Influential Factors Driving Material Sourcing for Sustainable Construction Practice

Mansir Dodo.[1]*, Muawiya Abubakar[2] and Abubakar D. Abdul Azeez[3]

[1, 2 & 3]Department of Building, Ahmadu Bello University Zaria Nigeria.

*corresponding author (mansirdo14@yahoo.com)

ABSTRACT

The construction industry is characterised to being highly resource dependent. Owning to the spiralling cost of resource processing as well as dwindling resources globally, sustainable construction emerged as a concept to optimise the use of resources in construction. Ever since its emergence, sustainable construction has been researched upon from several approaches such as: space management; energy and water efficiency of buildings; and waste management among other approaches. While these approaches are deemed to be rather specific, a sustainable construction approach deemed to be more generic is the use of alternative sustainable materials because most often than not, implementing the specific approaches relies on the use of construction materials that are sustainable. Although there exist researches on sustainable construction materials in Nigeria, not much exist on the influential factors driving the sourcing of sustainable construction materials which is key to successful construction project delivery. As such, this research investigates the influential factors driving the sourcing of construction materials for sustainable construction practices. Primary data is collected through conducting a survey with the aid of a structured questionnaire using purposive sampling from 61 postgraduate students in the Department of Building Ahamdu Bello Univeristy Zaria Nigeria. The procedure for data analysis is both descriptive and inferential using IBM SPSS Statistics 23 as well as MS Excel to compute the Mean Score as well as the Relative Index (RI). Out of the 61 questionnaires distributed, only 48 were used for analysis. Results indicate that all the respondents believe that all influential factors studied drive sustainable construction. This study found that while ‘environmental impact’ and ‘material quality’ are the most influential factors always driving material sourcing in sustainable construction, instances prevail whereby ‘compliance to statutory regulations and laws’, ‘available specialist skills to use material for sustainable construction’ and also ‘incentive in the use of sustainable material’ never drive material sourcing in sustainable construction. The study concludes by asserting that professionals in the construction industry rely on various influential factors to drive their decisión on material sourcing in sustainable construction. There is need to invest more efforts on enforcing material compliance to regulations, developing skills to use material for sustainable construction and provide more incentives in the use of sustainable materials. Future studies can cover influential factors speciafically categorised according to the three dominant pillars of sustainable practice which are social, economic and environmental. Also, more indepth relationships between and among the influential factors may be explored.

Keywords: Influential factors; Material sourcing; Sustainable construction.

1.0 INTRODUCTION

Globally, the construction industry is characterised to not only being highly resource dependant, but also, expereince variations and fluctuations in resources used based on the usually long duration in executing a construction project compared to projects in other industries. With resources becoming more scarce, the concept of sustainable construction is becoming an area of concern. According to Ofori & Toor (2012), sustainable construction refers to designing constructed items and planning construction activity to ensure that the process and its products are sustainable in broadly defined terms. Similarly, Practical Recommendations for Sustainable Construction PRESCO (2018) report that the European Union (EU) defines sustainable construction as the use and/or promotion of environmentally friendly materials, energy efficiency in buildings as well as management of construction and demolition waste. Both these definitions inform that the concept of sustainable construction cuts across design and construction of any construction project as well as new or retrofit construction project.

There exist several efforts to promote sustainable construction by statutory authorities. In Canada for instance, Canada's Federal Housing Agency offered a performance based model for sustainable construction (Practical Recommendations for Sustainable Construction PRESCO, 2018). In UK as well, the UK national guidelines for sustainable construction guides the implementation of sustainable construction (Xia, Olanipekun, Chen, Xie, & Liu, 2018). In Russia also, there is a wide movement to sustainable construction in terms of multi-level programs designed to become a transition to sustainable construction (Practical Recommendations for Sustainable Construction PRESCO, 2018).

Similar to these efforts by statutory authorities, there is growing interest among researchers on sustainable construction. While such growing interests have yielded numerous researches, existing researchers adopt different approaches to sustainable construction. Some authors have approached sustainable construction relative to space management (Steiner, 2005). Others take the approach of material waste minimization (Formoso, Soibelman, Cesare, & Isatto, 2002). Also, other researches embark on an approach relative to alternative sustainable materials (Sajane, Agam, Patil, Shirgave, & Pituk, 2017; Shoubi, Shoubi, & Barough, 2013; Kapoor, Jena, & Govil, 2012). Equally, other researchers choose to approach sustainable construction on the basis of energy and water efficiency of buildings (Piper, 2017; Harun & Ghafar, 2003). Even though the scope of these research approaches to sustainable construction differ, they however all unanimously aim for resource optimization in construction.

