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Waste effectiveness of the construction industry: Understanding the impediments and requisites for improvements

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ABSTRACT

Construction industry contributes a large portion of waste to landfill, which in turns results in environmental pollution and CO_2 emission. Despite the adoption of several waste management strategies, waste reduction to landfill continues seeming an insurmountable challenge. This paper explores factors impeding the effectiveness of existing waste management strategies, as well as strategies for reducing waste intensiveness of the construction industry. Drawing on series of semi structured focus group discussions with experts from the UK leading construction companies, this paper combines phenomenological approach with a critical review and analysis of extant literatures.

Five broad categories of factors and practices are responsible for ineffectiveness of construction and demolition waste management strategies, which subsequently results in waste intensiveness of the industry. These include end of pipe treatment of waste, externality and incompatibility of waste management tools with design tools, atomism of waste management strategies, perceived or unexpected high cost of waste management, and culture of waste behaviour within the industry. To reduce waste intensiveness of the construction industry, the study suggests that six factors are requisites. These are tackling of waste at design stage, whole life waste consideration, compliance of waste management solutions with BIM, cheaper cost of waste management practice, increased stringency of waste management legislation and fiscal policies, and research and enlightenment. The proposed strategies are not only important for achieving low waste construction projects, they are important for reducing waste intensiveness of the construction. Implementation of the suggested measures would drive waste management practices within the construction industry.

1. Introduction

Owing to its waste intensiveness and consumption of large resources, construction industry has particularly remained a major target for environmental sustainability (Anderson and Thornback, 2012). Evidence shows that the industry consumes up to 50% of mineral resources from nature (Anink et al., 1996) and generates up to 35% of waste to landfill (Solís-Guzmán et al., 2009). It also contributes over 33% of global CO_2 (Baek et al., 2013). In addition, waste reduction and reduced resource excavation have significant economic benefits (Coventry and Guthrie, 1998). Evidence shows that reducing construction waste by 5% could save up to £130 million in the UK construction industry (BRE, 2003). Although, these clearly show that reducing waste generated by construction activities tends to provide both economic and environmental benefits, waste generated by construction and demolition (C&D) activities remains alarming. These concerns have influenced formulation of various strategic policies towards diverting construction waste from landfill sites.

Several waste management techniques and strategies have been adopted over the years, with ability to efficiently manage waste becoming criteria for measuring successful construction operations. Governments across nations have formulated various

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strategies towards minimizing waste to landfill, thus becoming a major driver of construction waste management in many regions (Yuan, 2013). For instance, in a bid to ensure that economic growth associated with increasing construction activities does not result in increasing waste and environmental pollution, waste management across the entire project lifecycle remains a top priority of the European Union's Environment Action Plan (EU, 2010). These set of policies often become reviewed over the years to express change in government approach towards tackling impending environmental problems associated with waste generation.

While government's efforts towards waste management is usually influenced by environmental concerns (DEFRA, 2011), financial gains associated with the strategies usually influence the industry professionals (Al-Hajj and Hamani, 2008; Oyedele et al., 2013). As such, economic benefit of implementing different waste management strategies is well investigated (Begum et al., 2006; Durana et al., 2006). However, the efficacy of construction and demolition (C&D) waste management strategies and associated life cycle analysis (LCA) towards actual waste minimization are usually based on general assumptions, thus remains inadequately explored. Yuan and Shen (2011) reviewed trends in C&D waste management research and concluded that although various strategies have been employed towards managing waste in construction projects, there is no benchmark for determining effectiveness of the different approaches.

In addition, evidence shows that despite increasing waste management research and policies, proportion of construction waste landfilled increases. For instance, proportion of C&D waste in UK landfill sites increases from 33% in 2010 (Paine and Dhir, 2010) to 44% in 2013, according to the Department for Environment, Foods and Rural Affairs. This increasing proportion of C&D waste is not necessarily because of increasing construction activities. Rather, while other sectors have effectively put a check on their waste going to landfill through a set of proven strategies, waste landfilled by construction industry remains alarming. As such, there is a decrease in rate of landfill waste from household, industrial, commercial, mining and other activities (DEFRA, 2013). This suggests that existing strategies for managing construction waste remain largely ineffective and poorly conceptualised.

