MATERIAL WASTE CAUSES AND THEIR IMPLICATIONS ON COST OVERRUNS IN ABUJA, NIGERIA: A MATERIALS-PROCUREMENT STAGE PERSPECTIVE

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Material wastage and cost overruns are global problems affecting construction projects. These problems occur at different stages of a project, from planning, design, estimating, materials procurement and construction stage of a project. The purpose of this paper is to examine the material waste causes and control measures that have effects on project-cost overruns at the materials procurement stage of a project. The study covers building-construction professionals in Abuja, Nigeria, from which a purposive sample of 30 professionals was drawn. Interviews were conducted with the sampled professionals; and in the process, quantitative data were generated by using a tick-box questionnaire. The tick-box questionnaire contained literature based information, which was personally perused by the researcher – when the respondents mentioned any of the issues contained in the tick-box. The results from the tick-box were the only data utilised in this research. The data were analysed by using the descriptive and inferential methods. The research found that the material waste causes that have 'very high effects' on cost overruns with respect to materials procurement stage are: procuring items not in compliance with specification, inexperienced personnel in estimation and procurement, mistakes in quantity surveys (poor estimate for procurement), and damage of materials during transportation. Conversely, difficulties of vehicles in accessing site and errors in shipping among others were identified to have 'very little effects' on cost overruns. Analysis of variance revealed a none significant difference in the views of the professionals on these issues. The study concludes that effective management of the identified material waste causes would translate into reduction in the amount of cost overruns with respect to procurement stage of a building project.

Keywords: control measures, cost overruns, material waste, procurement stage

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INTRODUCTION

The construction industry plays a leading role in improving the quality of the built environment, but faced with the problems of time overrun, cost overrun and material waste (Osmani et *al.,* 2008; Saidu and Shakantu, 2016a). Cost overrun and material waste are global problems which make it difficult for many construction projects to be completed within their budget (Saidu and Shakantu, 2015; Ameh and Itodo, 2013; Abdul-Rahman *et al.,* 2013; Nagapan *et al.,* 2012a). Material waste from the construction industry represents a relatively large percentage of the production costs, thus, poor management of materials and waste leads to an increase in the total cost of building projects (Ameh and Itodo, 2013). The problems of material waste and cost overrun are occasioned by several causes at different stages of projects. These include: the planning stage, estimating stage, design stage, material procurement stage and the construction stage. Identification of these causes at different stages and the application of relevant control measures to minimise their occurrence is a step towards alleviating the consequences (Mou, 2008; Oladiran, 2009; Nagapan *et al.,* 2012a; Saidu and Shakantu, 2015).

Material waste is a problem requiring urgent attention in the construction industry; it is a contributing source of municipal solid waste in megacities around the world; and frequently accounting for 10% to 40% of the total waste sent to landfills (Li and Zhang, 2013; Begum, 2009). For instance, the US generates 164million ton of construction waste annually representing 30-40% of the country's Municipal Solid Waste (MSW) (Osmani, 2011). China alone generates 30% of the world's MSW, out of which construction and demolition waste represents 40% of the country's MSW (Lu and Yuan, 2010). In Hong Kong, construction waste consists of 30% to 40% of the total waste sent to landfills (Li and Zhang, 2013). 28.34% of the total waste sent to landfills in Malaysia originates from construction activities (Begum 2009). 10% of the materials delivered to sites in the UK construction industry end up as waste that may not be accounted for (Osmani, 2011). Ameh and Itodo (2013) noted that for every 100 houses built in Nigeria, there is sufficient waste material to build another 10 houses.

Cost overrun is a problem which plague the construction industry for decades; and the argument on how to reduce or totally remove it from projects has been ongoing among the built environment professionals, project owners and the users for the past seventy years (Apolot *et al.*, 2010; Allahaim and Liu, 2012), but there is no substantial improvement nor significant solution in mitigating its detrimental effects (Allahaim and Liu, 2012). Flyvbjerg *et al.* (2004) conducted a global study on cost overruns and concluded that cost overruns were found across twenty (20) nations and five (5) continents of the world. Cost overruns are a problem, which affects 90 percent of completed projects (Flyvbjerg *et al.*, 2004; Memon, 2013; Abdul-Rahman *et al.,* 2013). Moreover, most developing countries

experience overruns exceeding 100 percent of the initial budget (Memon *et al.,* 2013).