Resources optimised in sustainable construction vary based on the scope of construction project. Irrespective of the variability however, bulk of the resources are material resources. This is confirmed from the generic model of sustainable construction proposed by Practical Recommendations for Sustainable Construction PRESCO (2018) whereby the role of material resources in sustainable construction is stressed upon to being key to sustainable construction. Based on such, issues pertaining to material sourcing (among other processes in material management) are key to achieving successful construction project delivery in sustainable construction. This is attested by Kasim (2008) where the author claims that purchasing materials from the best source, at the right price and with timely delivery is key to successful construction project delivery. Although there exist researches on sustainable construction materials in Nigeria (such as Mansir, Gambo, Yar'adua, & Abduljabbar, 2019; Ede, Alegiuno, & Aawoyera, 2014; and also Ibrahim, Bankole, Ma'aji, Ohize, & Abdul, 2013 among others), not much exist on the influential factors driving the sourcing of sustainable construction materials. As such this research investigates the influential factors driving the sourcing of construction materials for sustainable construction practices.

2.0 LITERATURE

The subsequent sub-sections begins by discussing sustainable construction. Afterwards, factors driving material sourcing for sustainable construction are articulated.

2.1 Sustainable Construction

Over the last decade, there has been wide discussions on sustainable construction. Although the reasons for such discussions vary, Briga-Sá et al. (2013) are of the opinion that taking into account that the construction sector carries out a high consumption of resources such as materials, energy, and water, it is imperative for the use of more sustainable construction solutions. There exist several definitions of sustainable construction. For instance, Practical Recommendations for Sustainable Construction PRESCO (2018) defines sustainable construction as a wide array of criteria about how to build in a sustainable way. Also, Ofori & Toor (2012) defines sustainable construction as designing constructed items and planning construction activity to ensure that the process and its products are sustainable in broadly defined terms. Irrespective of the definition of sustainable construction, the goal is to primarily optimise resource. In other words, sustainable construction should aim at keeping the total cost of construction on a reasonable (minimum) level and also, social and cultural aspects of construction at a feasible (maximum) quality. In line with such definitions, Practical Recommendations for Sustainable Construction PRESCO (2018) outlines some goals of sustainable construction which include:

a. Decrease exhausting of primary raw materials and energy;
b. Regulate consumption of renewable resources;
c. Decrease the amount of harmful emissions and wastes;
d. Increasing the structure's serviceability, durability and reliability throughout its entire life.

Resulting from the interests of authors on sustainable construction, several approaches to its implementation have been researched upon. While some researches on sustainable construction focus on alternative sustainable materials such as Expanded Polyesterene (EPS) or plastic bottles (such as Sajane et al., 2017; Shoubi et al., 2013; and also Kapoor et al., 2012), others focus on energy and water efficiency of buildings (such as Piper, 2017; and also Harun & Ghafar, 2003). Also, while some researches approach sustainable construction relative to space management (such as Steiner, 2005), others take a material waste minimization approach (such as Formoso et al., 2002). Irrespective of the approach however, Practical Recommendations for Sustainable Construction PRESCO (2018) stresses that sustainable construction should be generic and not context specific whereby they proposed that sustainable construction be approached as a closed loop process as is depicted in Figure 1.

