

EVALUATION OF WASTE MANAGEMENT STRATEGIES ADOPTED IN TSHWANE BUILDING INDUSTRY

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Abstract

The minimisation and disposal of construction wastes has become one of the most construction and environmental issues in recent years. The disposal of waste can have a significant impact on the environment as total volume of available landfill is decreasing and cost associated in its disposal are quite enormous. Primary data were obtained using structured questionnaire, interviews and site visits. The questionnaire was also designed in line with the method to cover various factors that lead to wastages on construction sites, waste control measures, existence of waste management plan in contractual process and remedies to the problem. The findings indicate that waste of materials in the building industry is fairly high and that a large variability in waste incidence is found across different projects. The study established that the strategies adopted in minimising material wastes in the City of Tshwane building industry were good but evidence on site reveal to the contrary.

Keywords: Waste, Management Strategies, Waste Management Plan, Internal Company Waste Plan

INTRODUCTION

Construction industry is the most significant sector on a global scale with respect to its economic, technological, and environmental impact (Georgios et al., 2010). Its rapid growth over the last decade has resulted in an enormous increase of construction and demolition waste. Therefore, the need of appropriate waste management strategies has arisen to contribute to the environmental sustainability.

Dealing with waste is one of the most difficult environmental problems faced by many nations. For instance, while countries such as Belgium, Holland and Denmark recycle 80-90% of their construction waste (Symonds et al.,1999), Israel recycle only about 20% and most of the rest is dumped in legal and illegal land filling sites (Amnon and Hadassa, 2010).

The reasons provided for illegal dumping include a shortage of legal land filling sites, long transportation distances to land fill sites and high tipping fees. Further, lack of enforcement measures as well as lack of knowledge on recycling options for different waste materials has been identified as the underlining causes of illegal dumping (Ammon and Hadassa, 2010).

Thwala et al. (2004) posit that South African construction industry has a reputation of low productivity compared to other sectors of the economy such as manufacturing. However, waste of material in the industry is fairly high and that a large variability in waste incidence is found across different project (Thwala et al., 2004). Most of this waste can be avoided by implementing inexpensive preventive measures. This study therefore was undertaken to explore and evaluate the waste management strategies adopted in the City of Tshwane.

LITERATURE REVIEW

Although waste minimization is defined as one of the key factors for achieving sustainability, the relative significance of construction waste sources and a comprehensive waste assessment system have yet to be developed (Ekanayake and Ofori, 2000). Implementing any successful waste minimization strategy during project execution requires the assessment of waste. Waste minimization has to be embedded as one of the project objectives that lead to sustainability (Ekanayake and Ofori, 2000).

Studies at the Building Research Establishment (BRE) in the 1970's cited by (Ekanayake and Ofori, 2000) established that waste levels were not necessarily related to the type of construction or the building company but to the site and the people engaged in the particular project. According to Henry et al (2009), the construction sector represents one of the most dynamic and complex industrial developments the world over. Therefore, construction activities in the context of the South African economy cannot be treated with laxity.

Ilesanmi (1996) posited that the cost of materials accounted for 50 to 60% of the total cost of construction of any project, while Skoyles (2000) came out with the most recent information that cost of material alone in the building construction project is 55 to 65%. To reduce cost of construction projects, an optimum material control on site should be therefore adopted.

As noted by CSIR, (2004) the industry is underachieving in amongst others, quality and efficiency and that the industry needs to radically improve the practice through which it delivers its project. Improvement to the process will require construction professionals to review their current practices.

CONSTRUCTION WASTE

The construction sector generates enormous amounts of waste by consuming natural resources (Poon, 2007). Waste in the industry include such delays as time, cost, lack of safety, rework, unnecessary transportation journeys, long distances, improper choice or management of programme or equipments and poor constructability (Lee, et al.,1999). Shen et al., (2004) stated that construction wastes are in the form of building debris, rubble. earth, concrete, steel, timber and mixed site clearance materials arising from various construction activities for example, excavation, demolition, pavement work, and refurbishment. Gavilan and Bernold (1994) produced a framework which recognises that construction waste comes from six sources including design, procurement, materials handling and operation, residual and other sources.

The study of Pinto and Aopayan, (1994) reported that Brazil's construction industry waste is accounted as 20-30 percent of material weight on construction site. Research by Bossink and Brouwers (1996) found that construction waste is 1-10 percent of each building materials weight purchased depending on the material type. Their research examined the construction waste from the application of a range of building materials and classified the waste source by the nature and the technology of using materials into stone tablets, piles, concrete, sand-lime bricks and elements, roof tiles, mortar, packing and other small fractions of metal and wood.

