A theory of waste behaviour in the construction industry

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Levels of waste within the construction industry need to be reduced for environmental and economic reasons. Changing people's wasteful behaviour can make a significant contribution. This paper describes a research project that used Ajzen's 'theory of planned behaviour' to investigate the attitudinal forces that shape behaviour at the operative level. It concludes that operatives see waste as an inevitable by-product of construction activity. Attitudes towards waste management are not negative, although they are pragmatic and impeded by perceptions of a lack of managerial commitment. Waste management is perceived as a low project priority, and there is an absence of appropriate resources and incentives to support it. A theory of waste behaviour is proposed for the construction industry, and recommendations are made to help managers improve operatives' attitudes towards waste.

Keywords: Attitudes, waste, behaviour, operatives, environment, sustainability

Introduction

Construction activity generates an enormous amount of waste. For example, in the USA it contributes approximately 29% of overall landfill volumes, in the UK it contributes more than 50% and in Australia it contributes 20–30% (Rogoff and Williams, 1994; Ferguson *et al.*, 1995; EPA, 1998). Waste is best defined as any material by-product of human and industrial activity that has no residual value (Serpell and Alarcon, 1998). Although it is inevitable in all industries, research indicates that much of what the construction industry wastes has a residual value and is avoidable (Pinto and Agopyan, 1994; White *et al.*, 1995). This suggests that waste can be reduced, producing benefits for the construction industry and the environment.

Despite being a major generator of avoidable waste, the construction industry has been slow to embrace environmentally friendly practices. For decades, land-fill has provided a convenient and cost-effective solution to its wasteful practices (Mills *et al.*, 1999). However, the world is changing. Resource depletion, global warming, increasing pollution levels, exponential population growth, a more educated and outspoken public and an increasingly legislative business environment are forcing the construction industry to take a more responsible attitude towards the environment.

Almost without exception, waste management research in the construction industry has traditionally focused on how existing work practices, processes and technologies contribute to the generation of waste (Formoso *et al.*, 1993; Bossink and Brouwers, 1996; Poon, 1997; Faniran and Caban, 1998). Although this research has been useful, it has largely neglected the important influence of people's willingness to change their attitudes and behaviour. Indeed, far from providing answers, some argue that new technologies are primarily responsible for the escalation of environmental degradation (Hill *et al.*, 1994). It would seem that people have been ignored in the waste management equation: a view supported by Skoyles and

Skoyles (1987), Heino (1994), Soibelman *et al.* (1994) and Olomolaiye *et al.* (1998). This is ironic in a labour intensive industry like construction. Lingard *et al.*'s (2000) research has provided some valuable insights into attitudes towards waste in the construction industry, but the single case-study approach and the wide range of occupational groups sampled provide only general insights into peoples' attitudes and behavioural tendencies. It is likely that attitudes will differ across different organizations according to their culture and waste management policies and across the various occupational groups in the construction industry. More focused research is now needed to build on Lingard *et al.*'s work, to understand the influences of these variables upon people's attitudes and behaviour. This will enable managers to focus their change efforts more effectively.

Although everyone in the construction process contributes to waste and merits investigation, the aim of this paper is to focus upon the attitudes of site operatives. More specifically, it is to report the results of a research project that investigated the main influences upon their attitudes towards waste and any impediments to them being positive. Operatives are defined as site foremen, leading hands, tradesmen, labourers and other workers acting in a technical, hands-on capacity. They were the focus of the research because commonly they make up the bulk of the site workforce and have the most direct physical contact with the materials being wasted. They are important because they occupy a critical position in the construction waste generation chain, and their attitudes have a direct and immediate impact upon its efficiency.

