Material Wastage in Construction Projects: Factors Causing Material Wastage on Construction Project delivery in Benin City, Edo state[1]

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Abstract

Material wastage remains a persistent challenge affecting construction efficiency in developing cities. This study investigates the major causes of material wastage on construction sites, identifying design changes, poor storage, inaccurate estimation, procurement inefficiencies, and inadequate supervision as dominant factors. Using survey responses from construction professionals, the research establishes that wastage originates from both managerial and operational failures. The study recommends integrated material management systems and improved site coordination to minimize losses.

Keywords: Material wastage, construction management, estimation accuracy, site supervision, procurement.

1. Introduction

Construction waste is the solid waste that arises from construction, renovation and demolition activities. The construction industry plays a vital role in meeting the needs of society and enhancing quality life. The construction industry contributes to the socioeconomic growth of any nation by improving the quality of life and providing the infrastructure such as roads, hospital, schools and other basic facilities. Hence, it is imperative that construction projects are completed within the scheduled period of time, within the budgeted cost and meets the anticipated quality. However, being a complex industry, it is faced with the severe problem of cost overruns, time overrun, and construction waste (Elikeem, Anglamgne & Ahuma-Smith, 2018).

Construction waste normally constitute large portion of total solid waste that contribute to degradation of the environment (Lu et al. 2018). Construction waste management is often at the top of government agenda. It is also major theme as stipulated in the global green building movement. Material management in construction project is an important function that significantly contributes to the success of a project. Poor management of materials on site during

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construction process will influence the total project cost, time and quality.. Material wastage is one of the major causes of contractor's business failure in developing countries (Andualem& Aklilu, 2019). The reduction in construction material waste can significantly help in gaining total profit and gaining economic stability for a country and construction firms. Project managers and construction staff usually find it difficult identifying the causes of material waste due to the absence of appropriate tools to measure it (Ibrahim & Winston 2019). Construction site and staff can reduce the material waste with efficient management (Adewuyi & Otali, 2019). The reduction in construction waste can significantly help in increasing total profit and gaining economic stability for a country and construction firms. Wastage of construction is much greater than the minor figures assumed by the companies while estimating cost of the project (Elikem, Anglamgne & Ahuma-Smith, 2018). So, material management is a vital function for improving productivity in construction projects. The management of materials should be considered at all phases of the construction process and throughout the construction and production periods.

There are many ways through which causes of wastage can be identified in construction. Waste can be categorized according to its source. Waste may result from process preceding construction, such as material manufacturing, design and material supply, and planning as well as the construction stage. Wastage in construction site is often due to inadequate storage and protection, poor or multiple handling, poor site control, over ordering of materials, bad stock control, lack of training, and damage of material during delivery. Most researchers categorized these causes into four categories (Adewuyi &Otali, 2019), procurement, handling, operation and culture ; while another researcher (Andualem& Aklilu, 2019) grouped factors generating material wastage into design, procurement, handling of material, and operation.

2. Literature Review

Material waste often referred to as construction demolition waste encompasses discarded building materials generated during construction, renovation, alteration, repair and demolition activities .it involves materials such as ;concrete, brick, steel, timber, plastic, excavated soil as well as potential harmful materials also these material waste arise from design inefficiencies, procurement error, poor handling of material, poor storage of this materials than eliminating waste through reducing, reusing, and recycling.

Construction material waste occurs throughout the lifecycle of a building, from the design phase down to the completion stage. Ghaleb et al (2021) stated that poor design models and decision are among the main factors that make the design phase responsible for early waste in construction materials.

Table 2.1 presents a detailed set of factors responsible for material wastage, and a closer discussion of these factors reveals that waste arises from a combination of design-related problems, procurement shortcomings, site operational weaknesses, labour inefficiencies, and environmental constraints. One of the earliest sources of waste is design changes, which occur when the original design is altered after construction has commenced. As indicated in the table, such changes often force demolition or adjustment of existing work, leading to damaged or discarded materials (Osmani et al., 2008). Because revised designs usually require new dimensions or specifications,

materials already procured or installed become unusable, confirming earlier findings that design-stage decisions strongly influence waste generation.

Table 2.1 Causes of Material Wastage in Benin City, Edo State.

