

AN EVALUATION OF SITE OPERATIVES' KNOWLEDGE, BEHAVIOUR, MOTIVATION, BELIEFS AND ATTITUDES TOWARD CONSTRUCTION & DEMOLITION WASTE MANAGEMENT IN IRELAND

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ABSTRACT

Despite ever-evolving environmental concerns resulting from increased awareness of environmental sustainability and the rising costs of landfill levies, taxes and raw materials, the Construction and demolition (C&D) industry remains a massive producer of waste, both in Ireland and globally. The overall aim of the current programme of research was to examine, through a mixed methods approach to data analysis, the effects of a 'tool-box-talk' construction and demolition waste (C&D W) management training intervention on site operatives' knowledge, behaviour, motivation, beliefs and attitudes towards waste management. Results from the current research programme revealed: (1) that the 'tool-box-talk' training intervention significantly enhanced knowledge towards waste management; (2) a positive variance in behaviour towards waste management from pre-to-post- intervention assessment; (3) there was no effect of the tool-box-talk training intervention on motivation, beliefs or attitudes towards waste management; (4) there was an effect of time on both positive beliefs and attitudes towards waste management; (5) there was no effect of age, years on-site/experience or education on waste management knowledge, overall motivation, beliefs or attitudes; (6) there was a significant effect of position/trade on waste management knowledge, in which electricians scored significantly higher than non-electricians on waste management knowledge, overall motivation and two motivation sub-scales (i.e. help-seeking and control of beliefs); (7) overall motivation was significantly correlated with all motivation sub-scales and positive beliefs at pre-testing, but only with motivation towards effort regulation at post-testing; (8) positive beliefs about waste management was significantly correlated with motivation towards control of beliefs at pre-testing; (9) beliefs about waste management were correlated with attitudes towards waste management at post-testing, as was motivation to control beliefs; (10) though age and years on-site/experience were both positively correlated with each other, they were both negatively correlated with pre-intervention knowledge; and (11) though the operatives rated the tool-box-talk training favourably, they thought it would be too difficult to implement, given that what the training presents as appropriate waste management protocol is both restricted (by "space, time and organisation" [participant IM]) and contradictory to the site practices they indicate are imposed on them. Overall, the results suggest that the 'tool-box-talk' C&D W management training intervention is an efficacious learning method, as it was shown, empirically, to enhance site operatives' waste management knowledge and was shown to have further beneficial effects on site operatives' waste management behaviour. Empirical and theoretical implications of these results and future research possibilities are discussed in light of past research.

Keywords: attitudes, behaviours, beliefs, construction and demolition waste, environmental, knowledge, motivation, operatives.

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1.0 INTRODUCTION

C&D W and its management is one of many developing and ever-evolving environmental concerns, due to the increased awareness of environmental sustainability and perhaps equally, to the rising costs of landfill levies, taxes and raw materials. However, despite these concerns, the construction industry remains “notorious” for (over) producing massive amounts of C&D W (Kwan et al., 2003).

The harmful effects of C&D W are plentiful. For example, C&D W contributes to waste sent to landfill; and consequently, a large amount of land resources are consumed through the construction of landfill sites (Poon et al., 2003). C&D W can also cause harm to surrounding areas, through hazardous pollution (Esin & Cosgun, 2007). Furthermore, material wastage contributes to a greater demand for raw materials which, in turn, contributes to the overuse of natural resources. The overuse of natural resources by the construction industry has resulted in it becoming, globally, one of the largest consumers of virgin, raw materials. Holm (1998) suggests that roughly 40% of the materials produced worldwide are consumed alone by the construction industry. Moreover, Holm (1998) postulates that the industry is responsible for consumption of 25% of the virgin wood produced and 40% of raw stone, gravel and sand extracted annually.

Research has long emphasised that high levels of waste in construction, would significantly reduce the availability of materials and energy in the future (Wyatt, 1978). Although attention has been brought to the subject of waste reduction, rather than reducing quantities of waste produced in the C&D industry, waste output quantities have continued to grow. This is perhaps, due in part to the materialistic and consumptive nature of today’s society (Hostovsky, 2004). Waste quantification studies have estimated that C&D W accounts for somewhere in the region of 40% of the total waste generated, globally (Holm, 1998). Such C&D W frequently comprises 10–30 % of the waste received at many landfill sites around the world (Fishbein, 1998). Similarly, the C&D industry is one of the largest waste producers in the Republic of Ireland, in which C&D W accounts for approximately 22% (i.e. including contaminated soils) of total waste going to landfill (EPA, 2012). Notably, a majority of C&D W in Ireland is either land-filled or illegally dumped (Duran, Lenihan & O’Regan, 2005). According to the EEA (2010) there is still a strong reliance on landfill in Ireland as a method of disposal. Hence, it is important that methods to reduce waste on-site are identified and as a result, fewer materials are disposed of at landfill.

1.1 What is C&D W?

One of the most common conceptualisations used by researchers is derived from the European Council Directive 91/156/EEC, which refers to C&D W as:

“any substance or object which the holder disposes or is required to dispose, which arises from construction, renovation and demolition activities”

(European Communities, 1991).

Though the EC Directive provides a very general definition of C&D W, a more detailed definition is presented by Skoyles and Skoyles (1987) who define C&D W as a material

“which needs to be transported elsewhere from the construction site or used on the site itself other than the intended specific purpose of the project due to damage, excess or non-use or which cannot be used due to non-compliance with the specifications, or which is a by-product of the construction process”

(Skoyles and Skoyles, 1987)

According to Skoyles (1976), C&D W can be further defined as either ‘direct’ (i.e. waste that involves an absolute loss of materials, where the materials are damaged to the extent that they cannot be salvaged, or are just lost) or ‘indirect’ (i.e. waste which may occur, for example, as a result of placing of steel bars with diameters thicker than that specified by the structural design; Formoso et al, 2002).

From an Irish perspective, the Irish Environmental Protection Agency (EPA) define C&D W as comprising

“all waste that arises from construction, renovation and demolition activities and all wastes mentioned in Chapter 17 of the European Waste Catalogue”.

(EPA, 2000)

This includes all left-over and damaged goods and materials that occur on construction works, as well as dredge spoil. According to Osmani (2012), this definition applies to all waste, irrespective of whether or not it is destined for disposal or recovery operations. Notably, C&D W also includes hazardous waste (EPA, 2002; RPS, 2004).

