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Determinants and outcomes of environmental practices in Malaysian construction projects

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ABSTRACT

Construction activities produce an enormous quantity of waste and consume massive amounts of energy. These activities have considerable environmental effects and have resulted in mounting demand to implement environmental practices (EP) at all levels in the construction industry. The present study investigates the determinants of EP implementation in construction projects and the impacts of such practices on the environmental and economic performance of construction firms. Data were gathered from a survey of 210 firms that were part of project teams in the Malaysian construction industry, and these data were analysed using the partial least squares technique. The results indicate that organizational support, customer pressure, and regulatory pressure have a positive impact on implementing EP in construction projects and that implementing EP has a positive effect on the environmental and economic performance of construction firms. The research results provide valuable information for understanding the determinants and outcomes of EP and are particularly critical for improved assessments of the effectiveness of EP investments to reduce the negative environmental impacts of construction activities.

1. Introduction

The construction industry is commonly recognized as being environmentally unfriendly. Previous studies showed that traditional construction methods are a major cause of environmental pollution (Abidin et al., 2015), with the construction industry ranked as the primary source of carbon emissions (Wu et al., 2012). Reports have stated that the building sector consumes 32% and 40% of the worldwide total final energy and primary energy, respectively (International Energy Agency, 2014; Anderson et al., 2015). In China, the energy consumption of construction-related projects is even higher, constituting approximately 45.5% of the country's total energy usage (Zhaojian and Yi, 2006). Moreover, approximately 67.5% and 21% of the ecosystem and natural resources in Malaysia are affected by construction activities, respectively (Zolfagharian et al., 2012).

In response to the negative environmental impact of construction projects, governments around the world have implemented a variety of laws and guidelines to limit these effects (Dirckinck-Holmfeld, 2015). The Malaysian government first implemented the Environment Quality Act in 1974, which aimed to control pollution, and in 1987, the scope of this legislation was expanded to cover preventive measures (Memon, 2000). In 2009, the National Green Policy was launched, and an assessment for environmental practices (EP) was introduced through the Green Building Index (GBI), which provides the direction for EP in Malaysia (Abidin et al., 2015). EP refers to practices that are harmless or cause minimal damage to the environment (Gagnon et al., 2012); in construction projects, EP consists of waste minimization (reducing, reusing, and recycling), waste sorting, and integrated project management (Wang et al., 2015). The Malaysian government has sought to prioritize the management of construction and demolition (C&D) waste to mitigate its environmental impacts; however, the recycling rate is still as low as 15%, which is far less than those in developed countries such as Singapore, Germany and South Korea where the recycling rate ranges from 50% to 75% annually (Esa et al., 2017; Sarabatin, 2016). To encourage green technology investment in the private sector, financial initiatives were also introduced via

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the Green Technology Financial Scheme (GFTS) (Kamar and Hamid, 2012). In addition to regulatory pressure and financial incentives, consumers are increasingly insistent on green practices in their choices (Eskerod et al., 2015; Hillestad et al., 2010). Consumers opt for high-quality housing that promotes local ecosystems, reduces energy consumption, and uses renewable energy and recycled materials (Heffernan et al., 2015). Therefore, the fundamental principles of a construction project – to remain on schedule, stay within the budget and meet the quality, safety, and health requirements – are no longer sufficient. Despite the many governmental efforts to mitigate the negative effects of EP for construction firms and the increased pressure from consumers, the EP adoption rate by construction firms remains below expectations (Abidin, 2010; Renard et al., 2013; Wirahadikusumah and Ario, 2015). Most of the main players in the construction industries in developing countries, especially that in Malaysia, are more comfortable with the linear economy-based practices of the "take-make-consume-dispose" paradigm (Esa et al., 2017). In this paradigm, resources are presumed to be plentiful and easily obtainable, and discarding used products is a cheaper option than properly managing waste. In addition, the awareness of proper waste management is still lacking (Esa et al., 2016). This situation creates an urgent need to reduce the negative environmental impacts of construction projects through the implementation of EP.