Consequently, Ameh and Itodo (2013) believed that building material wastage on construction sites accounts for cost overruns. And this is as a result of the fact that, most managers of construction projects pay little attention to the effects of generated material waste on cost overruns. Many studies have been conducted in this field, for instance, Tam *et al.* (2007) assessed the levels of material wastage affected by sub-contracting relationships and projects types with their correlations on construction site; Ameh and Itodo (2013) assessed professionals' views of material wastage and cost overruns, as well as the most wasteful materials on construction sites. Saidu and Shakantu (2015) examined the relationship between quality of estimating, construction material waste generation and cost overruns in Abuja, Nigeria; Saidu and Shakantu (2016a) examined the relationship between material waste and cost overrun in the construction industry using literature based methodology and recommended further empirical investigations. Moreover, Saidu and Shakantu (2016b) developed a framework and an equaion for managing construction-material waste and cost overruns. Saidu and Shakantu (2016c) also determined the contributions of material waste to project cost overrun in Abuja, Nigeria. None of the above-mentioned research clearly identified the materials waste causes that have effects on cost overruns at the materials procurement stage. These therefore, provides the need for a research that provides a holistic assessment of the effects of material waste causes and their control measures on cost overruns at the materials procurement stage of a construction project. Hence, the aim of this paper is to examine the material waste causes and control measures that have effects on cost overruns with respect to materials procurement stage of a building project. To achieve this aim, the following objectives are formulated: To examine the material waste causes that have effects on cost overrun; to examine the material waste control measures that have effects on cost overruns; and to compare the views of professionals on the material-waste causes and control measures that have effects on cost overruns, all with respect to materials procurement stage of project

MATERIAL WASTE AND COST OVERRUN

Construction waste is a global challenge facing construction professionals; It has a significant impact on time, cost, quality and sustainability (Nagapan *et al.,* 2012a). Construction waste is generally classified into two main classes, namely: the physical and the non-physical waste (Nagapan *et al.,* 2012b). The physical construction waste is the waste from construction, renovation activities, including civil and building construction, and demolition activities. It is, however, referred by some directly as solid waste (Saidu and Shakantu, 2015). This type of waste consists of material waste for recovery (re-use and recycling) or complete loss of materials for landfill disposal (Saidu, 2016).

The non-physical waste normally occurs during the construction process. In contrast to the physical or material waste, non-physical waste relates to time overruns and cost overruns for construction projects (Nagapan *et al.,* 2012b; Saidu, 2016). Similarly, Ma (2011) defines waste as not only associated with wastage of materials, but also to other activities such as delays due to repair, waiting time, among others. Besides that, waste can be considered as any inefficiency that results in the use of equipment, materials, labour, and money in the construction process (Ma, 2011). In other words, waste in construction is not only focused on the quantity of materials wasted onsite, but also covers issues like overproduction, waiting time, material handling, inventories, and unnecessary movement of workers (Nagapan *et al.,* 2012a).

Saidu and Shakantu (2015) emphasised that since the term 'construction waste' entails both the physical and the non-physical waste, there is a relationship between material waste originating from physical waste and cost overruns from the non-physical waste, since they both emanate from the same waste family. This classification is shown in Figure 2.1.

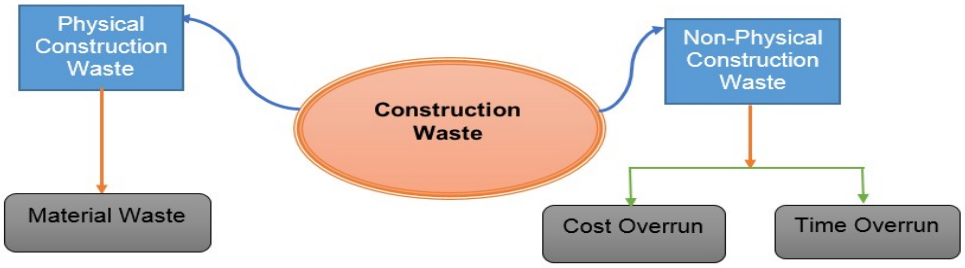

Figure 1: Classification of construction waste

Linking material waste to cost overruns, Ameh and Itodo (2013) assert that material wastage on site leads to an increase in the final cost of the building project. Teo *et al.* (2009) believe that as materials are wasted, more are procured and this thereby affects the estimated cost. Studies from different parts of the world revealed that poor management of materials and waste leads to an increase in the total cost of building projects (Ameh and Itodo, 2013; Saidu, 2016). Saidu and Shakantu (2016a) concluded through a desktop research that all the causative factors of material waste also cause cost overruns at the pre-contract and post-contract stages of a project. However, 96.88% and 81.81% of the causes of cost overruns also cause material waste at the pre-contract and post-contract stages respectively (Saidu and Shakantu, 2016a). Averagely, an overlap of 86.74% existed between the causes of material waste and those of cost overruns at all stages of a project. Other causes which are not related are mostly the micro-economic and macro-economic factors. Table 1 shows the causes of material waste that are linked to causes of cost overruns at the materials procurement stage of a project.