1.2 Past Research on Managing C&D W

The traditional focus of research on C&D W management has largely concentrated on existing frameworks regarding how work practices, procedures and relevant technologies contribute to the generation of C&D W management (Formoso *et al.*, 1993; Bossink and Brouwers, 1996; Poon, 1997; Faniran and Caban, 1998). Furthermore, research has identified how such frameworks may potentially facilitate C&D W minimisation and resource optimisation (e.g. Osmani, 2012; Kulatunga et al., 2006). However, substantially less focus is paid to practices involving the inevitable management of C&D W. This is interesting to consider as waste has been accepted as an inevitable by-product of the C&D industry, with a strong belief that minimisation practices will not be able to completely eliminate the generation of C&D W (Teo and Loosemore, 2001). According to Kulatunga et al. (2006) and Skoyles and Skoyles (1987), these negative outlooks are the major impediments to effective waste management.

Yuan & Shen (2010) conducted a systematic trend analysis of eight of the most recognised scholarly journals publishing C&D W related research from the years 2000 to 2009. The six most frequent topic areas identified in the analysis were as follows:

1. C&D W generation; reduction;
2. reuse;
3. recycling;
4. management (in general); and
5. human factors affecting C&D W management.

According to Yuan and Shen (2010), though existing research in these topic areas has taken into account human factors in both their research methodologies and their recommendations, this consideration has been to a lesser extent than other C&D W topic areas identified. Despite this, some research has focused on these more ‘human’ factors, such as attitudes, behaviours and knowledge (e.g. Begum et al., 2009; Fabrigar, 2004; Herresman & Allwright, 2000; Jashapara, 2004; Kulatunga et al., 2006; Teo & Loosemore, 2001; Teo et al., 2000). Such research has revealed interesting findings - notably, that a lack of waste management training is a major cause for operatives’ poor attitudes, beliefs, knowledge, behaviours and motivation towards C&D W minimisation (e.g. Teo et al., 2000; Lingard, Graham & Smithers, 2000; McDonald & Smithers, 1998). However, there is a substantial gap in the research which evaluates the effectiveness of training on attitudes, beliefs, knowledge, behaviours and motivations. As a result, the aim of the current research was to examine the effects of a C&D W management tool-box-talk training programme on knowledge, behaviour, motivation beliefs and attitudes towards C&D W management.

1.2 Attitudes, Behaviours and Beliefs

An attitude is conceptualised as an evaluative view, either positive or negative, that an individual has towards an object or a *behaviour*. Notably, in this context, ‘behaviour’ is the action taken by the individual towards that object (Ajzen, 1985; 1993; Teo & Loosemore, 2001; Wang & Yuan, 2010). A large body of research suggests that attitudes toward environmental management practices often dictate related *behaviours* (Begum et al., 2009; Fabrigar, 2004; Herresman & Allwright, 2000). More specifically, research indicates that attitudes towards waste management impact not only the way in which waste is actually managed, but also the amount of waste produced (Loosemore et al., 2002; Skoyles & Skoyles, 1987).

A belief is a premise, or set of premises, that an individual holds to be true (Schwitzgebel, 2006). With respect to beliefs about waste management, though research in C&D W management cites beliefs about waste management as an important factor affecting operatives’ C&D W management practices (e.g. Lingard, Graham & Smithers, 1997; Teo et al., 2000; Teo & Loosemore, 2001), there is a lack of research that actually examines *beliefs* as an independent variable. This may be due, in part, to the variance in definitions provided throughout the C&D W literature as to how beliefs are defined. However, the research that has examined beliefs has found that if site operatives believe that they have little control over waste management performance, or that their contribution will not be valued, behaviour will reflect these beliefs (Lingard, Graham & Smithers, 1997). Research also indicates that operatives possess the underlying belief that people in managerial roles have greater responsibilities than those in more technical roles for ensuring that C&D W is managed appropriately (Teo et al., 2000).

2.0 RATIONALE FOR THE CURRENT RESEARCH

The first hypothesis is that the ‘tool-box-talk’ intervention will significantly enhance site operatives’:

1. Waste management knowledge;

2. Motivation towards waste management;
3. Beliefs about waste management;
4. Attitudes towards waste management; and
5. Waste management behaviour.

With respect to the enhancement of knowledge, research indicates that training in a specific domain facilitates the schema-construction (i.e. the building of knowledge) for that domain, yielding domain-specific knowledge, or expertise (Pollock, Chandler & Sweller, 2002; Sweller, 2010). This perspective is consistent with research by Chi, Glaser and Rees (1982), Marzano (1998) and Sweller (1999). Furthermore, in research by Kulatunga et al. (2006), it was speculated that providing on-site waste management training to operatives might enhance their waste management knowledge and subsequently, their waste management practices.

The tool-box-talk training will present information about waste management practices and specifically, both the financial and environmental costs of poor waste management practices (i.e. information which site operatives may not have previously known). Therefore, it is hypothesised that learning such information may enhance positive beliefs and attitudes towards waste management. Furthermore, it is hypothesised that the motivation to manage waste correctly will increase, given that the benefits of appropriate waste management will be made explicit.

Consistent with *theory of planned behaviour* (Ajzen, 1993; 2001), it is hypothesised that knowledge will inform beliefs and beliefs will inform attitudes. This is a perspective which is also consistent with research by Teo and Loosemore (2001). Furthermore, given the potential for increase in knowledge, as well as positive attitudes and beliefs towards waste management, it is hypothesised that motivation (i.e. one's own 'personal drive' to think or act in a certain manner and the extent to which they are willing to perform, consistent with this 'personal drive'; Valenzuela, Nieto & Saiz, 2011) will also increase over the duration of training. This hypothesis is consistent with research by Hattie, Biggs and Purdie (1996), which found a significant correlation between motivation and learning. In turn, it is hypothesised that with enhanced knowledge (Ajzen, 1993; Maycox, 2003) and motivation towards waste management (Hattie, Biggs & Purdie, 1996), positive beliefs and attitudes towards waste management (Begum et al., 2009; Fabrigar, 2004; Herresman & Allwright, 2000; Kulatunga et al., 2006; Teo & Loosemore, 2001; Teo et al., 2000), site operatives will exhibit more appropriate waste management behaviours (Bennett, 1975; Kulatunga et al., 2006; Purcell & Magette, 2010) at post-intervention assessment. Similarly, the second hypothesis is that that knowledge, motivation, beliefs and attitudes towards waste management will all be significantly, positively correlated, given the links among these variables discussed in past research (e.g. Ajzen, 1993; Begum et al., 2009; Marzano, 1998; Maycox, 2003; Pintrich et al., 1991; Purcell & Magette, 2010; Teo & Loosemore, 2001; Teo et al., 2000).