The study in the UK conducted by BRS (1981) cited by Yang and Mitchell(2010) dealt with waste for specific materials on 230 different constructions sites and identified that actual waste is consistently higher than the number estimated for all the materials examined. The research highlights that new purchases to replace wasted materials, rework to correct mistake, delay and handling of generated waste caused heavy financial losses to the contractor (Ekanayake and Offori, 2000).

Thus the development of innovative approaches to managing construction waste is an important issue to improve profitability and the effectiveness of construction project management.

METHODS OF WASTE MANAGEMENT

Various researches have attempted to create waste management programmes, plan, methods of minimisation of waste on construction projects and sites. According to CIRIA (1995) it is initially through design that waste minimisation, reuse and recycling of construction materials can be encouraged and promoted. Design has taken a leading role in controlling and handling materials waste on construction sites (Shen et al., 2004). Shen and Tam (2002) suggested that the method of management of construction waste should be part of project management functions and involve employee's participation. The design stage of construction project was playing a central role to minimise waste generated lately on building sites and material wasted. Formoso et al. (1999) developed a method of controlling waste on building sites. The method focused on the control procedures as part of project management on a routine basis. It shows components of waste management on building sites. The tools used were to collect the information of construction activities to establish the pattern of usage of building products and materials on site so that the construction and building waste could be reduced by applying improved and more precise management procedures. Mills et al. (2001) proposed that to provide a cost-effective and successful waste management plan, the project management is required to:

- Asses the project materials
- Standardise alternative waste disposal
- Calculate the economic effect of available disposal method,

WASTE MANAGEMENT STRATEGIES

The construction Industry Research and information Association (CIRIA) attempted to address waste management by organising research which concentrates on the use of the advanced technologies to deal with construction waste on site in the UK construction industry

(CIRIA 1993). Shen et al. (2004) applied a mapping approach to management of waste on construction sites.

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The mapping approach named as Waste Management Mapping Model (WMMM) integrates the good operations embodied in the existing systems and tools, and provides an alternative tool to aiding in planning, controlling and managing waste on site. Mc Grath (2001) developed a waste minimisation system named Site Methodology to Audit and Target Waste (SMARTWaste) to classify and appraise waste arising on a construction site. The purpose of the system is to improve material recovery for reuse and to reduce waste generated on sites.

Begum et al. (2007) developed a tool called Waste Minimisation Factors (WMF) which is to identify major influential factors of waste generation in projects. The waste minimisation system examines two aspects of the waste management: source reduction and recycling materials. Source reduction emphasises on products, material input, good practice of operation, and technologies. Recycling focuses on use / reuse and reclamation. Bertram, et al (2002) further applied materials flow analysis system to establish the budget for the European waste management which takes a leading role in managing and controlling the waste crossing European countries. Other system such as waste management planning system (McDonald and Smithers, 1998), ready mixed concrete waste management (Sealey and Jill, 2001), integrated waste management (Bossink and Brouwers, 1996) look at different reasoning, factors which are directly linked to waste generation and reduction.

RESEARCH METHODOLOGY

The scope of coverage of this work was limited to construction companies in the City of Tshwane (CoT) in South Africa to evaluate the waste management strategies adopted. The restriction to the city was informed by the fact that there is little or no research done on material waste management strategies within the province as a whole in which CoT falls. For this research purposes a simple random method was used from the study population of construction firms in CoT.

Different methods to evaluate waste generated during construction process have been used by different researchers. For instance, Bossink and Brouwers (1996) used brainstorming technique, while Serpell and Labra (2003) used the interview method.

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In the study of Poon et al. (2004) on construction waste management in Hong Kong public housing projects; there was the use of questionnaire that covered a wide range of topics concerning waste minimisation; regular visits to know the scope of work done where waste were generated by using a checklist of information and the quantities of waste estimated by visual inspection tape (that is volume) measurements and truck load records.

In this study therefore, primary data were obtained using structured questionnaire, interviews and site visits. Questionnaires were designed to get information about personal data of the respondents to depict their profile that may let them have experience on issues relating to waste management and control in construction process. The questionnaire was also designed in line with the method adopted by Poon et al. (2004), but also made to cover various factors that lead to wastages on construction sites, waste control measures, existence of waste management plan in contractual process and remedies to the problem. One hundred (100) structured questionnaire were administered to the practitioners in the industry involved in construction process. The views of the respondents were assess by using likert scale to measure the waste management strategies and a total of forty-four (44) questionnaire were returned and found useful which amounts to a return rate of 44%.

Interviews were conducted among construction professionals namely Client, Architects, Engineer, Quantity surveyors, Project manager and Contractor by covering issues related to the order of site activities, waste generation rate, waste management strategies and likely suggestions to avoid and minimise waste. The data collected were analysed with the use of mean percentage.

