Human Resource and Systems (2008, Anna University, Chennai, India). She has been awarded FHEA (Fellow Higher Education Academy, UK), April 2021, and CIPD Level 5 in Learning and Development, January 2021. She has over 13 years of teaching and research experience, with books and articles in leading publications. Her areas of interests include leadership, organisational culture, quality management, organisational development and change management. Her vast academic experience includes roles such as Teaching, Dissertation supervision, HEA (Higher Education Academy) mentoring, HEA Reviewer, Head of Student Placement and Entrepreneurship Development Cell and Faculty Editor for Newsletter and Magazine. She presently works with QAHE – Northumbria University, London Campus, London, UK, as a Programme Leader, International Project Management (FT) teaching postgraduate students. She has also held an additional responsibility as Student Retention and Engagement Coach for the Campus.

Dr Gursimranjit Singh, is working as an Assistant Professor in the Department of Humanities and Management at Dr B.R. Ambedkar National Institute of Technology Jalandhar, Punjab, India. He received his Doctoral in Management from the I.K. Gujral Punjab Technical University, Kapurthala, Jalandhar, India. His area of research includes green marketing, sustainability, brand management, technology models, entrepreneurship and contemporary issues in marketing. He has published several research articles in International Journals of repute. He is an avid researcher and has also published several book chapters published with IGI Global and Taylor and Francis. Further, he has presented research papers at various international conferences.

Md Sakib Ullah Sourav, is currently pursuing his master's degree in management science and engineering at Shandong University of Finance and Economics, Jinan, Shandong, China, and has received his bachelor's degree in Electrical and Electronic Engineering from East West University Bangladesh in 2018. Previously he worked as a Foreign Faculty at Delhi Public School, Sonepat, India, under UN fellowship. He has been engaged in academic research since 2017 and is

mostly interested in image processing, machine learning, computational intelligence, engineering design and others. Mr Sourav is the founder of a non-profit educational research organisation called STEM in Bangla. He will be starting his PhD in Concordia University Montreal Canada from September 2023.

Md Abu Sufian, University of Leicester, UK. Email: mas124@student.le.ac.uk, abusufian.tex.cu@gmail.com. As a skilled Data Analyst and Business Analyst, Sufian has a comprehensive understanding of the factors that drive business decisions, such as market trends, competition and regulatory requirements having experience providing high-level insights from data to influence and support key decision-making strategies, including identifying both functional and non-functional requirements for projects. His expertise in descriptive-analytical and statistical data analysis allows him to work under pressure and deliver results within tight deadlines. Also, universities' different data analytics projects and HSBC project work define his project management as well as data management skills.

Rejwan Bin Sulaiman, is a highly accomplished individual who is currently pursuing his PhD degree in Computer Science from the University of Bedfordshire, located in the United Kingdom. Prior to this, he earned an MSc in Computer Science from the same institution in 2019, after completing his BSc from Wrexham Glyndwr University in 2018. In addition to his academic qualifications, he holds several professional certifications, including C|EH, CCNA and AWS, which testify to his deep knowledge and expertise in the field. Rejwan's research interests primarily focus on the cutting-edge fields of Cyber security, Artificial Intelligence and Machine Learning, where he has made significant contributions. His innovative work has been presented in various conferences and journals, and he regularly participates in scientific meetups to share his insights and learn from others in his field. Recently, Rejwan has been working as a Lecturer at Northumbria University. He is also leading a dynamic research group at STEMResearch.ai, where he continues to drive innovation and advance the boundaries of knowledge in his field.

Dr Anwar Ul Haq, is a Senior Lecturer in QA Higher Education working in partnership with Northumbria University London Campus. He has extensive expertise and more than 20 years of experience in academia and industry and has worked with organisations like Accenture and Vodafone as part of an integration team developing large-scale corporate systems. He has a research interest in the infusion of technology in education, business and strategy domains and has a number of publications in these areas.

Dr Ranjeet Verma, is a Doctor of Philosophy from National Institute of Technology, Kurukshetra with specialisation in the field of Marketing and General Management at the Postgraduate level and graduated from Kurukshetra University, Kurukshetra, and currently working as a Professor in University school of Business, Chandigarh University, Mohali, Punjab. Dr Ranjeet has more than 20 years of teaching and administrative experience, published more than 20 research papers in National and International journals of repute (Scopus Indexed), Authored seven Books titled Brand Management, Fundamentals of

Management, Basics of Economics and Management, Micro Business Environment, Macro Business Environment, Business Environment and Production and Operations Management and presented papers in more than 20 national and international conferences.

Huidong Wang, is currently serving as an Associate Professor at School of Management Science and Engineering at Shandong University of Finance and Economics, Jinan, Shandong, China. He received his PhD from Chinese Academy of Sciences in 2010. His research focuses are in the areas of decision-making, computational intelligence, machine learning, etc.