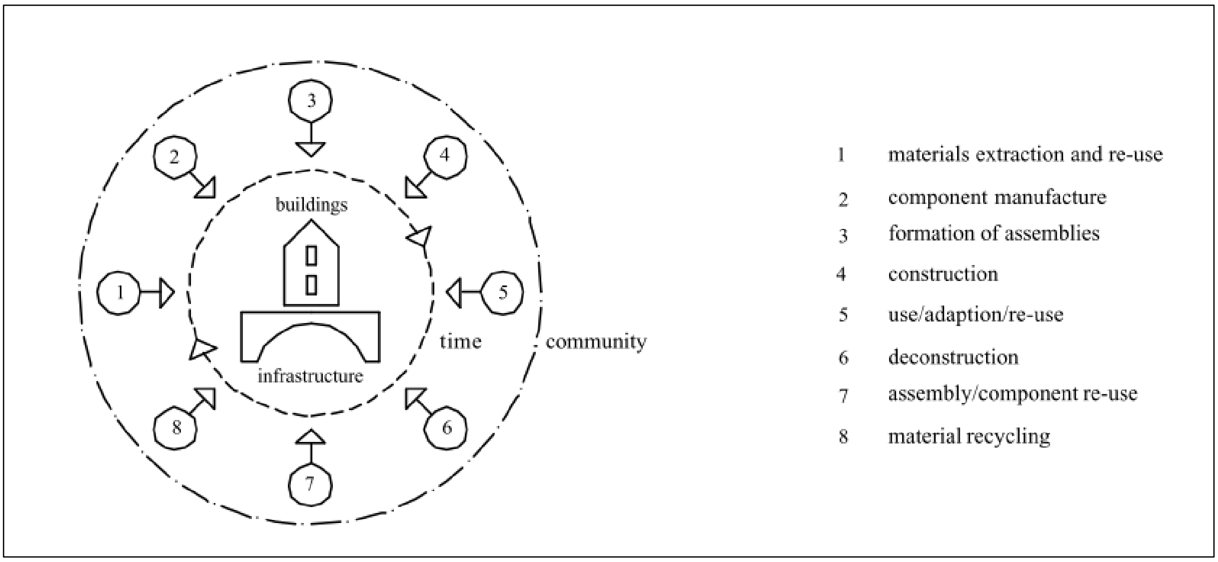

Figure 1: Closed loop Paradigm for Sustainable Construction (Practical Recommendations for Sustainable Construction PRESCO, 2018)

From this illustration, the approach to resources used in construction are in a continual cycle of extraction, production, recovery and recycle. Although this model of sustainable construction could have universal application, its adoption particularly in developing counrties is timely due to the scarcity of resources relative to the wide infrastructural gap which calls for sustainable construction practice.

2.2 Material sourcing for sustainable construction

Similar to manufacturing and other production processes, construction involves the use of numerous materials to produce a product. Unlike other production/manufacturing projects however, construction projects are characterized by longer duration and variable scope thereby, materials to be used are subject to variations and fluctuations. Planning for material sourcing in a construction project as such, should have an optimal strategy (Said & El-rayes, 2011). Whatever strategy adopted must consider obtaining information on the demand and supply of the material to source.

In certain cases, sourcing materials to use in a construction project involves taking certain decisions usually guided by certain influential factors. In the material sourcing process, these influential factors are key to getting the optimal value of materials to use for any construction project. According to Kasim (2008), purchasing materials from the best source, at the right price and with timely delivery is key to successful construction project delivery. In other words, making the right material sourcing decision has a significant role to play in achieving the desired quality, optimizing cost and timely completion of any construction project. Several authors have identified influential factors driving material sourcing in construction projects. Table 1 is a summary of the influential factors.

Table 1: Influential Factors Driving Mateiral Sourcing in Construction Projects

S/No	Factor	Authors
1	Locally sourced	EPS-Industry-Alliance (2017); Samuel & Eziyi (2014); Slater, Heath, Peng, Dan, & Choi (2012); King (2012); Susan (2010)
2	Compliance of material to statutory regulations and laws	Frazier et al. (2018); Sim & Puthena (2015); Rawat & Kansal (2014); Paolella & Grifoni (2013); University of Maryland (2009),
3	Incentive in the use of sustainable material	OAS Cataloging-in-Publication Data (2016); Karki (2013); Paolella & Grifoni (2013); Al-Hajj & Hamani (2011); Hussin (2006)
4	Sustainable market of a material	University of Nebraska (2011); Nazali & Pitt (2009)
5	Available specialist skills to use sustainable material for construction	Bilau, Witt, & Lill (2015); Kasim (2007)
6	Potential of being recycled	Suleiman (2018); Greene (2014); Briga-Sá et al. (2013); Kapoor et al. (2012); Samper, Garcia-Sanoguera, Parres, & López (2010); Ofori (2001)
7	Environmental Impact	Niranjan, Rushikesh, Sahil, & Omkar (2018); Nishad, Parthe, Rathod, Yadav, & Neha (2018); Shoubi et al. (2013); Slater et al., (2012); Smriti (2010); Samper et al. (2010); Li, Chen, Yong, & Kong (2005); Graettinger, Johnson, Sunkari, Duke, & Effinger (2005), Formoso et al. (2002); Faniran & G. (1998)
8	Material Quality	Daramola, Oni, Ogundele, & Adesanya (2016); Elkhalifa (2015); Hassan & Harun (2013); Shoubi et al. (2013); Raghuchandra, Vatsalya, Dutta, & Bhanuprakash (2004)

It is important to state that these influential factors are not exhaustive. Equally, it is worthy to note that the extent to which each of these influential factor impact sustainable construction varies across researches of the different authors.

