OPERATIVES' ATTITUDES TOWARDS WASTE ON CONSTRUCTION PROJECT

Melissa M M Teo, Martin Loosemore, M. Marosszeky, K. Karim and D. Gardner

University of New South Wales, Sydney 2052, Australia

An emerging concern within the construction industry is how to better manage waste, because of the associated environmental and cost implications. Current research in this area has focused on the quantification of waste and on identifying ways in which it can be minimised, reused, recycled or disposed of. However, the labour-intensive nature of construction activity suggests that behavioural impediments could also influence waste levels. This paper presents the results of research which investigated the forces which shaped operatives' attitudes towards waste in the construction industry. The findings suggested that operatives' attitudes towards waste were positive but that any goodwill was impeded by a lack of managerial commitment to the issue of waste reduction.

Keywords: attitudes, construction waste, solid waste management, environmental.

INTRODUCTION

Over the last decade, environmental awareness has emerged as an area of concern that the construction industry cannot afford to ignore (UNCHS, 1993; CIRIA, 1993; Griffith, 1995). Central to the environmental debate is a global reassessment of methods employed to manage the substantial amount of waste produced annually by the construction industry. It has been estimated that construction waste contributes 20-30% of all waste deposited in Australian landfills and similar proportions of landfill in the US and parts of Europe (Apotheker, 1992; Craven *et al.*, 1994; Faniran and Caban, 1998). Despite being a major generator of waste, the construction industry has had little motivation to adopt efficient waste management practices, with landfill disposal of waste providing a convenient solution to conceal the construction industry's contribution to environmental degradation. This accepted practice arose out of the construction industry's environmentally complacent culture, which was driven by landfill disposal costs that were considerably less than the cost of incorporating waste management practices into projects (Moavenzadeh, 1994; Mincks, 1994). However, for environmental and economical reasons, levels of waste need to be reduced significantly.

Current research in waste management has focused on the quantification of waste and on identifying ways in which it can be minimised, reused, recycled or disposed of (Allessie, 1989; Apotheker, 1990; Gavilan and Bernold, 1994; Lauritzen, 1994; Bossink and Brouwers, 1996; Poon, 1997). However, the labour-intensive nature of construction activity suggests that behavioural impediments are likely to influence waste levels significantly. While some research has been conducted on how existing work processes contribute to waste, this viewpoint is insufficient to tackle the problem

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of waste in its entirety since waste generation also arises from the wasteful work-practices of people on construction projects.

Attitudes to waste

Construction is a labour-intensive industry and consequently, the effectiveness of waste management practices are dependent on the willingness of individuals involved in the construction process to change their attitudes and behaviour. In particular, Skoyles *et al.* (1974) identified that waste levels were more dependent on human factors than upon the type of construction or building company employed to do the work (Faniran and Caban, 1998). More recently, other research has suggested that waste management practices were directly related to existing attitudes and the behavioural tendencies of individuals involved in the construction process (Skoyles *et al.*, 1987; Lingard *et al.*, 2000). Indeed, studies by Soibelman *et al.* (1994), Heino (1994) and Pinto and Agopyan (1994) have substantiated Skoyles *et al.*'s earlier findings and concluded that a change in people's attitude was much more important than changes in building technology. Collectively, these studies have highlighted the need for operatives to develop an awareness of the high value of materials and the adoption of more cautious work practices. It would appear that an understanding of operatives' attitudes to waste management could make a significant contribution to reducing levels of construction waste. Operatives are defined in this research as site foremen, leading hands, tradesmen, labourers and other workers in a technical, hands-on capacity. While there has been some attitudinal research at managerial level, there has been a complete lack of research conducted at operative level. This is an important deficiency because operatives make up the bulk of site work-forces and have the most direct contact with the materials being wasted (Rowings et. al, 1996).

AIMS AND OBJECTIVES OF THIS RESEARCH

The aim of this paper is to report the preliminary results of research into site operatives' attitudes, beliefs and perceptions towards construction waste and to determine the influences, both internal and external, that shape them. The ultimate objective of this research is to produce a model which will assist in explaining the forces that shape operatives' attitudes towards waste on construction projects.

