

Barriers to Effective Construction Waste Reduction: A Study of Contractors in The Eastern Cape Province, South Africa

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Abstract

In the Eastern Cape Province, construction projects generate massive amounts of solid waste that pose a threat to environmental sustainability and resource efficiency. This study aims to identify the obstacles Eastern Cape Province contractors have in effectively cutting construction waste. The study employed a quantitative research approach, and a questionnaire survey was used to examine the challenges of minimising construction waste. Descriptive and inferential statistics were applied in data analysis. Principal factor analysis indicated that there are seven significant factors with eigenvalues greater than one that affect contractors' capacity to minimise waste: insufficient communication for waste reduction, poor access to recycling facilities, inappropriate on-site reusing of materials, no zero-waste philosophy, failure to identify near-on-site recycling facilities, inadequate waste management equipment, and inability to trace on-site-produced waste. The findings offer valuable insights into the challenges faced by contractors in the Eastern Cape in reducing construction waste. These findings will help industry professionals, policymakers, and contractors develop targeted solutions, design effective training programmes, and adopt best practices to promote sustainable construction, reduce waste, and lower costs. The primary aim of this research is to span the knowledge gap in understanding the waste minimisation problems faced by contractors in the Eastern Cape, a province with unique socioeconomic and infrastructure challenges.

Keywords: Construction waste, Waste reduction plans, Recycling facilities, Waste management, Sustainable procurement strategies.

1. Introduction

Construction has a significant detrimental impact on the environment due to building waste, despite being a significant contributor to economic expansion (Purchase *et al.*, 2021). Das *et al.* (2019) state that waste reduction in the construction industry has become a critical concern as attention shifts globally to sustainability. However, even with increased awareness and improved eco-friendly building practices, contractors face numerous challenges in controlling and reducing waste (Udawatta *et al.*, 2015). These barriers include insufficient facilities for accessing recyclables, financial matters, poorly implemented waste management systems, and inadequate training on sustainable practices for employees (Al-Otaibi *et al.*, 2022). In addition, inconsistent rules, variable recycling service charges, and client requests for cost reductions all make it more challenging to implement effective waste reduction plans (AlJaber *et al.*, 2023).

The problem, therefore, persists in that contractors face continuous barriers in reducing construction waste that is harmful not only to the environment but also to increased project costs and reduced opportunities for material recovery and recycling (Ajayi & Oyedele, 2018). Lack of awareness, inadequate infrastructure, and the need to weigh the long-term advantages of waste reduction against the immediate cost savings all

contribute to this problem (Hasmori *et al.*, 2020). It is for this reason that this study seeks to address the following research question:

What are the key barriers faced by contractors in the Eastern Cape Province in implementing effective construction waste reduction practices?

This study aims to fill a gap in the existing methods of waste management by determining the major barriers that contractors face in trying to minimise construction waste and by offering practical solutions to overcome such challenges. While sustainable building practices have been researched in the past, very little attention has been paid to the specific barriers contractors face in the full implementation of waste reduction measures (Adetooto *et al.*, 2024; Masia *et al.*, 2020). The study's analysis of these issues and identification of areas in urgent need of growth contribute to the growing body of research on sustainable construction techniques. The following sections include a literature review relevant to the study, the research methodology used in the study to meet the study objectives, the analysis and discussion of results, and the conclusions and recommendations.

2. Literature review

2.1. Construction waste management

Construction waste management is essential for promoting sustainable practices in the construction

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industry, focusing on minimising waste generation and maximising resource recovery. Key strategies include waste reduction, reuse, recycling, and proper disposal to mitigate environmental impact (Dosumu & Aigbavboa, 2019). According to Ajayi and Oyedele (2018), effective waste management not only reduces environmental harm but also lowers project costs by improving overall efficiency. However, Nyika *et al.* (2019) highlight that poor planning and insufficient stakeholder awareness exacerbate waste-related issues in South Africa's construction industry. These challenges underline the need for theoretical frameworks that guide more efficient and sustainable waste management practices.

2.2. Underpinning theories

To address the challenges of construction waste management, theoretical approaches such as lean construction and the circular economy offer valuable insights. The circular economy promotes the reuse and recycling of resources, creating closed-loop systems that minimise waste and maximise resource efficiency (Geissdoerfer *et al.*, 2017). In contrast, lean construction focuses on reducing material waste and optimising processes to enhance overall project efficiency (Al-Otaibi *et al.*, 2022). By integrating these theories, contractors can better understand how inefficiencies in the construction process and linear waste management strategies contribute to waste generation. These theoretical foundations provide a basis for improving design, material selection, and construction procedures, ultimately helping to reduce waste and promote more sustainable practices (Mbote *et al.*, 2016).