Waste management practices in the construction industry

Past research into the causes of waste in construction projects indicates that waste can arise at any stage of the construction process from inception, right through the design, construction and operation of the built facility (Spivey, 1974; Gavilan and Bernold, 1994; Craven *et al.*, 1994; Faniran and Caban, 1998). According to Craven *et al.* (1994) and Johnston and Mincks (1995), waste management is made difficult in the construction industry due to the unique nature of each project, the hostility and unpredictability of the production environment, the fragmented nature of the project organizations used to procure buildings, and the intense cost and time pressures that characterize many construction projects. However, the commercial benefits of overcoming these problems are increasingly being recognized in terms of better public relations, safer sites, better quality products and services and more efficient working practices. For example, CIRIA (1995) estimated that wasteful companies can be at a 10% disadvantage in tendering for new work.

In reducing waste, two principles prevail: first reduce the quantities of waste generated and second adopt an effective system for managing the unavoidable waste produced. In managing the unavoidable waste, there are three options in order of preference, namely, 'reuse', 'recycling' or 'disposal'. The balance between the three will depend upon the nature of the materials wasted, legislative requirements for specific materials and the cost effectiveness of each option. The cost will in turn depend upon the availability of reusing and recycling options and the opportunities for reuse on a specific project (Chun *et al.*, 1994).

The function of attitudes

Attitudes represent peoples' evaluations of objects or situations that predispose them to behave in a certain way (Rokeach, 1972; Ajzen, 1993). It is widely accepted that an attitude has four dimensions, namely, 'affective' (feelings/emotions), 'behavioural' (intentions/actions), 'cognitive' (knowledge/beliefs) and 'evaluative' (values/likes or dislikes). People form attitudes because they help to give structure and priority to a complex world, providing some degree of consistency and clarity in an individual's explanation and interpretation of objects and situations (Olson and Zanna, 1993). Attitudes are valuable also in enhancing a person's self-esteem, being a defence mechanism to protect them from feelings of insecurity and inferiority, particularly in times of conflict. Finally, attitudes serve to express an individual's self-identity and guiding values. They are important to managers because they determine the direction of people's behaviour in response to a particular stimulus, and provide insights into appropriate motivating mechanisms.

The formation of attitudes

Managers need to understand how attitudes are formed if they are to manage them. Research indicates that attitudes are shaped over time and change according to a variety of factors, the most powerful of which is an individual's personal experiences of a situation or object (Malim, 1997). For example, if an individual has worked on a project where waste management practices were highly successful, then his or her attitude is likely to be positive. Other determinants include the generational 'cohort' effect, which refers to the attitudes acquired from growing up in a particular historical socio/economic/political environment. For example, it

is probable that current concerns about global warming will make future generations far more concerned than past generations about environmental issues (*ENN*, 1999). Additionally, parents and families are important in shaping attitudes, because they exercise extensive control over the information a person receives in their most formative years (McGuire, 1985). More generally, the community at large has an important influence on attitudes, through the imposition of social norms that can invoke a sense of moral obligation towards society (Bratt, 1999). In a work context, workmates can exert a significant influence over attitudes through peer pressure and by determining acceptance into a group that provides security needs (Robbins *et al.* 1994). Indeed, different occupations tend to develop different 'cultures', which can further influence attitudes by defining a member's role and status in that society, and expectations of certain behaviour. For example, the construction industry and therefore its workers are generally perceived to have a very negative and wasteful attitude towards the environment (Barrie, 1999). Such occupational cultures are shaped largely by people's common educational background, which determined their access to information about a particular issue. Environmental consciousness has traditionally not been taught as part of educational programmes for professions in the construction industry. However, in modern times, this lack of education about the environment has been counteracted by the most powerful modern influence upon people's environmental attitudes: the 'mass media' (Chan, 1998). For example, in an investigation of the media's influence over environmental attitudes, The Roper Organisation (1990) found that the order of influence was TV (75%), newspapers (65%) and radio (39%). Finally, laws also are a shaper of people's attitudes, by dictating their perceptions of what is right and wrong in society's eyes. Indeed, stricter legislation is currently being seen as the way to moderate the wasteful practices of many industries such as construction. For example, in 2001, the UK government will provide a range of tax incentives for green technology and make the building regulations more environmentally stringent (Pattison, 2001). Like the Australian Government, which required the construction industry to reduce its waste by 60% between 1990 and 2000, the construction industry has been singled out as a relatively poor performer (EPA, 1998). However, Douglass and Pratkanis (1994) found that the effect of legislation upon people's attitudes is relatively weak, because often they are insulated from it by company policies and by obscure language and complexity, which can make legislation difficult to understand. Furthermore, it often helps if the legislation is accompanied by incentives to adopt it. This has been well illustrated by the UK Government's recent attempts to improve the construction industry's safety record (Knutt, 2000).