3.0 METHODOLOGY

Primary data for this study is collected using a survey technique. The data collection instrument is a structured questionnaire developed specifically for this study based on influential factors deemed to being drivers of sustainable construction obtained from previous studies (presented in Table 1). The questionnaire consists of two sections. The first section sought to fetch data on the demographics of the respondents. While the second section sought to fetch data by means of guaging the frequency to which respondents believe each influential factor is a driver of sustainable construction. Questions of the second section of the questionnaire is designed to be answerd on a 5-point Likert-type response scale with ratings as follows: Always (5); Often (4); Sometimes (3); Rarely (2); and Never (1). This 5-point Likert-type response scale is recommended for use by: John & Itodo (2013); Brown (2010); Field (2009); Saunders, Lewis, & Thornhill (2009); and also Xie, Thorpe, & Baldwin (2000).

Purposive sampling is used in selecting the respondents. The choice of such non-probability sampling is informed by the claim of Cohen, Manion, & Morrison (2007) that it is employed when a sample is selected for a specific purpose or need. Similarly, Kumar (2011), Saunders et al. (2009), Lavrakas (2008) and also Kothari (2004) all report that a researcher can use this technique if selection is based on likely people who can provide the required information (or have expert knowledge) to achieve the objectives of a study. Likewise, Saunders, Lewis, & Thornhill (2009) recommend purposive sampling when a researcher wish to select respondents that are particularly informative in fulfilling the research objectives. Since this research covers those who have experience on sustainable construction practices, 61 postgraduate students enrolled in Masters in Facilities Management and also Post graduate Diploma in Building in the Department of Building Ahamdu Bello Univeristy Zaria Nigeria constitute the respondents for this study. The choice of selecting these PG students is based on the premise that they either offer courses covering aspects of sustainable construction or have experience in sustainable construction practices.

The tool for data analysis is IBM SPSS Statistics 23. The procedure for data analysis is both descriptive (using frequency and Mean Score) and inferential (by relating and comparing ratings of the influential factors studied). This Mean Score is computed using the equation obtained from researches of John & Itodo (2013), Samuel & Eziyi (2014), Chan & Hou (2015) and also Ejohwomu et al. (2017) whereby they express it as:

$$\overline{X} = \frac{\sum X_i}{n}$$

whereby: $\overline{X}$ denotes the Mean Score
$\sum X_i$ is the sum of the number of responses and score awarded a variable (V_i; for $5 \geq V_i \geq 1$)
n denotes the total number of responses

Additionally, MS Excel is used to compute the Relative Index (RI) which serves as a basis to rank the frequency to which respondents believe each influential factor is a driver of sustainable construction. The suitability in using RI on frequency is obtained from the works of (Holt, 2014) as well as (Joshi, Kale, Chandel, & Pal, 2015) where they express RI as:

$$RI = \frac{1n_1 + 2n_2 + \ldots.\ An_A}{AN} \quad (0 \leq RSI \leq 1)$$

Where:

$n_1, n_2, \ldots, n_A$ = number of respondents scoring response stem integers 1 to Amax (5), respectively.
A = largest integer on the response item (5 for this research)
N= total number of respondents

The Mean Score obtained is used as a basis to ascertain where each driver of sustainable construction practice leans towards on the 5 point scale used. Furthermore, the proportion of the respondent scoring above or below the median value is computed. Such analysis helps in drawing inferences from the scoring profiles for each frequency to which respondents believe each influential factor is a driver of sustainable construction (refer to Holt, 2014; Joshi, Kale, Chandel, & Pal, 2015; Bishop & Herron, 2015; Carifio & Perla, 2007; and Harpe, 2015).

4.0 RESULTS

Out of the 61 questionnaires distributed and retrieved, a total of 49 questionnaires were retrieved. However, only 48 questionnaires had complete data suitable for analysis. The results of the demographics for this study are presented in Table 2. The proportion of the respondents are: Architects, 13; Builders, 14; Civil Engineers, 8; Quantity Surveyors, 11; and other professionals, 2. While over 68.75 percent of the respondents have working experience of over 5 years and more, 31.25 percent have working experience of 5 years and below. Similarly the proportion of the highest academic qualification of the respondents are: HND, 21 respondents; B. Sc., 21 respondents; and PGD, 6 respondents. Also, the first source of awareness on sustainable construction in descending order are: seminars/workshops/classes, 17 respondents; personal research, 15 respondents; media (social, print among others), 8 respondents; co-workers/colleagues, 7 respondents; and client, 1 respondent.