Factors	Description	Citations
Design changes	Alterations to original design often leads to demolition work	Osmani et(2008)
Poor Material Storage	Inadequate storage leads to material storage deterioration or theft	Ekanayake an (2002)
Inaccurate Estimation	Over- ordering or under-ordering due to quantity take off	Al-Hajj and Hamani (1991)
Inefficient Procurement	Delays or wrong deliveries result in damage or spoilage of materials	Tam et al.(2007)
Lack of Skilled Labor	Poor workmanship often leads to breakage and incorrect usage of materials	Formoso et al(2002)
Poor Site Management	Ineffective site control leads to disorganization	Nagapan et al(2012)
Excessive Handling	Multiple handling increases chances damage and loss	Poon et al (2004)
Weather Conditions	Rain, wind, and sun can damage improperly protected materials	Kibert (2004)
Vandalism and Theft	Unsecured site leads to stolen or vandalized materials	Kaartam et al (2008)

The table further highlights poor material storage as a major contributor to wastage. When materials are exposed to moisture, sunlight, or ground contact due to inadequate storage structures, deterioration occurs rapidly. Cement becomes lumpy, timber warps, steel rusts, and finishing materials lose quality. This challenge is widely acknowledged, and Ekanayake and Ofori (2002) similarly observed that improper storage practices in developing countries lead to substantial material loss long before installation. Poor storage conditions also make materials vulnerable to theft and vandalism, increasing both direct waste and replacement cost.

Another important factor is inaccurate estimation, where errors in quantity take-off lead to either surplus or insufficient material. Over-estimation results in excess materials that often remain unused and eventually become waste, while under-estimation disrupts workflow and forces

unplanned procurement, which increases the likelihood of spoilage or damage. This aligns with the earlier findings of Al-Hajj and Hamani (1991), who argued that inaccurate estimating practices are a recurring cause of material waste in the construction industry.

Procurement issues also contribute significantly to wastage. The table identifies inefficient procurement**,** where delays, wrong deliveries, or poor scheduling undermine efficient material utilization. Such inefficiencies force materials to sit idle for long periods, expose them to damage, or necessitate last-minute adjustments that compromise handling and storage. Tam et al. (2007) emphasized that procurement-related problems often trigger a chain reaction of rework, material damage, and mismanagement, all of which raise waste levels on construction sites.

Labour-related factors appear prominently as well. The table shows that labour directly influences waste through poor workmanship, inaccurate material cutting, lack of skilled labour, incorrect mixing ratios, and careless handling. Formoso et al. (2002) also noted that labour inefficiency is one of the leading causes of rework-related waste, particularly in concreting, block work, and finishing activities. Beyond lack of skills, human negligence such as mishandling materials, ignoring storage instructions, or rushing tasks further contributes to waste, underscoring the need for training and behavioral supervision.

Weak managerial structures also play a significant role. Poor site management highlighted in the table, results in disorganized storage, uncontrolled material movement, absence of inventory systems, and poor housekeeping. These conditions increase material breakage, loss, contamination, and repeated handling. Nagapan et al. (2012) confirmed that inadequate site control is among the most persistent root causes of construction waste. Related to this is excessive handling, which arises when materials are moved repeatedly due to poor layout planning. Every additional movement increases the risk of breakage, especially for tiles, bricks, glass, and plasterboards a relationship documented by Poon et al. (2004).

Environmental exposure is another significant factor. The table identifies weather conditions as a cause of waste, and this is consistent with Kibert (2004), who explained that rain, wind, and sunlight significantly damage unprotected materials. For instance, rain affects cement and gypsum products, sunlight warps timber, and wind scatters lightweight materials or contaminates sand and aggregates. Sites without adequate shelters are therefore more vulnerable to weather-induced loss.

Security concerns also contribute to material wastage. Vandalism and theft, as included in the table, occur frequently on sites that lack proper fencing, lighting, or surveillance. Kartam et al. (2008) argued that theft-related waste is particularly acute in developing regions, where high-value items such as steel reinforcement, cement, and electrical fittings are commonly targeted. Vandalized materials also create additional waste because damaged elements must be repaired or replaced.

The table also lists improper mixing of materials especially concrete, mortar, and plaster as a notable cause of waste. Incorrect batching, whether due to lack of supervision or inadequate training, leads to compromised strength and performance. Materials produced under such conditions are typically rejected and demolished, resulting in double consumption of aggregates,

cement, and labor. This issue reflects concerns raised by Formoso et al. (2002), who identified improper mixing as a major operational source of waste.

Finally, the table emphasizes the importance of effective communication and adequate supervision. Ineffective communication among designers, supervisors, and artisans leads to misinterpretation of drawings, installation errors, and procurement mistakes. Tam et al. (2007) observed that communication failures are a significant driver of rework, which in turn generates material waste. Inadequate supervision allows errors to go unchecked, material misuse to occur unnoticed, and poor practices to continue, ultimately increasing waste levels.

In summary, the causes of material wastage identified in table2.1reveal that waste is not caused by a single factor but by a combination of human errors, managerial shortcomings, technical inefficiencies, environmental exposure, and design-related issues. These causes interact in ways that amplify waste, reinforcing the need for coordinated site management, clear communication, skilled labor, and proper procurement and storage practices if waste is to be minimized.