The influence of attitudes upon behaviour

The relationship between attitudes and behaviour is far from conclusive, and a number of theories have emerged to explain it. Most prominent within environmental research are: norm-activation theory (Schwartz, 1977), the ipsative theory of behaviour (Frey, 1988) and the theory of planned behaviour (Ajzen, 1993).

Schwartz's norm-activation theory asserts that environmentally conscious behaviour depends directly on the activation of altruistic moral norms rather than on general environmental concerns. People feel a sense of moral obligation if they expect serious negative outcomes for other people and if they feel responsible for ameliorating these consequences. While valuable, this theory reduces explanations of behaviour to a dispositional level, and does not accommodate the many other mediating influences upon operatives' attitudes towards waste, such as industry culture and project constraints. By contrast, the ipsative theory of behaviour (Frey, 1988) goes beyond personal attributes in determining attitudes and behaviour, focusing upon how intervening factors such as resource constraints can prevent pro-environmental attitudes being expressed in people's behaviour. Unfortunately, however, it has been widely criticized for ignoring social influences in environmental behaviour, and has had remained largely untested in the environmental arena. This cannot be said for the theory of planned behaviour (Ajzen, 1993), depicted in Figure 1, which has been widely tested and refined, providing many new insights into the full range of factors influencing people's behaviour in an environmental context (Hamid and Cheng, 1995; Taylor and Todd, 1995; Chan, 1998; Harland *et al.*, 1999).

Central to the theory of planned behaviour is the 'behavioural intention' of an individual, which reflects how motivated he/she is to behave in a certain way. This is determined by three factors: attitudinal, social and perceptual. The attitudinal factor is based on an
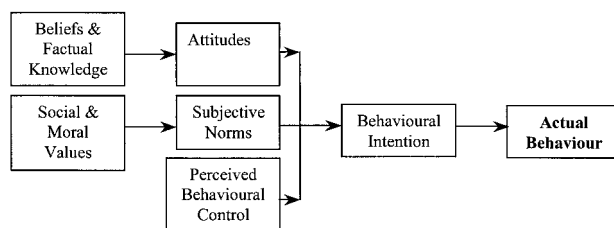

Figure 1 The theory of planned behaviour (source: Ajzen, 1993, p. 182)

individual's positive or negative evaluation of a particular type of behaviour, and is based upon personal beliefs or knowledge about the outcome flowing from it. The social factor reflects an individual's sense of social pressure to behave in a certain way, and in the model it is referred to as 'subjective norms'. The perceptual factor refers to an individual's perception of the ease or difficulty of performing the type of behaviour, and reflects past experiences as well as anticipated obstacles to doing so. In the model, it is referred to as 'perceived behavioural control'.

Method

For the reasons discussed above, Ajzen's theory of planned behaviour provided the conceptual basis for our research into operatives' attitudes towards waste. The theory provided a conceptual vocabulary to help organize empirical observations, and indicated the important variables in the attitude-formation process.