Table 2: Demographics of Respondents

Demography	Number of respondents	Percentage
Profession of respondents		
Architect	13	27.08
Builder	14	29.17
Civil Engineer	8	16.67
Quantity Surveyor	11	22.92
Other professionals	2	4.12
Total	**48**	**100**
Working Experience (years)		
0-5	15	31.25
6-10	15	31.25
11-15	12	25
16 years and above	6	12.50
Total	**48**	**100**
Highest educational qualification		
HND	21	43.75
B.Sc	21	43.75
PGD	6	12.50
Total	**48**	**100**
First source of awareness on sustainable construction		
Personal research	15	31.25
Seminars/workshops/classes	17	35.42
Media (social, print among others)	8	16.67
Co-workers/colleagues	7	14.58
Client	1	2.08
Total	**48**	**100**

Table 3 depicts the results of the 8 drivers of sustainable construction studied. While Environmental Impact ranked 1st (with a Mean Value of 4.54; RI of 0.91), 'material quality' ranked 2nd (with a Mean Value of 4.19; RI of 0.84). Also, while 'potential of being recycled' ranked 3rd (with a Mean Value of 4.08; RI of 0.82), 'locally sourced' ranked 4th (with a Mean Value of 3.96; RI of 0.79). Furthermore, while 'compliance of material to statutory regulations and laws' ranked 5th (with a Mean Value of 3.90; RI of 0.78), 'sustainable market of a material' ranked 6th (with a Mean Value of 3.71; RI of 0.74). Also, while 'available specialist skills to use sustainable material for construction' ranked 7th (with a Mean Value of 3.67; RI of 0.73), 'incentive in the use of sustainable material' ranked 8th (with a Mean Value of 3.50; RI of 0.70).

Table 3: Results of the Frequency of Influential Factors Driving Material Sourcing

Influential factors	Frequency of responses					Total	Scores below median	Scores above median	Mean Score	RI	Rank
	5 A	4 O	3 S	2 R	1 N						
Environmental Impact	28	18	2	0	0	48	0	46	4.54	0.91	1st
Material quality	18	21	9	0	0	48	0	39	4.19	0.84	2nd
Potential of being recycled	20	17	6	5	0	48	5	37	4.08	0.82	3rd
Locally sourced	19	13	11	5	0	48	5	32	3.96	0.79	4th
Compliance of material to statutory regulations and laws	14	20	10	3	1	48	4	34	3.90	0.78	5th
Sustainable market of a material	12	13	20	3	0	48	3	25	3.71	0.74	6th
Available specialist skills to use sustainable material for construction	15	13	10	9	1	48	10	28	3.67	0.73	7th
Incentive in the use of sustainable material	10	13	17	7	1	48	8	23	3.50	0.70	8th

Legend: 5- Always, 4- Often, 3- Sometimes, 2- Rarely, 1- Never

Results of scores below and above the median also show that among all influential factors studied, there exist one respondent each that believe 'compliance of material to statutory regulations and laws', 'available specialist skills to use material for construction' and also 'incentive in the use of sustainable material' all have likelihood of not driving material sourcing. Additionally, results of the Mean Score show that on the average, 'environmental impact' is an influential factor that has very high likelihood to 'always' driving material sourcing for sustainable construction. Furthermore, all other influential factors studied have a high likelihood to 'often' drive material sourcing for sustainable construction.

