

Preface

Introduction

In a resolution adopted by the UN General Assembly, 25th September 2015, titled “Transforming our World: The 2030 Agenda for Sustainable Development,” the UN identifies significant challenges to our future sustainable development over the next 15 years that includes extreme poverty as one of the greatest nemeses humanity faces in the twenty-first century.

Seventeen Sustainable Development Goals (SDGs) and 169 targets are identified by the UN General Assembly, which indicate the scale of the task that we face.

One of the key debates around sustainable development, in recent decades, has been around the impact of technology and whether technology is “a solution or a problem.” United Nations, 2016, Global Sustainable Development Report 2016 suggests that: *“Technology has greatly shaped society, economy and environment. Indeed, technology is a double edged tool, while technology progress has been a solution to many ills and problems, it has also added ever new challenges.”*

Clearly the emergence of the technology has had an immense positive and negative impact on our environment. The carbon footprint of our technological usage and requirements (running over two billion smart devices and over two billion computers, laptops, tablets, etc.) as well as the energy required to keep our “connected world” running 24/7 365 days a year is enormous and while it will be difficult to measure all this while it is rapidly expanding, some research have indicated that these requirements are fast getting out of control.

In an interesting report by Mark Mills (CEO of Digital Power and sponsored by the National Mining Association American Coalition for Clean Coal Electricity) produced in August 2013, Mills states that: *“The information economy is a blue whale economy with its energy uses mostly out of sight. Based on a mid-range estimate, the world’s Information Communications Technologies (ICT) ecosystem uses about 1,500 TWh of electricity annually, equal to all the electric generation of Japan and Germany combined as much electricity as was used for global illumination in 1985. The ICT ecosystem now approaches 10% of world electricity*

generation. Or in other energy terms the zettabyte [1000⁷] era already uses about 50% more energy than global aviation.”

The impact of technology on built environment has also been significant. From one side we can see that technological development and research in the area of built environment has been used as enablers providing the bases for new and more environmentally friendly design, smart materials and smart construction techniques, and smarter way of generating and using energy.

Our Focus

The main focus for this book, in its broadest remit, is the “Built Environment and Environmental Sustainability” with particular attention to Building Information Modelling (BIM), building performance and sustainable design, and smart construction.

One of the challenges identified in the literature dealing with “sustainable design and built environment” is the different viewpoints and approaches between industry, business and environmental campaigners, and researchers and academia and how to bridge the gap between the differences and more importantly how to tackle the issues facing our environment.

This edited volume is divided into four parts and includes interesting collaborative research work between the Industry and Academia challenging some of the current perspectives and norms and offering interesting perspectives.

Part I of this volume is dedicated to presenting some of the key conceptual discussions around what sustainability agenda is all about.

Peter Young and Patricia A. Aloise-Young in their chapter “*The Problem Is Also the Solution: The Sustainability Paradox*” point out that sustainability shares the same word root as sustenance. It isn’t a coincidence. Food, water, air, and energy—sustainability is at the very heart of our long-term survival. Furthermore, they argue that people and technology are at the centre of our climate crisis. Technological advances, particularly since the industrial revolution, have contributed to the accumulation of GHG. On the other side of the coin, technological advances such as renewable energy hold promise for ameliorating our environmental woes.

Barbara Colledge in her chapter “*Appreciating the Wicked Problem: A Systems Approach to Sustainable Cities*” argues that sustainable city place making is a complex process and can deliver systemic unintended or undesirable development paths such as poverty, health inequality, or environmental degradation over generations. The chapter goes on to suggest a new conceptual model and alternative reference frames to understand and influence transformative action necessary to realise sustainable cities.

Francesco Pomponi and Alice Moncaster in their chapter “*A Theoretical Framework for Circular Economy Research in the Built Environment*” discuss the new and emerging research area of *Circular Economy* and state that the founding principles of circular economies lie in a different perspective on, and management

of, resources under the idea that an ever-growing economic development and profitability can happen without an ever-growing pressure on the environment. They go on to propose a framework to formulate building research from within a circular economy perspective.

Part II is dedicated to BIM and some key research questions associated with BIM. Farzad Khosrowshahi, in his chapter “*Building Information Modelling (BIM): A Paradigm Shift in Construction*,” argues that BIM has been hailed as a catalyst for a fundamental change in the way the industry conducts its business in a data-intensive and complex environment that significantly relies on effective collaboration of a diverse range of disciplines. He then goes to point out that there are numerous ways by which BIM can contribute to the sustainability agenda. Energy modelling, building orientation (saving energy) lifecycle evaluation, building massing (optimise the building envelope), daylighting analysis, water harvesting, and sustainable materials (to reduce material needs and to use recycled materials) are only a few examples where all three sustainability parameters come together. In the second chapter of this part titled “*Using Agile Project Management and BIM for Improved Building Performance*” by Mohammad Sakikhales and Spyros Stravaravdis, the authors argue that the early design stage is the most crucial stage to achieve sustainability targets because this is when major design decisions that affect sustainability performance are taken. They further emphasise that their work will be discussing the advantages of agile project management through an extended literature review and analyse the potential benefits from the adoption of this methodology in the construction industry and sustainable design process. It introduces an iterative design framework for the design phase of construction projects, using agile principles. The chapter further explores how BIM can facilitate the implementation of this framework to achieve improved building performance.