Attitudinal research poses numerous challenges, not least of validity, because an attitude is an intangible construct which is resistant to observation. Research indicates that attitudes are best inferred from people's words or actions that provide insights into their psychological orientation towards an object or situation (Ostrom, 1989). Validity is best assured by having a number of phases of data collection and analysis separated by periods of reflection, and by using a combination of qualitative and quantitative methods (Hammersley and Atkinson, 1995). To this end, our research involved two phases of data collection and analysis, the first phase involving an attitudinal survey and the second phase involving focus group interviews. The two-phase approach was important to permit the researchers to reflect upon and respond to the unexpected 'leads' which emerged in phase one of the process. As Hammersley and Atkinson (1995) and Bourner (1996) have argued, under the pressure of many research projects, few researchers leave enough time for reflection, which often results in the research following the path of least resistance and facing an analytical impasse in its final stages. Reflection is a particularly important component of qualitative research.

Phase one

The first phase of data collection involved an attitudinal survey designed around the attitudinal factors identified in Ajzen's theory of planned behaviour. The aim of the survey was to determine:

1. operatives' beliefs and perceptions towards waste and to determine the influences that shape them;

2. operatives' knowledge-base and awareness of their role in the waste generation process; and
3. impediments to the effective adoption of waste management practices on construction sites.

Attitudinal surveys are the most widely used method of data collection about environmental behaviour because they provide a stable, consistent and uniform method that permits the drawing of causal inferences between precisely defined variables. The survey consisted of 25 questions, of which three were open and 22 were closed, taking the form of categorical or rating scale answers to ascertain the intensity of a respondent's attitudinal response on a negative or positive evaluative dimension. The survey was tested on 17 operatives via a pilot study on an A$350 million commercial construction site in Sydney, Australia. After a discriminatory analysis to ensure variable independence, and some adjustments, to assure the validity and reliability of the data (which largely related to better accommodating the cultural diversity of the site work-force), the main attitudinal survey was administered to 475 operatives from eight large commercial construction sites in central Sydney which had a collective value of over A$2 billion. The response rate was 29.1%, which may be due to the unfamiliarity of operatives with surveys and the transitional nature of the workforce at that level. Although this may impact on the generalizability of the results, there is no reason to believe that those sampled were not representative of the population as a whole, and the response rate would have been much lower if not for the union's assistance.

Sample details are provided in Table 1. The operative workforce sampled was largely subcontracted, although the sites were controlled by five of the largest principal contractors in Australia, whose managerial culture may have influenced the results. However, without an in-depth study of these cultures and their influence upon subcontractors, it is difficult to know. Furthermore, the balance between the responses obtained from each organization ensured that no one company dominated the results. Finally, questions were framed in a way that avoided this effect. To secure respondent participation and trust and to minimize the possibility of bias from managerial intimidation, the Construction, Forestry, Mining and Engineering Union administered and collected the survey. Stratified sampling was employed using occupation as the criterion to classify operatives into five strata, which were then randomly sampled. The five occupational groups were supervisors, leading-hands, tradesmen, labourers and others working in a technical, hands-on capacity. Data from the survey were analysed for significant bivariate associations using the chi-squared goodness-of-fit test, cross tabulation and one-way ANOVA.

Table 1 Survey sample details

Demographic information	Response category	Frequency of response	% of respondents
Age band	24 years or under	23	16.6
	25 to 34 years	44	31.9
	35 to 44 years	40	29.0
	45 to 54 years	20	14.5
	Over to 55 years	11	8.0
Occupation	Supervisor	35	25.4
	Leading hand	21	15.2
	Tradesmen	44	31.9
	Labourer	28	20.3
	Others	10	7.2
Site			
A (Office)	—	12	9
B (Hospital)	—	11	8
C (Refurb)	—	30	22
D (Air terminal)	—	32	23
E (Office)	—	15	11
F (Hotel)	—	5	4
G (Stadium)	—	26	18
H (Refurb)	—	7	5
Company			
A	—	32	23
B	—	15	11
C	—	22	16
D	—	26	19
E	—	43	31
Average tenure	Foreman/ Supervisor	21.5 years	—
	Leading hand	20.5 years	—
	Tradesman	16.1 years	—
	Labourer	8.3 years	—
	Others	10.5 years	—