3.0 METHOD

3.1 Design

A 2 (time: pre-and-post-testing) x 2 (condition: training group and control group) mixed analysis of covariance (ANCOVA) was conducted in order to examine the effects of a C&D W management training programme, with respect to both time and condition, on C&D W management knowledge. This was conducted while controlling for baseline motivation, beliefs and attitudes towards C&D W management. A series of 2 (time: pre-and-post-testing) x 2 (condition: training group and control group) mixed analyses of variance (ANOVAs) was also conducted in order to examine the effects of a C&D W management training programme, with respect to both time and condition, on motivation, beliefs and attitudes towards C&D W management. Pearson correlations were also conducted in order to examine the relationships among C&D W management knowledge, motivation, beliefs and attitudes towards C&D W management. A series of independent samples t-tests was also conducted in order to examine potential differences between groups (i.e. groups derived from demographics, including age, years working on-site/experience and education) on C&D W management knowledge, motivation, beliefs and attitudes towards C&D W management. Behaviour was observed by the primary researcher for three days prior to the training intervention and for two days following the training intervention. The primary behaviour observed and analysed was the disposal of materials on-site (i.e. what materials were segregated into which skips). Other observed behaviours (e.g. storage practices), that may have an effect on site waste production, were noted and included in the analysis.

After completion of the waste management training intervention, a semi-structured focus group interview was also conducted in order to investigate their perceptions of the training course, with specific focus on: the presentation and quality of the training sessions; the participants' experience of the training sessions; and the likelihood that the training will facilitate appropriate C&D W management practices in the future. Notably, the focus group was also conducted in order to elicit a deeper understanding of the quantitative findings. The interview transcript was examined using thematic analysis.

3.2 Participants

Participants (N=19; 10 in the training group, 9 in the control; all male) were employees of BAM Building Ltd., Galway, aged between 18 and 49 years; and consisted of site operatives, including: Plumbers (N= 4), Labourers (N= 4), Electricians (N= 3), Builders (N= 2), Fitters (N= 2) and (N= 4) others. The initial pre-test sample size (N= 34) was decreased by an attrition rate of 44%. Participants in the focus group (N = 5) were site operatives who took part in the training group and completed both pre-and-post-testing.

3.3 Materials and Measures

A series of three 'tool-box-talk' videos was presented to site operatives via a laptop computer and a projector, as part of the waste management training intervention (see Table 1 for a course outline). The tool-box-talks were developed based on the *WRAP Site Practice Course* (WRAP, 2012), *WRAP's Waste Recovery Quick Wins* (WRAP, 2007), *WRAP's Demolition: Implementing Best Practice* (EnviroCentre, Controlled Demolition & National Green Specification, 2005), the *HSE Waste Management Awareness Handbook* (HSE, 2011) and multiple Envirowise information sheets for site workers (e.g. Envirowise, 2009). The tool-box-talks were voice recorded and dubbed over *Prezi*TM slideshows using *CamTasia*TM recording software.

Insert Table 1 around here

Expertise knowledge of waste management was measured by a 15 item multiple choice question (MCQ) assessment developed by the researcher, based directly on the content of the tool-box-talk videos. Each question presented 5 possible solutions. Only one of the five options was correct for each question. Two versions of the knowledge assessment (i.e. Form A and Form B) were developed and each participant completed each form once over the duration of the intervention.

A seven item 'attitudes towards waste management' scale and a six item 'beliefs about waste management' scale were adapted from research by Ajzen (1985; 1993), Begum et al. (2009) and Teo et al. (2000). Each item on the scales was responded to using a seven-point likert scale. Test reliability of the attitudes scale used in the current study was strong, with an internal consistency of $\alpha = .88$; and $\alpha = .62$ for the beliefs scale.

Motivation towards C&D W management was measured by a customised questionnaire, adapted from the *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich et al., 1991). The version of the MSLQ used in this current study consisted of 9 items, each of which was responded to using a seven-point likert scale (1 = strongly agree, 7 = strongly disagree). Internal consistency for the MSLQ ranges from $\alpha = .52 - .69$ (Pintrich et al., 1991).

Observed behaviour was assessed qualitatively by the researcher. The researcher examined, recorded and photographed the quantity and proportion of materials put in skips, as well as the composition of materials in skips. A skip audit sheet was used to record the quantity, type and compaction level of waste in skips. Other observed behaviours were noted and included in the analysis. Behaviour was observed for three days prior to the training intervention and for two days following the training intervention. The duration of each observation period (i.e. once per day on-site) was approximately one and one-half hours.

A *HTC Wildfire STM* media device with recording capability was used to record the focus group interview.

3.4 Procedure

BAM Building Ltd., specifically the project manager was contacted for research recruitment and established a suitable visitation schedule for the researcher. The project consists of the construction of two buildings namely, Merlin Woods Primary School and Coláiste Mhuirinne/ Merlin College Post-Primary School. The address of the project is Merlin Woods, Doughiska, Galway, Ireland. The estimated value of the project is €10,423,140. A point of contact was made on Day 1 of the observation (i.e. July 19th, 2013); specifically, the Safety, Health and Environmental (SHE) officer for the site.

The study took place over the duration of five weeks. Pre-intervention behavioural observation began on Friday, July 19th 2013 and resumed in Week 2 (i.e. on July 23rd and 24th). During behavioural observation, the primary researcher examined and recorded waste

management, waste disposal and storage practices on site. In Week 3, the intervention began. On Monday, 29th July, 34 site operatives (including electricians, plumbers, labourers and builders) were administered measures which assessed knowledge, motivation, beliefs and attitudes towards C&D W management.

Notably, two forms of the knowledge assessment were developed for the current study, both consisting of 15 MCQs (all of which provided 5 possible solutions, with only one of which being correct). All 30 items developed (i.e. the sum of the 15 items from each of the two assessments) were piloted on six volunteers that were not from the BAM site. Some minor changes were made to the phrasing of questions based on the findings from the piloting session.

