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The Implications and Barriers Preventing Effective Waste Management in The UK Construction Industry

Research Article

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Abstract

The construction industry in every country plays an important role in the development of such a country economically and socially. In the UK, 400million tonnes of materials are used for construction purposes. Of these 400million tonnes of materials, 100millions tonnes of waste is produced and 25million tonnes are deposited in landfills, contributing to about 45% of CO2 emissions which then causes the environment to be harmful. Therefore, it is necessary to uncover the barriers affecting the effectiveness of construction waste management in the UK construction industry which is the aim of this research. To achieve this, this research will adopt the use of the mixed method to research to gather findings. Quantitatively, the use of a well-structured questionnaire was adopted and qualitatively, an interview survey was adopted. Both were administered to construction professionals in the west-midlands region of the UK construction industry with above 5 years of experience with knowledge of waste management. From the findings, it was evident that construction contractors in the UK are not rightly supplied with the right information about waste management, but this information is readily available. Therefore, it is necessary for the main body of construction industry professionals to sensitise contractors about how important waste management is as it assists in improving a company's turnover and preserving the environment. On the micro level, a proper and proactive approach to planning should be adopted by construction contractors as poor planning may lead to poor and incompetent managers which leads to poor workmanship and in turn increases waste generated and lastly poor output of the construction work which then reduces a company's profit margin.

Keywords: Barriers; Construction; Industry; Waste; Management; United Kingdom

Introduction

The UK construction industry makes a vital contribution to the UK economy as it has an annual turnover of over £100 billion and contributes about 9% of the UK Gross Domestic Product (GDP) [1]. Similarly, the construction industry in the UK provides employment for over three million of the UK population and also, they provide other sectors of the economy such as the financial sector, retail sector and business services sector with a "critical factor of production" i.e. Buildings to which their businesses can be carried out from [2]. However, the construction industry is one of the greatest waste generators amongst industries in the UK and is responsible for over 32% of the total waste generated which equals to about three times the waste produced by households in the United Kingdom [3]. Also, about 25 million tonnes of waste from construction and demolition practices end up in landfill without any form of recovery or reuse which costs the industry about £ 1 billion every year in costs for disposal of waste [4]. Generally, there

is no accepted definition for waste in construction, but one common definition as issued by the European council directive in Osmani [5] is "any substance or object the owner discards or intends or is required to discard" which theoretically applies to any type of waste is it construction or household waste which is scheduled for recovery or disposal operations. Similarly, Jones and Womack [6] described waste as a generation of human activities that utilize resources but do not create value such as unnecessary employee waiting and movement time, unwanted or unnecessary process steps, unwanted item production and mistakes to rectify. Construction wastes are generated in various forms, including material cost and time losses, which may be a physical and non-physical waste. Generally, construction waste is usually generated throughout the lifespan of a project right from the pre-construction phase. However, in research by Ikau et al. [7], concerning the factors influencing waste generation in Malaysia, it was concluded that lack of experience or knowledge in construction waste, improper storage which leads to re-work and damage, purchasing ma-



materials which are not in accordance with specifications are amongst the main construction wastes which is generated throughout the phases of construction. Construction waste can be generated through several factors during design, handling, workers, procurement, site condition and external factors which are described as follow:

- a. Frequent Changes in Design,
- b. Poor Planning by Management,
- c. Wrong Storage of Materials Weather Effects,
- d. Unskilled Workforce.

Adopting construction waste management across construction sites in the UK has its benefits or implications it shows the dedication of a firm to provide better quality life of for inhabitants through environmental management and similarly to sustainable construction. However, some key implication of construction waste management includes meeting legal and other requirements, reduction in material and disposal costs, environmental implications and increases contractor competitive edge.

Barriers Preventing the Effectiveness of Construction Waste Management

However, due to the reputation of the construction industry in the very country for consuming large quantities of resources and in turn producing large amounts of waste [8]. However, it is evident that these wastes have not been properly disposed or that firms' operations have not been checked to reduce the amount of waste generated due to an ineffective waste management process for several reasons.