Table 2 Focus group propositions

Category	Proposition	Recommendation
Management support	1. Waste management is a low project priority 2. Not enough is done to reduce waste. 3. Insufficient recycling facilities are provided.	Managers need to demonstrate greater commitment to waste management.
Common perceptions of waste	1. There is little recycling or re-use value in construction materials. 2. Waste is an inevitable by-product on construction projects.	Restore value to materials by developing more efficient ways of dealing with waste.
Waste management training	1. Waste management training is insufficient. 2. Knowledge about waste reduction techniques is lacking. 3. Effective waste management has other benefits such as improving safety.	More high quality training is needed across a wider range of occupational groups.
Incentives	1. Cost savings are the most attractive benefits to reducing waste. 2. Site staff and management should both benefit from the potential cost savings of waste reduction.	Create greater awareness of the economic benefits of waste reduction.
Employee	1. I am not encouraged to provide feedback on how waste can be reduced. 2. Waste reduction is not part of my job.	Instil a sense of collective responsibility for waste management.

Phase two

Unfortunately, although the survey results provided information about significant associations between the attitudinal variables explored, they provided little insight into the reasons behind these associations. These were explored further in a second phase of data collection using focus-group discussions on six of the construction sites that were surveyed in phase one of the research. This was after a pilot study on a large commercial project, involving five operatives from each of the occupational groups surveyed in phase one.

Focus groups are designed to promote interaction and self-disclosure among a carefully structured group of respondents who can share their perspectives about a specific topic in a non-judgmental environment (Sink, 1991; Krueger, 1994; Morgan, 1997). In our research, the topic of discussion was a series of 12 findings that emerged as important from phase one of the research. These were presented as preliminary propositions to stimulate debate, and are given in Table 2. They were arranged under five main headings: management support, common perceptions of waste, waste management training, incentives and employee involvement. This structured approach ensured uniformity in the order of discussions, which in turn facilitated easier analytical comparison. The value of the qualitative data produced

was that it complemented and enriched the data produced by the first phase of this research, enabling deeper explanations of any variable associations discovered.

The strength of the focus group sessions was their ability to provide insights into participants' opinions and preferences in a flexible environment. Flexibility is derived from the ability to explore unexpected leads that emerge during the group discussions, enabling greater insights into people's attitudes, beliefs and feelings about waste. However, careful management of the focus group sessions was required because one of the main dangers of this technique is the potential emergence of 'groupthink', which could bias the data. Groupthink occurs when a sense of cohesion develops within a group to stifle expressions of individual opinions and force people to conform to group norms (Janis, 1988). This effect is particularly strong in highly homogeneous groups, and for this reason the focus groups were carefully structured, using random stratified sampling, to consist of one respondent from each of the five occupational groups surveyed in phase one (Table 1). Furthermore, respondents were selected from different work teams on a site, and none of the respondents had participated in phase one of the research.

The focus-group data were taped, transcribed and then analysed using content analysis. This technique is particularly useful for highly unstructured data, and involves categorizing communication content into its component parts and quantifying it (Berg, 1989). The assumption is that inferences about a person's behaviour, values, motives and beliefs can be made from the content of their communication with others. Berelson's (1971) framework was used for categorization because its content categories closely matched the three components of attitudes contained within Ajzen's (1991) theory of planned behaviour, which is the theoretical basis of this research. The relationship of Berelson's content categories with Ajzen's three attitudinal components is illustrated in Table 3, a typical table used to record, organize and analyse the focus group data.