Dr Sufian Yousef, won the Royal Academy of Engineering award to be seconded to GEC Marconi for one year during 1999. His main theme of expertise is electronic design of telecommunication networks in wireless status. His research interest focused on electronic systems design and mobile communications at different generations through considering QoS, security, physical layer measurements of fading, modulation techniques, noise cancellation, coding theory, Ad Hoc mobile networks, fourth generation mobile network issues and all electronic engineering related designs including TETRA systems design and RF MEMs design. Sufian was also involved in a number of consultancy and supervision contracts in the United Kingdom where he designed full electronic controller for Glazing Vision in Brandon, designed wireless electronic system for domestic security, designed wireless communication system for emergency rescue to Sedgewall Ltd. Currently he is involved in designing sensors and mobile multi-protocol switches using RF MEMs. He is a leader of a consortium for bidding regularly on FP6, FP7 and 14-20 EU (European Union) Horizon. Sufian has also supervised 12 PhD students for completion.

Preface

Information and communication technology and social media are creating awareness and new stories about the role of technologies in creating sustainable cities, energy-efficient cities, smart cities, smart communities, green rooms and so on. Is there is any real potential, or it is a conflict of interest – 'technology claims that technology is the best solution for you'.

Currently, half of the world's population lives in cities, and this number is going to cross 70% by the year 2050. Rapid urbanisation is creating problems of optimal capacity, energy consumption, social inequality, traffic congestion, water contamination, education and health-related issues, pollution and suitable development (International Telecommunication Union (ITU), 2021).

Governments, communities and planners are considering the use of ICT (Information and Communication Technology), renewable energies and a host of other technologies to build sustainable and smart cities for their citizens. Sustainable smart cities intend to improve the efficiency of operations in the cities, green energy, water supply, sanitation and waste management, inclusive housing, healthcare and education, optimise the flow of air, water, people and traffic, improve quality of life, efficiency policing, innovations and the overall attempt to meet economic, social, environmental and cultural needs of the present as well as that of the future. The use of technologies can accelerate the efficient achievement of UN specified 17 Sustainable Development Goals (SDGs) goals. However, are our cities ready for this as per capacity, needs, sustainability and smartness is concerned?

A sustainable smart city is an innovative city that uses Information and Communication Technologies (ICTs) and other technological means to improve the quality of life, the efficiency of urban operations and services and competitiveness, while also meeting the economic, social, environmental and cultural needs of current and future generations (UNECE and ITU, 2021). A sustainable Smart city is 'more sustainable, efficient, inclusive, pleasant, with better livability, workability inclusiveness, sustainability, responsive and continuously improves the quality of life' (Hamza, 2021) (Woetzel, 2021) (Woetzel, 2021) (Amazon Web Services, 2018).

A smart city has three layers; technology enables Internet of Things (IOTs), smart applications of data analytics for better decision-making and behaviour change to continuously enhance the quality of life (Woetzel, 2021). The quality of life has many dimensions such as safety, time and convenience, health,

environmental quality, social connectedness and civic participation, jobs, and the cost of living and so on.

Are the technologies themselves enough to create real differences in countries, cities and communities as per MDGs and create a healthier planet, or do we need some complementary actions such as the role of awareness and actions of stakeholders, leaders, governments and communities? Do people bother about MDG and the triple bottom line – people, planet and profits? What kind of cities does people need and would love to have in the future? What about the agenda of sustainable and smart cities? How can we inspire actions?

It has been widely argued that the application of the technology will save energy, cloud technologies can save forests, Blockchain can bring ethics and authenticity saving millions from frauds and so on; however, what about the use of energy itself in the running of the technologies?

Audience

This book will aid in the knowledge of policymakers, governments, researchers, entrepreneurs and practitioners, to design, develop and implement technology to create and develop sustainable smart cities. Using many theoretical and practical approaches, this innovative book aims to further explore the use of disruptive technology.

Key Features of the Book

This book will be a unique interdisciplinary project inculcating and integrating ideas of public policies, business and techno-entrepreneurs with those with a stream of technology. This book will be a useful source for academics, researchers, governments, city planners and techno-entrepreneurs to understand and apply the principles and the practices of technology empowered strategies to develop integrated sustainable and smart cities in developed, developing and least-developed countries. This book brings in ideas from east and west in one place and is useful in light of UNOs Millennium Development Goals, in particular of least-developed countries, developing countries and emerging markets. This book has a focus to humanise technological applications in a green and sustainable way for smart cities and futures.

Organisation of This Book

This book has explored the concept, model and practice of conceptualising and developing smart cities. This book is written from a strategic point of view. It has also covered a range of functional areas of smart sustainable cities. An integrated approach is taken to organise this book from top to lower levers of organisations. Though each chapter on its own has independent standing and can be read for its relevance to relevant functional areas, however, an integrated approach has been

taken organising each chapter to ensure smooth flow, coherence and process approach.

This book is organised into 14 chapters. A brief description of the chapter is given in the next sections.

Chapter 1 – *IoT (Internet of Things), Cloud Computing and the Elementary Building Blocks of Smart Sustainable Cities*

As the size of the population is growing and the capacity of the planet earth is limited, human beings are searching for sustainable and technology-enabled solutions to support society, ecology and economy. One of the solutions has been developing smart sustainable cities. Smart sustainable cities are cities as systems, where their infrastructure, different subsystems and different functional domains are virtually connected to the information and communication technologies (ICT) and internet via sensors and devices and the Internet of Things (IoT); to collect and process real-time Big Data and make efficient, effective and sustainable solutions for a democratic and liveable city for its various stakeholders. This chapter explores the concepts and practices of sustainable smart cities across the globe and explores the use of technologies such as IoT, Blockchain technology, Cloud computing, etc. their challenges and then presents a view on business models for sustainable smart cities.

