Critical management practices influencing on-site waste minimization in construction projects


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ABSTRACT

As a result of increasing recognition of effective site management as the strategic approach for achieving the required performance in construction projects, this study seeks to identify the key site management practices that are requisite for construction waste minimization. A mixed methods approach, involving field study and survey research were used as means of data collection. After confirmation of construct validity and reliability of scale, data analysis was carried out through a combination of Kruskal-Wallis test, descriptive statistics and exploratory factor analysis.

The study suggests that site management functions could significantly reduce waste generation through strict adherence to project drawings, and by ensuring fewer or no design changes during construction process. Provision of waste skips for specific materials and maximisation of on-site reuse of materials are also found to be among the key factors for engendering waste minimization. The result of factor analysis suggests four factors underlying on-site waste management practices with 96.093% of total variance. These measures include contractual provisions for waste minimization, waste segregation, maximisation of materials reuse and effective logistic management. Strategies through which each of the underlying measures could be achieved are further discussed in the paper. Findings of this study would assist construction site managers and other site operatives in reducing waste generated by construction activities.

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1. Introduction

Effective site management is increasingly recognised as the strategic approach for achieving the required performance in construction projects (Forster, 2014). This is due to the understanding that effective site management is a key requisite for achieving key project performance indicators such as time, cost, quality, waste, and safety target, among others (Mustapha and Naoum, 1998). With increasing project complexity regarding administrative and technicalities, modern day’s site management techniques should be able to manipulate all site dynamics towards enhancing project performance. Meanwhile, a key project requirement that is becoming more required of site managers is the extent of project sustainability (Cox et al., 2003; Bassioni et al., 2004), among which waste output is crucial (Udawatta et al., 2015). Currently, the construction industry remains a key target for the global sustainability agenda (Anderson and Thornback, 2012), particularly since the industry consumes the largest portion of materials resources excavated from nature, and generates the greatest portion of landfill waste (Ajayi et al., 2016a; Bilal et al., 2015). For instance, evidence suggests that the construction industry produces about 44% of landfill waste in the UK (DEFRA, 2013), 29% in the US, 44% in Australia (Shen and Tam, 2002). The figure is similarly alarming in several other countries, with overall global average of about 35% (CMRA, 2005 in Solís-Guzmán et al., 2009).

The need to reduce the volume of waste generated by the industry has engendered various research and policy formulation. As a result, different construction techniques have been recognised as been essential to reducing construction waste to landfill. For instance, evidence suggests that the use of prefabrication is capable of reducing construction waste by up to 84.7% (Tam et al., 2007). However, a significant percentage of construction projects do not adopt the use of prefabrication and other offsite construction techniques, thus making it practically impossible to reduce waste through such means. Albeit the importance of site management techniques in driving innovative technologies and
engendering project performance (Forster, 2014), most waste management research have concentrated on construction techniques and the use of modern methods of construction (cf. Lu and Yuan, 2011; Poon et al., 2004; Jaillon et al., 2009; Esin and Cosgun, 2007). Whereas the decision to adopt the use of such technologies is usually taken during the design stages, site managers are therefore left without objective weighing of managerial decisions that are capable of reducing waste generated by construction activities.

As such, the overall aim of this study is to determine the key site management practices for engendering waste minimization in construction projects. The study offers insights that could be used whether a project is adopting offsite construction technique or not, especially as site management is an important aspect of every project (Mustapha and Naoum, 1998). The study fulfills its goal through the following objectives.

1. Evaluation of difference in perception among projects stakeholders concerning critical decisions with impacts on waste generation.
2. Identification of top management practices for minimizing on-site construction waste.
3. Exploration of underlying site management measures for waste efficient construction projects.

In order to explore and confirm the site management practices for mitigating construction waste generation, a combination of qualitative and quantitative methods was employed in the study. Based on field studies of construction processes and literature review, some waste efficient site management strategies were identified. These set of measures were then put in a questionnaire survey to explore their generalizability. Descriptive statistics and exploratory factor analysis were used to establish key strategies and underlying measures for mitigating waste through site management practices.