In a study by Yean Ying Ling and Song Anh Nguyen [9] on strategies for construction waste management in Vietnam, it was evident that lack of support from building stakeholders, designers and clients is one of the major barriers to ineffective construction waste management. This statement is one of fact as if there is indecision from construction clients as regards the works which brings about constant changes and in turn frequent revision of the design, this gives birth to frequent change requests and then alteration to the works occur and the amount of waste produced by increases thereby preventing effective waste management on that project. In the same study by Yean Ying Ling and Song Anh Nguyen [9], no budget for waste management in construction contract bills and tight schedules (timelines) for construction projects were other factors that hindered the effectiveness of construction waste management. This is however possible in the UK as some bills have been sampled and it is evident that there are no provisions for waste management in the bills hence making it the sole responsibility of the construction contractor. This should be so that reducing waste would assist the contractor's profit margin in the long run.

Najafpoor et al. [10] uncovered the low cost of sending waste materials to landfill, this is another factor hindering the effectiveness of construction waste management in a study concerning identifying causes of waste products in construction and safety management applications on construction sites. However, this barrier is not applicable to the UK construction industry as the cost of landfill tax is high thereby hindering the dumping of wastes in a landfill. Also, in the UK Greenwood (n.d.) assert that uncertainty of site staff is a major barrier to the effectiveness of construction waste management. This may be seen as a general problem which does not affect only the UK as during the course of a project staff on managerial levels leave halfway through the work, all of the planned endeavours concerning waste management may need to be repeated or may not be considered by new staffs as they are usually concerned with finishing the project within the agreed timeline and may not be willing to or ignore other initiatives. Therefore, from the literature review conducted, in the UK, the most prominent barriers to construction waste management may be the lack of design consideration during design stages which is in line with the

lack of support from major stakeholders, clients and investors and uncertainty of site staff during construction projects are some major barriers that affect the effectiveness of construction waste management in the UK.

Methodology

This research adopts the use of the mixed method approach of research to collect relevant primary data. The qualitative method will lead in this research due to the nature of the subject matter which has to deal with trying to determine the perception of participants to why a certain model is ineffective. The mixed method approach was chosen to accurately determine what the implication of management of waste during the development of commercial buildings in the United Kingdom by using close-ended (quantitative) and open-ended (qualitative) questions to a sample population which will act as the entire population representative. The mixed method to research chosen for this study is based on the pragmatic framework of research which aids to improve the quality of research findings where one method's strength is used to check the setback of the other so as to accurately determine the aim of this study which is to determine the overall implication of waste management in the UK construction industry and in turn determine the barriers hindering the effectiveness of this waste management in this industry.

The data collection method for this research using the quantitative approach of research is through a well-structured questionnaire hosted on google forms. Interview survey (interview- Qualitative) in this research was adopted by the researcher as it involves low cost in terms of money and time to conduct as only travelling cost may be expended. The quantitative framework for this research involves posting the link to the questionnaire on website forums/discussions and direct emails as well. Also, visiting construction sites and handing out questionnaires to construction professionals present. The target participants for this research are primarily the professionals who or have engaged in the construction of commercial buildings with knowledge as regards waste management such as civil engineers, mechanical and or electrical engineers, quantity surveyors and managers in the West-midlands region of the UK. Also, the research sample area will be limited to the West midland region of the UK [11]. There has been a total of 6,382 commercial buildings newly constructed between the Q1 of 2015 and Q2 of 2017 which is currently the 5th hub of commercial buildings across the regions in the United Kingdom as shown in Table 1 below.

Table 1: Number of new commercial buildings between 2015 Q1 – 2017 Q2 and ranks adapted from Office of National Statistics (2017).

