

Built environment sustainability: what's new and what's next?

Introduction

The growing concern on population growth, resource scarcity and climate change has resulted in sustainable development becoming an imperative for governments, businesses and civil society alike over the past decades. Being the foundation for almost all other economic activities and having significant impacts on the environment as well as the health and well-being of people, the built environment has a central role to play in addressing sustainability. The criticality of the built environment in achieving sustainable development is further accentuated by the rising levels of urbanisation throughout the world and the realisation that 70 per cent of the current building stock will still be in existence in year 2050 (Georgiadou and Hacking, 2012).

As more and more attention is given to integrating and mainstreaming sustainability considerations into built environment related activities, a need now arises for a fundamental review of the available body of knowledge, along with a systematic exploration of the future narrative in terms of the built environment sustainability agenda. Hence, this special issue provides a much-needed platform for bringing together the innovative, up-to-date research on built environment sustainability with the aim of shedding light and amalgamating our understanding on “what's new and what's next” in this area.

Overview of special issue

The special issue consists of ten papers providing insights into diverse themes within the environmental, economic, social and cultural dimensions of built environment sustainability. The addressed issues are related to both the products (i.e. the consumption phase, which covers the use, operation and maintenance of existing buildings) and the processes (i.e. production processes of new buildings and infrastructure, as well as their refurbishment and reconstruction) of the built environment.

The first few papers of the special issue mainly focus on a variety of contemporary themes related to environmental sustainability. These themes include: waste management, low-carbon built infrastructure, green retrofitting, sustainable project procurement, embodied carbon management and green certification systems.

In the first paper, Pérez and Costa take a look at a less researched area related to waste in construction, i.e. transportation waste. With a theoretical underpinning on transformation-flow-value generation theory of production and using findings from two exploratory case studies conducted in selected residential building projects in Brazil, the authors propose a taxonomy of transportation waste applicable to construction production processes. The proposed taxonomy includes definitions and classifications for transportation activities, transportation waste events, transportation waste causes and transportation waste consequences. Thus, the paper makes a useful contribution that can be utilised to help improve the efficiency and effectiveness of construction by better controlling the material flows and reducing construction times.

The second paper by Dolla and Laishram delves into the area of procurement of low carbon infrastructure. The authors highlight the need for remodelling public private partnerships to incorporate low carbon infrastructure principles in delivering municipal solid waste projects in India. Using findings from case studies, a five-fold framework has been proposed to address the same. The proposed framework comprises of selection, financial, operational aspects, as well as standards and target measures



necessary for integrating low carbon infrastructure principles in municipal solid waste project procurement in India.

Staying within the theme of procurement, the third paper by Agbesi, Fugar and Adjie-Kumi, focus on proposing an organisational model to improve the adoption of sustainable procurement in public sector construction client organisations. Using Diffusion of Innovation Theory and Technology–Environment–Organisation framework as foundations, the authors have developed a conceptual model to assess the effects of technological, organisational and environmental factors on adoption of sustainable procurement in a multi-stage process. The findings have identified perceived relative advantage, complexity, compatibility, trialability, observability, top management support, organisational values, organisational readiness, competitive pressure and the regulatory environment to have an effect on organisational adoption of sustainable procurement.

As existing buildings comprise the largest segment of the built environment (European Climate Foundation, 2013), significant reductions in CO₂ emissions associated with energy use are not possible without retrofitting existing buildings (Palmer and Walls, 2013). In the fourth paper, Ranawaka and Mallawarachchi evaluate risks associated with green retrofitting of high-rise buildings in Sri Lanka. The authors have evaluated 35 identified risks associated with green retrofitting based on scores for probability of occurrence and severity of impact. The findings reveal the low, medium, high and extreme risk factors associated with green retrofitting of high-rise buildings in Sri Lanka with “uncertainty on energy-saving” and “design changes” identified as the risk factors with the highest risk scores. Other extreme risk factors identified include “inflation”, “productivity and quality risk” and “procurement delays”. A risk responsive framework has been proposed by the authors that suggests suitable strategies to avoid, retain, reduce or transfer these evaluated risks based on their risk scores.

The fifth and sixth papers of the special issue focus on the theme of embodied carbon management in buildings, which has been receiving growing attention in the recent climate conventions as well as academic research. Crippa, Boeing, Caparelli, da Costa, Scheer, Araujo and Bem propose the integration of building information modelling and life cycle assessment to improve embodied carbon data analysis. The authors argue how such an integrated framework could assist in the selection of building elements and components giving due consideration to their impacts on the building’s carbon footprint. The authors also evaluate four different types of interior walls commonly used in Brazil using this proposed method.