3. Results And Discussion Of Findings

Demographic Characteristics of respondents

This presents and analyses the data obtained from respondents using structured questionnaires administered across construction stakeholders in Benin City, Edo State. The analysis covers the demographic distribution of respondents and causes of material wastage.

Table 3.1 Demographic Characteristics of Respondents.

Category		**Frequency**	**Percentage (%)**
Highest Educational Qualification	B.Sc / B.Tech	53	26.50
	Ph.D	19	9.50
	HND	42	21.00
	MSC	36	18.00
	OND	50	25.00
	Total	**200**	**100.00**
Professional Role in Construction Industry	Architect	45	22.50
	Builders	67	33.50
	Civil Engineers	41	20.50
	Quantity Surveyor	47	23.50
	Total	**200**	**100.00**
Years of Work Experience in The Construction Industry	Less than 5 years	67	33.50
	5-10 years	38	19.00
	11-15 years	32	16.00
	16-20 years	29	14.50
	Over 20 years	34	17.00
	Total	**200**	**100.00**
Professional Affiliation	MNIA	45	22.50
	MNIQS	47	23.50
	MNSE	41	20.50
	MNOB	67	33.50
	Total	**200**	**100.00**

Majority of the respondent does possess B.Sc/ B.Tech (26.5%), OND (25%), and HND (21%), indicating technically competent respondent base. A good portion also possess higher degrees, showing in-depth industry knowledge needed for reliable evaluation in terms of professional roles, the distribution was fairly balanced across major construction disciplines. Builders (33.5%)

constituted the largest group, followed by Quantity Surveyors (23.5%), Architects(22.5%), and Civil Engineers (20.5%). This wide representation ensures that the findings reflect perspectives from different fields involved in construction project delivery.

Table 3.2 Causes of Material Wastage, in Benin City, Edo State.

Causes	MIS	SD	RANK
Delay in use of materials	3.99	1.182	1
Ineffective communication	3.96	1.134	2
Use of substandard materials	3.92	1.233	3
Human negligence	3.91	1.230	4
Improper mixing of materials	3.89	1.195	5
Inadequate supervision	3.86	1.244	6
Poor site management	3.31	1.393	7
Lack of skilled labor	3.30	1.382	8
Efficient procurement	3.23	1.461	9
Excessive handling	3.18	1.469	10
Accurate estimation	3.15	1.458	11
Poor material storage	3.14	1.428	12
Vandalism and theft	3.14	1.563	13
Design changes	3.12	1.488	14
Weather condition	3.12	1.550	15

The highest causes of material wastage identified include:

1. Delay in the use of materials (MIS = 3.99): When materials stay too long on-site, deterioration, theft, and spoilage increase, especially for cement, timber, and sandcrete blocks.
2. Ineffective communication (MIS=3.96): Poor coordination among project team members leads to wrong material delivery and rework, thereby increasing waste. Proposed by Tam et al (2007)
3. Use of substandard materials (MIS=3.92): Substandard materials often fail quality checks, necessitating rework and replacement.

4. Human negligence (MIS = 3.91): Carelessness, mishandling, and improper usage significantly contribute to wastage.

Factors ranked lowest such as excessive handling still contribute, but less significantly. These results confirm that management and human-related factors play the most significant roles in material wastage on construction sites in Benin City.

Discussion of Findings

The findings revealed that the major causes of material wastage on construction sites in Benin City include delay in the use if materials, ineffective communication, use of substandard materials, human negligence, improper mixing, and inadequate supervision. These results indicate that the dominant sources of waste are human and managerial in nature rather than technical constraints. This aligns with literature which identifies human related factors as the most significant contributors to construction waste generation. Osmani et al.(2008) reported that design changes and reworks resulting from human error significantly increase the volume of waste generated on construction projects, supporting the high ranking of negligence and poor super vision in this study.

Similarly, Ekanayake and Ofori (2002) highlighted that improper storage and material handling practices leads to deterioration and loss, which corresponds with respondents' emphasis on delayed usage and poor handling. Furthermore, Formoso et al. (2002) argued that lack of skilled labor result in material breakage and incorrect installation; consistent with the finding that workmanship- related issue is a major cause of waste. The study also agrees with Nagapan et al. (2012), who identified weak site management and supervision as core drivers of waste generation in developing countries. Therefore, the findings reinforce existing research that organizational inefficiencies and poor site practices remain the most critical factors contributing to material wastage.

4. Conclusion

Based on the findings, the study concludes that material wastage remains a major contributor to poor construction performance in Benin City. It leads to substantial financial losses, delays, and inefficiencies in project delivery. The study establishes that: Material wastage is predominantly caused by human and managerial lapses, including ineffective communication, negligence, inadequate supervision, and improper handling. Material wastage is largely preventable when proper planning, communication, and logistics systems are implemented early in projects.

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