The next section of the paper provides a review of literature. The methodological approach to the study, which includes data sourcing, collection and analytical process are then justified and described. This is followed by the findings, which are presented and discussed before culminating the study with conclusion and implication for practices. This study would assist site managers and other construction experts to understand key management decisions that are requisite to reducing waste generated by construction activities. Implementation of the identified measures could help in diverting substantial proportion of construction waste from landfill.

2. Site management and construction project performance

Effective management of construction site activities is indispensable to overall performance of construction projects (Forster, 2014). It involves direction and supervision of operations on construction projects to ensure timely, safety, quality and cost-effectiveness of the projects, among other success indicators (Harlow, 1992). Usually, a site manager is responsible for the whole project, and sometimes in charge of a particular section of the project, thereby reporting to a senior site manager. In either way, the role or decisions taken by the site manager is essential to project success (Fellows et al., 2002). These sets of roles, among others, may include job schedule planning, HR management, discussion with other stakeholders, quality check and control, legal compliance and progress monitoring (Mäki and Kerosuo, 2015).

Although it is clear that the site managers cannot achieve anything in isolation, various relationships have been established between indices of project performance and site management. Site management has a crucial role to play in reducing accident and death on construction projects, especially as the control of site activities and accident-inducing factors are within the role of site management (Golob, 1992). A study to investigate key causes of poor construction further corroborates the assertion that site management is essential to reducing poor safety performance of construction projects (Tam et al., 2004). The study confirmed that poor safety awareness of site managers and inadequate safety training are the main causes of poor safety performance of Chinese construction industry. This further demonstrates the key role of site management in ensuring project success.

As much as project delay has bedevilled the construction industry, evidence suggests that effective site management is a key measure for tackling the problem. According to Faridi and El-Sayegh (2006), poor supervision and poor site management are the leading causes of construction project delay in the UAE. This finding corroborates earlier findings by Kumaraswamy and Chan (1998) who found out that Poor site management and supervision is one of the main causes of construction delay in Hong Kong. Studies across other nations have similarly indicated a strong link between site management practices and project delay (cf. Toor and Ogunlana, 2008; Kaming et al., 1997; Assaf and Al-Hejji, 2006).

The relationship between site management practices and cost effectiveness of projects has also been a subject of an extensive range of literature. A study carried out to investigate the key causes of time and cost overrun in Vietnam suggests that site management functions such as planning and scheduling, and site management experience are key determinants of cost performance of projects (Long et al., 2004). Based on labour intensive nature of the construction industry, the extent to which workers are adequately managed in site management roles is important to achieving key project goals such as quality, time and health and safety (Fellows et al., 2002). Thus, with site management being important to achieving various project goals and performance indicators, it is important that site managers and other project stakeholders understand the underlying site management practices for engendering waste minimization in construction projects.

3. Research methods

This study is part of a larger applied research that seeks to develop a holistic protocol for minimizing waste generated by construction activities. Based on the aim of this study, which is to identify the key site management practices and measures for mitigating construction waste, qualitative and quantitative research methods were adopted as methods of enquiry. At the early stage of the research, field studies were carried out on six construction sites to explore management measures for reducing waste outputs. This was then followed by a literature review and subsequent operationalization of existing management practices for mitigating construction waste. This approach was selected due to availability of potential waste mitigating site management measures in various waste management studies that are not specifically addressing site management practices. This section justifies and discusses the methodological approach to the study. Fig. 1 depicts the methodological flow chart for the study.

3.1. Field study

In order to observe the site management practices that are capable of minimizing waste generated by construction activities, a total of six construction sites were studied over a period of 30 months. These included one school building, two residential developments, one office block, one health and social care building and one shopping mall. Waste mitigating management practices
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