The researcher compared the results from the pilot testing with a difficulty ranking previously developed for each item. Using these measures, the researcher split the 30 items into two separate, though reasonably similar tests (i.e. with respect to difficulty). Nevertheless, a cross-over repeated measures approach was utilised for administration of the assessment. That is, half the site operatives completed Form A as the pre-test and Form B as the post-test, and the other half of site operatives took Form B as the pre-test and Form A as the post-test. This design automatically corrects for any differences in difficulty between the two forms (Hitchcock, 2004). In addition, given that test-takers would not be encountering any of the same questions from one testing-time to the next, this design also eliminated the potential for any practice effects. Furthermore, neither basement effects (i.e. extreme low scoring; e.g. less than chance – in this context, 3/15 correct), nor ceiling effects (i.e. extreme high scoring), were observed in the resulting data analysis as mean scores ranged from a minimum of 5.2 to a maximum of 9.3.

After completion of the pre-intervention assessments, participants were randomly allocated to either the training group or the control group. Those who participated in the training group received three ‘tool-box-talks’ - one each day for three days. The ‘tool-box-talks’ were designed to teach C&D W management procedures according to the WRAP framework (again, see the Materials and Measures section) and presented educational/training information about: C&D W management; why C&D W should be managed correctly; and procedures for how to conduct C&D W management appropriately. The duration of the tool-box-talks ranged between seven-and-a-half and nine minutes, so as to not to lose the attention of the participating viewers, given that research indicates that didactic presentations (such as those used in the current research) which last longer than 15 minutes can substantially decrease attention to the source of instruction (Wankat, 2002). Those allocated to the control group did not attend any ‘tool-box-talks’.

The tool-box-talks began on Tuesday, 30th of July and ended on Thursday, 1st August. Following completion of the training intervention, participants were again administered measures which assessed knowledge, motivation, beliefs and attitudes towards C&D W management. Again, those who received Form A at pre-testing were administered Form B at post-testing and vice versa.

The researcher returned to site on Monday, August 12th and conducted a follow-up, semi-structured focus group interview, in order to elicit a deeper understanding of the quantitative results. Five site operatives participated in the focus group interview. After completion of the interview, all participants were debriefed and thanked. Also on August 12th, the first post-intervention behavioural observation took place, followed by the second and final

behavioural observation on Wednesday, August 14th. During both days of post-intervention behavioural observation, the researcher again examined and recorded waste management, waste disposal and storage practices on site.

4.0 RESULTS

The results from the ANCOVA (i.e. means and standard deviations for scores on knowledge, overall motivation, motivation towards control of beliefs, motivation towards help-seeking, motivation towards effort regulation, beliefs and attitudes towards C&D W management) are presented in Table 2. Table 3 presents inter-correlations between all outcome measures included in this study.

4.1 Group differences in Knowledge, Motivation, Attitudes and Beliefs

Preliminary analysis of the 2 x 2 ANCOVA indicated that for motivation, beliefs and attitudes, the relationship with knowledge did not differ significantly as a function of the training condition. That is, change in knowledge was not accounted for by motivation, beliefs or attitudes.

Results from the mixed ANCOVA revealed a significant² effect of time ($F [1, 17] = 12.84, p = 0.002, \text{partial } \eta^2 = 0.43$)³. Specifically, knowledge scores significantly increased from pre-to-post-testing. However, there was no effect of condition (i.e. group), though a trend⁴ towards significance was observed ($F [1, 17] = 3.10, p = 0.097$). That is, those in the training group scored higher than those in the control group. There was also a significant time x condition interaction effect ($F [1, 17] = 14.31, p = 0.001, \text{partial } \eta^2 = 0.46$), whereby the benefits of training were greater at the post-testing (see Figure 1).

Insert Table 2 around here

As a result, post hoc analyses were conducted via a series of paired samples t-tests. These examined the differences between pre-and-post-test knowledge scores for both conditions. They also examined differences between the training and control groups' pre-test knowledge scores, as well as their post-test scores. With respect to pre-testing, there was no significant difference between groups on knowledge. This indicates that the two groups were well matched. At post-testing, the training group scored significantly higher than controls on waste management knowledge ($t = -3.86, df = 17, p = 0.001, \text{two tailed}, d = 1.80$). The paired samples t-tests further revealed that those who participated in the training group scored significantly higher on post-testing compared with pre-testing on knowledge ($t = -7.24, df = 9, p < 0.001, \text{two tailed}, d = 2.08$). Finally, there were no significant differences between the pre-and-post-testing knowledge scores of participants in the control group.

² Where $p < 0.05$ is significant

³ Where η^2 is a measure of the effect size, a determination of the power of the relationship between the two variables

⁴ Where $p = 0.097$ was close to $p < 0.05$

Insert Figure 1 around here

A series of 2 (time: pre-and-post-testing) x 2 (condition: training group and control group) mixed analyses of variance (ANOVAs) was also conducted in order to examine the effects of both time and condition on motivation, beliefs and attitudes towards waste management. Results from the ANOVAs revealed a significant effect of time on beliefs ($F [1, 17] = 5.24, p = 0.035, \text{partial } \eta^2 = 0.24$) and attitudes ($F [1, 17] = 10.89, p = 0.004, \text{partial } \eta^2 = 0.39$), both of which increased in positivity over time. However, there were no effects of condition, no interaction effects, nor any other significant effects.

Further quantitative analysis was conducted in order to examine any pre-existing differences in knowledge, motivation, beliefs and attitudes towards C&D W management resulting from demographical data.⁵ A series of independent samples t-tests was conducted in order to examine the effects of the following:

1. Age (i.e. 34 years old and above v. those less than 34 years old);
2. Years on-site/experience (i.e. 15 years or more v. less than 15 years experience);
3. Education (i.e. those who completed at least an apprenticeship v. those who did not);
and
4. Position held on-site (i.e. labourers, plumbers, builders, electricians and others) on knowledge, motivation beliefs and attitudes towards C&D W management.

Results revealed no significant differences based on age years on-site/experience, education or position held. However, a trend was observed in which electricians scored higher, on average (though non-significantly), than participants from other fields on all outcome measures with the exception of positive attitudes. As a result, in order to further investigate this trend, a further series of independent samples t-tests was conducted to examine the effects of work position (i.e. in this context, being an electrician or not being an electrician) on knowledge, motivation, beliefs and attitudes towards C&D W management. Results from the t-tests revealed that electricians scored significantly higher than non-electricians on knowledge ($M= 7.22, SD= 2.44; M= 5.33, SD=2.11$, respectively), $t = -2.19, df = 31, p = 0.036$, two tailed, $d = 0.83$; and motivation, ($M= 50.56, SD= 5.05; M= 42.96, SD= 6.70$, respectively), $t = -3.08, df = 31, p = 0.004$, two tailed, $d = 1.28$.