Regions in the United Kingdom	Number of New Commercial Buildings between 2015 Q1 – 2017 Q2	Rank
North East	2412	11th
North West	6837	4th
Yorkshire and the Humber	4800	8th
East Midlands	4704	9th
West Midlands	6382	5th
East	6330	6th
London	18461	1st
South East	9160	2nd
South West	5739	7th
Wales	2789	10th
Scotland	7159	3rd



Data Analysis and Discussion

Qualitative Analysis (Interview)

The response from the face-to-face interview conducted was coded using Microsoft Word Office suite 2016 Table 2 where differences and similarities in opinions were concisely outlined. Participants were identified using the acronym “P” which stands for participant followed by a hyphen (-) and then an alphabet to differentiate both interviewees. Table 3 below shows the code designated to both participants.

Table 2: Sample Frame for Quantitative data participants (CITB, 2016).

Population Data (West-Midlands)	Total Population	Percentage Representation (%)
Working Population	56,00,000	43.9
Workers in Construction Population	2,57,000	3.7
Number of interviewed persons	34	0.00013

Table 3: Codes designated to interview participants.

Codes for Participants	Profession
P-A	Quantity Surveyor with over 7 years of industry experience.
P-B	Site Engineer/ Construction Manager with over 15 years’ of experience

To determine the various sources of waste in the UK construction industry

Themes from the question “from your experience, what are the sources of waste in construction” are shown as coded in Table 4. Figure 1 shows the major source of waste as indicated during the interview conducted is packaging waste followed by offcut wastes. Therefore, it is important to address how material packaging can be tackled to reduce its contribution as a source of waste in the UK construction industry. To identify which factors, contribute to waste in the construction of commercial buildings in the UK Themes from the question “What factors contribute to waste generation or what factors cause waste on your site?” are shown as coded in Table 5.

Table 4: Themes show the sources of waste in construction.

Themes	Participants	
	Participant P-A	Participant P-B
Wastes	Offcut wastes	Packaging wastes
	Packaging wastes	

Cross-examining Figure 2, the most contributing factor to waste generation is Poor which consists of poor planning and workmanship and unprotected storage of materials coming next. This just overemphasises how much factors such as proper planning is necessary and select-

ing experienced trade men during construction works to reduce their contribution to waste in the UK. To investigate the barriers preventing the effectiveness and implications of construction waste management in the UK construction industry. Themes from the question “What are the barriers that prevent proper waste management on your site?” and “what are the implications of adopting waste management?” are shown as coded in Table 6.



Figure 1: the frequency of themes of sources of waste in the UK construction industry.

Table 5: Themes show the factors contributing to waste generation.

Themes	Participants	
	Participant P-A	Participant P-B
Waste Generation (Poor, Others)	Poor planning	Poor workmanship
	Unprotected storage materials	

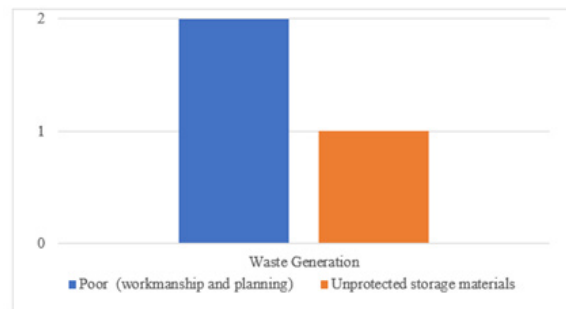


Figure 2: Frequency of themes of factors contributing to waste generations.

Table 6: Barriers preventing effective waste management and implications of waste management

Themes	Participants	
	Participant P-A	Participant P-B
Barriers	Programme	Programme
	Cost savings	
Implications	Time	Time
	Cost	
	Area	



Figure 3 illustrated the major barrier preventing the effectiveness of waste management in the UK construction industry is the programme of work which has to do with time schedules of the ongoing work followed by UK construction industry contractors aiming at cost savings, therefore, preventing the effectiveness of waste management in the UK. Table 7 Also, time is the most prominent implication of waste management followed by cost and area as stated during the interview conducted. To identify what type of waste management method is adopted in the UK construction industry. Themes from the question “what waste management method does your firm usually adopt or which is most effective?” are shown as coded in Table 8.