As a result of the increasing pressure to minimize the negative impacts of construction project activities, EP have received increased attention in recent years among practitioners and researchers. The large body of literature on EP consists of three main streams: investigation of the benefits of EP to construction companies (Shi et al., 2013; Zhang et al., 2015), investigation of the barriers to implementing EP (Olubunmi et al., 2016; Ahn et al., 2013; Du et al., 2014), and investigation of the measures for implementing EP (Tam, 2008; Abidin et al., 2013; Wang et al., 2015). Although understanding the determinants of EP implementation is essential for facilitating better implementation decisions, there still remains a lack of research in this area. Among these limited studies is the work of Akadiri and Fadiya (2013), which focused on three determinants: management support, regulatory pressure and stakeholder pressure. They found that regulatory measure is the most important determinant of EP in the construction industry; however, they ignored the potential effect of EP on the performance of construction firms. It is widely known that construction firms are unwilling to invest in EP because of the uncertainty regarding its effects on firm performance. Häkkinen and Belloni (2011) argued that firms are reluctant to embrace EP because of their hidden costs and because EP are not compatible with current firm operations. Zhang et al. (2015) attributed the lack of EP implementation in project-based firms to the fact that when EP are implemented, they conflict with the current organization system and increase the daily operation costs – even when firms receive increased pressure from government regulations and stakeholders. It is not surprising that little is known about the effect of EP implementation on the environmental and economic performance of construction firms because this area has not received significant attention in the construction industry. Furthermore, Zou and Moon (2014) and Bilec et al. (2006) provided warning about the seriousness of environmental problems caused by construction projects, which in itself warrants research to improve the construction industry's environmental performance and image. Birkeland (2014) noted the vast potential of reducing the destructive impacts of construction activities through EP implementation, which is significant for widespread implementation of EP throughout the construction industry. A more recent study by Shi et al. (2016) acknowledged the immense benefits of EP in construction projects not only for the environment but also for the economy, society and user comfort. Thus, this study investigated the determinants of EP in construction projects and the potential effects of EP on the environmental and economic performance of construction firms. By investigating the relationship between EP in construction projects and the environmental and economic performance of construction firms, this study will enrich the current knowledge about construction firm interrelationships, which have received increased interest due to the uncertain impacts of EP. By helping illuminate these relationships, the findings of this study are useful for helping policy makers and construction firms to implement EP and to ensure widespread EP in the construction sector.

2. Hypotheses and research framework

As previously mentioned, EP refers to practices that are harmless or cause little damage to the environment (Gagnon et al., 2012). The implementation of EP in construction projects can be divided into three categories: waste minimization (reducing, reusing, and recycling), waste sorting, and integrated project management (Wang et al., 2010, 2015). Construction waste is known to have a significant impact on the environment (Kourmpanis et al., 2008; Wang et al., 2015). The development of major infrastructure projects, commercial buildings and housing programmes in Malaysia has resulted in a considerable volume of construction waste (Begum et al., 2007). Therefore, waste management is a critical aspect of EP in Malaysian construction projects. Wang et al. (2015) suggested that construction waste prevention is one of the best and most efficient methods for minimizing waste generation and solving various waste disposal problems. Reusing and recycling waste have also been regarded as strategic alternatives for reducing waste from construction and demolition sites sent to landfills (Kourmpanis et al., 2008; Rodriguez et al., 2011) and to alleviate the exhaustion of chief mineral resources (e.g., Blum and Stutzriemer, 2007; Weil et al., 2006). However, to guarantee a high reuse or recycling rate, on-site sorting of construction waste should be implemented before further processing (Wang et al., 2010). Additionally, the construction process is unique because it is divided into several phases from idea initiation to project completion, and each phase is performed by different project team members (Blayse and Manley, 2004). Additional construction materials, equipment and supplies are often purchased due to a lack of concern about EP in general and waste management in particular in project planning, design, implementation and completion (Tam, 2008). Integrated project management play an important role in aligning the fragmented phases of project planning, design, construction and completion with an environmental agenda (Yusof et al., 2015). Therefore, integrated project management is necessary for effective waste management in construction projects.

Several studies have noted the internal and external drivers for EP implementation in construction projects. In general, the internal drivers of EP consist of organizational support and high-quality human resources (Akadiri and Fadiya, 2013), and the external drivers are customer and regulatory pressures (Häkkinen and Belloni, 2011) and government support (Shi et al., 2013).

Organizational support is defined as the degree to which an organization acknowledges the contributions of its employees and is concerned about their well-being (Chen et al., 2009). Support from the organization is essential for implementing green project practices (Li et al., 2011; Zailani et al., 2014). This support can be in the form of top management encouraging employees to practice EP, developing regulation to help employees address environmental issues, providing rewards for environmentally friendly behaviour, or providing resources for employees to gain environmental knowledge (Zailani et al., 2014).

A construction project team comprises clients; professionals,