4.2 Correlations

At pre-testing, there was a significant, positive correlation between motivation and positive beliefs about waste management ($r = 0.39, p < 0.05$). Also at pre-testing, knowledge was significantly, negatively correlated with age ($r = -0.37, p < 0.05$) and years on-site/experience ($r = -0.38, p < 0.05$). At post-testing, there was a significant, positive correlation between positive beliefs and attitudes towards waste management ($r = 0.76, p < 0.01$). Furthermore, age was significantly, positively correlated with years on-site/experience ($r = 0.90, p < 0.001$).

⁵ Due to a diminished small sample size, such analysis was not possible for post-training data.

Insert Table 3 around here

4.3 Observed Behaviour

Table 4 presents the Skip Audit for behavioural observation. Overall, the level of non-compliance was low across all observation days, in comparison with the researcher's experience on other construction sites. This may potentially be due to influence/encouragement from upper site management, who were anticipating the arrival of the visiting researcher. That is, reduction in waste may have been established in the immediate days prior to site visitation. Nevertheless, the presence of segregated skips, such as on this particular BAM site, fosters the process of waste segregation and hence, landfill waste reduction.

With respect to waste segregation, the first day of observation was by far the most successful. However, this possibly due, to managements' expectation of the observer's arrival on site. Subsequently, successful waste management practices declined over the coming observation days. Particularly, Days 2-4 (i.e. the first two days occurring prior to the intervention and the latter occurring post-intervention) had a higher frequency of non-compliance than on Day 1. Day 5 (i.e. the second and final day of post-intervention observation) showed the lowest level of compliance with correct C&D W management practices. For example, a lack of skip identification inevitably lead to one site worker mistaking a timber skip for a mixed waste skip (in which a sizeable amount of mixed waste was disposed). This lead to no timber skip being available on that day; and hence, a greater amount of waste going to landfill. Cumulatively, compliance with skipping materials correctly was superior at pre-intervention observation in comparison with post-intervention observation.

However, there is a caveat to this recommendation (i.e. the restriction of site operatives to manage waste correctly as a result of 'oversights' made by upper management). For example, similar to Day 5, though the presence of skip identification (i.e. the clear display of skip signage adjacent to the corresponding skip) declined over the duration of behavioural observation days (which is likely to have accounted for an increase in non-compliance with correct C&D W management practices), this aspect of site practice is the responsibility of site management and *not* that of site workers. In addition, site procedure states that personnel are required to segregate waste at their workspace, accomplished by filling a mini skip with one type of waste, waiting for it to be emptied and then filling it with a different type of waste. However, this did not occur in practice, nor was it likely to occur as personnel are also required to clear their workspace as they go, due to health and safety constraints (i.e. stockpiling of waste materials is discouraged as they are possible trip hazards). Thus, it appears that conflicting site objectives were restricting operatives from managing site waste correctly with respect to mini skip segregation.

Furthermore, during observation, a lack of availability of segregated mini skips (i.e. no more than one mini skip was made available at a time on each floor) resulted in all mini skips being utilised as mixed skips. Although mini skips are frequently, further separated by labourers into the main skips, it is not likely that this will occur, particularly if all labourers are occupied elsewhere (as is often the case on this site); and/or if an empty mini skip is required elsewhere on the worksite. Notably, it is the responsibility of upper management to provide

adequate skips for site personnel; and thus, the training intervention would have no effect on this aspect of behaviour, given that:

1. This is not an outcome attributed to site operatives (i.e. it is not the responsibility of site operatives to organise skip logistics); and
2. Upper management did not take part in the training intervention.

Across the five days of site visitation, storage areas were observed, as improper storage of materials can lead to waste creation. On observation days prior to the training intervention, the storage areas were observed to contain many incidences of incorrect storage practices (e.g. see Day 1 above). However, during post-intervention behavioural observation, the storage areas exhibited a marked improvement. This change was fully attributed to a member of site personnel (i.e. operatives were not instructed to do this) - showing personal initiative by means of tidying the store area and replacing broken lighting. This behaviour is consistent with the quantitative results above, specifically those which indicate enhanced knowledge, positive beliefs and positive attitudes towards waste management – which is reasonable to suggest, given that correct storage of materials was included in the training materials (i.e. Video 2 - *Avoiding and Reducing Construction Waste: Part 1*).

There was also a noticeable improvement on the compliance of the contents of the mixed waste skip during post-intervention observation. Though this may have been due to the training received by site operatives, it may also have resulted from the presence of a recyclables skip on Day 4. The presence of the extra recyclables skip clearly aided mixed waste reduction.

In conclusion, the results of the behavioural observation indicate that many incidences of non-compliance could be greatly reduced through the provision of segregated mini skips on the worksite and through an improvement in main skip identification. In both cases, upper management, rather than site personnel, would be responsible for the incorrect practices of waste management, as a result of not having procedures implemented that facilitate correct waste management practices. Thus, the results of the behavioural observation analysis suggests that, when excluding incidences of poor waste management practice attributable to upper management, site operatives exhibited a marked improvement in behaviour towards waste management.

Insert Table 4 around here

4.4 Focus Group

After completion of the waste management training intervention, a semi-structured focus group interview was conducted with five participants, in order to investigate their perceptions of the training course, with specific focus on the presentation and quality of the training sessions, as well as the participants' experience in the training sessions and the likelihood that the training will facilitate appropriate waste management in the future. The interview transcripts were examined using thematic analysis. Overall, there were five themes identified:

1. The quality of the waste management training;

2. The perceived futility of waste management training;
3. The perceived restrictions to waste management;
4. The possibility of waste reduction; and
5. The varying perceptions of those who 'clean' on-site.

Results revealed that though the participants thought the training provided to them in the current study was “good”, “easy to understand” and “informative”, they did not think it would be helpful, because it would be too difficult to implement, given that what the training presents as appropriate waste management protocol is contradictory to the site practices they indicate are imposed on them. Furthermore, the participants question the financial viability of managing waste correctly and deem it impractical. They further suggest that they are restricted from managing waste correctly (in the event that they wished to do so), by “space, time and organisation” (Participant IM). Finally, results indicate that though participants feel that waste can be reduced on-site, they fail to see waste management as their own personal responsibility. Rather than present a full results section for the thematic analysis, the findings are elaborated in the discussion in order to fulfil the purpose of the focus group interview, which was to shed light upon the quantitative findings and their implications.