Table 1: Material waste causes related to the causes of cost overruns with respect to material procurement management stage of a project

Causes of material waste related to the causes of cost overruns	Material Waste		Cost overruns	
	Author & date	Location	Author & date	Location
Procurement & Transportation				
Errors/mistakes in material ordering/procurement	Nagapan *et al.* (2012a	Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Procuring items not in compliance with specification	Adewuyi and Otali (2013); Osmani, *et al.* (2008)	Rivers, Nigeria; UK	Allahaim and Liu (2012)	Saudi Arabia
Errors in shipping/supply	Osmani, *et al.* (2008); Nagapan *et al*. (2012a	UK; Malasia	Nega (2008)	Ethiopia
Lack of experience	Nagapan *et al.* (2012a	Batu, Malaysia	Abdul Rahman *et al.* (2013); Ameh *et al.* (2010)	Malaysia; Nigeria
Mistakes in quantity surveys: Poor estimate for procurement (over procuring)	Nagapan *et al*. (2012a	Malaysia	Aziz (2012); Allahaim and Liu (2012)	Egypt; Saudi Arabia
Wrong material delivery procedures	Nagapan *et al*. (2012a	Malaysia	Aziz (2012)	Egypt
Delivery of substandard materials	Nagapan *et al.* (2012a	Malaysia	Nega (2008)	Ethiopia
Damage of material during transportation	Osmani *et al.* (2008)	UK	Nega (2008)	Ethiopia
Late delivery /Inadequate delivery schedule	Nguyen, Gupta and Faniran (nd)	Geelong, Australia	Al-Najjar (2008); Abdul Rahman *et al.* (2013)	Gaza Strip; Malaysia
Poor material handling	Osmani *et al.* (2008)); Nagapan *et al.* (2012a	UK; Malaysia	Ameh *et al.* (2010	Nigeria
Poor protection of materials and damage during transportation	Osmani *et al.* (2008); Aiyetan and Smallwood (2013)	UK; Lagos, Nigeria	Nega (2008)	Ethiopia
Over allowance (difficulties in ordering less)	Osmani *et al.* (2008); Nagapan *et al.* (2012a	UK; Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Frequent variation orders	Nguyen, Gupta and Faniran (nd)	Geelong, Australia	Aziz (2012); Baloyi and Bekke	Egypt; South Africa
Poor product knowledge	Nagapan *et al*. (2012b)	Malaysia	Jackson (2002)	Reading
Difficulties of vehicles in accessing site	Osmani *et al.* (2008); Nagapan *et al.* (2012b)	UK; Batu, Malaysia	Allahaim and Liu (2012); Zewdu and Aregaw (2015)	Saudi Arabia; Ethiopia
Manufacturers				
Poor quality of materials	Adewuyi and Otali (2013)	Nigeria	Ameh *et al.* (2010	Nigeria
Non-standard sizes of materials	Osmani (2011)	UK	Lee-Hoai *et al.* (2008)	Vietnam
Poor product information	Nagapan *et al*. (2012)	Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Lack of awareness	Al-Hajj and Hamani (2011)	UAE	Ameh *et al.* (2010	Nigeria
Suppliers				
Poor supply chain management	Al-Hajj and Hamani (2011)	UAE	Ameh *et al.* (2010	Nigeria
Supplier errors	Odusanmi, Oladiran and Ibrahim (2012)	Nigeria	Nega (2008)	Ethiopia
Poor product incentive	Nagapan *et al*. (2012)	Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Poor handling of supplied materials	Osmani, etal (2008); Ameh and Itodo (2013)	UK; Nigeria	Ameh and Itodo (2013)	Nigeria
Poor methods of unloading materials supplied in loose form	Adewuyi and Otali (2013)	Nigeria	Nega (2008)	Ethiopia

RESEARCH METHODOLOGY

The study covers building construction projects within Abuja, the Federal Capital Territory of Nigeria. Abuja was selected because it is one of the metropolitan cities of Nigeria that has the highest population of professionals within the built environment and has many on-going construction projects.