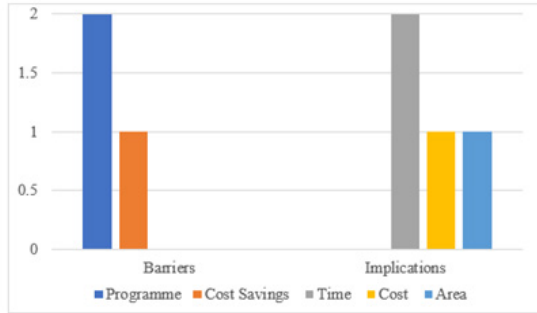


Figure 3: Frequency of themes of barriers preventing the effectiveness and implications of waste management.

Table 7: Themes showing waste management methods

Themes	Participants	
	Participant P-A	Participant P-B
Method	Skips	Skips
	Waste companies	
	Recycling companies	

Figure 4 shows the frequency of themes of waste management methods adopted by construction companies in the UK construction industry. Skip hire is at the top of list of methods following recycling and waste management companies. Therefore, it is obvious that contemporary methods to waste management are not known by construction professionals.

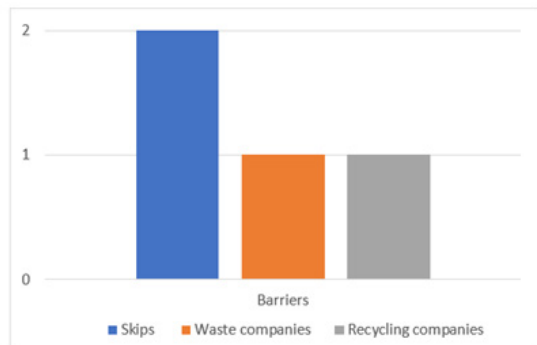


Figure 4: Frequency of themes of waste management methods adopted in the UK construction.

Quantitative Analysis (Well-Structured Questionnaire)

Analysing the Figure 5 which shows the profession of participants, it shows that 32.35% of participants work as civil engineers, 29.41% as others, 17.65% as project managers, 11.76% as architects, and 2.94% as quantity surveyors, mechanical engineers and electrical engineers respectively. However, the 29.41% representation of construction pro-

professionals includes construction managers, site managers and facility managers. However, with this representation of participants, to an extent, a vast opinion concerning the subject matter has been realised since the majority of the participants are involved in the construction process and would have good knowledge concerning waste management in the UK. To determine the various sources of waste in the UK construction industry Going by Figure 6, 47.06% of participants very strongly agreed that material waste, vandalism and weather are major sources of waste in the UK construction industry, 20.59% very strongly agreed and 32.35% agreeing. Generally, the majority of participants agreed with this statement. Figure 7 shows the percentage of participants agreeing to sources of non-physical waste in the UK construction industry where 32.35% of participants agreed, 26.47% strongly agreed and 20.59% agreed and disagreed, respectively. However, a good percentage of participants agreed to cost and time overrun as sources of waste in the UK construction industry.

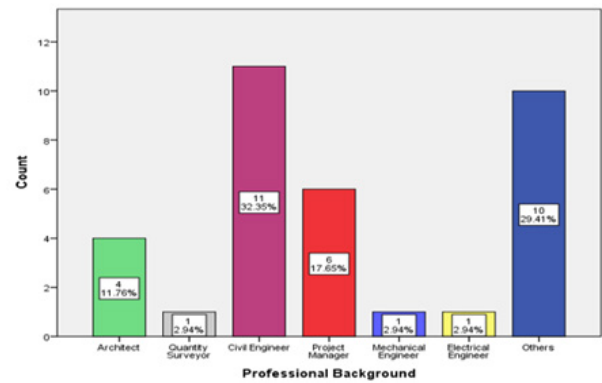


Figure 5: profession of questionnaire participants.