2.3. Barriers to construction waste reduction

The main challenges that Eastern Cape Province is facing in achieving effective reduction of construction wastes are a lack of clear goals about waste reduction, a lack of appropriate training, and a scarcity of recycling facilities (Godfrey & Oelofse, 2017). Major logistical issues which contractors often face in managing wastes include an inadequate infrastructure for segregating and recycling wastes and an inadequate storage area on site (Oelofse & Nahman, 2013). According to Wilson *et al.* (2017), financial obstacles also make it challenging to embrace waste reduction strategies, such as waste management systems and the purchase of sustainable materials, which are expensive endeavours. Godfrey and Oelofse (2017) add that effective waste management adoption is also hindered by behavioural and cultural factors such as disinformation and resistance to change.

2.4. Policy and legislative context

Construction waste management in South Africa is governed by the National Environmental Management Waste Act, No. 59 of 2008. This act emphasises

minimisation, reusing, and recycling. It provides the basis for effective, sustainable waste management and empowers the local authorities to enforce such in respect of waste management. However, most policies are not fully effective due to enforcement issues, lack of resources, and uncoordinated players (Nyika *et al.*, 2019). Nahman (2021) suggests incorporating clear guidelines for contractors, giving financial and technical support, and providing incentives for compliance.

2.5. Contractors' role in waste management

Contractors play a crucial role in waste management at construction sites since they are responsible for implementing waste reduction strategies at the sites. Ong and Pheng (2021) note that contractors contribute a great deal to waste generation and waste disposal in their decision-making on the procurement of materials, waste segregation, and optimisation of processes. Liu *et al.* (2020) emphasise that those contractors applying sustainable practices, including materials recycling and optimisation of construction methods, significantly contribute to waste reduction efforts. Alazmi *et al.* (2025) indicated that most of these strategies are limited in their real-world effectiveness by information gaps, competing priorities, and financial constraints. Kabirifar *et al.* (2020) demonstrated that contractors could be offered clear rules, financial incentives, and training to increase the sustainability of effective measures against waste management.

3. Research Methodology

3.1. Research design

This study employs a **quantitative research approach** using a structured survey questionnaire to examine barriers to construction waste reduction among contractors in the **Eastern Cape Province, South Africa**. The questionnaire was designed on a **five-point Likert scale** to capture contractor perceptions. **Descriptive statistics and Principal Factor Analysis (PFA)** were used to identify and categorise key barriers (Ravid, 2024; Sürücü *et al.*, 2022).

3.2. Population and sample size

The study targeted **cidb Grades 5–9 contractors** registered in the Eastern Cape, giving a total population of **228 contractors**. **Purposive sampling** was applied to select **201 key professionals, including project managers, quantity surveyors, construction managers, site agents, health and safety managers, and site technicians** directly involved in construction waste management.

A **95% confidence level** and **50% assumed population proportion** yielded a required sample size of **144 respondents**, as per (Mutisya *et al.*, 2017). A total of **105 completed responses** were received, representing a **52.2% response rate**, which is deemed acceptable for survey-based research (Ong *et al.*, 2020).

3.3. Data collection

The survey questionnaires were email-administered between 15 October 2023 and 24 November 2023, accompanied by a consent letter ensuring confidentiality and voluntary participation. The questionnaire comprised Section A, which collected demographic details such as age, gender, qualifications, profession, experience, and cidb grade, and Section B, which addressed construction waste reduction challenges. Section B was measured on a five-point Likert scale, with responses ranging from 1 (Unsure) to 5 (Strongly Agree).

3.4. Data analysis

Data was analysed using SPSS Version 29, incorporating descriptive statistics for respondent profiles, including frequencies and percentages. Mean ranking was used to determine the relative importance of barriers (Pallant, 2020), while standard deviation assessed response variability (Creswell & Creswell, 2017). Cronbach's alpha was applied to test reliability, with a threshold set at 0.70. Principal Component Analysis (PCA) was conducted to consolidate key barriers, retaining components with eigenvalues greater than 1 (Pallant, 2020).