Interviews were conducted with construction professionals using purposive sampling techniques. Purposive sampling technique was used, because only building-construction professionals handling projects that are worth 1.6 billion Naira/R100 million and above were consulted/interviewed. This is because building projects of such value/amount are likely to generate more waste and are likely to be handled by more experienced professionals, who might be more familiar with the issues leading to material waste and cost overruns than the projects of lesser value. Furthermore, Leedy and Ormrod (2014) believe that the size of a purposive sampling technique ranges between 5 and 25 participants. For this research, thirty (30) professionals were interviewed (15 Project Managers {PMs}, 9 Quantity Surveyors {QSs}, 5 Site Engineers {SEs}, and 1 Senior Technical Officer {STO} of a waste management department). The interviews were on the issues relating to material waste and cost overruns at the materials-procurement stage of a construction project. All thirty (30) respondents identified in this research responded to all the questions presented for discussion.

The research method is quantitative which is in line with the positivist paradigm assumption. It is quantitative because in the course of the interviews, a tick-box structured questionnaire containing a list of literature based information (waste causes and control measures that relate to cost overruns) was ticked/marked by the interviewer/researcher as the respondents mentioned or commented on any of the issues in the tick-box. This was done to validate the literature based information by determining their frequencies and percentages of occurrence. The results of the tick-box questionnaire were the 'only research data' utilised in this study. The, study is therefore quantitative rather than qualitative or mixed method research.

The research employed the descriptive and the inferential analyses. The descriptive tool that was used to analyse the data (tick-box structure questionnaire) was the cross-tabulation method. The responses from the tick-box questionnaires are rated based on the cut-off points highlighted by Morenikeji (2006) in a five-point Likert scale; the material-waste causes and control measures that have a percentage of "90 to 100" are rated "Very High (VH) effect"; 70 to 89% are rated "High (H) effect"; 50 to 69% are rated "Moderate (M) effect"; 30 to 49% are rated "Little (L) effect"; and 1 to 29% are rated "Very Little (VL) effect" on cost overruns.

Inferentially, the analysis of variance (one-way ANOVA) was used to compare the means of the results/views of the different

respondents/professionals, to determine if there is a statistically significant difference by the respondents on the effects of material waste causes on cost overruns at the site management stage of a building construction project.

RESULTS AND DISCUSSION

Material waste causes that have effects on project cost-overrun with respect to materials procurement management stage of a project

Table 2 indicates that 100 percent of the respondents agreed that "procuring items not in compliance with project specifications" and "engaging inexperienced personnel in estimation and procurement" were the major material-waste causes that have a 'very high effect' on project-cost overruns at the materials-procurement stage of a project. These results confirm the findings of Abdul Rahman *et al.* (2013); Ameh *et al.* (2010) and Allahaim and Liu (2010) on the causes of cost overruns for projects identified in Table 1. The same results also corroborate the findings of Adewuyi and Otali (2013); Osmani *et al.* (2008) and Nagapan *et al.* (2012a) on the causes of material waste for projects.

The percentages of 76.7, 73.3,73.3 and 73.3 relative to "mistakes in quantity surveys (poor estimate for procurement)", "mistakes in material procurement", "procuring wrong quantities of materials", and "procurement and delivery of substandard materials", respectively, were the material waste causes considered by the respondents to have a 'high effect' in causing cost overruns; because they fall between 70 and 89 percent. The results corroborate the findings of Nagapan *et al.* (2012a) on the causes of material waste and those of Nega (2008); Aziz (2012); and Allahaim and Liu (2012) on the major causes of cost overruns for projects.

Additionally, percentages of 60, 56.7, 53.3, 53.3, 53.3, and 50, in relation to "wrong material delivery procedures", "lack of quality control/assurance for evaluation of procured product", poor material handling", "poor product knowledge", "poor supply-chain management" and "damage of material during transportation", respectively, were deemed by the respondents to have a 'moderate effect' on cost overruns.

Nevertheless, the material waste causes that have very little effects on cost overruns were: (a) errors in shipping; (b) damage of material during transportation; (c) poor market conditions; and (d) lack of awareness; because they fall between 1 and 29 percent. These results confirm some of the findings of Nagapan *et al.* (2012a); Osmani *et al.* (2008) on the causes of material waste for a project. The findings also corroborate the findings of Nega (2008) on the causes of cost overruns.

