Building Responsibly: Awareness of Sustainability Metrics in the South African Construction Industry

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Abstract

Sustainability has become an essential focus within the global construction industry, driven by the need to minimise environmental impact, promote social responsibility, and enhance economic efficiency. In South Africa, integrating sustainability practices is increasingly critical due to the country's unique environmental and socio-economic challenges. Sustainability metrics have also been developed, and their use is increasingly encouraged to ensure a truly sustainable construction sector. Therefore, this study aims to determine the awareness level of sustainability assessment tools (SATs) within the South African construction industry. A quantitative research approach was employed, using a structured questionnaire distributed to construction professionals in South Africa. The collected data were analysed using descriptive and exploratory factor analysis to assess the level of familiarity, understanding, and application of SATs in practice. The findings reveal varying degrees of awareness among professionals, with the Building Environmental Assessment Method, Green Building Index, Lifecycle Assessment, Leadership in Energy and Environmental Design and Building Research Establishment Environmental Assessment Method being the top five tools known to the respondents**.** The results suggest that while there is a general recognition of the importance of sustainability, there is limited knowledge regarding specific assessment frameworks. This highlights the need for enhanced education, training, and policy support to encourage the adoption of SATs across the industry. The study underscores the importance of increasing awareness to drive sustainable development and improve construction practices in South Africa.

Keywords

Construction Industry, Green Building, South Africa, Sustainability Assessment Tools, Sustainable Construction.

1. Introduction

In the contemporary global landscape, sustainability has emerged as a critical imperative across all sectors, with the construction industry playing a pivotal role in shaping environmental, social, and economic outcomes (United Nations, 2015). Historically recognised as a significant contributor to environmental degradation, resource depletion, and carbon emissions, the construction sector is now undergoing a transformative shift toward more sustainable practices (Kibert, 2016). This transformation is driven by increasing awareness of the industry's substantial environmental footprint, including its impacts on climate change, natural resource consumption, and waste generation (Gabcová & Kuncová, 2019). Simultaneously, there is growing recognition of the sector's potential to promote social equity, economic efficiency, and long-term resilience through sustainable development approaches (Bragança et al., 2014).

South Africa's construction industry is at a crucial juncture, facing unique sustainability challenges that reflect the country's complex socio-economic and environmental context (Musengo et al., 2020). As a developing nation grappling with issues such as energy shortages, water scarcity, socio-economic inequality, and environmental degradation, South Africa requires a construction sector that can address infrastructure needs while simultaneously advancing sustainable development objectives (Musango et al., 2011). The industry is vital to the country's economic growth and socio-economic transformation, contributing significantly to employment creation and infrastructure development (CIDB, 2022). However, this critical role must be balanced with the urgent need to minimise environmental impacts and promote social responsibility within construction practices (Nnaji et al., 2020).

Globally, the construction industry has responded to sustainability challenges by developing and implementing various sustainability assessment tools (SATs) (Haapio & Viitaniemi, 2008). These tools provide structured frameworks for evaluating the environmental, social, and economic performance of buildings and infrastructure projects throughout their life cycles (Ding, 2008). Internationally recognised tools such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and Green Star have been instrumental in guiding sustainable development in construction, influencing planning, design, construction, and operational practices (Cole, 2005; Azhar et al., 2011). These assessment frameworks measure project performance and serve as educational tools, raising awareness and driving innovation in sustainable construction practices (Kibert, 2016). In South Africa, the Green Building Council of South Africa (GBCSA) introduced Green Star SA as a localised sustainability assessment tool designed to promote greener buildings and development practices tailored to the country's specific context (GBCSA, 2023). Despite the availability and potential benefits of Green Star SA and other international SATs, their adoption and consistent application in the South African construction industry remain limited, particularly outside major metropolitan areas (Adewumi et al., 2019). This low level of implementation can be attributed to various factors, including a lack of awareness among professionals, insufficient technical knowledge, weak enforcement of policies promoting sustainability, and perceived cost implications (Abdullahi et al., 2017).

Given South Africa's pressing sustainability challenges, the gap in awareness and implementation of SATs is particularly concerning. The country faces significant environmental issues, including water scarcity, energy insecurity, biodiversity loss, and vulnerability to climate change impacts (Department of Environment, Forestry and Fisheries, 2021). These challenges are compounded by socio-economic issues such as inequality, unemployment, and inadequate access to basic services (StatSA, 2022). In this context, the construction industry has both a responsibility and an opportunity to address these challenges through more sustainable practices that balance environmental protection, social equity, and economic viability (Mabogunje & Anigbogu, 2019). Research indicates that many professionals in the South African construction sector encounter difficulties in understanding and applying SATs due to gaps in their education and limited exposure to sustainable construction practices during their training and industry experience (Häkkinen & Belloni, 2011). This knowledge gap hinders the effective implementation of sustainability principles in construction projects, limiting the industry's potential contribution to sustainable development (Ofori & Kodwo, 2015). Furthermore, the varying levels of awareness across different professional groups, regions, and sectors suggest the need for targeted interventions to enhance understanding and promote the adoption of SATs (Darko et al., 2017).