The next paper from the UK focuses on identifying the carbon intensive building elements or “carbon hotspots” of office buildings. In the paper, Victoria and Perera take on a quantitative approach to identifying the carbon intensive elements early in the design process in order to maximise the carbon reduction ability of office buildings. The findings reveal frame, substructures, external walls, services and upper floors as carbon hotspots suggesting 36 per cent of the elements are responsible for 80 per cent of the embodied carbon impacts from office buildings. The findings have been used to propose a design timeline in the form of a matrix taking both design sequence and the carbon intensity of elements into consideration.

With the high level of interest in green certification systems, the seventh paper from Bandara, Disسانayake, Karunasena and Madhusanka delves in to the challenges associated with maintaining green certifications in Sri Lankan hotel sector. Based on the findings from three case studies conducted in Green Globe certified hotels, challenges have been identified under five main categories: namely, technical; managerial; political and legal; environmental and biological; and social and cultural. The findings also reveal various mitigation strategies such as following proper procurement processes, linking incentives and promotions of workers to sustainable practices, allocating separate budgets for sustainable projects, etc., that can be used to overcome the identified challenges.

Higher initial costs have often been cited as a main barrier for adopting green buildings. However, economic sustainability focuses not just on the initial investments in terms of land and construction costs, but also the costs associated with maintaining and operating a building over its useful life (UN, 2010). In the eighth paper of this special issue, Weerasinghe and Ramachandra examine the life cycle cost of two green certified industrial manufacturing buildings and a similar natured conventional building in Sri Lanka. Findings of the comparative analysis indicate that while the construction cost of the green certified buildings were indeed higher, they also offer savings of 28, 22 and 11 per cent in terms of operation, maintenance and the end life costs, respectively.

The final two papers focus on novel issues related to social and cultural dimensions of built environment sustainability. Yumarni and Amaratunga, in their paper, provide useful insights into integrating gender mainstreaming into sustainable post-disaster reconstruction. Focusing on the case of post-disaster reconstruction in earthquake-prone Yogyakarta province in Indonesia, the authors seek to explain why, how and to what extent gender mainstreaming should be integrated within post-disaster reconstruction policies and practices in order to positively contribute to the sustainable development agenda. The findings show that gender mainstreaming strategies within the context of sustainable post-disaster reconstruction should have two main goals: i.e. protecting against women's vulnerabilities and promoting women's capacities. Both strategies are required to create gender equality and women's empowerment, which are fundamental to sustainable post-disaster reconstruction.

While the environmental, economic, social dimensions have been touted as the paradigm of sustainable development since the 1980s, there is growing concern that these dimensions alone are not sufficient to expose the complexities of modern society. Hence, many have raised the need for including culture as a fourth dimension in the sustainable development model (Opoku *et al.*, 2015). Accordingly, the tenth and final paper of this special issue by Samaraweera, Senaratne and Sandanayake explore the nature of project cultures in the public-sector construction projects in Sri Lanka. Through three exploratory case studies, the authors have found that contractors believed in a relationships-based project culture, while consultants believed in a task-based project culture. The findings further reveal that public sector project culture was not leader-centred and that differentiated behavioural norms were clearly visible forming contractor, consultant and client professional sub-cultures.

The contributions presented in this special issue address novel knowledge gaps relevant to contemporary issues of the modern world while providing insights into the future narrative in terms of the built environment sustainability agenda. Many of the different themes discussed here under the environmental, economic, social and cultural dimensions of built environment sustainability are interrelated, highlighting the importance of understanding complexities and of taking a holistic view of interconnected variables. It is our hope that this special issue will facilitate a paradigmatic improvement in the body of knowledge on built environment sustainability while contributing to future research, practice and teaching in relation to design, construction and management of the built environment. As the guest editors, we would like to thank all the authors who chose this special issue as a platform for disseminating their research. We greatly appreciate the constructive feedback given by the reviewers who have helped to ensure the quality and standard of submissions. We are grateful to the Editor-in-Chief Professor Mohan Kumaraswamy for the opportunity to publish this special issue within *BEPAM* and for the advice and unwavering support extended throughout this journey. We also want to thank the Emerald publishing team for their constant support and assistance in bringing this special issue to fruition.

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