METHODOLOGY

Data Collection

Data was collected using an attitudinal survey as an exploratory instrument to provide “leads” to investigate in further detail via retrospective focus-group interviews. Survey participants were operatives from 5 occupational groups across 8 construction projects in Central Sydney. 475 surveys were administered and the response rate was 29.1%, providing a sample of 138. The survey was based on a model of attitude formation that was adapted from Ajzen's Theory of Planned Behaviour (Ajzen, 1985; 1987; 1991; 1993). This model is illustrated in Figure 1 and it provides the main survey variables which related to:

People's definitions of waste

Recycling practices

Level of training in waste management

Responsibility to reduce waste

The perceived important of waste as a project goal

Acceptable levels of waste

Knowledge of what happens to waste generated on projects

Overall experience of waste management on past projects

Factors that prevented people from reducing waste

Motivations to reduce waste

Levels of support for waste management practices

Analysis

The survey data was analyzed for significant associations, which justified more detailed exploration in phase two of the research which is currently on-going and involves focus-group interviews. Frequency analyses were computed for each variable and the chi-square 'goodness of fit' test was used to measure how close observed frequencies of occurrences were to expected frequencies. Cross tabulation was also used to determine if two variables were statistically independent. Finally, a 'one-way ANOVA test' was used for rating scale data for testing the equality between sample means. A significant association was inferred when the p-value or observed level of significance was less than 0.05. This was indicative that there was a 5% chance or less that the statistical significance occurred by chance and was useful in inferring whether the results can be generalised to the wider population.

DISCUSSION OF RESULTS

People's definitions of waste

The results indicated that definitions of waste offered by operatives fell into three broad categories, namely *material types*, *perceived consequences* and *any action or inaction of others on-site*. In identifying specific *material types* like "leftover materials e.g. tiles steel", waste was defined in terms of value lost as a result of the materials not being put to better uses. Alternative solutions therefore need to be developed to overcome the problem of dealing with excess materials after project completion. Respondents' definition of what constituted waste also seemed to be influenced by the *perceived consequences* or inevitability of what they assumed happened to waste afterwards e.g. disposed at landfills, as well as its associated discard value. For example "any material that has finished its whole life" and "any material removed and discharged from site".

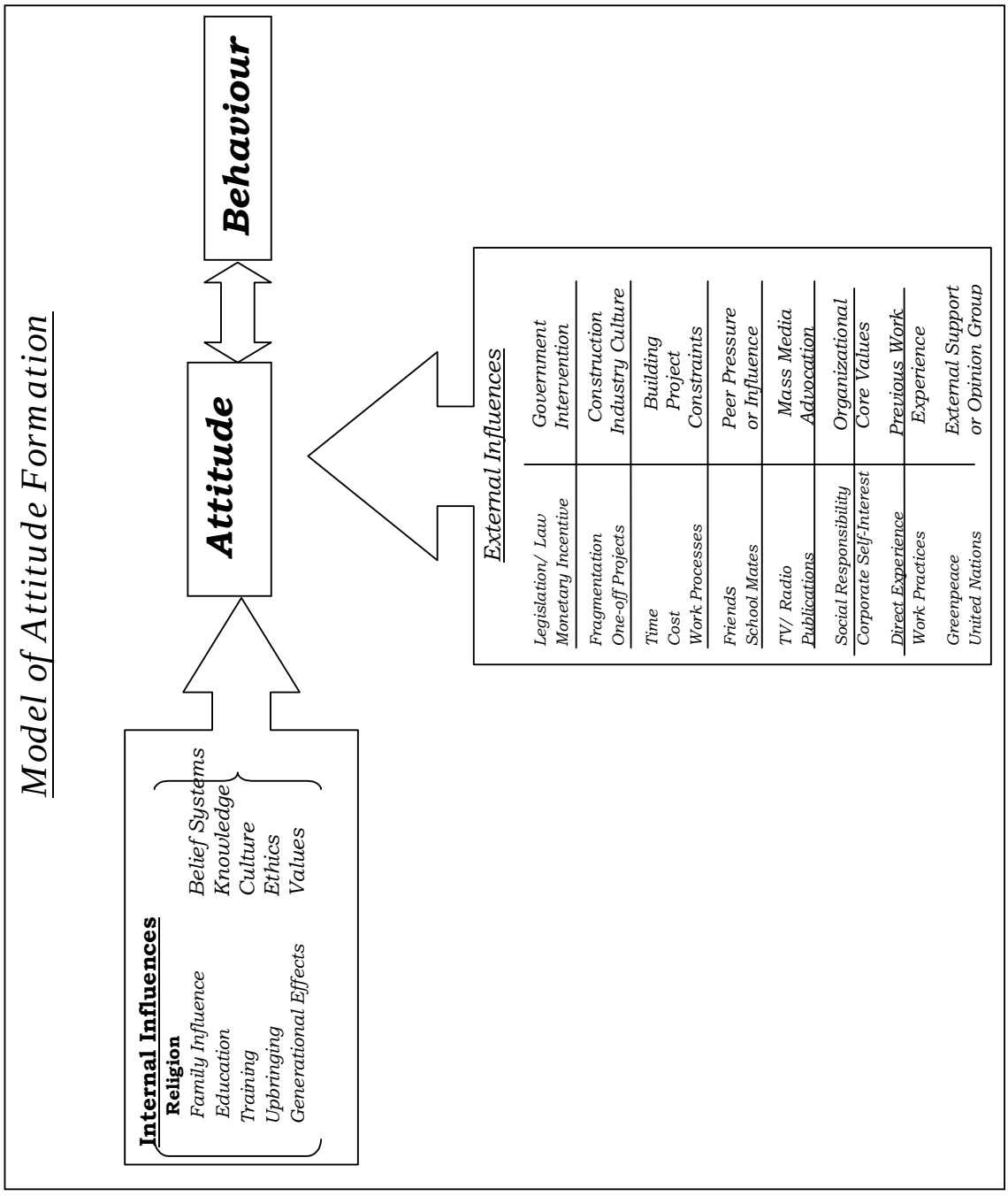
This suggests that waste levels can be reduced if there were more innovative approaches to recycling and reusing waste. Respondents who defined waste as being generated due to the *action or inaction of others on-site*, namely "any materials over-ordered", "all materials mixed together, making it infeasible to recycle or reuse", view waste as being generated by situations that were beyond their control and as such, perceived it as not being part of their responsibility or fault.

