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The role of the construction industry in China's sustainable urban development

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ABSTRACT

The construction industry is a large energy consumer and carbon emitter. Although the Chinese government has had sustainable development on the agenda for some years, the construction industry has seemed to respond more slowly than other sectors. As a result the construction industry in China suffered from low competitiveness in the global market, skill shortage and lack of initiatives toward technology innovation. This research reviewed the role of the construction industry in China's sustainable urban development. The social, economic and environmental impacts of the construction industry on China's sustainable urban development are also analysed. The results show that the construction in China plays both positive and negative roles in China's sustainable urban development. Suggestions including establishment of standard measures, strictly regulating the tendering process and improvement of law enforcement, technical innovation, and encouraging the collaboration between the construction industry and the education and professional institutes, are provided for the future development of the construction industry in China.

Introduction

As the world paid greater attention to climate change issues, sustainable development has been on agenda in many countries in recent years. Sustainable urban development has to achieve three goals of sustainability which are economic, social, and environmental in order to be well implemented (Giddings, Hopwood, Mellor, & O'Brien, 2005; Liu, Zhou, Wennersten, & Frostell, 2014; Nuzir & Dewanckera, 2014; Wang, Wei, & Sun, 2014). As one of the most important sectors in urban development, the construction industry, worldwide, consumes a large proportion of natural resources and energy, hence it potentially has an important role in sustainability. The construction industry faces urgent pressure as regards environmental management and sustainability in many countries. It has a significant impact on the environment, affecting as it does such aspects as air, water, noise, light and land pollution in the process of urban development. It consumes enormous natural resources and energy, produces a large amount of waste and contributes significant amounts of toxic air emissions (Hendrickson & Horvath, 2000; Kartam, Al-Mutairi, Al-Ghusain, & Al-Humoud, 2004). Shen, Bao, and Yip (2000) claimed that the environmental impact of construction includes fossil fuel and minerals, extending consumption of generic resources, the production of waste requiring land disposal and pollution of the living environment.

Despite the remarkable achievement in economic development, China is still and will remain a developing country, for some time to come. Economic development is critical in improving social status and the living standards of the nation. In fact, the gross national income (GNI) per capita was only around half of the world average, ranked as 89 in the world and there were currently 4.6% of the 1.3 billion population, living below the poverty line (World Bank, 2013). In China, the construction industry has made a considerable contribution to GDP, both directly and indirectly. Crosthwaite (2000) conducted a cross-sectional analysis of the world construction market and predicted the Chinese construction market would become one of the most attractive markets for global construction companies. Since 2010, the Chinese construction market has become the largest in the world, which situation was strengthened during the recent financial crisis (Langdon, 2012). During the past 30 years, the number of construction-related companies in China has increased ten times, whilst the output value of the construction industry has increased 136 times (National Bureau of Statistics, 2012). In the meantime, the rapid development of construction has caused enormous environmental

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problems in China, which in turn, has affected sustainability in China's urban development. For instance, the embodied energy of construction projects accounted for 25–30% of total energy consumption in China (Chang, Ries, & Wang, 2011). The Chinese government has included sustainable development in recent national development plans, examples being The National Economic and Social Development Outline of the 11th Five-year Plan (2006) and The National Economic and Social Development Outline of the 12th Five-Year Plan (2010). As the construction industry has a large impact on China's development path, it is necessary and of value, to review the role of the construction industry in China's sustainable development.

Theoretical background

Environmental performance of the construction industry

The environmental performance of the construction industry has recently attracted great attention. Shi, Zuo, Huang, Huang, and Pullen (2013) identified additional costs, incremental time and the limited availability of green suppliers and information, as the critical barriers to green construction. Giang and Pheng (2011) found a significant relationship between the construction industry and economic growth, in developing countries. By using questionnaire and interview survey, Tam, Tam, Zeng, and Chan (2006) suggested environmental performance measurement indicators in construction, including regulatory compliance, auditing activities and resource consumption. Zeng et al. (2011) studied the driving forces for small and medium-sized enterprises to promoting environmental management. They found social, market and government incentives have a major effect on their environmental performance. Tam, Shen, Yau, and Tam (2007) addressed the communication issue in the environmental management of construction projects. Li, Chen, Chew, and Chee Chong Teo (2014) identified the critical resources and capabilities for design firms to deliver green buildings. Zhang et al. (2008) discovered that the pressures from the supply chain, customers and communities, all had a positive effect on firms in improving their environmental management performance, however, the pressure from a regulatory system had no significant impact. Larger-scaled firms were found to be more active in engaging in environmental management initiatives in China.