Chapter 2 – *Financing of Sustainable Smart Cities: Indian Experience*

India launched Smart City Mission in 2015 with an objective of development of 100 smart cities with a completion deadline in 2019 that was extended till June 2023. This chapter focuses on financing of sustainable smart cities in India. This chapter summarises financing options explored by the government in the beginning, challenges faced in financing of Smart City Mission in India over a period due to various developments such as pandemic and delay in execution of projects under the Smart City Mission, among others. Finally, suggestions have been given for making financing means effective and sustainable. These suggestions are based on the gaps between the 'financing means thought of' in the beginning and 'financing means actually applied' while executing Smart City Mission in India. Financing part is worth exploring in the background that India had the fiscal deficit at 3.9% of Gross Domestic Product (GDP) in 2015–2016 and most recently, the country had the fiscal deficit at 6.71% of GDP in FY22. And the country also dealt with the pandemic like other economies and provided Covid-19 vaccine free of cost to all citizens. Insights are useful for any other economy with a similar sustainable and Smart City Mission while facing resource constraints.

Chapter 3 – *The Role of Digital Agriculture in Transforming Rural Areas into Smart Villages*

A rural economy can contribute significantly to producing employment, fostering economic growth and fostering sustainable development. The Smart Villages strategy delves into a vast range of policies and there can be no one-size-fits-all approach that can fit the context of each community and cater to their unique circumstances. There is no single route to being smart. From the perspective of any nation, rural areas present a comparable set of problems, such

as a lack of proper health care, education, living conditions, wages and market opportunities. Some nations have created and developed the concept of smart villages during the previous few decades, which effectively addresses these issues. The landscape of traditional agriculture has been radically altered by digital agriculture, which has also had a positive economic impact on farmers and those who live in rural regions by ensuring an increase in agricultural production. We explored current issues in rural areas, and the consequences of smart village applications, and then illustrate our concept of smart village from recent examples of how emerging digital agriculture trends contribute to improving agricultural production in this chapter.

Chapter 4 – *Rural Areas, Smart Villages and Digital Agriculture – Case Study of Coimbatore's SMART Water Management System*

The purpose of this chapter is to develop academic answers to the key rural areas and smart villages and digital agriculture. This chapter analyses the National level initiatives of Government of India Mission to convert rural areas into smart cities. The Union Ministry of urban development collaborates with the State Government and nominates a particular city or cities in their state. Financial Incentives or benefits will be provided to enhance the quality of the city. Coimbatore is a cosmopolitan city where it is also a combination of rural villages and urban township. The main objective of this chapter is to identify and explore the initiatives of SMART CITIES MISSION a joint venture activity initiated by Government of India and State Government of Tamil Nadu. The results clearly indicate how digital technologies play a pivotal role in enhancing the quality of eco-friendly initiatives and improving smart villages and agriculture. The key recommendations are the lessons learnt from other smart cities initiatives in other states and how Coimbatore can be an example and adopt key takeaways from other states and cities around the world.

Chapter 5 – *Role of the Governance and Good Governance to Build a Smart Economic and Smart City – A Case Study of Bangladesh*

This chapter discusses the role of government to ensure good governance and good citizen policy choices that benefit the smart city and economy in Bangladesh. The concept of governance recognises the power dependency that exists between institutions that are engaged in collective action. Government, according to UNESCAP, is a process through which choices are made and executed or rejected. Corporate governance, international governance, national governance and municipal governance are just a few examples of how the term governance may be employed. Governance was also cited by UNESCAP as a player in government. To build a smart city and economy national level of governance focuses on freedom of media, country history and traditions, civil society, private sector and good government. All those elements are important to build a smart economy and smart city.

Chapter 6 – *Towards Sustainable Smart Cities: Current Trends and Development*

This chapter analyses a conceptual model for sustainable smart cities that integrates the three main components – technology, Sustainability and citizen. As

the world continues to urbanise, cities face increasing pressure to become more sustainable, efficient and livable. Sustainable smart cities are emerging as a promising solution to this challenge, leveraging technology and data to improve urban systems and services while reducing environmental impact. This chapter provides an overview of the concept of sustainable smart cities and its implications for urban development. It explores the key features of sustainable smart cities, including their focus on technology, data and citizen engagement, and the challenges they are facing in terms of infrastructure, data management, social equity, environmental sustainability, governance and regulations. This chapter also highlights the implications of sustainable smart cities for urban planners, policymakers and other stakeholders, emphasising the need for collaborative approaches that engage citizens and stakeholders in the design and implementation of smart city initiatives.

