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Review article

Critical analysis of green building research trend in construction journals

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ABSTRACT

In recent years, green building (GB) has become the flagship of sustainable development, leading to a number of published works on the topic. This paper examines GB research trend in construction management (CM) through analyzing selected GB research papers published in 10 selected CM journals from 1990 to 2015 (as of end of August). The analysis is conducted in terms of the number of annual GB research publications, contributions made by various countries, institutions and authors, and research topics covered. The analysis reveals an increasing GB research interest in recent times, implying that the importance attached to GB by the construction industry is accelerating. The findings also indicate that during the studied period, researchers from developed economies such as the US, Hong Kong, the UK, Singapore, Italy, and Australia contributed most to promoting GB research. Developing countries such as China, Egypt, and Colombia also made good efforts to promote GB research. Research topics covered tend to focus on GB project delivery and developments, GB certifications, energy performance, and advanced technologies. Research gaps are discussed with directions for future research proposed. This study may serve as a valuable platform for both industry practitioners and researchers to appreciate GB research trends and developments.

Contents

1. Introduction

Since the early nineties (Kibert, 2012; Yudelson, 2007), green or sustainable building has attracted a worldwide attention from both

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researchers and practitioners (Li, Yang, & Lam, 2013). In turn, several green building (GB) studies, from both developed and developing countries, have been conducted and published (Cassidy, 2003; Zuo & Zhao, 2014). Academic GB research publications are important to industry experts and researchers. However, the existing literature consists of highly diversified topics that when integrated and classified for better understanding of the GB concept, would pave way for future researchers to undertake more efficient and intensive research. Also, research reports and papers are among the key channels through which scholars and universities influence industrial practice (Cohen, Nelson, & Walsh, 2002). Although a country may benefit from research outputs from other countries, it is believed that the number of published research outputs on a topic in a particular country might have an influence on the level of industrial developments on the topic in that country (Hong, Chan, Chan, & Yeung, 2012). That is, it is likely that the more research works conducted and published on a particular topic in a country, the greater the extent of industrial innovations and developments on the topic will be in the country, and vice versa. It is therefore necessary to keep a track record of research outputs on a particular topic in different locations in order to derive strategies for improvement where necessary.

In 2014, Zuo and Zhao conducted a critical review of GB research; they classified and discussed common GB research themes, and highlighted future research opportunities. However, Zuo and Zhao failed to provide insights into GB research outputs from various countries and institutions, which could trigger efforts for improvements in different regions on the topic. This paper aims to fill this research gap by answering the following research questions:

1. What was the annual publication trend of GB-related studies from 1990 to 2015?
2. What was the contributions of authors from different countries (regions) and institutions to GB research from 1990 to 2015?
3. What are the key research areas?

This kind of literature review, in which active contributors to research on a certain topic are identified, has been conducted by many researchers (Li, Shen, & Xue, 2014a; Yi & Chan, 2014; Yuan & Shen, 2011) to present research trends in different construction management (CM) disciplines. This study, however, is the first to replicate this review methodology in the context of GB research.

For academics, especially firsthand researchers, to gain an understanding of the trend of research in a particular research area (Hong et al., 2012), and to investigate the research developments on a chosen topic, papers published in academic journals are vital (Tsai & Wen, 2005). For this reason, this study is restricted to GB research papers that have been published in selected CM journals from 1990 to 2015 (as of end of August). It is hoped that this paper will allow researchers and practitioners to appreciate GB research trends and developments, and expand the knowledge in the field.

2. Green building definitions

Public concerns about the impacts of the construction industry on human health and energy use, and global climate change have made GB a popular field of research (US Green Building Council (USGBC) Research Committee, 2008). In the literature, the terms green buildings (GBs), sustainable buildings, high-performance buildings, sustainable construction, green construction, and high-performance construction are interchangeably used (Kats, Alevantis, Berman, Mills, & Perlman, 2003; Kibert, 2012; USGBC Research Committee., 2008; Woolley, Kimmins, Harrison, & Harrison, 2002), and with numerous definitions (Comstock, Garrigan, & Pouffary, 2012; Kibert, 2007). According to Kibert (2012, p. 1), "the outcome of applying sustainable construction approaches to creating a responsible built environment is most commonly referred to as high-performance green buildings, or simply, green buildings". Kibert (2012) again defined a GB as a facility that is healthy, designed and constructed with ecological principles and efficiently used resources. In the view of Yudelson (2008), a GB is a high-performance building that has minimal impacts on human health and the environment. He further noted that a GB is not only designed to consider and reduce its lifecycle environmental impacts, but its water and energy consumption also. Similarly, Laustsen (2008) mentioned that major characteristics of GBs include improved environment and human health, natural and material resources efficiency, and water and energy-efficiency.

The GB approach, unlike the conventional (non-green) building approach, aims at designing, constructing, and operating a building with minimal use of resources (Kubba, 2010; Wedding, 2008; Zigenfus, 2008). Hong Kong Green Building Council (HKGBC) (2015) wrote that the main idea behind GB is to minimize unfavorable impacts of buildings on the environment through three underlying processes: lifecycle planning of a building, efficient use of resources, and environmental waste and pollution reduction. Additionally, Sangster (2006) emphasized that the main objectives of GB are to: (1) minimize environmental disturbances and waste generation; (2) minimize energy and other resources utilization; (3) boost renewable energy usage; and (4) improve human health and comfort. Usually, principles such as sustainable site development, water-efficiency, energy-efficiency, reduced material resources consumption and indoor environmental quality are used to judge GBs (Gou, Lau, & Prasad, 2013). The USGBC (2003), in its paper entitled "Building Momentum", defined GBs as "buildings that are designed, constructed, and operated to boost environmental, economic, health, and productivity performance over non-green buildings". Hoffman and Henn (2008, p. 392) stated that "*GB is a term encompassing strategies, techniques, and construction products that are less resource-intensive or pollution-producing than regular construction*".

From the above definitions, it is clear that "GBs are examples of applied ecology, where designers understand the constitution, organization, and structure of ecosystems, and the impacts of architecture are considered from an environmental perspective" (Zhai, Wang, Dai, Wu, & Ma, 2008, p. 1904). As Ahmad, Thaheem, and Anwar (2016) suggested, energy-efficiency, reduced maintenance and operation costs, and extended lifespan of GBs are the main factors driving their adoption. These definitions suggest that GB presents a promising contractual approach for the construction industry to contribute to sustainable development.

3. Research methodology

For researchers and practitioners to gain insights into the current status and future trend of research on a particular topic, Tsai and Wen (2005) stated that a methodical analysis of papers published in academic journals is vital for a research community. Hence, adopting the review method utilized by previous researchers (Hong et al., 2012; Osei-Kyei & Chan, 2015; Yi & Chan, 2014), GB research papers published in selected CM journals from 1990 to 2015 were retrieved and systematically analyzed to provide insights into GB research trend, and to identify key research areas. The review method comprises of three steps: (1) selection of construction journals; (2) selection of relevant papers; and (3) assessment of contributions.