5.0 DISCUSSION

5.1 Interpretation of Results

The overall aim of the current programme of research was to evaluate the use of waste management training on waste management knowledge, motivations, attitudes, beliefs and behaviours. The overall findings indicate that waste management training (i.e. tool-box-talks focused on presenting information about waste management and teaching waste management procedures) is an efficacious method of enhancing waste management knowledge and behaviour. However, findings suggest that there was no effect of waste management training on motivation, beliefs or attitudes towards waste management.

Specifically, results revealed a significant effect of time and a significant time x condition interaction effect, in which those who took part in the waste management training intervention significantly outperformed those in the control group from pre-to-post-testing on waste management knowledge. The results indicate, simply, that the training intervention was successful in enhancing waste management knowledge. This finding is consistent with research by Begum et al. (2009), which also found beneficial effects of that construction-related education. This finding is also consistent with past research on training (in general) and the development of expertise (e.g. Chi, Glaser & Rees, 1982; Marzano; 1998; Pollack, Chandler & Sweller, 2002). Specifically, research suggests that training in a specific domain facilitates the schema-construction (i.e. the building of knowledge) for that domain, yielding domain-specific knowledge, or expertise (Pollock, Chandler & Sweller, 2002). Thus, the results from the current research indicate that the waste management training facilitated operatives' schemas-construction for C&D W management facts and procedures – represented as waste management knowledge.

Notably, results were somewhat counter to the hypothesis based on Ajzen's (1993; 2001) *Theory of Planned Behaviour* - that an increase in knowledge would yield increases in

positive beliefs and attitudes. That is, there was no significant effect of training on beliefs, attitudes or motivation from pre-to-post-testing. However, there was an effect of time on both beliefs and attitudes towards waste management, in which positive beliefs and attitudes about waste management increased over-time (i.e. accounted for by *both* the control and training groups). This is an interesting finding, given that, though it was hypothesised that the training group would exhibit enhanced positive beliefs and attitudes towards waste management from pre-to-post-intervention testing, the control group was not provided any treatment that would warrant an increase in positive beliefs and attitudes. It is possible that, following the initial testing session (i.e. the first meeting between site operatives and the researcher), site operatives were prepped or encouraged by the SHE Officer to exhibit a more positive disposition towards managing waste correctly (i.e. for purposes of maintaining a positive perception of the construction company on the part of the researcher). Subsequently, such a positive disposition may have been reflected in the manner in which operatives responded to the post-test beliefs and attitudes scales.

On the other hand, the increase in positive beliefs and attitudes may have possibly been the result of the Hawthorne effect (i.e. observer effect), in which participants (i.e. in both groups or perhaps in the control group only) modify their performance (in this context, attitudes and beliefs). This occurs as a result of knowing that they are being examined and not as a result of any other experimental manipulation (e.g. being provided or not being provided a training intervention). This modification of performance could have been implicit or intentional. It is worth noting that, if this finding is a result of an observer effect and if it was localised to the control group only, then this would provide some support to suggest that those in the training group may have potentially exhibited enhanced positive beliefs and attitudes towards waste management as a result of the training. Unfortunately, however, there are many 'if's in this speculation, which is also not readily testable.

With respect to waste management behaviour, the results of the behavioural observation analysis indicated that, when excluding incidences of poor waste management practice that are attributed to upper management (i.e. a behavioural anomaly also identified in research by Teo et al., 2000; Teo & Loosemore, 2001), site operatives exhibited a marked improvement in behaviour towards waste management over the duration of the intervention. This finding suggests that the training accounted for at least some variance in behaviour. Thus, in addition to successfully enhancing waste management knowledge over time, there is some evidence to support the indication that waste management training also positively influences waste management behaviour. However, it is also possible that behaviour improved from pre-to-post-intervention as a result of increases in positive beliefs and attitudes towards waste management over the same duration. Notably, both of these interpretations are consistent with Ajzen's (1985; 1993; 2001) *Theory of Planned Behaviour*. Nevertheless, given the significant interaction effect of time x condition on knowledge, it seems likely that training accounted for at least some positive variance in behaviour.

To reiterate, these recommendations (i.e. with reference to improved behaviour from pre-to-post-intervention) are made with the caveat that certain behaviours associated with poor waste management practice are excused as a result of responsibility. That is, the results of the behavioural observation also indicated that many incidences of non-compliance could be greatly reduced through the provision of segregated mini skips on the worksite and through an improvement in main skip identification. In these cases, upper management, rather than site personnel, would be responsible for the incorrect practices of waste management. To clarify, during the on-site observation, upper management were identified as responsible for

many of the incorrect waste management practices, as a result of not having procedures implemented that facilitate correct waste management practices. This indication is further consistent with findings from the focus group interview. For example, according to participant IM, in order for waste management training to make a difference to waste management behaviours, it must be implemented properly and must be consistent with the instructions that they are given on-site:

“...it all has to be done by a process, hasn't it, like? You know, everything has to be done step by step, like, if you want to, yeah? ...You see, it has to be implemented, like...there's no point training everyone and then like, saying like, just use that skip there.”

(Participant IM)

Also consistent with onsite observation regarding the use of a limited amount of mini skips was the frequent allusion of focus group participant towards the following statement:

“Everything in the one skip!”

(Participant FM)

The notion that often, there is only enough room to fit one skip, which is then used for all materials is further elaborated upon by one participant who stated that:

“There isn't enough area [space] to segregate”

(Participant IM)

Such restrictions to correct waste management practices were identified by both the behavioural observation and focus group participants and are also not attributable to site operatives, given that such logistics are not their responsibility. Thus, it is both fair and reasonable to suggest that certain poor waste management practices observed should not be counted against the site operatives' behaviour. Taking this into account, site operatives exhibited a marked improvement in behaviour towards waste management over the duration of the intervention. Again, this finding is consistent with research by Teo and Loosemore (2001) who found that that, operatives' ability to implement good waste management practices were often hindered by management, through a lack of dedication to the problem of waste reduction.

Results also revealed that, at pre-testing, motivation was significantly, positively correlated with positive beliefs about waste management, indicating that the more motivated a site operative is to manage waste correctly, the more likely they are to hold positive beliefs about waste management and vice versa. At post-testing, consistent with the hypotheses outlined in this research, there was a significant, positive correlation between beliefs about waste management and attitudes towards waste management. Though there was no significant difference between older and younger participants on pre-existing knowledge towards waste management, results revealed that age was significantly, negatively correlated with pre-existing knowledge. This result suggests, contrary to hypotheses above, the older the site operative, the less they know about managing waste on-site correctly. With respect to years on-site, there was no effect of experience on knowledge, motivation, beliefs or attitudes towards waste management. However, like age, experience was negatively correlated with knowledge, consistent with the rationale presented above, with regards to age. This may also reflect the possibility for changing protocols in waste management 'over the years' to confuse

or confound what experienced site operatives thought they already knew. Notably, this correlation is also consistent with research by Begum et al. (2009), which found that lower levels of experience increased consciousness of waste management practices.