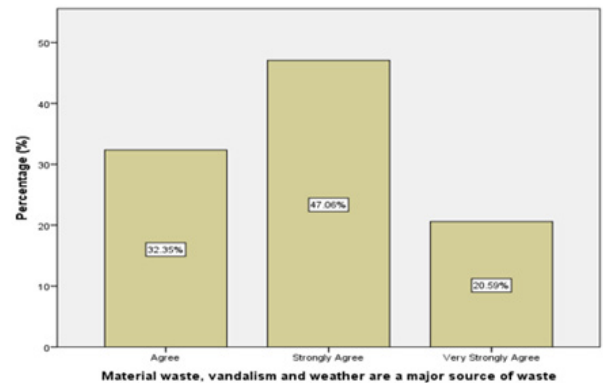


Figure 6: percentage of participants agreeing to sources of physical waste in the UK construction.

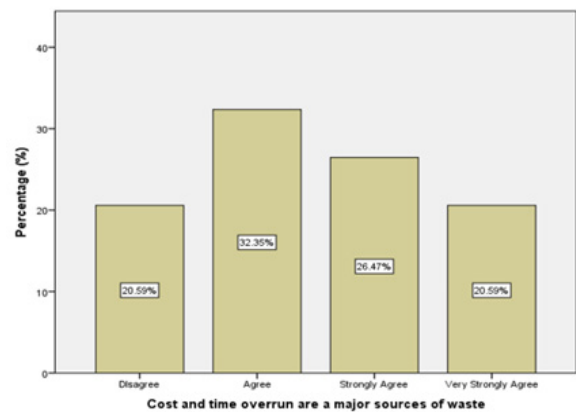


Figure 7: percentage of participants agreeing to sources of non-physical waste in the UK.



Table 8: Descriptive analysis for objective 1

Objective Questions	Mean Response	Weight	Standard Deviation Weight	Range Weight
Do you think material waste, vandalism and weather are major sources of waste?	Strongly Agree	4.88	0.729	2
Do you think cost and time overrun are the major sources of waste?	Agree	4.47	1.051	3

To identify which factors, contribute to waste in the construction of commercial buildings in the UK. Examining Figure 8, the majority of participants 38.24% strongly agree that management issues/factors such as poor planning and coordination of management as factors contribute to waste generation in the UK construction industry. 29.41% very strongly agreed, 29.41% agreed and a very low percentage of participants with 2.94% disagreeing. When examining how much design errors and incompetent or unskilled labour contributes to waste generation, 47.06% of participants very strongly agreed, 26.47% of participants strongly agree, 17.65% agreed and 8.82% of participants disagreed as shown in Figure 9.

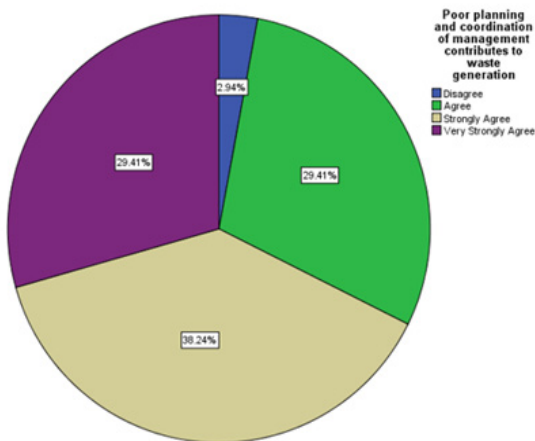


Figure 8: Percentage of participants agreeing to management issues as a waste generator in the UK.