Chapter 7 – *Smart City Digital Twins: Overview of Implementation Challenges and Recommendations for Citizens Training*

A Digital Twin (DT) is a digital replica of an artefact that is updated on real time or semi-real time basis. In 2017, Gartner listed DT as one of the top 10 emerging technologies of the year. Since then, there have been numerous attempts to develop architecture and reference models for DTs (Digital Twin), and in some studies DT construction for real world case studies is reported. Digital Twin has evolved to a dynamic model, especially in the design of systems and products. It comes into existence digitally during the creation phase, takes a physical form in the manufacturing phase, continues through its operational life and is eventually disposed of as explained by Grieves and Vickers. This chapter attempts to provide a contextualised background on Digital Twins for Smart Cities. In the first phase of creating the physical twin, the designed and developed physical system is embedded with the digital twin and any changes experienced in the physical twin throughout the lifetime of the lifecycle of the product or the system impact the digital twin. In the next phase of the system or product development, the predictions of its behaviour during the creation phase are tested out in the operation phase. If done correctly then all the Unpredicted Undesirable (UU) and Unpredicted Desirable (UD) would result in a low chance of significant challenges occurring in the system. The culminating process, also known as the disposal stage, focuses on the impact the system has on its surroundings once decommissioned. This chapter also discusses various stakeholders involved in devising and/or employing DTs in a Smart City. This chapter concludes with a set of recommendations for the training requirements of final DT users.

Chapter 8 – *Decision-Making in Smart Cities – Blockchain Technology*

Successful smart cities' implementation will require organisational leadership decision-making competences. The foundation of smart cities is digital technologies; many of these technologies are emerging technologies that require IT skills, which are scarce and will exacerbate the battle for talent between organisations. Filling the talent gap will necessitate global hiring, which has implications for organisational culture, cultural diversity and organisational leadership. Organisational cultural mix is an important contributor to leadership decision-making.

However, decision-making is underpinned by trust. Blockchain is an emerging technology that has the potential to engender organisational trust in decision-making and, by extension, in the leadership with the 'right' organisational culture. Smart cities will be required to leverage emerging technologies to give business performance a competitive advantage and use emerging technologies applications to build a sustainable competitive advantage.

Chapter 9 – *Investigating the Influence of Blockchain in Building Trust Network – Smart Transport Networks in a Smart City*

This chapter aims to investigate and identify blockchain-related innovation trends that can improve trust networks in Smart city's transport and supply chain networks. Trust networks are crucial in building and maintaining the trust of citizens in smart cities. By promoting transparency and accountability, facilitating collaboration and innovation, enhancing citizen participation and protecting privacy and security, trust networks can help to ensure that smart cities are developed and implemented responsibly and sustainably. A systematic literature review identifies 60 conceptual and empirical studies while focusing on the automotive sector. This research focuses on the current problems and developing procurement and supply chain strategies, and the potential benefits of using blockchain in these areas. It suggests ways for the Smart city's transport and supply chain networks to utilise the blockchain to improve operations and supply chain strategy and identifies innovation trends related to blockchain. This study also includes a systematic literature review and Blockchain Transformation and Influence model as a basis to enhance trust networks in the Smart Transport Networks in a Smart City.

Chapter 10 – *Microgrid TestBed for Temporal Forecasting Patterns of Failure for Smart Cities*

The malfunction variables of power stations are related to the areas of weather, physical structure, control and load behaviour. This chapter explores the most useful factors that affect the accuracy of the Smart Grid short-term prediction process. Predicting temporal power failure is difficult due to its unpredictable characteristics. As a high accuracy is normally required, the estimation of failures of short-term temporal prediction is highly difficult. This study presents a method for converting stochastic behaviour into a stable pattern, which can subsequently be used in a short-term estimator. For this conversion, K-means clustering is employed, followed by Long-Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) algorithms are used to perform the Short-term estimation. The environment, the operation and the generated signal factors are all simulated using mathematical models. Weather parameters and load samples have been collected as part of a dataset. Monte-Carlo simulation using MATLAB programing has been used to conduct an experimental estimation of failures. The estimated failures of the experiment are then compared with the actual system temporal failures and found to be in good match. Therefore, for any future power grid there is a ready testbed to estimate the future failures.

Chapter 11 – *CNN (Convolution Neural Network) Based Intelligent Streetlight Management Using Smart CCTV Camera and Semantic Segmentation*

One of the most neglected sources of energy loss is streetlights that generate too much light in areas where it is not required. Energy waste has enormous economic and environmental effects. In addition, due to the conventional manual nature of operation, streetlights are frequently seen being turned 'ON' during the day and 'Off' in the evening, which is regrettable even in the twenty-first century. These issues require automated streetlight control in order to be resolved. This study aims to develop a novel streetlight controlling method by combining a smart transport monitoring system powered by computer vision technology with a closed circuit television (CCTV) camera that allows the light-emitting diode (LED) streetlight to automatically light up with the appropriate brightness by detecting the presence of pedestrians or vehicles and dimming the streetlight in their absence using semantic image segmentation from the CCTV video streaming. Consequently, our model distinguishes daylight and nighttime, which made it feasible to automate the process of turning the streetlight 'ON' and 'OFF' to save energy consumption costs. According to the aforementioned approach, geolocation sensor data could be utilised to make more informed streetlight management decisions. To complete the tasks, we consider training the U-net model with ResNet-34 as its backbone. Validity of the models is guaranteed with the use of assessment matrices. The suggested concept is straightforward, economical, energy-efficient, long-lasting and more resilient than conventional alternatives.