Discussion of results

Overall, this research into the nature and determinants of operatives' attitudes towards waste indicated that they are not negative but that any goodwill is impeded by a lack of managerial commitment to the issue of waste reduction. Current 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 factors that shape attitudes, the main areas of concern for managers are in the areas of knowledge,

Table 3 Typical content analysis table

Components of an attitude (Ajzen, 1991)	Communication content categories (Berelson, (1971)	Focus group data (G1 = data from focus group 1)
Cognitive/ knowledge component	Direction – Supportive or critical treatment of the subject matter: agree/disagree/ undecided	G1:- G2:- G3:- G4:- G5:- G6:-
	Knowledge – Explanation of direction	G1:- G2:- G3:- G4:- G5:- G6:-
	Values – Goals, desires and motives underlying a message	G1:- G2:- G3:- G4:- G5:- G6:-
Cognitive behavioural component	Methods – Means used to realise the ends expressed by content values	G1:- G2:- G3:- G4:- G5:- G6:-
Affective/ emotion component	Intensity – Emotional component of a message	G1:- G2:- G3:- G4:- G5:- G6:-

values and building project constraints. In particular, five key issues emerged as impeding the adoption of positive attitudes to waste on construction projects.

Management support

The ability of operatives to contribute to waste reduction activities on construction projects is dictated largely by managers' interest in waste management and their willingness to commit organizational resources to it. Although individuals saw the relevance and importance of waste reduction, their attempts to do so were constrained by time and cost pressures on projects, and by work processes which were not designed to facilitate waste-reduction strategies. Managers were seen as the main source of responsibility for waste management efforts, and there was a common perception that standards were applied inconsistently across the industry. Therefore it is difficult for operatives to take the issue seriously, especially when they perceive that most

managers are unconcerned about reducing waste. If waste levels are to be reduced, it is essential that waste management be made a priority in relation to other project goals, and that managers promote a conducive environment by demonstrating commitment and providing the necessary resources. Company and project policies also need to be created and clearly communicated, so that operatives can understand the performance standards that they are expected to achieve.

Perceptions of waste

Operatives held negative perceptions of the recycling or reuse value of construction materials, reflecting the prevalent view of wasteful attitudes in the construction industry. Waste was perceived as an inevitable by-product of construction activity, and attitudes were driven by pragmatism, with low residual values being attributed to materials left over from construction activity. There were also few personal benefits perceived from taking the trouble to reuse or recycle materials. Waste management activities were merely another workload burden perceived to be irrelevant to operatives' jobs. This defeatist mindset represents a psychological barrier to the adoption of positive attitudes, and indicates that waste reduction depends upon the ability of managers to restore the value that operatives attach to construction materials. If perceptions of economic viability change, then so could attitudes. This can be achieved through measures such as educational programmes to increase knowledge levels, incentives to operatives to engage in less wasteful practices and the development of more efficient and convenient ways of dealing with waste to make its generation less of a certainty.

Training

Operatives lacked knowledge about the consequences of waste, what happened to it and the potential for reducing it. There was a strong desire for information regarding these issues and for more good quality training courses to equip operatives with the necessary skills in practical waste reduction techniques. The limited training available was perceived to be too generic, uninteresting and difficult to apply. Work experience served as the primary source of knowledge about waste reduction activities, making it difficult for operatives to achieve what was required by some managers.

Incentives

Cost savings prevailed as the primary motivating force for the adoption of waste reduction behaviour, although perceptions of potential savings and rewards were low. There was little knowledge of the cost impli-

cations of wasteful practices, and a perception that the main responsibility for reducing waste was being placed at operative level but that potential rewards were not. This perception could be reversed by highlighting the potential cost savings of employing effective waste management strategies. It is particularly important that these cost savings be passed down the project hierarchy in an equitable way, to motivate both site staff and management to engage in waste reduction activities. The evidence suggests that, despite operatives' direct involvement with the materials being wasted onsite, they perceive any potential cost benefits to be of little relevance to them.

Participation

Despite being willing to contribute to waste reduction efforts and feeling able to do so, operatives felt excluded from the development and implementation of waste management initiatives on site. Waste management was perceived to be unilaterally imposed from above. There is a general perception and frustration among operatives that their special and intimate knowledge of the materials they deal with on a day-to-day basis is not valued. This generates a sceptical attitude towards waste that is exacerbated by the inequitable imposition of responsibilities for its reduction upon operatives. Many of these responsibilities were unclear, largely because most materials pass through a number of occupational boundaries separated by strong lines of demarcation. The research indicated that wider involvement in the development and implementation of waste management initiatives is needed to engender a greater sense of collective responsibility for waste reduction.