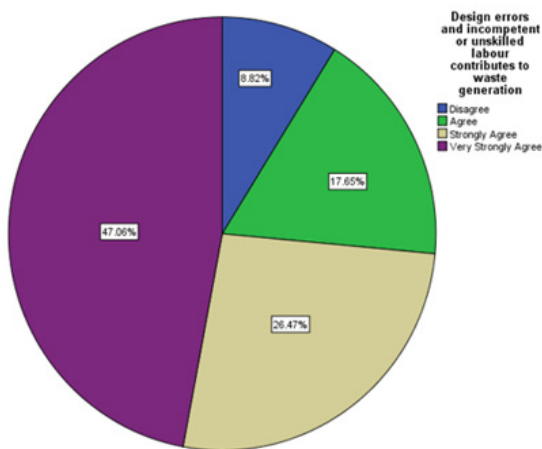


Figure 9: Percentage of participants agreeing to design errors and incompetent or unskilled labour as waste generators in the UK construction.

Figure 10 investigates the barriers preventing the effectiveness and implications of construction waste management in the UK. 35.39% of the sampled population strongly agree that lack of design consideration is a barrier to effective consideration, 32.35% agreed, 17.65% very strongly agreed and 14.71% disagreed. Figure 11 shows the level of agreement of participants as to whether the uncertainty of site staff is a barrier to effective waste management. However, a huge percentage of 45.45% of participants strongly disagreed, 24.24% agreed, 15.12% strongly disagreed, 12.12% disagreed and only a small percentage of 3.03% very strongly agreed. The questionnaire survey was administered to identify the type of waste management method in the UK shown in Figure 12, participants were asked if sorting and recycling are suitable waste management being adopted in the UK construction industry and 35.29% of the population sampled strongly agreed, 32.35% very strongly agreeing, 29.41% agreed and 2.94% disagreeing. On the other hand, When asking about sorting and recycling is a suitable method of waste management in the UK? 41.18% of participants agree, 38.24% very strongly agreed and 20.59% agreed to make none of the participants disagrees that sorting and recycling is a suitable waste management method as shown in Figure 13.

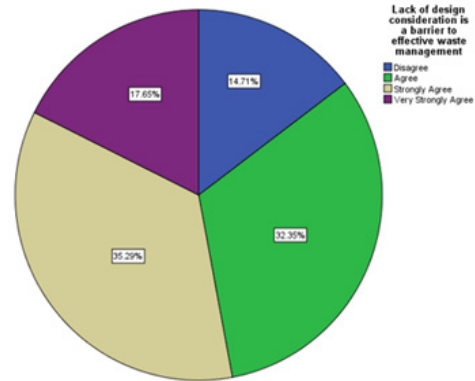


Figure 10: The extent of agreement of participants to lack of design considerations as a barrier to waste management.

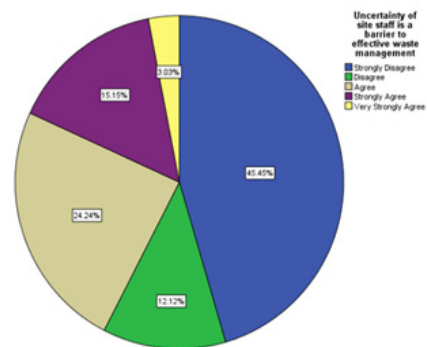


Figure 11: The extent of agreement of participants to whether the uncertainty of site staff is a barrier to effective.



Table 9: Descriptive analysis for objective 3.

Objective Questions	Mean		Standard Deviation	Range
	Response	Weight	Weight	Weight
Do you think lack of design consideration during design stages are a barrier of effective waste management?	Strongly Agree	4.56	0.96	3
Do you think site staff uncertainty during the entire project duration (site staff on the managerial level leaving during the project process) is a barrier to effective waste management?	Disagree	3.18	1.261	4

Table 10: Descriptive analysis for objective 4.