Chapter 12 – *Security Challenges of Digital Transformation in Smart Cities: Case of Banking Sector*

Banking traces back to 2000 BC in Assyria, India and Sumeria. Merchants used to give grain loans to farmers and traders to carry goods between cities. In ancient Greece and Roman Empire, lenders in temples provided loans and accepted deposits while performed change of money. The archaeological evidence uncovered in India and China corroborates this. The major development in Banking came predominantly in the mediaeval, Renaissance Italy, with the major cities Florence, Venice, and Genoa being the financial centres. Technology has become an inherent and integral part of our lives. We are generating huge amount of data in transfer, storage and usage, with greater demands of ubiquitous accessibility, inducing an enormous impact on industry and society. With the emergence of smarter cities and societies, the security challenges pertinent to data become a greater, impending impact on consumer protection and security. The aim of this chapter is to highlight if, SSI (Self Sovereign Identity) and Passwordless authentication using FIDO-2 protocol assuages security concerns such as authentication and authorisation, while preserving the individual's privacy.

Chapter 13 – *Data Analytics on Key Indicators for the Smart City's Urban Services and Dashboards for Leadership and Decision-Making by Machine Learning*

This chapter culminates in data analytics on key indicators for the city's urban services and dashboards for leadership and decision-making. A single web page with consolidated information, real-time data streams pertinent to planners and decision-makers as well as residents' everyday lives, and site analytics as a method

to assess user interactions and preferences are among the proposals for urban dashboards. Integrating technology and data analytics is revolutionising how cities manage their urban services. This chapter explores the use of data analytics to evaluate key performance indicators for smart cities, and the potential benefits of using dashboards for leadership and decision-making. The results of the analysis provide valuable insights into the strengths and weaknesses of these services and can be used to guide decision-making processes. In addition to data analytics, this chapter also examines the use of interactive dashboards to visualise and communicate the results of these performance indicators to decision-makers. Dashboards can provide real-time data, allowing leaders to quickly understand the current state of their urban services and make informed decisions to enhance these services. The results of this study demonstrate the potential for data analytics and dashboards to significantly improve the management of urban services in smart cities. By utilising these cutting-edge tools, cities can increase their efficiency, provide better services to their citizens and promote sustainable and habitable communities.

Chapter 14 – *The Role of Psychometric Test and Behavioural Profiling in Civil Service Exams in Developing Countries for Smart Societies*

The changing environment and competitive market forces have brought many changes in the business sector that has put organisations under immense pressure. Therefore, to gain a competitive advantage various transformations and new developments are found in the area of recruitment and selection to make precise decisions. Therefore, the use of psychometric assessments and behavioural profiling has increased significantly worldwide as organisations of all sizes and natures have found these assessment tools valid and effective. Although behavioural profiling and psychometric assessments are accepted worldwide, however, developing countries particularly the public sector still relies on conventional recruitment methods and the adaptation of contemporary behavioural profiling and psychometric assessments is a challenge. Therefore, this chapter evaluates how the adaptation of behavioural profiling and psychometric assessments in the civil service exams in developing countries can improve the selection process. It also explores the potential challenges and argues how the adaptation of behavioural profiling and psychometric assessments can help to improve the quality of public services, capacity building and achieving sustainability goals.

Conclusion

This book will be a unique interdisciplinary project inculcating and integrating ideas of public policies, business and techno-entrepreneurs with those with a stream of technology. This book will have inputs from fields of technologies, ICT, IoT (Internet of Things), big data analytics, blockchain, robotics, business, city planning, sociology of communities, sustainable development and an integrated approach to sustainable smart city futures.

Feedback

The editor and the authors look forward to readers' constructive feedback. Please let us know your view of this book and suggested areas of improvement by emailing the editors.

This page intentionally left blank

Acknowledgement

It is our pleasure to thank everyone, who has directly or indirectly supported us on this project.

We are thankful to almighty God, whose blessings lead to the successful completion of this book on Technology and talent strategies for Sustainable Smart Cities: Digital Futures.

We want to thank each of the contributing authors from the bottom of our hearts for giving their time, support and contributing chapters and sharing their knowledge with all.

Our sincere gratitude to the team of peer reviewers and our Editorial board team members for very constructive feedback and engorgement to shape each chapter of this book.

We want to thank each one of the previous researchers and writers whose sources have been used and cited in this book.

We are very thankful to our family members for letting us sacrifice the time that they deserved, but instead we used it on this project.

We want to convey our sincere thanks to Emerald publications and their team for their continued support through the process.

Very grateful to every reader for being our motivation for this book.

Warm Regards

Editors

Sumesh Singh Dadwal, Hamid Jahankhani, Gordon Bowen, Imad Yasir Nawaz

This page intentionally left blank

Chapter 1

IoT (Internet of Things), Cloud Computing and the Elementary Building Blocks of Smart Sustainable Cities

Sumesh Singh Dadwal

Abstract

As the size of the population is growing and the capacity of the planet Earth is limited, human beings are searching for sustainable and technology-enabled solutions to support society, ecology and economy. One of the solutions has been developing smart sustainable cities. Smart sustainable cities are cities as systems, where their infrastructure, different subsystems and different functional domains are virtually connected to the information and communication technologies (ICT) and internet via sensors and devices and the Internet of Things (IoT), to collect and process real-time Big Data and make efficient, effective and sustainable solutions for a democratic and liveable city for its various stakeholders. This chapter explores the concepts and practices of sustainable smart cities across the globe and explores the use of technologies such as IoT, Blockchain technology and Cloud computing, etc. their challenges and then presents a view on business models for sustainable smart cities.