Interestingly, results from further, demographical analysis revealed that electricians scored significantly higher than non-electricians on waste management knowledge and motivation. Though one of the first possible explanations for these findings would generally be linked with level of education and/or having completed an apprenticeship, such speculation would be inaccurate, given the null effects of education. However, given that the electricians on-site are held personally accountable for their own waste management (i.e. they are contractually obligated to remove their own waste from site and have it disposed), then it seems reasonable to suggest that it would have been in their own interest to educate themselves (i.e. prior to the intervention) on waste management procedures, as mismanagement of waste could potentially result in personal fines. Accordingly, the desire to avoid fines for the mismanagement of waste would also account for their significantly higher motivation to manage waste correctly. The suggestion of financial incentives, or in this context, the avoidance of financial punishment, is also consistent with the findings that though effects were observed for knowledge and motivation, there were no effects of trade (i.e. being an electrician vs. non-electricians) on attitudes or beliefs. That is, if electricians' avoidance of financial punishment is the driving force for behaviour, then it doesn't matter how they feel about managing waste management or even what they believe about managing waste, but rather, what they know about doing it correctly (i.e. to avoid losing money) and whether or not they are motivated to do so.

Results from the focus group indicated that participants thought the training intervention was "good", "easy to understand" and "informative", which are largely consistent with the quantitative findings that the training intervention significantly enhanced waste management knowledge. Nevertheless, results from the focus group also indicated that participants thought that, regardless of the quality of the training, it would not be helpful, due to the many restrictions (e.g. "space, time and organisation" [IM]), placed on them by higher management, they feel would impede the implementation of the procedures taught within the training. This finding is consistent with research by Kulatunga et al (2006), which found a lack of available time was a main impediment to implementation of good waste management practices. This finding is further consistent with research by Teo et al. (2000) and Teo and Loosemore (2001), which found that operatives' ability to manage waste was obstructed by a deficiency in higher management, through lack of commitment to plan waste reduction (Teo et al., 2000); and hindered by a lack of dedication from management (Teo & Loosemore, 2001).

Finally, results indicated that though participants feel that waste can be reduced on-site, they fail to see waste management as their own personal responsibility. This finding may possibly reflect the trades of the focus group participants. That is, no labourers participated in the focus group. This is notable because on the construction site examined, according to the on-site SHE Officer, labourers are the primary 'care-takers' of waste-management. Thus, if the focus group participants view labourers as the 'care-takers' of waste management (as participant IM explicitly states on multiple occasions), then it comes as reasonably unsurprising that non-labourers would view waste management as not being their own personal responsibility. A further noteworthy point is one exception in the sample of focus group participants, an electrician (participant EM) who did not strongly oppose personal responsibility of waste management – an individual, who unlike other focus group

participants, would be directly responsible for his own waste management (as described above). For example, according to EM, when “down tools” is called, everyone should contribute to ‘cleaning’.

Overall, a number of interesting findings were observed in the current study. The main findings from the current research indicated that though that the tool-box-talk training had no effect on motivation, beliefs or attitudes towards waste management, the ‘tool-box-talk’ training significantly enhanced knowledge towards waste management. Results also revealed a positive variance in behaviour towards waste management from pre-to-post-intervention assessment, perhaps to some extent, as a result of the tool-box-talk-training. Finally qualitative data analysis from the focus group interview yielded five major themes:

1. The quality of the waste management training;
2. The perceived futility of waste management training;
3. The perceived restrictions to waste management;
4. The possibility of waste reduction; and
5. The varying perceptions of those who ‘clean’ on-site;

The results of the analysis revealed that though the participants rated the training favourably, they thought it would be too difficult to implement, given that what the training presents as appropriate waste management protocol is both restricted (i.e. by space, time and organisation) and contradictory to the site practices they indicate are imposed on them. Furthermore, though participants feel that waste can be reduced on-site, a majority fail to see waste management as their own personal responsibility.

6.0 LIMITATIONS & FUTURE RESEARCH

Though the current research produced a number of interesting findings, there were two limitations that warrant consideration. One limitation was the small sample size, which may have decreased the power of the statistical analysis; thus, making it more difficult to identify significant effects when comparing groups on motivation, beliefs and attitudes, particularly at post-testing (i.e. as a result of a further decrease in sample size due to attrition). For example, from a pool of approximately 80 potential participants, only 34 completed pre-testing and subsequently, only 19 completed post-testing, yielding an attrition rate of 44% from pre-to-post-testing. The attrition may have resulted from the occurrence of a fault with the crane on the day of post-testing, in which many operatives were forced to skip lunch and aid in fixing the difficulties associated with the crane, as according to the SHE officer, ‘all hands were on deck’. Attrition may also have occurred as a result of some participants, who completed pre-testing, no longer being on-site at the time of post-testing. Another possible reason for the small sample size was that recruitment for voluntary participation took place during site operatives’ lunch/break-time and thus, operatives may have been reluctant to participate as this would impinge on their breaks.

In order to overcome problems of attrition, future research might aim to implement and evaluate tool-box-talk training in the context of a mandatory course, as opposed to a voluntary course (as employed in the current study). By making such a training intervention mandatory (on the part of site management), attrition would have been significantly reduced

and perhaps, as a result of increasing the statistical power associated with a larger sample size, there may have been a better chance of detecting a significant effect of training on motivation, beliefs and/or attitudes towards waste management.

Another limitation of the current study was the manner in which observed behaviour was assessed. Observed behaviour by the researcher was deemed the most accurate method of assessing behaviour as it would allow for the researcher to quantify specific behaviours, such as correct/incorrect waste disposal practices. Though other methods of assessing behaviour exist, particularly self-report measures (such as those used in research by Teo & Loosemore, 2001), many are limited in that they are taking the word of the test-taker that they do indeed behave in a certain manner, in specific contexts. Thus, it is a more accurate and valid method of assessing behaviour to observe and quantify behaviours as they occur. However, given that approximately 80 individual worked on-site each day, only 10 of these workers took part in the training regime (i.e. 12.5%). As a result, it is difficult to attribute observed differences in behaviour (e.g. changes) from before the training and after the training to the training intervention itself. However, given that: the four labourers on-site were the primary 'care-takers' of waste-management (i.e. according to the on-site SHE Officer); and all four labourers participated in the training intervention, variance in behaviour attributed to the training intervention warrants additional weight. Despite warranting additional weight, however, results and subsequent recommendations pertaining to the training intervention's effect on observed behaviour must be interpreted with caution.