Meanwhile, Van Manen (1990) suggests that when an important phenomenon has been poorly conceptualised, a phenomenological approach is required to correct the misapprehensions. Phenomenologists believe that by putting asides the general belief about a concept and interacting with key players, it is possible that a new meaning and understanding could be derived (Crotty, 1998). Although, continuous efforts are being made towards diverting waste from landfill, opportunities offer by phenomenological understanding of waste management strategies is yet to be explored. In order to understand the impediments to effective waste management, this study approach the problem from phenomenological perspective. The overall aim of this study is to scrutinise construction waste management techniques in a bid to identify impediments and strategies for improving their effectiveness.

To achieve this goal, the study would fulfil the following objectives:

- To identify and evaluate existing construction waste management strategies towards understanding impediments to their effectiveness.
- To suggest strategies/framework for improving waste effectiveness of the construction industry.

Unlike other studies seeking to develop waste management strategies, the focus of this study is to illuminate factors hindering effectiveness of the existing strategies as well as measures that could be put in place to improve rate of diverting whole-life C&D waste from landfill. This paper offers insights into factors and strategies to be considered to achieve effective waste management strategy. It would assist both construction professionals and policy makers in understanding impediments that hinder effectiveness of existing waste management techniques as well as strategies required for their improvement.

2. Construction waste management strategies

Apart from waste landfill, which has been widely discouraged as a waste management strategy, several strategies are being employed towards diverting waste from landfill. Summarised in Fig. 1, the existing waste management strategies are briefly swotted below.

2.1. Sorting and recycling

Waste recycling has been widely adopted in many industries, among which the construction industry is not left out. This strategy has been recognised as the next line of action in a bid to prevent waste landfilling, the oldest and most environmental harmful form of waste treatment (Manfredi et al., 2009). Recycling is one of the strategies adoptable after waste has occurred and it involves sorting of the waste materials into "recyclable and non-recyclables" during the construction activities or at the recycling site (Barros et al., 1998). The option of site sorting has been widely encouraged across the UK, as it eases recycling operations and ensures accurate separation of inert and non-inert materials (Poon et al., 2001). The strategy is not necessarily an approach for reducing waste in construction activities, but it proves valuable due to its tendency to divert waste from landfill sites. In addition, recycling as a waste management strategy ensures that waste materials are reprocessed to produce derivative materials, which replace the need for the use of virgin materials for materials production. It therefore saves the environment from pollution due to materials excavation, transportation and processing (Davidson, 2011; Treolar et al., 2003).

Peng et al. (1997) argues that substantial recycling operation, with respect to construction waste, has helped communities in freeing up large spaces in their landfill sites as construction and demolition usually generate large waste. Corsten et al. (2013) believe that an effective recycling operation saves an additional annual emission of 2.3 Mt CO_2 in The Netherlands. A typical Japanese building constructed of recycled materials would save at least 10% of energy need according to Gao et al. (2001). Other benefits in forms of job creation and economic gains are also claimed to the credit of recycling as a strategy for waste management. However, several pre-requisite are important to the success of recycling operation. A substantially large area of land of not less than 0.8 ha, easily accessible site, experienced recycling specialists as well proper recycling equipment (Peng et al., 1997) such as screeners, crushers and wind-sifting are expected of a typical recycling site. Dedicated construction professionals available to adequately sort the waste materials play major part in successful recycling operations.

2.2. Materials re-use

Materials reuse is an essential approach to diverting waste from landfill sites. Unlike recycling, materials reuse involves the use of the materials with little or no alteration to its physical state, and without any change to its chemical constituents (Guthrie and Mallet, 1995). In the construction industry, material re-use has been adopted as a means of diverting own waste as well as domestic and other industrial waste from landfill. Construction demolition