4. Findings and Discussion

4.1. Demographic profile of the respondents

The survey included 229 respondents, with 53.3% being men. The majority of respondents (69.5%) were between the ages of 26 and 39. The highest proportion of respondents held a bachelor's degree (46.7%). The largest group of respondents were quantity surveyors (58.1%). Most respondents (81.9%) had 0 to 5 years of relevant experience. In terms of cidb grading, the highest proportion of contractors was in Grade 5 (46.7%).

4.2. Ranking construction waste reduction barriers experienced by contractors

Table 1 (Appendix 1) presents the results on the barriers to construction waste reduction faced by contractors. The highest-ranked barrier was the lack of waste reduction plans (MV=4.26), with 81.9% of respondents agreeing that this is a significant challenge. A moderate level of agreement was shown by 12.4%, while 2.8% were unsure and 2.9% disagreed. The second-highest ranking barrier was the lack of education on waste reduction (MV=4.24), with 81% of respondents agreeing, and 16.2% showing a moderate position. In contrast, 2% disagreed, and only 0.8% were unsure. The lowest-ranked barrier was 'Fear of project delays due to waste reduction initiatives' (MV=3.82), with 69.5% agreeing that it is a concern. However, 14.3% were moderate, 10.5% disagreed, and 5.7% were unsure. Since all the mean values are greater than 3.00, the mean value of 4.08 suggests a high degree of agreement or relevance in the evaluated elements. The

difficulties that have been identified are typically deemed significant by the respondents.

4.3. Underlying barriers experienced by contractors

This study adopts factor analysis to identify barriers experienced by contractors related to the reduction of construction waste in construction sites. Evidence from Table 2 (Appendix 1) shows that a total of 30 barriers experienced by contractors were examined to identify key barriers. The sample was judged suitable for factor analysis since its Kaiser-Meyer-Olkin (KMO) value of sampling adequacy was 0.834, which is more than 0.60. Furthermore, the chi-square value of 1631.370 and the significance level of 0.001 of the Bartlett's test of sphericity verify that the correlations between the variables are sufficiently high to support component analysis. Factor analysis is acceptable when the variables are connected, as indicated by a statistically significant Bartlett's test ($p < 0.05$) (Pallant, 2020). Seven (7) meaningful components with eigenvalues greater than 1.0 were revealed by principal components analysis factor extraction with varimax rotation, after examining 30 construction waste reduction. These components account for a cumulative variance of approximately 72.37%. Specifically, factor one explains 45.97% of the variance; factor two, 5.80%; factor three, 4.59%; factor four, 4.39%; factor five, 4.11%; factor six, 3.88%; and factor seven, 3.63%. Except for a few suppressed variables with values less than 0.30, multiple strong loadings on the component matrix are displayed. Field (2013) suggests that factor loadings below 0.30 should be suppressed, since such low values indicate that the factor accounts for less than 10% of the variance in the observed variable, rendering them less meaningful for interpretation.

Table 2 presents variables that are appropriate for components; this is indicated by a positive relationship between seven (7) components. The variable that are enclosed on Component 1 signifies "ineffective communication regarding waste reduction", Component 2 signifies "limited access to recycling facilities", Component 3 signifies "improper reuse of materials on-site", Component 4 signifies "there is no zero-waste culture in the construction worksite", Component 5 signifies "identification of nearby recycling facilities", Component 6 signifies "the use of inadequate equipment" and Component 7 signifies "facing difficulties in tracking waste on site".

5. Discussions of principal factor analysis findings

Component 1: Ineffective communication regarding waste reduction comprises several factors that highlight key barriers to efficient waste management. The first two factors are **ineffective communication regarding waste reduction (0.800)** and **lack of contractors' integrated waste management systems (0.799)**.

Effective communication is key for aligning project goals with waste reduction practices (Udawatta *et al.*, 2015). Without integrated systems, contractors struggle to implement waste reduction strategies consistently (Ajayi & Oyedele, 2018).

Component 2: Comprises the following barriers. The first two factors are **limited access to recycling facilities (0.527)** and **lack of clear waste reduction goals and targets (0.447)**. According to Darko *et al.* (2017), the inaccessibility of recycling facilities discourages contractors from making an effort toward recycling in their operations. The other important barrier is the lack of clear and specific targets regarding waste reduction. Durdjev *et al.* (2018) note that clear and measurable targets guide contractors in waste reduction, while Ajayi and Oyedele (2018) indicate that less frequent monitoring and insufficient enforcement of such goals result in further delays.