In addition, time restrictions impeded the behavioural observations. For example, the researcher was to restricted to site visitation and likewise, site observation, based on the availability of the SHE Officer, who was to escort the researcher at all times on-site. This allowed for only five days of observation. Approximately one and one-half hours were granted to the researcher to observe behaviour on each of the five days. Due to these time restrictions, it became difficult to observe the entirety of the site for any extended duration. This ability was further impeded by the fact that there was only one observer. For example, on Day 5, at the time the researcher was observing the main skips, it would be unknown if operatives were inappropriately skipping incorrect materials in the mini skips elsewhere on the work site. Moreover, the ability to witness the skipping of material, as it happened, was a rare occurrence.

Given the restrictions above, the methodology for quantitative analysis of behaviour was amended and the new criteria for behavioural measurement – product recording (i.e. the measurement of behaviour through the quantification of a tangible outcome; Marholin & Steinman, 1977) of incorrectly skipped materials became the sole measure of observed behaviour. As the researcher photographed the skips on-site as part of the qualitative data collection, these photographs were also used in the quantitative analysis of the contents of the skips. Notably, however, it was only feasible, time-wise, to photograph each skip on one occasion each day (i.e. when doing the 'rounds' with the SHE officer). To reiterate, the researcher analysed the materials visible in each skip (within the photographs) and assessed the approximate percentage of materials incorrectly disposed of in each skip. The primary researcher employed a secondary adjudicator to do the same, in order to avoid researcher bias. Though the secondary adjudicator was also blind to what day the photo was taken, in order to eliminate any bias towards the potential success or failure of the training intervention, it remains that these approximate percentages of materials incorrectly disposed are arbitrary at best, as it was not possible to decipher the contents of the skip below the surface area.

As a result, despite having completed a full skip audit for the skips used on each of the observation days, formal analysis of behaviour was limited to qualitative analysis, only. Given that this analysis was originally designed to be, in large part, objective; and was conducted by the researcher alone (who tried their best to analyse the data 100% objectively), there remains the potential for subjectivity in the observations. As a result, though the qualitative analysis was intended as only one aspect of behavioural evaluation, the results are consistent with findings from the focus group data analysis; thus, results and subsequent recommendations pertaining to observed behaviour are worth considering, but must be interpreted with caution.

In order to overcome problems of measuring observed behaviour, future research might aim to employ a research team in order to simultaneously observe different aspects of waste management behaviour in different site locations. This would maximise the amount of time a section of the site is observed. For example, two researchers might observe the main skips at one end of the site for one and one-half hours (i.e. the approximate amount of time granted to the researcher for observation by the SHE officer in the current study), while at the same time, two different researchers might observe the mini skips on the work site for one and one-half hours, as opposed to having one researcher try and observe all facets of site behaviour within the allotted one and one-half hours. Employing a research team would also decrease the potential for subjectivity in the reporting of behavioural observations. Again, for example, having two observers at each skip would allow for a cross-referenced rating of each observed behaviour. In addition, future research might also aim to video-record the main skips on site from the opening to the closing of each working day, in order to provide researchers with the ability to quantify each and every item of material that is skipped, thus providing a more reliable method of quantifying non-compliance than simply approximating the percentage of non-compliant disposal. One final recommendation, along similar lines, is that future research should aim to develop a method of quantifying potential effects (i.e. both positive and negative) of site management's influence on waste management procedures, for purposes of controlling for such a variable in future data analysis (e.g. the intervention of management on site operatives' behaviour prior to the arrival of the researcher in order to establish positive waste management practices 'just in time' and established logistics and practices that are contradictory to correct waste management practices, for example, having one mini skip available per floor and providing inappropriate signage). This notion is important to consider and investigate in future research given not only the findings in the current research, but also in research by Teo et al., (2000) and Teo and Loosemore (2001), regarding higher management's potential impact on operatives' ability to manage waste.

7.0 SUMMARY & CONCLUSION

In conclusion, results from the current research programme revealed that the 'tool-box-talk' training intervention significantly enhanced knowledge towards waste management. Results also revealed a positive variance in behaviour towards waste management from pre-to-post-intervention assessment. In addition, results revealed that there was no effect of the tool-box-talk training intervention on motivation, beliefs or attitudes towards waste management. However, there was an effect of time on both positive beliefs and attitudes towards waste management. Furthermore, there was no effect of age, years on-site/experience or education

on waste management knowledge, overall motivation, beliefs or attitudes. However, there was an effect of position/trade on waste management knowledge, in which electricians scored significantly higher than non-electricians on waste management knowledge, overall motivation and two motivation sub-scales (i.e. help-seeking and control of beliefs).

Moreover, results revealed that overall motivation was significantly correlated with all motivation sub-scales at pre-testing, but only with motivation towards effort regulation at post-testing. Overall motivation was also positively correlated with positive beliefs about waste management at pre-testing, as was motivation towards control of beliefs. At post-testing, beliefs about waste management were correlated with attitudes towards waste management, as was motivation to control beliefs. Though age and years on-site/experience were both positively correlated with each other, they were both negatively correlated with pre-intervention knowledge. Finally, the main findings from the qualitative focus group interview indicated that though the participants rated the tool-box-talk training favourably, they thought it would be too difficult to implement, given that what the training presents as appropriate waste management protocol is both restricted (by “space, time and organisation” [participant IM]) and contradictory to the site practices they indicate are imposed on them.

In conclusion, consistent with reports which highlight the value of C&D W management training and likewise, C&D W management knowledge and behaviour (e.g. Begum et al., 2009; Kulatunga et al., 2006; Teo et al., 2000; Teo & Loosemore, 2001), the results of the current research suggest that waste management knowledge and behaviour can be enhanced by participating in ‘tool-box-talk’ waste management training. However, future research is necessary to further examine the effects of waste management training on associated knowledge and, particularly, waste management behaviour, as well as the relationships among these constructs; and the conditions that most positively affect waste management knowledge and behaviour, such as site management support.

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