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Improving waste management in construction projects: An Australian study

Nilupa Udawatta [a], Jian Zuo [a,*], Keri Chiveralls [a], George Zillante [b]

[a] School of Natural and Built Environments, University of South Australia, GPO Box 2471, Adelaide, SA 5001, Australia
[b] School of Architecture and Built Environment, University of Adelaide, SA 5005, Australia

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ABSTRACT

Construction waste generation has been identified as one of the major issues in the construction industry due to its direct impacts on the environment as well as the efficiency of the construction industry. As the industry cannot continue to practice if the environmental resources on which it depends are depleted, the significance of waste management needs to be understood in order to encourage stakeholders to achieve related goals. Therefore, this research aims to determine effective approaches to eliminate and/or minimise waste generation in construction projects. Mixed methods were adopted by combining qualitative and quantitative research approaches. Interviews and a questionnaire survey were conducted as the primary data collection methods. The findings reveal twenty six critical solutions for waste management. Five factors of solutions for waste management were extracted from the exploratory factor analysis. These factors were: team building and supervision; strategic guidelines in waste management; proper design and documentation; innovation in waste management decisions; and lifecycle management. The evidence from this study suggests that both technologies and attitudinal approaches require improvement to eliminate/minimise waste generation in construction projects. Similarly, attention should be paid to being mindful of the environmental effects of waste generation and avoiding waste generation as early as possible in construction projects.

1. Introduction

Construction waste generation has been identified as a major issue due to its direct impacts on the environment as well as the efficiency of the construction industry (Formoso et al., 2002). A study conducted by Ameh and Daniel (2013) found that on average 21–30% of cost overruns occurred in construction projects due to material wastage. Similarly, a low priority is assigned to construction waste management and often few resources and incentives are made available to facilitate waste management (WM) processes (Osmani et al., 2008; Teo and Loosemore, 2001). As a result of waste generation, contractors have to bear loss of profit due to the involvement of additional overhead costs and delays; loss of productivity due to additional time involvement for cleaning (Skoyles and Skoyles, 1987); and considerable waste disposal costs (Lingard et al., 2000). Similarly the responsibility for waste generation is often passed to subcontractors who have to estimate the amount of cost and time associated with waste generation during bidding (Johnston and Mincks, 1995). However, Guthrie et al. (1995) stressed that it is also a burden to the client, since the client ultimately has to bear the cost associated with WM. Manowong (2012) found that clients perceived construction WM as less important than profit maximisation and viewed WM as an activity which contributes strongly to project expenses. Since profit maximisation is the main objective of organisations, they are reluctant to adopt environmentally friendly measures towards WM unless they are profitable (Hao et al., 2008). Johnston and Mincks (1995) argued that a false assumption exists among construction practitioners that time spent in managing construction waste is a loss of productivity and pointed out that the construction industry should consider WM as a profitable venture. Construction waste generation not only has cost implications for handling processes but also consumes valuable land due to disposal activities (Hao et al., 2008). Furthermore, the industry cannot continue to practice if the environmental resources on which it depends are depleted. Thus, the significance of WM needs to be understood in order to encourage stakeholders to achieve goals related to WM (Manowong, 2012). However, the quantity

* Corresponding author. Tel.: +61 8 8302 1914; fax: +61 8 8302 2252.
E-mail addresses: nilupa.udawatta@mymail.unisa.edu.au (N. Udawatta), jian.zuo@unisa.edu.au (J. Zuo), Keri.Chiveralls@unisa.edu.au (K. Chiveralls), George.Zillante@adelaide.edu.au (G. Zillante).

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of waste generation varies from country to country depending on the economic and cultural characteristics of a country, definitions used to categorise waste and data recording methods (Kourmpanis et al., 2008). Similarly, the effective implementation of WM plans is influenced by the compatibility of WM plans with the actual situation (Manowong, 2012). There is lack of comprehensive research to explore solutions for construction waste generation in Australia. This research aims to explore effective approaches to eliminate and/or minimise waste generation in construction projects in Australia. Findings of this study provide useful inputs for decision making processes around construction WM.

2. Literature review

By implementing proper WM practices, the construction industry can gain economic, quality and sustainability benefits (Kulatunga et al., 2006). Lingard et al. (1997) have argued that contractors can reduce the cost of construction by implementing WM plans. Construction WM plans help to achieve such cost benefits due to: cost reduction in material purchasing (Bossink and Brouwers, 1996; Coventry and Guthrie, 1998; Jaillon et al., 2009), transportation costs of materials and waste (Coventry and Guthrie, 1998; Jaillon et al., 2009), waste minimisation (Johnston and Mincks, 1995), waste disposal and tipping (Bossink and Brouwers, 1996; Coventry and Guthrie, 1998; Johnston and Mincks, 1995). Effective WM also has social and environmental benefits as it reduces the area needed for landfill along with the health risks related to waste disposal (Lingard et al., 2000). Similarly, managing construction waste can be seen as a way of achieving better productivity and safety on construction sites (Gavilan and Bernold, 1994). Shen et al. (2004, p. 473) defined construction waste as,

> Building debris, rubble, earth, concrete, steel, timber, and mixed site clearance materials, arising from various construction activities including land excavation or formation, civil and building construction, site clearance, demolition activities, roadwork, and building renovation.