RECYCLING PRACTICES

The study showed that 88.4% of respondents recycled at home and a further 87.3% of these respondents also indicated that they thought that it was possible to recycle in a similar way at work. A proportion of respondents felt that "anything was possible", but that it "required a commitment from all persons involved", therefore implying that a sense of collective responsibility should exist for waste recycling to be a success at

work. A significant association was registered with respondents over the age of 35 years (x^2=4.89, 1df, p<0.05) as being more likely to say "no" when asked whether it was possible to recycle in a similar way at work. This age group may be more resistant to change than others.

Figure 1: Attitude formation model



Level of training in waste management

The data in Table 1 illustrated that specialised training in waste management was low, with only 17.5% of respondents indicating that they had some form of training, which reflected the low priority given to waste management by companies. This was particularly so at lower technical levels, since there was a higher incidence of training among foremen (42%) as compared to other occupations. The need for more training was supported by 63.6% of the respondents who answered 'yes" by indicating that the training they did receive to be at least quite useful.

Table 1: Proportion of respondents trained in waste management

Training in Waste Management	% of Respondents
Yes	17.5%
No	82.5%

Responsibility to reduce waste

Table 2 indicates a widely held perception among respondents that waste reduction can be most effectively achieved when everyone on-site (69.6%) were made equally accountable for its implementation. While this was an encouraging perception of collective responsibility, there was also an underlying belief that people in managerial role have greater responsibilities than those in more technical roles, as was indicated by the downward trend of perceived responsibilities placed upon each party in the construction project. Overall, sub-contractors, tradesmen and labourers ranked lowest on perceived responsibilities to reduce waste. An interesting finding that emerged from the study was that foremen rated themselves highest as being personally responsible for reducing waste, with the same pattern also noted with tradesmen. This self-imposed sense of responsibility indicates that foremen and tradesmen felt more compelled than the other occupational group to act responsibly and undertake waste reduction activity by their own initiatives. This suggests that it is in the other occupational groups that efforts to change attitudes to reduce waste should be targeted.

Table 2: Responsibility for waste reduction on-site

Responsible Party	% of Respondents
Project Manager	42.8%
Site foreman	29.7%
Environmental Officer	24.6%
Sub-contractors	18.1%
Tradesmen	10.1%
Labourer	10.1%
Everyone	69.6%

*Percentage for each category calculated from a total of 100%

The perceived importance of waste as a project goal

Table 3 shows that the top three project priorities important to respondents were safety (71%), quality (70.3%) and time (55.1%). Waste management was identified by respondents as the least important project priority, and was indicative that current efforts and commitment to manage construction waste were low.

Table 3: Project goals important to respondents

Project goals	% of Respondents
Cost	44.9%
Time	55.1%
Quality	70.3%
Waste management	10.9%
Safety	71.0%
Productivity	44.2%

*Percentage for each category calculated from a total of 100%

Acceptable levels of waste

Table 4 shows operatives' perceptions of acceptable levels of waste generated in their work. A significant proportion of respondents (58.8%) have indicated that the acceptable waste level generated fell between 1% to 10%, which was in line with the current industry average of 10% generated on-site (CIRIA, 1995). An encouraging 9.7% also felt that zero waste was realistically achievable, which suggests that they perceive waste currently generated on-site as being excessive and unnecessary.

Table 4: Acceptable levels of waste generated

Acceptable overall % of waste generated	% of Respondents
0%	9.7%
1% to 5%	29.8%
6% to 10%	29.0%
11% to 15%	19.4%
16% to 20%	12.1%

Knowledge of what happens to waste generated on projects

A sizeable proportion of respondents (51.4%) reported knowledge about what happened to waste generated on-site, with respondents indicating that in most situations, waste generated simply goes straight to landfills without any regard for any alternative methods of usage or disposal. A significant association was discovered between respondents' knowledge levels and the nature of their jobs held (x^2=4.04, 1df, $p<0.05$) and this knowledge decreased the lower respondents' occupations were on the project hierarchy.