The ISO 14001 provided an environmental management system, which was recognised as an effective tool in improving the environmental performance of a construction business. Turk (2009) claimed that the ISO 14001 certification has had a positive impact on the construction sector, as it has contributed to construction firms, in terms of environmental benefits, as well as regards corporate management and marketing effects. Research showed that a more stringent environmental regulation has a strong and significant impact on competitiveness, in terms of innovation, intangible and green business performance. Some researchers suggested, however, that there might not be a single solution for the entire construction industry (Ball, 2002; Chen, Li, & Hong, 2004). Rodriguez, Alegre, and Martinez (2011) pointed out that the construction sector responds more slowly to environmental problems and in adopting Environmental Management Systems (EMS), in comparison with other business sectors. Ofori, Gang, and Briffett (2002) pointed out the short-term cost/benefit view of ISO 14001, inhibited a contractor's commitment to EMS. Sakr, Sherif, and El-Haggar (2010) research showed there was a low dissemination of information regarding ISO 14001/EMS among the leading contractors in Egypt because of the absence of promotion from local institutions. Lannelongue and González-Benito (2012) discussed the stakeholder pressure impact on the implementation of EMS by a firm. They found that only those primary stakeholders who could verify the effects on a firm, appear to have an influence on environmental imbalance.

Sustainability in different stages of construction

The pre-construction stage is crucial to the selection of appropriate design and materials to reduce pollution and this aspect has attracted many researchers' attention. Ding (2008) developed a sustainable assessment tool for the building appraisal stage. The importance of the development of green specifications for sustainable construction was recently highlighted (Lam, Chan, Chau, Poon, & Chun, 2011). Life cycle assessment was used in sustainable building design (Ortiz, Pasqualino, Diez, & Castells, 2010; Wang, Chang, & Nunn, 2010), in order to achieve long-term sustainable performance of the building products. Wong, Li, Huang, Luo, and Li (2013) developed a virtual prototyping design tool, to assist in the design of low-carbon construction, aiming to reduce the energy consumption of buildings.

Some research focused on the construction stage, for example Chen, Okudan, and Riley (2010) identified sustainable performance criteria for the selection of construction methods as regards concrete buildings. The construction and demolition (C&D) waste is one of the major negative impacts on the environment of construction activities. There are researches focussing on the environmental management of C&D waste. Kartam et al. (2004) studied recycling efforts to minimise total C&D waste for landfill in Kuwait. The sustainable performance of buildings at the operational stage, was also addressed by researchers (Wang et al., 2014).

Construction industry and sustainability

Many researchers studied the challenges the Chinese construction industry is facing, as a result of rapid growth. Gonzalez and Echaveguren (2012) pointed out that the challenge to the construction industry was the practical implementation of sustainability. The environmental impact of the construction industry in the developing countries is more serious than that in the developed countries, therefore, the developing countries should pay more attention to sustainability in the rapid development of their infrastructure and public facilities construction. The rapid growth has also caused the loss of valuable land resources in China, leading to environmental degradation and a reduction in available green land (Yeh & Wu, 1999). Such a development pattern is no longer sustainable to the nation, there is, however, a lack of research on the impact of the construction industry in relation to China's sustainable development. Jiang and Tovey (2010) discovered the Chinese government had overlooked the opportunity to use clean development mechanisms, to reduce carbon emissions from buildings.

Sustainable urban development

An important principle in urban development is to build more robust and resilient cities, otherwise they could not adapt to future problems such as climate change and resource shortage (Liu et al., 2014). Wang and Chang (2014a) studied the carbon emission target development during the fast urbanisation in China and suggested there were still room for improvement, for example there was a lack of strict energy efficiency target for construction sector. Liu et al. (2014) analysed the different approaches to sustainable urban development in China, and pointed out the main barrier for China to develop sustainable cities was the lack of clear targets,