Keywords: Smart city; sustainable city; information and communication technologies (ICT); Internet of Things (IoT); blockchain technology; cloud computing; business models; city planning

Introduction

The journey of human civilisation from deep forests, hunters to settled tribes with agriculture, to villages and then cities and so on could be used to learn about our current journey towards sustainable smart cities on earth and then maybe in space in the future. This journey explains why the homo-sapiens decided to aggregate themselves into tribes, and then settled in their living spaces with self-employment

Technology and Talent Strategies for Sustainable Smart Cities, 1–33

doi:10.1108/978-1-83753-022-920231001

as the main means in villages to address their basic physiological, safety and social needs. As the economy and globalisation spread, the means of achieving those personal needs diversified into industrial economies, business and external jobs and external employment. As the population started immigrating and emigrating, some villages gradually added infrastructure and economic activities at their existing location and they became big villages or cities; on the other hand, due to the top-down approach of governments or kings some cities were established from scratch as the centres of social, administration and economic activities. This journey explains what a city is and why people started living in the cities! As the resources became more limited and the size of the population swelled, the cities started thinking about another movement to serve the new needs of many stakeholders. But due to limited land, labour and capital, etc. the idea took the direction of efficient and effective cities that may be smart cities; and recently the idea evolved into sustainable smart cities; and the idea is still expanding into the concept and reality of cities in the outer space and so on. Why these kinds of developments are happening? What are the reasons and the needs? Is it top-down reasons (government, MNC (multinational companies) corporations, city administration) that are pushing the development of smart cities or is it bottom-up reasons, i.e. citizens and other stakeholders want such happy liveable living spaces?

Growth of population implies that cities will occupy around 60% of world's population by 2030 and might reach around 75% by 2050. Frost & Sullivan forecasts a US$1.5T global market opportunity in smart cities' with needs of energy, transportation, healthcare, building, infrastructure and governance. We need to meet the current and future demands of citizens and other stakeholders of any city, and only a smart, intelligent and sustainable city can do it effectively.

What is a smart city? What is a sustainable smart city? Why do we need it? As the size of the population is increasing, multiple issues such as limited capacities of resources and infrastructure of the city, the living standards of the people and the ecological balance of the cities, etc. are being faced by humanity.

A Smart city has many building blocks such as urban space, government, citizens, mobility, energy and a sustainable environment connected with ICT.

In some eastern philosophies, the five elements which are the building blocks of all living beings are space, air, water, fire and earth. So a smart city or a smart nation or a smart location or a smart home is an integrated system of all those five elements. A smart city is all about organising the horizontal and vertical space of the city, so that the consumption and production of its resources, such as environmental quality, water and sewage treatments and energy, are in line with the sustainability of the planet Earth. This requires efficient production of food, disposal of waste, efficient use of land for recreational or festivals or playgrounds and so on. In a smart city, various building blocks or elements will be well-integrated so that the city has the maximum possible capacity, and the city operates democratically, efficiently, effectively, transparently, equitably and sustainably.

Sustainable related activities are the principal areas of interest in the future smart city. Such activities should analyse and balance the needs of *society* (safety,

health, access, equity), *ecology* (climate change, air quality, noise, land use, biodiversity, waste) and *economy* (growth, efficiency, employment, competitiveness, choice) using a range of data from sensors, games, devices, mobile phones and social networking platforms (Nowicka, 2014).

The Internet of Things (IoT) model is an integrated cloud-oriented architecture of networks, software, sensors, human interfaces and data analytics that are essential for value creation (Harmon, Castro-Leon, & Bhide, 2015). Thus, the use of IoT in a city will integrate the physical, social, IT and community systems of a city so that one can have an integrated view of the city and then service providers shall use information technologies to develop effective urban organisations and systems to engage with citizens and improve the quality of life of its stakeholders.

The argument for sustainable smart cities is that a sustainable smart city increases the capacity of a city and the potential of its resources and capabilities. The capacity of a city should not be seen as its space volume (in three dimensions – length, breadth and depth) but should be measured in five dimensions – three dimensions of space (length, breadth and height), a fourth dimension is time and the fifth dimension is citizens' cultural habits. For example, how can we increase the capacity of transportation roads; three dimensional expansion can be achieved by expanding the road network, i.e. lengthwise, and then underground and overground infrastructure; the fourth dimension expansion of capacity could be by rescheduling time of travel (transport services can be scheduled differently for different people and vehicles) and the fifth dimension of expansion of capacity can be achieved by changing the citizens' cultural habits, for example, advising them for working from home or car sharing or using public transportation and so on. Hence, a designer while designing a smart city should think of efficient, effective and sustainable use of the five dimensions of capacity. The efficiency of a smart city can be measured in domains, such as the right quality of output, the right quantity of output, the right cost of output, the right time of the output and the right flexibility or agility of the system to meet the needs and well-being of its citizens. In smart cities, smart technologies and the IoT and the use of sensors can enhance the ability to receive timely data information and make proactive decisions at the individual, micro and macro level.