Component 3: Includes the following barriers. The first two factors are **improper reuse of materials on-site (0.415)** and **consideration of deconstruction when appropriate (0.397)**. Tam *et al.* (2018) observed that inappropriate reuse of materials on-site can be linked to a lack of understanding of appropriate repurposing procedures. Due to the lack of information about successful repurposing, improper reuse often happens. Darko *et al.* (2017) further establish this connection, suggesting that comprehensive waste reduction strategies incorporating material reuse techniques are necessary for proper on-site waste management. Consideration of deconstruction when appropriate is also very important. According to Bao and Lu (2021), deconstruction can reduce waste by increasing on-site material reuse compared to conventional destruction methods. However, Liu *et al.* (2020) caution that deconstruction can be more costly and time-consuming.

Component 4: Comprises the following factors. The first two are **that there is no zero-waste culture on the construction worksite (0.508)** and **choosing material without thorough thinking (0.352)**. The absence of a zero-waste culture on construction sites poses a significant challenge to sustainable waste management practices. Zaman and Lehmann (2011) assert that establishing a zero-waste culture requires comprehensive strategies and commitment from all stakeholders, including clear policies and top-down leadership. However, the development of such a culture is often hindered by a lack of awareness and education regarding the importance of waste reduction (Ajayi *et al.*, 2015). The selection of materials without proper consideration contributes to waste generation. According to Purchase *et al.* (2021), most contractors select materials based on cost and availability rather than sustainability, often choosing materials that are not easily recyclable or reusable. Durdjev *et al.* (2018) indicated that this lack of awareness of alternatives leads to inefficient material selection.

Component 5: Comprises the identification of nearby recycling facilities (0.454) and the fear of project delays due to waste reduction initiatives (0.334). Access to recycling facilities is important for contractors to recycle materials rather than dispose of them improperly. Gharfalkar *et al.* (2015) noted that this ensures that construction waste is recycled in a timely and inexpensive manner. According to Portny and Portny (2022), source separation on crowded building sites is difficult due to a lack of space and a shortage of bins. Contractors may be concerned that waste management practices such as separation and on-site recycling of materials will delay operations or increase workload. These issues, as stated by Zaman and Lehmann (2011), are compounded by the absence of effective waste reduction procedures that further discourage contractors from practising sustainability. Ajayi *et al.* (2015) have stressed that such delays can be avoided and efficiency ensured without compromising on environmental goals by training the employees and integrating waste management into the project process.

Component 6: Includes the following factors. The first two are the **use of inadequate equipment (0.468)** and **disregard for sustainability practices (0.330)**. Using inadequate equipment in construction projects leads to inefficient waste handling and processing, increasing waste volumes and project costs (Ali *et al.*, 2010). Galvez-Martos *et al.* (2018) argue that when equipment not designed for effective waste management is used, it worsens the environmental impact, particularly when sustainability practices are disregarded. Kabirifar *et al.* (2020) further emphasise that promoting the use of sustainable equipment and practices would help reduce waste and preserve the environment.

Component 7: Comprises the following factors. The first two are **obstacles of waste tracking at the site level (0.502)** and **inadequate waste tracking and reporting systems (0.371)**. Tam *et al.* (2018) illustrated that the incompetence of waste monitoring systems has made on-site waste tracking complicated for contractors, which is a core factor in reducing waste and enhancing recycling operations. These inadequate methods limit the identification of areas for improvement, as they generate inexact data regarding creation and disposal, constraining practical projects for waste reduction implementation (Nawaz *et al.*, 2023).

6. Conclusion and Further Research

The study identified the significant barriers to the effective reduction of waste included poor communication about waste reduction, lack of access to recycling facilities, ineffective on-site material reuse, having no zero-waste culture available, difficulty finding appropriate recycling options within proximity,

not having good machinery in order to manage waste, and not being able to track on-site generated waste effectively. These add significantly to the woes of contractors in reducing construction waste and have a direct impact on environmental sustainability and resource efficiency. The study has highlighted that clearly stated goals regarding waste reduction, along with a proper tracking system and education and training for contractors, would improve the management of waste at the construction site.

While this study has contributed to the present pool of knowledge, there are many further lines of investigation. Subsequent studies could examine specific waste management policies and strategies that

have been implemented at national or regional levels in South Africa to assess their effectiveness. Research might also be directed at the way technology can support better waste management: the use of digital tools for waste tracking, mobile recycling solutions, and real-time reporting systems.