Poon et al. (2004) highlighted that in order to reduce the level of waste in building projects it is necessary to pay more attention to WM at the planning stage of building development. However, Osmani et al. (2008) found that architects are less engaged in waste minimisation due to lack of knowledge about what causes design waste generation and the perception that contractors are liable for waste minimisation. While promoting onsite WM systems helps to minimise construction waste generation (Poon et al., 2004; Wang et al., 2008), sites need to have enough space allocated for WM equipment, storage of construction waste and space for processed materials (Peng et al., 1997; Wang et al., 2010). Most of the time construction sites have limited space and onsite WM is not always possible. WM outcomes also depend on the availability of local infrastructure for recycling (Lingard et al., 2000).

Researchers advocate that by applying lean principles all forms of waste can be eliminated since lean production includes refocusing on the production process and creating value through process reliability (Thomas et al., 2002; Zhang and Chen, 2010). Tam et al. (2007) also suggested that construction waste generation can be fully avoided by using prefabrication technologies. However, Jaillon et al. (2009) revealed that the average waste reduction rate from the use of prefabricated material is 52%. They further stressed that even though prefabrication construction methods help to create a tidier and safer working environment as well as reducing the time and onsite labour requirements, these methods cannot fully avoid the production of construction waste. There are also other disadvantages associated with prefabrication including less flexibility with manufacturing, and restrictions on site and transportation (Jaillon et al., 2009).

All stakeholders need to be dedicated, engaged and collaborate to identify possible means of waste generation and consequently take action to minimise it immediately (Alwi et al., 2002, Manowong, 2012). Having WM plans and assigning implementation responsibility to designated people helps to manage construction waste effectively in construction projects (Johnston and Mincks, 1995). However, it is necessary to conduct regular site inspections and review WM performance periodically to identify additional waste reduction requirements (Poon et al., 2004). Researchers have highlighted the importance of enhancing communication when it comes to the implementation of effective WM in construction projects (Poon et al., 2004; Wang et al., 2008). Gavilan and Bernold (1994) argued that construction waste can be reduced by having clear communication between the main contractor and subcontractors. Furthermore, it is necessary to concisely communicate WM policies at both the company and site level (Teo and Loosemore, 2001), while having clear communication channels (Gavilan and Bernold, 1994; Kulatunga et al., 2006). Construction workers can be more engaged in WM issues by having regular meetings (Lingard et al., 2000). Through such measures, the awareness of project participants about WM can be enhanced (Wong and Yip, 2004).

Training and education is another effective way of minimising waste generation (Wang et al., 2008). The effectiveness of WM strategies can be improved by educating supervisors and estimating staff about waste minimisation strategies, highlighting the advantages of profit maximisation, and conveying to all staff that WM is as important as the time, cost, quality and safety issues of construction projects (Johnston and Mincks, 1995). Yuan (2013) also highlighted the critical role of enhancing major project stakeholders' awareness about saving resources and environmental protection in order to improve WM performance in construction projects. However, construction practitioners have conflicting views on the benefits of training programmes. Lingard et al. (2000) inferred that even though managers think training programmes are effective to use, construction workers believe it is irrelevant. Thus, it is necessary to encourage the industry to promote suitable WM practices (Merino et al., 2010) and take environmental aspects into consideration in the design and tendering stages (Wang et al., 2008).

The implementation of relevant policies and regulations also helps to enhance the awareness and willingness of contractors to address WM (Manowong, 2012). Osmani et al. (2008) demonstrated that legislation is one of the key incentives for the implementation of WM in the design process and asserted that WM policies encourage architects to design out waste in construction projects. In order to promote zero waste culture, the construction industry and authorities have to improve legislation with a solid enforcement plan and methods of systematic tracking of proposed measures (Merino et al., 2010). However, such procedures and policies should also address behavioural changes at the construction site level (Lingard et al., 1997). Researchers have argued that it is necessary to increase landfill charges to discourage dumping and landfilling of construction and demolition waste, as most of the time waste is disposed with little or no attempts at early recovery (Jaillon et al., 2009; Martin and Scott, 2003; Merino et al., 2010). A study conducted in Hong Kong related to the impacts of the Construction Waste Disposal Charging Scheme (CWDCS) on construction work practices revealed that the amount of landfill was substantially reduced during the first three years of implementing the CWDCS. However, it was found that even though WM practices were slightly improved, there was no impact from this policy on subcontractors' practices and waste reduction could not be sustained after three years of implementation of the CWDCS (Yu et al., 2013). At the same time, it was found that illegal dumping of waste was substantially increased as a result of implementation