FINDINGS AND DISCUSSIONS

Table 1 indicates that the majority of respondents were project managers (34%), followed by contractors (25%) and Quantity surveyors (23%). It is worth mentioning though that in number, five (5) of the quantity surveyors were working for contracting companies even

though they indicated their profession as quantity surveyors bringing the number of contractor respondents to 16 and could reduce the number of quantity surveyors to five. The percentage of responses from clients and engineers was 7% for each and 4% for the architects.

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Of the 25% contractor respondents, 2% were registered in grade 5 of the Construction Industry Development Board (CIDB) and 9% were registered in grade 6. Larger categories of grades 7, 8 and 9 had more respondents to the questionnaire of 14% and 11% respectively.

Table 1: Distribution of professionals who responded to the questionnaire

Professionals	Numbers	Percentage (%)
Client	3	7.0
Architect	2	4.0
Engineers	3	7.0
Quantity Surveyors	10	23.0
Project manager	15	34.0
Contractor	11	25.0

Further, Table 2 indicates that majority of respondents have over five years working experience in construction industry. 32% had less than 5 years experience and 36% had over 15 years of working experience in construction industry made up of 23% 15 to 20 years and 13% with working experience greater than 21.

Table2: The years of experience of respondents within construction industry

Years of experience	Frequency	Percentage (%)
0<5	14	32.0
5<10	7	16.0
10<15	7	16.0
15<20	10	23.0
>20	6	13.0

Waste Management Strategies

The results in Table 3 suggest that the majority of respondents have a waste management goal. This is seen in the 43% of the respondents indicating that they always have a waste management goal and 27% sometimes have the waste management goal, while 27% were unsure. Only 5% indicated that they rarely have a waste management goal with another five percent indicating that they never have waste management goal. However, despite about 70%

suggesting they either always or sometimes have a waste management goal, evidence on site reveal to the contrary.

Further, 25% of the respondents indicated that they always implement good material abstracting, while 30% sometimes implement good material abstracting.

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Few respondents (2% rated rarely and 5% rated never) do not implement good material abstracting while 38% were unsure. It is evident from the results that only minority of the respondents do not implement good material abstracting on their site. It could be that they may not appreciate the benefits accrued to it or they lack the will power to implement that and the resultant effect would be high waste generation rate on the sites as suggested by various scholars (Poon et al 2004).

In table 3, 27% of the respondents indicated that they always analyse site waste to be generated before purchasing materials while 25% sometimes analyse site waste to be generated before purchasing. Twenty three percent and 14% of the respondents rated not sure and rarely respectively while 11% never analyse site waste to be generated before purchasing materials. It is evident that only minority of the respondents do not analyse site waste to be generated before purchasing. Their inability to do so could be attributed to lack of awareness that such strategies could lead to reduction of waste as suggested by Macdonald and Smithers (1998.)

With regards to training of labour in usage of materials, 27% of the respondents specified that's they are always trained to use material use optimally while 25% of the respondents only suggested that they are sometimes trained. Fewer respondents (14% indicated rarely and 11% suggested never) do not train their workers on material usage while 23% are not sure. However, despite about 52% suggesting they, either always or sometimes, train their workers on optimum material usage, evidence on site reveal that workers still could not understand how one can use materials optimally. Respondents also attributed failure to manage waste to their inability to organise waste management meetings with their project site personnel. For instance, 25% of the respondents indicated that they never organise waste management meetings with 11% of the respondents unsure and 22% indicating rarely organise waste management meetings. Only 21% of the respondents always do and 21% of the respondents

sometimes organise waste management meetings. This implies that those respondents that do not organise waste management meeting will inevitably have high waste generation rate as posited by suggested by Poon et al. (2004). Workers will not know how to management waste because they never were informed in any meeting in the first place. Further, about 50% of the respondents (represented by 27% and 23%), either always or sometimes, issue guideline for hazardous waste management.

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Another 50% were either unsure or rarely or never issued guidelines for hazardous waste management. In addition, 18% of the respondents always segregate non-hazardous waste and 23% sometimes do, while 37% were unsure. 11% of respondents indicated that they rarely segregate non-hazardous waste with another 11% they never segregate non hazardous waste. Evidently, only minority of the respondents do not segregate non hazardous waste, but in a situation where construction waste could not be prevented and recovered, they need to be stored in an appropriate manner and kept under control (Tulay and Nilay, 2006).