Table 2: Result of the effects of material-waste causes on cost overruns at the materials procurement management stage of a project

S/n	Causes material waste that have effect on the causes of cost overrun a materials procurement stage of a project	PM	QS	SE	STO	Total	Ranking	Decision
a	Procurement and transportation source							
1	Mistakes in material procurement	12	7	2	1	22 (73.3%)	4	High effect
2	Procuring items not in compliance with specification	15	9	5	1	30 (100%)	1	Very high
3	Errors in shipping	2	0	3	0	5(16.7%)	17	Very little
4	Mistakes in quantity surveys (poor estimate for procurement)	11	7	4	1	23 (76.7%)	3	High effect
5	Procurement and delivery of substandard materials	11	5	5	1	22 (73.3)	4	High effect
6	Damage of materials during transportation	12	6	3	1	22 (73.3%)	4	High effect
7	Inadequate delivery schedule	5	4	2	0	11 (36.7%)	13	Little effect
8	Poor market conditions	2	0	1	0	3(10%)	21	Very little
9	Poor handling of materials	7	6	3	0	16(53.3%)	10	Moderate
10	Waiting for replacement	0	0	0	0	0 (0%)	29	No response
11	Poor protection of materials during transportation	10	4	2	1	17 (56.7%)	8	Moderate
12	Over allowance	3	4	0	0	7(23.3%)	15	Very little
13	Frequent variation orders	0	0	0	0	0(0%)	29	No response
14	Poor product knowledge	7	4	4	0	15(50%)	12	Moderate
15	Difficulties of vehicles in accessing site	3	1	0	0	4(13.3%)	19	Very little
16	Inexperienced personnel in estimatio and procurement	15	9	5	1	30 (100%)	1	Very high
17	Procuring wrong quantity of materials	11	5	5	1	22 (73.3%)	4	High effect
18	Lack of quality control assurance for evaluation of procured product	9	5	3	0	17 (56.7%)	8	Moderate
19	Incompetent procurement management	3	2	4	0	9 (30%)	14	Little effect
20	Lack of professionalism and transparency in procurement	4	1	0	0	5 (16.7%)	17	Very little
21	Lack of early materials requisition	1	0	0	0	1 (3.3%)	24	Very little
b	Manufacturers' source							
22	Manufacture of poor quality material	3	3	0	0	6(20%)	16	Very little
23	Poor product information	1	3	0	0	4(13.3%)	19	Very little
24	Poor projection for materials	0	0	0	0	0 (0%)	29	No response
c	Suppliers' source							
25	Poor supply chain management	10	3	2	1	16 (53.3%)	10	Moderate
26	Poor packaging	1	2	0	0	3(10%)	21	Very little
27	Supplier errors	1	1	0	0	2(6.7%)	23	Very little
28	Poor product incentive	0	0	0	0	0(0%)	29	No response
29	Poor handling of supplied materials	8	5	3	0	16(53.3)	8	Moderate

Material waste control measures that have effects on cost overrun with respect to materials procurement stage of a project

The material waste control measures that have a very high effect on controlling cost overrun with respect to quality of procurement management of a project are: (i) procuring in accordance with the specifications; and (ii) experienced personnel in estimation and procurement. These results confirm the findings of Abdul-Azis *et al.* (2013) who recommended the engagement of experienced personnel as a major control measure for project-cost overruns. The only cause of material waste that has a high effect on cost overrun is 'procuring the right quantity of materials at the right time'.

Table 3. Results of the effect of material waste control measures on cost overruns at materials procurement stage of a project

S/n	Control measures for material waste (Quality of Procurement management)	PM	QS	SE	STO	Total	Ranking	Decision
a	Procurement & transportation							
1	Better transportation of materials	3	0	1	0	4 (13.3%)	16	Very little
2	Enhanced construction materials handling by workers	7	6	3	0	16 (53.3%)	8	Moderate
3	Adopting good materials abstracting	1	2	1	0	4 (13.3%)	16	Very little
4	Provision of easy access road for vehicles delivery	3	1	0	0	4 (13.3%)	16	Very little
5	Adoption of unified methods of estimating for procurement	8	6	4	0	18 (60%)	6	Moderate
6	Ordering appropriate materials quantity	5	4	2	0	11 (36%)	11	Little
7	Timely delivery of materials	6	4	1	1	12(40%)	10	Little
8	Standard evaluation and comparing with specification	12	2	5	0	19 (63.3%)	4	Moderate
9	Procuring in accordance with specification	15	9	5	1	30 (100%)	1	Very high
10	Experienced personnel in estimation and procurement	14	9	5	1	29 (96.7%)	2	Very high
11	Insurance of the procured materials	1	1	1	0	3 (10%)	21	
12	Procuring the right quantity of materials at the right time	11	5	5	1	22 (73.3%)	3	High
13	Formation of a quality control unit for evaluation of procured product	9	5	3	0	17 (56.7%)	7	Moderate
14	Competent procurement management	3	2	4	0	9 (30%)	13	Little
15	Professionalism and transparency in procurement	4	1	0	0	5 (16.7%)	15	Very little
b	Manufacturers source							
16	Improved quality of materials	3	3	0	0	6(20%)	14	Very little
17	Materials should be manufactured in standard units	9	3	2	0	14 (46.7%)	9	Little
18	Knowledge of product to be manufactured	1	3	0	0	4 (13.3%)	16	Very little
c	Supplier source							
19	Better and improved supply chain management	5	4	2	0	11 (36.7%)	11	Little
20	Efficient methods of unloading materials supplied in loose form	11	5	3	0	19 (63.3%)	4	Moderate
21	Better materials delivery to site	1	2	0	0	3(10%)	21	Very little