Objective Questions	Mean		Standard Deviation	Range
	Response	Weight	Weight	Weight
Do you think Offsite construction is a waste management method suitable to be adopted?	Strongly Agree	4.97	0.87	3
Do you think sorting and recycling is a suitable waste management method?	Strongly Agree	5.18	0.758	2

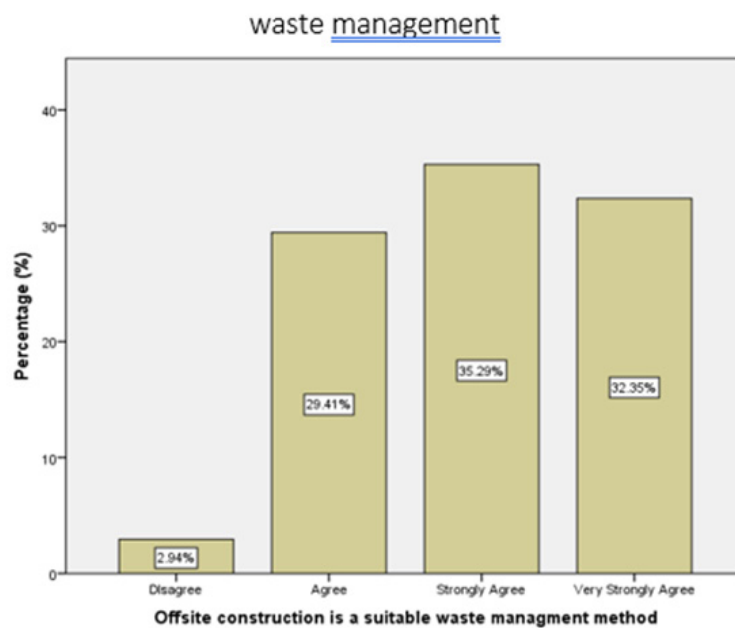


Figure 12: Percentage of participants agreeing to offsite construction as a waste management method in the UK construction industry.



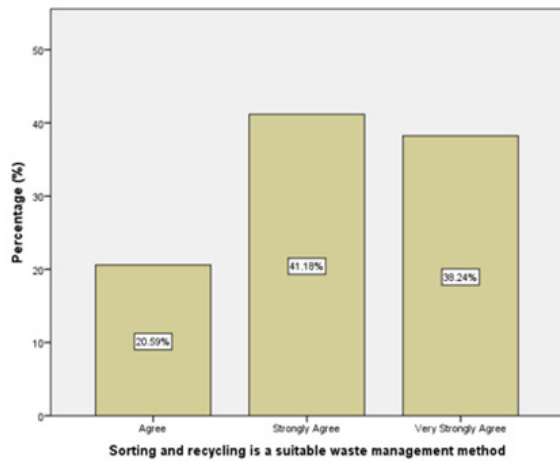


Figure 13: Percentage of participants agreeing to if sorting and recycling is suitable as a waste management method in the UK construction industry.

Descriptive Analysis

The various sources of waste in the UK construction industry

Descriptive analysis for this objective is shown according to asked questions in the research are presented below. In determining the various sources of waste in the UK construction industry, the most occurring theme from the qualitative data collected is packaging wastes which arise from material packaging from suppliers followed by offcut wastes which may be caused due to inexperience of tradesmen and irregular designs by designers. From the quantitative analysis collected, physical and non-physical wastes were sampled as uncovered during the literature review section of this research. In this light, participants strongly agreed that material wastes, vandalism and weather are major sources of physical waste in the UK construction industry. As regards non-physical wastes, participants agreed that time and cost overrun are major sources of non-physical waste. However, from the literature review section, Nagapan et al. [12] discussed various sources of waste in the UK construction industry, and it was evident that packaging waste is a huge source of waste which however may also be a causative factor for material waste to occur. Also, weather and vandalism play a major role as a source of waste but may not be common in the UK construction industry as discussed by kofoworola and Gheewala [13] due to fairly stable weather where there are less heavy rainfalls and storms and other weather factors to cause large amounts of wastes. Also, construction sites usually employ some sort of security to reduce the effect of vandalism. Consecutively, non-physical wastes such as time and cost overrun as discussed by Nagapan et al. [1] may be because of poor planning and further affect the overall development both with the project and industry at large.