Impediments to waste reduction in the construction industry

The nine main impediments that emerged as inhibiting operatives' adoption of waste reduction activities are summarized here.

1. A lack of managerial commitment and support for the issue of waste, resulting in inadequate resources, manpower and time for waste management activities in comparison with other issues, such as safety.
2. A lack of an industry norm or performance standard for managing waste, with waste management efforts undertaken in an ad hoc manner, causing uncertainty and confusion among operatives about waste management's relative importance.

3. Difficulties in changing existing work practices and an uninformed and indifferent workforce.

4. A lack of integration of operatives' expertise and experience in the waste management process.

5. Actions to reduce waste are predominantly profit motivated, and there is a perception that waste reduction activities are not cost-effective, efficient, practical or compatible with core construction activities. Environmental issues currently have little effect on motivating operatives' adoption of waste reduction behaviour.

6. A widespread belief that waste reduction efforts will never be sufficient to completely eliminate waste, which has been accepted as an inevitable by-product of construction activity.

7. Material recycling and reuse strategies are governed by financial viability and by the existence of secondary markets; this means that there is a reluctance to recycle or reuse materials with a low economic value or which are difficult to reuse.

8. Any financial benefits from waste reduction are inequitably distributed, providing little incentive for operatives to participate in the waste management process.

9. Individual responsibilities for waste management are poorly defined, inadequately communicated and are perceived as irrelevant to operatives, resulting in a sense of uncertainty or apathy about the problem.

To place these results in context, it is necessary to return to Ajzen's theory of planned behaviour, which guided this research. By transposing the research results into this theoretical framework we can conceptualize and better understand the forces that shape people's behaviour towards waste in the construction industry. This is illustrated in Figure 2 which, in effect, represents an initial theory of waste behaviour for the construction industry, albeit at operative level.

Conclusion and recommendations

The aims of this paper were to investigate the attitudes of site operatives towards waste, the main influences upon those attitudes and any impediments to them being positive. The objective was to make a set of recommendations that could be employed by managers to encourage positive attitudes towards waste amongst operatives. By doing this, the research would help to redress an important deficiency in waste management research in the construction industry, namely, a limited understanding of the behavioural aspects of waste man-
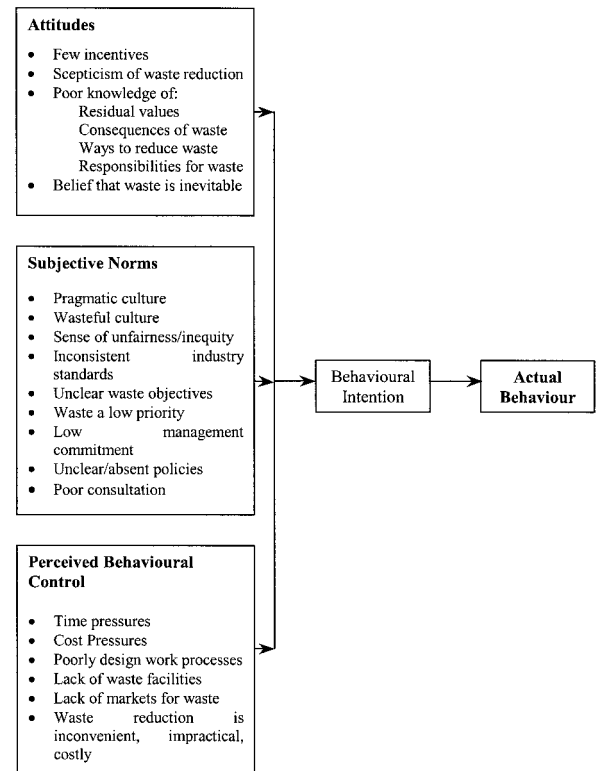

Figure 2 Expanded theory of planned behaviour (Source: Ajzen, 1993, p. 182)

agement, particularly at operative level. The theoretical basis of the research was Ajzen's (1993) theory of planned behaviour, and the research method comprised two phases of data collection and analysis using an attitudinal survey and focus group interviews.