Furthermore, percentages of 63.3, 60, 56.7, and 53.3 relative to standard evaluation and comparing with specification; efficient methods of unloading materials supplied in loose form; adoption of unified method of estimating for procurement; formation of a quality-control unit for evaluation of procured product; and enhanced construction material handling by workers, respectively, were considered to have a moderate effect in controlling cost overruns by the respondents because they fall between 50 and 69 percent.

The material waste control measures that have a very little effect on cost overrun with respect to materials procurement stage are: (a) better delivery of materials on-site; (b) adopting good materials abstracting; (c) provision of easy access road for vehicles delivery; and (d) knowledge of the product to be manufactured. These results support the findings of Osmani *et al.* (2008) on the control measures for material waste for projects.

Comparative views of respondents on the effects of material-waste causes and control measures on cost overruns with respect to materials procurement stage of project

Analyses of the differences in the professional views on the effects of material-waste causes and control measures on project-cost overruns reveal a non-statistically significant difference between the values of f-calculated (0.238 and 0.236) which are less than the value of f-tabulated (1.701) and the probability values of 0.790 and 0.792 are greater than the critical value of the 5 percent level of significance within the mean-squared groups of 1.81-7.59 and 1.16-4.92, respectively.

The evidence is not statistically significant. These imply that the respondents were of the same views on the effects of material waste causes and control measures on cost overruns with respect to materials procurement stage of a project. This is shown in Table 4.

Table 4: Test of difference in professional views on the effects of material-waste causes and control measures on cost overruns at materials procurement management stage of a project

S/n	Variables	Type of Analysis	Observation				Inferences
	$X1$ $X2$ $X3$ $X4$		Mean square within group	F-cal	F-tab	Probability value	Remark
1	PM QS SE STO Sources and causes	One-way ANOVA	1.81 7.59	0.238	1.701	0.790	Not statistically significant
2	PM QS SE STO Control measures	One-way ANOVA	1.16 4.92	0.236	1.701	0.792	Not statistically significant

CONCLUSION AND RECOMMENDATIONS

The construction industry plays a leading role in improving the quality of the built environment, but faced with the problems of cost overruns and material waste. These problems occur at different stages of a project, from

planning, design, materials procurement and execution. Material waste from the construction industry represents a relatively large percentage of the production costs, thus, poor management of materials and waste leads to an increase in the total cost of building projects. The purpose of this paper was to examine the material-waste causes and their control measures that have effects on cost overruns at the materials procurement stage of a construction project.

It was found that material waste causes and their control measures were identified to have significant (very-high, high, medium, low, and very-low) effects in causing/controlling cost overruns at the materials procurement stage of a project. Also, there was no statistically significant difference in the views of the respondents on these issues. The respondents have therefore the same views on the results of the effects of material-waste causes and control measures on cost overruns at materials procurement stage of a project.

It was also found that, in order to minimise the rate of material waste at the materials procurement stage of a project, materials must be procured in compliance with project specifications, experienced personnel must be engaged in procurement, proper estimation and ordering of appropriate materials quantity, formation of a quality control unit for evaluation of procured product, and enhanced means of handling the procured materials by workers.

Based on these findings, it can be concluded that effective management of material-waste causes on construction site would translate into a reduction in the level of cost overruns for projects.

The study recommends that management of material-waste causes at the procurement stage should be encouraged, as it has the potential to minimise cost overruns on projects. The management system should be revised based on the findings of this research as a reference document and included as part of the materials procurement planning process for a project.

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