5.0 FINDINGS, CONCLUSION AND RECOMMENDATIONS

This study found that almost all the respondents believe that all the influential factors studied drive sustainable construction. This is encouraging considering 87. 50 percent (over three-quarter) of the respondents are barely halfway into their carrier implying that they have more decades to practice and contribute to sustainable construction. This is equally encouraging considering 47.92 percent (almost half) of the respondents gained awareness of sustainable construction on their personal efforts. This study found that while 'environmental impact' and 'material quality' are the most influential factors always driving material sourcing in sustainable construction, instances prevail whereby 'compliance to statutory regulations and laws', 'available specialist skills to use material for sustainable construction' and also 'incentive in the use of sustainable material' never drive material sourcing in sustainable construction. It may be concluded that professionals in the construction industry rely on various influential factors to drive their decisión on material sourcing in sustainable construction. There is need to invest more efforts on enforcing material compliance to regulations, developing skills to use material for sustainable construction and provide more incentives in the use of sustainable materials. It is worthy to state that the influential factors covered in this study deemed to be drivers of material sourcing for sustainable construction practices are by no means exhaustive. Future studies can cover influential factors speciafically categorised according to the three dominant pillars of sustainable practice which are social, economic and environmental. Also, more indepth relationships between and among the influential factors may be explored. Similarly, rather than studying employees that are predominantly graduates, a study of a mixture of employees with formal, semi-formal and no formal educational qualification may reveal interesting results on diversity in construction projects. This is importnat considering the fact that a large number of the workforce in construction projects have semi-formal or no formal educational qualification.

REFERENCES

Al-Hajj, A., & Hamani, K. (2011). Material Waste in the UAE Construction Industry : Main Causes and Minimization Practices. *Architectural Engineering and Design Management*, 1–15.

Bilau, A. A., Witt, E., & Lill, I. (2015). A Framework for Managing Post-Disaster Housing Reconstruction. *Procedia Economics and Finance*, *21*, 313–320.

Bishop, P. A., & Herron, R. L. (2015). Use and Misuse of the Likert Item Responses and Other Ordinal Measures. *International Journal of Exercise Science*, *8*(3), 297–302.

Briga-Sá, A., Nascimento, D., Teixeira, N., Pinto, J., Caldeira, F., Varum, H., & Paiva, A. (2013). Textile Waste as an Alternative Thermal Insulation Building Material Solution. *Construction and Building Materials*, *38*, 155–160.

Brown, S. (2010). *Likert Scale Examples for Surveys*. Iowa USA.

Carifio, J., & Perla, J. R. (2007). Ten Common Misunderstandings , Misconceptions , Persistent Myths and Urban Legends about Likert Scales and Likert Response Formats and their Antidotes. *Journal of Social Sciences*, *3*(3), 106–116.

Chan, E. H. W., & Hou, J. (2015). Developing a Framework to Appraise the Critical Success Factors of Transfer Development Rights (TDRs) for Built Heritage Conservation. *Habitat International*, *46*, 35–43.

Cohen, L., Manion, L., & Morrison, K. R. B. (2007). *Research Methods in Education* (6th ed.). New York: Routledge.

Daramola, Y. A., Oni, O. T., Ogundele, O., & Adesanya, A. (2016). Adaptive Capacity and Coping Response Strategies to Natural Disasters : A Study in Nigeria. *International Journal of Disaster Risk Reduction*, *15*, 132–147.

Ede, A. N., Alegiuno, V., & Aawoyera, O. P. (2014). Use of Advanced Plastic Materials in Nigeria: Performance Assessment of Expanded Polystyrene Building Technology System. *American Journal of Engineering Research*, *3*(4), 17–23.

Ejohwomu, A. O., Oshodieen, O., & Lam, K. C. (2017). Nigeria's Construction Industry: Barriers to Effective Communication. *Engineering, Construction and Architectural Management*, *24*(4), 652–667. http://doi.org/10.1108/ECAM-01-2016-0003

Elkhalifa, A. (2015). The Magnitude of Barriers Facing the Development of the Construction and Building Materials Industries in Developing Countries, with Special Reference to Sudan in Africa. *Habitat International*, 1–10.

EPS-Industry-Alliance. (2017). *Expanded Polystyrene Insulation*. Retrieved from https://www.insulfoam.com/wp-content/uploads/2016/08/EPS-Insulation-EPD.pdf

Faniran, O. O., & G., C. (1998). Minimizing Waste on Construction Project Sites. *Engineering, Construction and Architectural Managem*, *5*(2), 182–188.

Field, A. (2009). *Discovering Statistics Using SPSS* (3rd ed.). London: SAGE Publications Inc.

Formoso, C., Soibelman, L. M., Cesare, D. C., & Isatto, E. L. (2002). Material Waste in Building Industry : Main Causes and Prevention. *Journal of Construction Engineering and Management*, *128*(4), 316–325.

Frazier, C., County, C., Commissioners, C., Council, E. A., County, C., Eac, T., … Kao, E. (2018). *Expanded Polystyrene (EPS) Reduction in Carroll County: Single-Use Food Service Ware and Loose Fill Packaging Products*. Retrieved from http://www.intcorecycling.com/take-out-

Graettinger, A. J., Johnson, P. W., Sunkari, P., Duke, M. C., & Effinger, J. (2005). Recycling of Plastic Bottles for use as a Lightweight Geotechnical Material. *Management of Environmental Quality: An International JournaL*, *16*(6), 658–669.