Overall, the findings indicate a sense of inevitability and pragmatism towards waste among operatives. Yet, encouragingly, this appears to be more a function of current waste management strategies than underlying attitudes that reflect a recognition and ability to contribute to waste reduction which is not being utilized. Superficially, the result is frustration and cynicism. Operatives are unlikely to perceive waste management with great importance on projects unless managers make it a priority and provide the necessary supporting facilities, incentives and resources. The findings of this research complement Lingard *et al.*'s (2000) study, which identified the availability of local infrastructure and top management supportiveness as the most critical determinant of waste reduction behaviour on projects. Furthermore, operatives' perceptions of practical and cost-effective solutions for reducing waste also have a significant influence upon their attitudes to waste. However, our research indicates that their adoption is conditional upon participation in their

generation, their perceived compatibility with operational tasks and the equitable distribution of any savings. For effective waste management, there must be a sense of collective responsibility for it. Unfortunately, our research also indicates that this is constrained by low knowledge levels about the impact of waste and methods for reduction, and by the absence of well communicated policies and effective training at a technical level. These findings are in contrast to Lingard *et al.*'s (2000) study, which identified that the perceived level of knowledge and involvement in waste management among workers was high. On the other hand, we agree that the involvement of operatives in the waste management process is essential if attitudes are to change and systems be effectively developed and implemented.

The above findings lead to a number of important recommendations for managers wanting to develop waste management policies that engender positive attitudes towards waste at operative level on construction projects.

1. Managers need to demonstrate commitment to the issue of waste and to provide the necessary waste infrastructure to help people reduce it.
2. The cost benefits of waste reduction must appear to exist and be shared out equitably.
3. More high quality, site-specific and practical information about waste management strategies needs to be provided via training courses and awareness campaigns to keep operatives informed about waste management practices and techniques.
4. More educational activities are needed to help raise operatives' consciousness of the longer term social and ethical implications of their activities on site.
5. Waste management policies need to be created and clearly communicated at project and company level so that performance requirements are visible and properly understood by operatives.
6. Performance requirements to reduce waste must be promoted and imposed equitably at all levels to promote a sense of collective responsibility for waste reduction.
7. Managers should facilitate the involvement of the workforce in waste reduction efforts by providing avenues in which operatives and managers can contribute ideas, opinions or feedback about eradicating wasteful activities.
8. The benefits of waste management should be linked to other project goals such as safety.

Although these ideas are valuable, it is important to appreciate that they should be interpreted within the context of this research, which was conducted within a construction boom that was triggered by the then forthcoming Olympic games. This may have influenced the research results, because of the extraordinarily high time pressures and incentives to complete projects on schedule. In this environment, it is likely that contractors would have devoted relatively less time and resources to reducing waste, and thereby negatively influenced operatives' attitudes. It is also important to appreciate that the research was restricted to an investigation of operatives' attitudes towards waste on large-scale residential, commercial and refurbishment projects. Furthermore, the research took place within one geographical area, central Sydney in Australia, and it is feasible that in domestic housing projects outside Sydney operatives' attitudes may be very different.

However, this research has been valuable in creating the foundations for exploring attitudes towards waste in these other contexts. There is a whole range of issues that merit further attention, and their investigation could make a significant contribution to the advancement of this new and important area of research. In particular, the construction industry could benefit from the following.

(1) More attitudinal studies of waste management behaviour, to determine whether attitudinal differences existed in various occupational groups. Managerial attitudes in general are particularly important to investigate. This group would include designers, project managers, supervisors, planners and company executives.
(2) Similar research to that reported herein needs to be conducted in a time of economic downturn, so that the influences of the economy can be understood.
(3) It is important to explore the impact of procurement and contractual systems upon attitudes towards waste.

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