Factors, that contribute to waste in the construction of commercial buildings in the UK

From the qualitative data collected the most contributing factor to waste generation with the most occurring theme is poor planning and workmanship. From the quantitative data collected, participants strongly agree that poor planning and coordination of management is a causative factor of waste and further strongly agreed also that design errors and incompetent or shortage of skilled labour contribute to waste generation with a weighting of 5.12. Osmani [5] agreed that poor planning of management is a major cause of waste which is as a result of poor and incompetent managers in the UK construction industry. Also, he asserted that 33% of waste generated is usually due

to design errors.

Investigate The Barriers Preventing the Effectiveness and Implications Of Construction Waste Management In The UK Construction Industry

Qualitatively, the data analysed makes it evident with the most occurring theme that the major barrier preventing the effectiveness of waste management in the construction industry is the programme of works which has to do with the time schedules of the project as they are usually stringent and strict as there is no allowance to be fully committed to waste management. As regards the implications of waste management, the most occurring theme was also time. Quantitatively, participants strongly agreed that lack of design consideration during design stages is a barrier to effective waste management and further disagreed that uncertainty of site staff throughout project duration is a barrier. In the literature review conducted, Yean Ying Ling and Song Anh Nguyen [9] further agreed that design consideration is a major barrier to effective waste management in the UK construction industry as there is no support from other stakeholders and there are frequent design changes throughout the project duration, therefore, making waste management non-effective. Also, is the case of tight schedules as if proper planning is not carried out by the construction contractor hence allocating time scheduled for the work for waste management and vice versa.

To Identify What Type of Waste Management Method Is Adopted in The UK Construction Industry

Results from the qualitative analysed most it obvious that the most occurring waste management adopted in the UK construction industry is the use of skip hire to transport wastes away from construction sites. From the quantitative data analysed, participants Strongly agreed that Offsite construction and sorting and recycling are suitable waste management methods adopted in the UK construction industry. However, from the literature review conducted, Manfred et al. [14] asserted that sorting and recycling which is adopted by skip contractors is the most widely used method of waste management across different industries in the UK. However, this selection by participants doesn't foresee waste but allows the waste to occur before its management. Also, offsite construction is a modern method of waste management which aims at managing and reducing waste as discussed by Tam et al. [15].

Conclusion

this research investigates the various sources of waste in the UK construction industry, it became obvious that in the UK construction industry [16-20], there are different sources of waste which are generated during the construction process but majorly, packaging waste which arises from excessive material packing although may have been carried out for reasons such as protection of materials from the suppliers then [21-25] is a huge contribution to waste in the UK construction industry. Also, offcut waste is perceived as a major source of waste which is usually caused due to un-buildable, irregular dimensions and specifications by designers. The inexperience of tradesmen may also cause excessive offcut waste to arise during the construction process. [26-30] However, offcut waste and packaging wastes can be viewed as physical wastes in construction. Concerning non-physical wastes, time and cost overrun were perceived as the major source of waste in this sampled industry and may be caused due to improper and un-proactive planning by management during preconstruction and during the construction phases. However, the client's indecision as regards design and other scopes of work which concern him can also contribute to cost and time overrun arising in the UK. [31]. To investigate the barriers preventing the effectiveness and implications of construction waste management in the UK construction industry and

findings in this study, [32] concerning the barriers preventing effective waste management, strict time schedules for construction works and no budget or waste management in contract bills are the greatest barriers preventing effective waste management. In the UK, due to investors wanting returns on their investments, there is no time allotted for waste management programs of works as they require their investments to be delivered just in time hence due to the poor planning in this industry, [33] time for the actual construction work may be allocated to waste management leaving the actual construction work to suffer and in turn cause waste. Also, no budget for waste management in contract bills. To identify what type of waste management method is adopted in the UK and findings depict that the most used waste management method is sort and recycling which is sorting and recycling which includes providing separate bins for waste disposal on site premises and also hiring skips, waste and recycling companies to dispose of generated waste.

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