Greene, P. J. (2014). *Sustainable Plastics: Environmental Assessments of Biobased, Biodegradable and Recycled Plastics*. New Jersey: JohnWiley & Sons, Inc.

Harpe, S. E. (2015). How to Analyze Likert and other Rating Scale Data. *Currents in Pharmacy Teaching and Learning*, *7*, 836–850.

Harun, S. N., & Ghafar, A. (2003). The restoration of Suffolk House, Penang, Malaysia. In *The XIX International Symposium, The Perspectives to Save Cultural Heritage* (pp. 109–112). Antalya, Tukey.

Hassan, Z., & Harun, S. N. (2013). Preservation of Malay Singgora Roof. *Procedia Environmental Sciences*, *17*, 729–738.

Holt, D. G. (2014). Asking Questions , Analysing Answers : Relative Importance Revisited. *Construction Innovation*, *14*(1), 2–16.

Hussin, R. (2006). *Ecotourism Development and Local Community Participation: Case Studies of Batu Puteh and Sukau Village Area of Sabah, Malaysia*. University of Glasgow UK.

Ibrahim, D., Bankole, O. C., Ma'aji, S. A., Ohize, E. J., & Abdul, B. K. (2013). Assessment Of The Strength Properties Of Polystyrene Material Used In Building Construction In Mbora District Of Abuja,Nigeria. *International Journal of Engineering Research and Development*, *6*(12), 80–84.

John, A. O., & Itodo, D. E. (2013). Professionals ' Views of Material Wastage on Construction Sites and Cost Overruns. *Organizat Ion, Technology and Management in Construction · An International Journal*, *5*(1), 747–757.

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Likert Scale: Explored and Explained. *British Journal of Applied Science & Technology*, *7*(4), 369–403.

Kapoor, A., Jena, A., & Govil, K. (2012). *Minimising Plastic Waste by Embedding them into Building Brick Form*.

Karki, T. S. (2013). Do Protected Areas and Conservation Incentives Contribute to Sustainable Livelihoods? A Case Study of Bardia National Park, Nepal. *Journal of Environmental Management*, *128*, 988–999.

Kasim, N. B. (2008). *Improving Materials Management on Construction Projects*. Loughborough.

Kasim, R. (2007). *Identifying Skills Needs for Improving the Engagement of the Communities in the Housing Market Renewal Process: A Case Study of Neighbourhood Facilities in Northwest England*. University of Salford, U.K.

King, V. T. (2012). UNESCO in Melaka: Cultural Politics, Identities and Tourism in a World Heritage Site. *Leeds East Asia Papers*, *4*, 1–50.

Kothari, C. R. (2004). *Research Methodology: Methods and Techniques* (2nd ed.). New Delhi: New Age International (P) Ltd.

Kumar, R. (2011). *Research Methodology: A Step by Step Guide* (3rd ed.). London: SAGE Publications Inc.

Lavrakas, J. P. (2008). *Encyclopedia of Survey Research Methods* (1 and 2). California: SAGE Publications Inc.

Li, H., Chen, Z., Yong, L., & Kong, S. C. W. (2005). Application of Integrated GPS and GIS Technology for Reducing Construction Waste and Improving Construction Efficiency. *Automation in Construction*, *14*, 323–331.

Mansir, D., Gambo, M. M., Yar'adua, H. F., & Abduljabbar, F. K. (2019). Factors Affecting the use of Expanded Polystyrene (EPS) for Sustainable Housing Construction in Nigeria. In *10th West African Built Environment Research Conference (WABER) Conference* (pp. 590–600). Accra Ghana.

Nazali, M. N. M., & Pitt, M. (2009). The Application of Supply Chain Management and Collaborative Innovation in the Delivery of Facilities Management Services. *Journal of Facilities Management*, *7*(4), 283–297.

Niranjan, D., Rushikesh, P., Sahil, J., & Omkar, P. (2018). Plastic Bottles Used in Construction. *International Journal of Advance Engineering and Research*, *5*(4), 1–4.

Nishad, S., Parthe, V., Rathod, S., Yadav, V., & Neha, P. (2018). Eco-Friendly House Construction using Pet Bottles, *6*(3), 101–103.