Muhammad Khalid, Muhammad Bashir, and Darryl Newport in their chapter “*Development of a Building Information Modelling (BIM) Based Real-Time Data Integration System Using a Building Management System (BMS)*” point out that the aim of BIM is to provide a complete solution for the life cycle of the built environment from the design stage to construction and then operation. Their interesting research work investigates the integration of real-time data from the BMS system into a BIM model, which would potentially aid facility managers to interact with the real world environment inside the BIM model.

Part III is dedicated to building performance and design. The first chapter in the part is an interesting collaborative work between Academia and Saint-Gobain Recherche. Johann Meulemans, Florent Alzetto, David Farmer, and Christopher Gorse in their chapter titled “*Qub/E—A Novel Transient Experimental Method for In Situ Measurements of the Thermal Performance of Building Fabrics*” present a novel transient experimental method developed in order to perform in situ measurements of the thermal performance of building fabrics: the QUB/e method.

Al kanani, Dawood, and Vukovic, in their chapter titled “*Energy Efficiency in Residential Buildings in the Kingdom Of Saudi Arabia*,” present an interesting case

study related to challenges in providing energy efficient buildings in Saudi Arabia. They emphasise that due to a rapidly escalating population and a high level of economic growth, the Kingdom of Saudi Arabia is experiencing a vigorous infrastructure expansion, especially with respect to residential buildings. As a result, energy demand for residential buildings is of a very high level whereby approximately 70% of electricity is consumed by air conditioning systems alone for interior cooling throughout the year due to the hot and humid Saudi climate. They go on to suggest that adding a thermal insulation of polyurethane to external walls and adopting an appropriate construction type could reduce energy consumption by over 30%.

Rajat Gupta and Matt Gregg in their chapter “*Local Energy Mapping Using Publicly Available Data for Urban Energy Retrofit*” make an important case for the urgent need to improve the energy performance of the built environment, so as to help alleviate fuel poverty, meet national carbon targets, and improve the local economy. They go on to point out how publicly available datasets on housing and energy can be used to plan mass retrofit and provide targeted low carbon measures across a city, in order to address the challenges of having incomplete data on which homes could benefit from which retrofit measures and the inability to aggregate private sector housing retrofit activities to minimise installation costs.

Part IV: The final part of this edited volume is dedicated to issues around “smart construction.” Alison Pooley in her chapter titled “*Things Change: Exploring Transformational Experiences Within the UK Construction Industry*” states that the built environment has a significant impact on energy consumption, resource depletion, and ecological degradation—reducing this impact is imperative. Existing policies and research are dominated by the assumption that increased regulation, and an improvement in professional skills and knowledge, will address these issues. She goes on to explain that her work is looking beyond a technical or regulatory fix, by exploring the potential opportunities for change that lie within the relationships between experience, learning, and the transformation of individual and professional perspectives.

Cormac Flood, Lloyd Scott, and William Gleeson in their chapter titled “*Comparison of Transient Hygrothermal Modelling Against In Situ Measurement for Thermal Transmittance*”—a joint work between academia and a firm of architects—point out that their work provides the context, research process, and analysis of four case studies situated in Dublin, Ireland. The case studies offer an account of the in situ thermal transmittance of exterior walls and link these to hygrothermally simulated comparisons along with more traditional design U-values. They further point out that their work can form the basis for further research on retrofit of the Irish housing stock.

Craig White and Oliver Styles in their chapter titled “*Decarbonising Construction Using Renewable Photosynthetic Materials*” discuss an important issue: the need to reduce CO₂ emissions from the operational energy use in buildings is more pressing as we seek to mitigate the effects of climate change. They go on to point out that the use of bio-based materials in construction might allow us to tackle both operational

and embodied CO₂ emissions. According to them the ModCell Straw Technology system achieves this by using the renewable materials timber and straw.

A Final Note

The UK's Sustainable Development Commission (www.sd-commission.org.uk) states that: "Sustainable development is a development that meets the needs of the present, without compromising the ability of future generations to meet their own needs."

Technological advances over the past four decades have brought significant changes to our lives. The technological revolution has opened new possibilities to develop new innovative solutions in health, education, and in planning our future. But the IT revolution has not been without a cost unless we take responsible steps to use our technological advances wisely and for the benefit of the society rather than for the short-term financial gains of the large conglomerates that control and own them.

A sustainable future requires new ways of urban living, new ways of production and consumption. In small, but significant ways, the issues discussed by the authors in this book have in many ways responded to that call and, more importantly, offered both socially informed and technically literate responses to the global and local challenge of working to make the place and spaces we inhabit more sustainable.

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Building Information Modelling, Building Performance,
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