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Appendix 1

Table 1: Barriers experienced by contractors

Barriers experienced by contractors N.....105	Unsure	Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree	Mean	Std.	Rank
Absence of waste reduction plans	2.8	1.0	1.9	12.4	37.1	44.8	4.26	.832	1
Lack of education about waste reduction	0.8	1.0	1.0	16.2	36.2	44.8	4.24	.830	2
Lack of a comprehensive waste management plan	3.9	0.0	1.9	11.4	45.7	37.1	4.23	.733	3
Lack of awareness about waste reduction	2.7	1.0	1.0	14.3	40.0	41.0	4.23	.807	3
Lack of sustainable procurement strategies	9.5	0.0	1.9	12.4	41.9	34.3	4.20	.752	4
Lack of on-site recycling facilities	1.9	0.0	5.7	8.6	43.8	40.0	4.20	.833	4
Improper waste segregation	8.6	0.0	1.9	14.3	41.9	33.3	4.17	.763	5
Ineffective communication regarding waste reduction	3.9	0.0	3.8	11.4	47.6	33.3	4.15	.780	6
Contractors focus on production rather than waste reduction	2.9	1.9	3.8	10.5	43.8	37.1	4.14	.901	7
Implementation of lean construction principles	8.6	0.0	1.9	16.2	41.9	31.4	4.13	.771	8
Limited space for on-site waste sorting and storage	4.8	1.0	4.8	15.2	35.2	39.0	4.12	.924	9
Lack of clear waste reduction goals and targets	4.7	1.0	2.9	14.3	43.8	33.3	4.11	.840	10
Ineffective systems for waste tracking and reporting	2.8	1.0	3.8	12.4	46.7	33.3	4.11	.843	10
Lack of training for contractors and workers	0.0	0.0	4.8	16.2	41.9	37.1	4.11	.847	10
Inadequate waste audits to assess types and quantities	4.8	1.9	2.9	11.4	47.6	31.4	4.09	.866	11
Source separation of waste	3.8	1.9	2.9	16.2	40.0	35.2	4.08	.913	12
Contractors face cost-related hurdles when implementing waste reduction measures	2.8	1.0	0.0	18.1	50.5	27.6	4.07	.748	13
Disregard for sustainability practices	9.5	1.9	1.0	13.3	47.6	26.7	4.06	.823	14
Facing difficulties in tracking waste on-site	2.7	1.0	6.7	12.4	42.9	34.3	4.06	.921	14
Limited space for waste storage	1.9	3.8	2.9	12.4	43.8	35.2	4.06	.978	14

Identification of nearby recycling facilities	3.7	1.0	1.0	18.1	48.6	27.6	4.05	.779	15
Lack of a contractor's integrated waste management system	5.7	1.0	1.9	19.0	42.9	29.5	4.04	.832	16
Improper reuse of materials on-site	1.9	1.0	4.8	13.3	51.4	27.6	4.02	.840	17
Unclear responsibilities for waste management at the construction work site	2.9	1.0	3.8	17.1	49.5	25.7	3.98	.832	18
The use of inadequate equipment	4.8	0.0	7.6	15.2	43.8	28.6	3.98	.887	18
Choosing material without thorough thinking	1.9	1.0	7.6	18.1	37.1	34.3	3.98	.970	18
Limited access to recycling facilities	2.9	1.9	6.7	15.2	43.8	29.5	3.95	.958	19
Consideration of deconstruction when appropriate	10.4	1.0	8.6	13.3	41.9	24.8	3.90	.951	20
There is no zero-waste culture in the construction worksite	2.7	4.8	6.7	14.3	41.0	30.5	3.88	1.084	21
Fear of project delays due to waste reduction initiatives	5.7	3.8	6.7	14.3	47.6	21.9	3.82	1.004	22
Average							4.08		

Table 2: Component Matrix on barriers experienced by contractors

Barriers experienced by contractors	Component						
	1	2	3	4	5	6	7
C1 Ineffective communication regarding waste reduction	.800						
Lack of a contractor's integrated waste management system	.799						
Contractors focus on production rather than waste reduction	.766						
Limited space for on-site waste sorting and storage	.763						
Contractors face cost-related hurdles when implementing waste reduction measures	.759						
Implementation of lean construction principles	.747						
Lack of education about waste reduction	.735						
Lack of a comprehensive waste management plan	.734						
Inadequate waste audits to assess types and quantities	.671						
C2 Limited access to recycling facilities		.527					
Lack of clear waste reduction goals and targets		.447					
Limited space for waste storage		.436					
Unclear responsibilities for waste management at the construction work site		.377					
Improper waste segregation		.301					