As the number of city dwellers increases, the demand for resources also increases. In the future, the limited capacity of the city's housing transportation facilities, roads, healthcare services, energy, water supply, air quality, lands, playgrounds and other facilities will become limited. Hence, limited capacities will bring in the problems of sustainability of the city and to city's ability to meet the people. In such a scenario, we need a city, which is self-intelligent with a brain based on the data infrastructures, so that the city can identify the issues in different domains of the city and respond with the right solutions in real time. Such a city will be a living city and organic city supported by technology, data infrastructure and inclusive participation of its citizens. Such a smart city will have the agility to match supply with demand. For example, if the demand decreases, the city would be able to shrink its capacity and when the demand goes up, the supply will also go up. The demand in a city could be related to means of transportation, energy, housing, parks, road congestion or utility of certain road

networks or water harvesting systems. Whenever the supply and demand fluctuate, the sensors and data infrastructure of such a city should be able to respond efficiently, effectively and with sustainability to the planet, people and profit of the city – triple bottom line.

Smart devices, phones, 5G net, Blockchain technology (BT), NFD, cloud computing and IoT are promoting real-world interfaces and applications and can become basic nodes for a smart city digital web infrastructure.

A city planner or a mayor of a city needs the internet to connect the IoT urban system. The data need to be collected for a real-time response from different subsystems of this city. A planer should think of a city as a system with its different facilities as subsystems and integrate them efficiently and effectively. The subsystems include outer space, housing, transportation and mobility, offices, shopping centres and entertainment centres, energy and sustainability and citizens.

Concept of Smart City

A few synonymous, namely 'Smart City' OR 'Smart Cities' OR 'Digital City' OR 'Wired Cities' 'Information City' OR 'Intelligent City' OR 'Knowledge-based City' OR 'Ubiquitous City' OR 'Wired City', etc. have been used in the literature to represent a smart city.

A smart city is a city that uses information and communications technology (ICT) and the IoT, invests in human capital, social capital, technological capital and modern urban infrastructure and services to sense data, analyse, integrate and use *key information* and create sustainable economic growth and high quality of life for citizens and various other stakeholders without compromising transparency, democracy, safety, privacy and security (Harmon et al., 2015). A smart city enables its citizens to use real-time information, communications and digital technologies to create and maintain a resilient, liveable, inclusive, intelligent, and sustainable city for themselves (DoT Govt of India, 2019). Several initiatives have been taken such as Busan (South Korea), Santander (Spain), Chicago (United States) and Milton Keynes (United Kingdom), etc. and several emerging countries, such as India, have taken a pledge to transform existing cities into smart cities.

A city does not become a smart city by just using technology, but the smartness of the city depends on smart citizens, the culture of democratic participation in developing smart city solutions, the education and engagement of citizens in the process of data generation, translation and participation in decision-making. Whereas some studies highlight smart cities with technology as a fundamental requirement, on the other hand, other studies highlight that the fundamental focus of smart cities should be the needs of its citizens or an ecological and green environment. Thus, a smart city is an integrated physical, social, technological and virtual system that utilises the CIT infrastructure, citizens' participation and public-private-enabled infrastructure to efficiently solve and balance the current and futuristic economic, social and environmental development needs of its stakeholders.

A smart city is an organic system that can sense issues, problems and trends in a city and make intelligent solutions to various kinds of needs of various subsystems of a city, such as environmental protection, good livelihood, public safety, e-governance and services, industrial, commercial activities and services. Imagine a city as a complex system constituted of many subsystems and elements. The subsystem can be viewed from multiple perspectives. For example, from a functional perspective, a smart city will be using IoT to address the functional needs of the city through efficient and effective use of resources. Thus, a smart city will have many subsystems, e.g. smart homes, smart transport, smart mobility, smart energy, smart safety, smart physical infrastructure, smart governance, smart education, etc. (See Table 1.1 concept and subsystems and domains of a smart city).

Another way to conceptualise a smart city is that it is a complex system of new smart technology-enabled physical infrastructure, business infrastructure, human capital, social capital, facilities and services, etc. From another perspective, the subsystems of a smart city may include – critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, electrical and water distribution, public safety, transportation and utilities.

Thus, a smart city uses information and communication technology (ICT) to connect various subsystems of the city to sense, collect, analyse Big Data, and

Table 1.1. Concept and Subsystems and Domains of a Smart City.

Smart environment	Smart maps	Smart people tracking	Smart health	Smart parking
Smart emergency system	Smart policing	Smart education	Smart entertainment	Smart sustainable governance
Smart industry	Smart water	Smart sewage	Smart parks	Smart retail
Smart infrastructure	Smart employment	Smart citizen	Smart government	Smart mobility transportation
Smart attractions	Smart agriculture	Smart public announcements	Smart weather	Smart housing
Smart energy	Smart innovation	Smart project management	Smart city coordination	Smart tourism
Monitoring of city trees, Air pollution or quality, Water quality, Green spaces	Smart citizens engagement	Crowdsourcing	Smart business	Smart architecture and technologies

then innovatively and intelligently respond to the needs of the city's stakeholders efficiently, effectively and sustainably (Thales, 2021). A smart city continuously improves its potential by effectively utilising IoT/ICT infrastructure, and other resources through participatory government to fuel sustainable economic growth and high quality of life.

A smart city uses its digital infrastructure of digital sensors and digital control systems (such as traffic sensors, building management systems, wearable sensors and devices, cameras and digital utility metres, etc.) for effective management of urban infrastructure.