OAS Cataloging-in-Publication Data. (2016). *Sustainable Alternatives Packaging to Replace the Expanded Polystyrene Foam Containers Produced in Trinidad and Tobago* (Vol. 17).

Ofori, G. (2001). *Challenges of Construction Industries in Developing Countries : Lessons from Various Countries*.

Ofori, G., & Toor, S.-R. (2012). Leadership and Construction Industry Development in Developing Countries. *Journal of Construction in Developing Countries, 1*(1), 1–21.

Paolella, A., & Grifoni, R. C. (2013). *The Use of Expanded Polystyrene in Construction: Critical Reflections on an Environmentally Harmful Material*.

Piper, J. (2017). *Handbook of Facility Assessment*. *Handbook of Facility Assessment*. http://doi.org/10.4324/9780203913727

Practical Recommendations for Sustainable Construction PRESCO. (2018). *Recent Advances in Energy Codes in Russia and Kazakhstan. Harmonization of Codes with European Standards*. Belgium.

Raghuchandra, G., Vatsalya, C., Dutta, U. B., & Bhanuprakash, T. S. (2004). *Investigating the Application of Plastic Bottle as a Sustainable Material in Building Construction*.

Rawat, S. A., & Kansal, R. (2014). PET Bottles as Sustainable Building Material: A Step Towards Green Building Construction. *Journal of Civil Engineering and Environmental Technology*, *1*(6), 1–3.

Said, H., & El-rayes, K. (2011). Optimizing Material Procurement and Storage on Construction Sites Optimizing Material Procurement and Storage on Construction Sites. *Journal of Construction Engineering and Management*, *137*, 421–431.

Sajane, A. S., Agam, S. E., Patil, R. R., Shirgave, A. A., & Pituk, S. Y. (2017). Construction of Houses using Plastic Bottles. *International Journal of Engineering Technology Science and Research*, *4*(4), 99–104.

Samper, M. D., Garcia-Sanoguera, D., Parres, F., & López, J. (2010). Recycling of expanded polystyrene from packaging. *Progress in Rubber, Plastics and Recycling Technology*, *26*(2), 83–92. http://doi.org/10.1177/147776061002600202

Samuel, L., & Eziyi, O. I. (2014). Proceedings of the 8th CIDB Postgraduate Conference. In *Advancing Construction Industry Development through Innovative Research and New Thinking*. Johannesburg, South Africa: University of the Wiwatersrand, Johannesburg, South Africa.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students* (5th ed.). England: Pearson Education Limited.

Shoubi, M. V., Shoubi, M. V., & Barough, A. S. (2013). Investigating the Application of Plastic Bottle as a Sustainable Material in the Building Construction, *2*(1), 28–34.

Sim, L. Y., & Puthena, F. (2015). Green Building Technology Initiatives to Achieve Construction Quality and Environmental Sustainability in the Construction Industry in Malaysia. *Sim, Liang Yeong Putuhena, Frederic*, *26*(2).

Slater, J., Heath, L., Peng, O., Dan, H., & Choi, N. (2012). *Plastic Bottle Bricks: A Report Documenting our Findings in Relation to Waste Management in Anh Minh District of Vietnam*. University of Western Australia.

Smriti, S. (2010). Bottle Bricks and the Esthetics of Beauty. *Pool Magazine*, 50–54.

Steiner, J. (2005). The Art of Space Management: Planning Flexible Workspaces for People. *Journal of Facilities Management*, *4*(1), 6–22.

Suleiman, M. G. (2018). *Investigating the use of Plastic Bottles as Recycle Material For Construction of Sustainable Buildings in Nigeria*. Zaria.

Susan, E. J. D. (2010). *Sustainable Heritage Management Practices at Visited Heritage Sites in Devon and Cornwall*. University of Plymouth United Kingdom.

University of Maryland. Facility Standards Manual (2009).

University of Nebraska. (2011). *Design Guidelines for Facilities Construction*. Lincoln.

Xia, B., Olanipekun, A., Chen, Q., Xie, L., & Liu, Y. (2018). Conceptualising the State of the Art of Corporate Social Responsibility (CSR) in the Construction Industry and its Nexus to Sustainable Development. *Journal of Cleaner Production*. Retrieved from https://doi.org/10.1016/j.jclepro.2018.05.157

Xie, X., Thorpe, T., & Baldwin, A. (2000). A Survey of Communication Issues in Construction Design. In

Association of Researchers in Construction Management (Vol. 2, pp. 771–780). Glasgow: Glasgow Caledonian University.