Overall experience of waste management on past projects

A significant proportion of respondents (45.4%) have reported negative experiences on past projects, as shown in Table 5 and was indicative that the waste culture on-site was not conducive to promoting positive attitudes to waste reduction. The importance of work experience in shaping operatives' current attitudes was crucial, as they are often in direct contact with materials in the physical environment. This meant that positive personal experiences to waste management is likely to have a self-perpetuating effect early in a project.

Table 5: Past experience of waste reduction policies on construction projects

Past Experience	% of Respondents
Very negative	28.9%
Negative	16.5%
Not sure	29.9%
Positive	15.5%
Very positive	9.2%

Factors that prevented people from reducing waste

Table 6 illustrates that there was a broad range of impediments to reducing construction waste. Inadequate provision of facilities on-site (55.8%) and time pressures (52.9%) were identified by respondents as the biggest barriers to waste reduction. The inadequacy of current waste facilities was not a positive indication of constructive attitudes towards waste at a managerial level by not providing the necessary time and resources infrastructure to do so. Space constraints (41.3%) and lack of knowledge (42.8%) were also significant factors identified by respondents and were issues which needed to be addressed for waste reduction to be a success on construction projects.

Table 6: Factors that prevent respondents from reducing waste

Factors	% of Respondents
Time pressures	52.9%
Space constraints	41.3%
Lack of incentives	33.3%
Inadequate facilities	55.8%
Lack of knowledge	42.8%
Others	5.8%

*Percentage for each category calculated from a total of 100%

MOTIVATION TO REDUCE WASTE

In Table 7, 58% of respondents have indicated relatively high levels of motivation to reduce waste. Although it was unclear if these respondents perceived their motivation to be intrinsic or extrinsic or how much of this motivation translated into actual actions to reduce waste, it did suggest that positive attitudes did prevail among respondents. Overall, foremen and tradesmen were found to be the most motivated across all occupational groups.

Table 7: Motivation to reduce waste

Level of motivation	% of Respondents
Not motivated at all	9.2%
Not really motivated	3.8%
Not sure	29.0%
Quite motivated	35.9%
Very motivated	22.1%

Levels of support for waste management practices

Respondents' perceptions of current attitudes towards waste management in the construction industry seemed to indicate that at least some form of support existed for managing waste, with 53% of respondents responding positively as shown in Table 8. Foremen, tradesmen and labourers were found to be more likely to indicate that at least partial support existed, while leading hands were more likely to indicate minimal support.

Table 8: Levels of support for waste management practices

Level of Support	% of Respondents
Full support	18.4%
Partial support	34.6%
Minimal support	25.0%
No support	14.0%
Not sure	8.1%

CONCLUSION

The aim of this paper was to investigate the factors that shape operatives' attitudes towards waste on construction projects. There has been very little research into behavioural aspects of waste management. The basis of this research was an attitudinal survey model which explored the external and internal influences upon operatives' attitudes within the construction industry. The results indicated that operatives' attitudes towards waste were positive but that any goodwill was impeded by a lack of managerial commitment to issues of waste reduction. Present efforts to reduce waste are in their infancy, with many respondents reporting low adoption of waste reduction activities on their sites.

In terms of the attitudinal model presented in Figure 1, the main areas of concern for managers were in the areas of knowledge, values and building project constraints. While individuals saw the relevance and importance of waste reduction, their attempts to do so were constrained by time and cost pressure and by work processes which were not designed to facilitate waste reduction strategies. If waste levels are to be reduced in the construction industry, it is essential that waste management be made a priority in relation to other project goals and that managers promote a conducive environment to so do by providing the necessary resources and demonstrating commitment. This applies to organisations and also on an individual basis. The current lack of attention to waste reduction activities may be related to the perceived cost implications that waste reduction brings and is an area of concern that needs to be

corrected by highlighting the potential cost savings that construction companies could enjoy. This could also be addressed by careful attention to risk distribution strategies. The sharing of risks should be encouraged to nurture a sense of collective responsibility which is currently lacking from waste reduction efforts on-site.

In terms of knowledge, company and project policies need to be created and communicated to operative level so that people can understand the performance standards that they are expected to achieve. Training is also an issue which needs addressing. There was a strong desire for information and a lack of understanding of what happens to waste and of the potential for reducing it. Currently, training is particularly lacking at technical level. Furthermore, it seems to be unimaginative and unstimulating in nature. In addition to training, information about the consequences of waste in terms of issues such as safety and environment, also needs to be provided on a continuous basis to maintain an alertness to the causes of waste on construction projects.

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