Smart City as Sustainable City

The United Nations has established 17 Sustainability Development Goals (SDGs) in 2015, for peace and prosperity for people and the planet, present and into future. With this lens, a smart city shall efficiently and effectively address its problems such as capacity, poverty, health and education, inequality, decent work and economic growth, affordable and clean energy, responsible consumption and production, peace justice, partnerships, etc. whilst tackling climate change and preserving our forests and oceans (Ismagilova, Hughes, Dwivedi, & Raman, 2019). Some important domains of sustainable smart cities are shown in hierarchical order in Table 1.2; the lines of the table represent connected networks and the flow of information and decisions.

A smart city sits on ICT/IOT digital infrastructure and soft infrastructure supports and guides the hard infrastructure of such a city.

The smart city is about integrating different components but it is also about thinking about new business models for developing smart cities. How the resources would be raised for investment and cost, and who would pay for all those facilities of the smart city? A smart city is designed for the futuristic trends, issues, challenges and problems of the city. For example, the problems can be related to traffic congestion, travel routes, health and safety, healthcare, ecological and air pollution, waste and water disposal, energy consumption, sustainability of the city, schools and education system, crime rate and gangs, city police, cyber security, tax, adopting modern technologies and methods of living, the harmony of the people, e-governance and various other needs of the stakeholders.

On a continuum of development of a city, when can we say that a city has reached the stage of the smart city? Is it when the city has heavy use of sensors and ICT devices or is it should have some other key performance indicators (KPIs) or metrics? There is no agreement yet on what are the KPIs or metrics to measure the smartness of a smart city. Although there are some attempts made globally to establish a matrix or KPIs of smart cities, certain organisations in Europe and America have commenced awarding cities as 'Smart cities' based on some KPI criteria of smart cities. An organisation named United for Smart Sustainable Cities (U4SSC) has established some KPIs of 'Liveability Standards in Cities' to classify a city as a smart city. These KPIs are based on the United Nations' Millennium Development Goals. Different countries have their own KPIs for

Table 1.2. Important Domains of Sustainable Smart Cities in Hierarchical Order.

Track packages	**Tourist routes and attractions**	**Park and city centre congestion**	**Emergency services and responses**
Smart me	Smart payment	Smart home	Smart car
Visa and access govt services	Find business/ATM	Find transport/ taxi	Utility services payment
Public policy violation	Rent/buy a home	Healthcare emergency services	Education, enterprising and employment
Open data sharing and intelligent, safe, sustainable decisions by devices, e-governance and public-private apps and data security			
Smart safety and crimes	Smart humidity and temperature	Smart technology obsoleteness	Smart ICT connectivity
Smart waste and sanitation	Smart energy grids, sources demand/ supply efficiency	Smart water, rain	Smart open spaces
Smart offices	Smart factories	Smart attraction	Smart sustainable energy
Smart citizen participation	Smart economy and employment	Smart education	Smart housing and inclusiveness
Identity, culture and cohesiveness	Smart healthcare	Smart transportation and mobility	Smart air quality and environment
Data, metrics, measurement of uses, demand, supply, efficiency, sustainability and learning			
ICT/IoT, sensors, devices, data and information			
Social programmes	Ecological environment	Energy	IXT connectivity
Healthcare	Natural resources	Land and space	IoT/ICT
Public safety and police	Heritage sites	Water and waste	Data security and privacy
Education	Citizen engagement	Mobility and transportation	Open and share Big Data

Table 1.2. *(Continued)*

Track packages	Tourist routes and attractions	Park and city centre congestion	Emergency services and responses
Capability of citizens for innovation and enterprise	Citizens and communities, their needs, inclusivity, cohesiveness	Roads, space, parks, buildings, electricity, attractions	ICT/IoT, sensor, devices, data and information
Human capital	Social capital	Physical capital	Technological capital
ICT/IoT, sensors, devices, data and information infrastructure			
	E-governance: Govt agencies and administration	City planning and management	
Leadership and citizen consultations, sustainable smart city business model and strategy			
Happy inclusive sustainable urban life for each			

Sources: CNBC (2017) and Computerworld (2016).

smart cities. For an instance, the Indian government has established 79 indicators to measure the smartness of a city, and all those indicators are based on the United Nations Millennium Development Goals (DoT Govt of India, 2019). India's smart city measurement index is based on four dimensions namely, *institutional and govt; social, health and educational; economic; and physical and ICT infrastructure* index.

The cities' local governments and other institutions are organising competitions such as solar decathlon, smart city designs, how you want your locality, etc. Such competitions award the winners based on KPIs such as the quality of homes and their sustainability, and energy consumption (that the best home will not consume energy more than what it can produce locally from the solar panels on the roof or may wind energy locally). Such competitions even explore (using sensors) the number of people in different rooms, the lights on/off and other utilities, or appliances energy, minimising wastage from the home and minimalising the water consumption and effluents. Thus, the overall aims are to check designs for smart, sustainable and energy-efficient homes.

Case Studies of Smart Cities in the World

New York City (NYC) in the United States has been trying to solve the problem of traffic congestion by using smart science IoT. They have installed several self-serving machines/open kiosks. Using solar power charging Wi-Fi systems people