Table 3: Waste management Strategies adopted by construction firms on site

Waste Management Strategy	Always	Sometimes	Not sure	Rarely	Never
The firm has a waste management goal.	43%	27%	25%	5%	5%
Implementation of good materials abstracting	25%	30%	38%	2%	5%
Analysing site waste to be generated before purchasing	25%	20%	25%	16%	14%
Good training of workers on optimum material usage	27%	25%	23%	14%	11%
Organising waste management meetings	21%	21%	11%	22%	25%
Issuing (implementing) guidelines for hazardous waste management	27%	23%	30%	9%	11%
Preparing a list of each waste material to be salvaged used and recycled	20%	14%	30%	20%	16%
Set waste reduction targets	22%	21%	27%	21%	9%
Non-hazardous waste segregation	18%	23%	37%	11%	11%
On site re-use of waste material	23%	47%	18%	7%	5%
Provide easy access for delivery vehicles	45%	25%	23%	2%	5%
Appropriate storage of material	45%	23%	21%	11%	0%
Off-site re-use of waste material	16%	18%	44%	11%	11%
Recycle waste material	20%	25%	23%	7%	25%

Where the strategy to salvage waste materials and recycle them, 20% of the respondents indicated that they always prepare a list of each material to be salvaged, used and recycled and 14% sometimes do that. A slight majority either rarely or never (20% and 16% respectively) prepare a list of each waste material to be salvaged, used and recycled. Thirty 30% were unsure.

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A further 21% indicated that they rarely set waste reduction targets and 9% indicating they never do, while only 22% of the respondents always set waste reduction targets and 21% sometimes do with 27% sure of the practice. However, with 23% of the respondents suggesting they always re-use waste material and 47% sometimes re-use waste material, it should have been clear that a similar proportion of respondents should have known how to salvage, used and recycle material. This however is not the case with the findings. It is evident from the result that only minority of the respondents of the respondents do not set waste management targets. It could be that they lack the will power or they are not aware that such strategies could lead to waste reduction (Lawal and Wahab, 2011). The results in Table 3 also suggest that a greater percentage don't re-use waste material off site, due to factors beyond the scope of this work but however it should be promoted on site and off site because that leads to sustainability (Ekanayake and Ofori, 2000).

Easy access for delivery vehicles was identified by the majority as one strategy that minimises waste. About 45% of the respondents indicating that they always provide easy access and 25% sometimes do. This strategy would minimal waste associated with it such as long distance to off load materials which would expose it to breakages, pilfers and other waste associated with transporting and lack of easy access to site. The results are further supported by the similar number of responded (45%) suggesting that appropriate storage of their material is important to their waste management. It could be that they do consider it worthwhile and the resultant effect will be minimal waste generation rate on site (Wahab and Lawal, 2011).

Internal Company Waste Management Strategies

To establish whether individual companies do have internal waste management strategies Table 4 indicates that only 45% of the respondents agreed to having the internal company waste management and thus incorporate waste management plan as one of the document in tendering process. A further 47% suggested that they know that waste indices could assist them to determine the amount of waste that could be generated on site and therefore do have them as an internal company strategy. A very significant percentage of respondents however recognised the need to set out waste management goals for their employees within the firm. This is seen in 57% of the respondents agreeing that they do set out waste management goals to their staff.

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Table 4: Internal company waste management strategies

Question on internal company waste management strategies	YES	NO
Does your company incorporate waste management plans as one of the documents in tendering process?	45%	55%
Does your company know that waste indices could assist them to determine the amount of waste that could be generated on site	47%	53%
Does your company set out waste management goal or guidelines to its staff?	57%	43%
Are you aware of the increase on material waste on the construction environment?	41%	59%
Do you have a full time material controller on your site?	32%	68%

According to Macdonald and Smithers (1998), waste management plan list is required to be produced by contractors while bidding for projects to show how wastes generated would be handled. They argue that such practice leads to sustainability of environment. It is also worthy noting that incorporation of waste management goal or guidelines aims at helping the project manager to anticipate the quantities of waste that will be produced in order to establish awareness of the management and to reduce waste generation during all stages of the construction project. This is not just good practice, but could save the firm from experiencing lost costs from waste materials. Further introduction of material controller is a new practice and so they don't know the benefit of having such for most of them. However, majority of the respondents have appreciably good waste management strategies, but evidence on site reveal to the contrary it can be likened to the fact that attitude of the people in construction towards waste are generally negative as posited by Kulantunga et al, (2006).

CONCLUSION

Authors (2012) indicate that waste of materials are fairly high and that a large variability in waste incidence is found across different projects and it is with the background that the researchers aim to explore and evaluate the waste management strategies adopted in the industry.

It can be concluded that in the City of Tshwane, organising waste management meetings as a waste management strategy is not practiced. Other strategies such as recycling of waste materials, preparing a list of each waste material to be salvaged, used and recycled, analysing site waste to be generated before purchasing materials with the view to monitor usage and manage waste as well as off-site reuse of waste materials are not used regularly as waste management strategies.

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The reasons could be that majority of firms as the evidence suggests do not have internal company policies that deal with waste management. The missing policies were identified as having internal company waste management policy, failure to incorporate waste management plan as one of the document in tendering process, use of waste indices to determine the amount of waste that could be generated on site and the need to set out waste management goals for their staff members within the firm.

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