This study aims to address this critical gap by exploring the level of awareness of sustainability assessment tools among construction professionals in South Africa, with a specific focus on the Eastern Cape Province. By examining the familiarity, understanding, and application of various SATs, the research seeks to identify barriers to their wider adoption and inform strategies for enhancing sustainability practices in the industry (Cattell & Higgitt, 2014). The findings have implications for education and training programmes, policy development, and industry initiatives to promote sustainable construction in South Africa. The research identifies the most and least recognised tools, explores factors influencing awareness levels, and discusses implications for policy, education, and industry practice. By shedding light on the current state of awareness regarding SATs in the South African construction industry, this study contributes to the broader discourse on sustainable construction in developing countries and provides insights that can inform efforts to enhance sustainability practices in similar contexts globally.

2. Research Methodology

The study was conducted in the Eastern Cape Province of South Africa, focusing on Nelson Mandela Bay Metropolitan and Buffalo City Metropolitan Municipalities. The targeted respondents are construction professionals within the Eastern Cape Province, including Engineers (Civil, Electrical, and Mechanical), Construction Managers, Construction Project Managers, Quantity Surveyors, Town/Urban Planners, Health & Safety Officers, and Architects, all of whom are actively involved in sustainable construction projects. This study uses a quantitative approach, consisting of numerical measures and following a deductive approach considered scientific (Baškarada & Koronios, 2016). In research, sampling techniques are categorised into two main types: probability (or random) sampling and non-

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probability (or non-random) sampling. Random sampling includes methods such as simple random sampling, stratified random sampling, cluster sampling, systematic sampling, and multi-stage sampling (Uprichard, 2013; Buelens et al., 2018). Non-random sampling encompasses techniques like convenience, purposive, quota, dimensional, and snowball (Kanaki & Kalogiannakis, 2023). This study employs a purposive sampling technique called judgment sampling (Guarte & Barrios, 2006; Rai & Thapa, 2015; Campbell et al., 2020). Purposive sampling involves intentionally selecting participants based on specific criteria (Suen et al., 2014; Greenwood et al., 2020). Campbell et al. (2020) note that the researcher decides on the sample participants based on various criteria.

3. Results

3. 1 Demographic Background of Respondents

The analysis from the demographic background of respondents reveals that for the construction professionals, architects were 6.5%, engineers (civil, electrical, and mechanical) were 11.2%, construction managers were 14%, health & safety officers were 17%, construction project managers were 11.2%, quantity surveyors were 33.6% and town/urban planners were 5.6%. For the respondent's years of experience in the construction industry, 68.22% have in the range of 1 to 5 years' experience; 21.49% have between 6 to 10 years of work experience, those who have between 11 to 15 years are 3.74%, 0.93% of the respondents have 16 to 20 years of work experience, and 5.61% had more than 20 years of work experience. Furthermore, the result reveals that 29.91% of respondents had a bachelor's degree, 28.04% had a diploma, 25.23% had an honours degree, 7.48% had a master's degree, 4.67% had a matric certificate, and 4.67% had a doctorate.

3.2 Results from Descriptive Analysis

Table 1 reveals the highest-ranked sustainability assessment tools. Findings showed that the Building Environmental Assessment Method (BEAM), with a mean score of 3.12, emerges as the most recognised tool among South African construction professionals. This indicates a relatively strong awareness of local or regional assessment tools tailored to South Africa's environmental context, emphasising its relevance in the industry. The Green Building Index (GBI) closely follows, with a mean score of 3.07, highlighting the industry's increasing familiarity with green building principles and sustainable design practices. The third most acknowledged tool, LCA, with a mean score of 3.04, underscores the growing importance of evaluating the environmental impacts of materials and building processes throughout their life cycle. These top scores reflect a positive trend where practitioners are increasingly aware of environmental performance evaluation methods, suggesting a foundational understanding of sustainability practices critical for reducing resource consumption and minimising ecological footprints.

However, the recognition of sustainability tools drops significantly towards the lower end of the scale, with Green Mark, Embodied Carbon Calculator (WSP Global), and Ecological and Environmental Warning System (EEWS) ranking as the least recognised frameworks. Green Mark, with a mean score of 2.71, appears to have limited awareness among respondents, possibly due to its regional specificity or lower global prominence. Similarly, the Embodied Carbon Calculator and EEWS, with mean scores of 2.73 and 2.78, respectively, suggest that many professionals are less familiar with tools focused on quantifying embodied carbon and early-warning environmental systems. This gap indicates that while there is growing awareness of certain tools, a significant portion of assessment frameworks, particularly those related to embodied carbon and environmental monitoring, remain underutilised or poorly understood within the industry. This may be attributed to a lack of training, limited exposure, or the perceived complexity of these tools, emphasising the need for targeted education and capacity building. The overall picture painted by this analysis reveals both progress and gaps in the industry's familiarity with sustainability assessment tools. The higher awareness of tools like BEAM, GBI, and LCA demonstrates an industry that recognises the importance of environmental performance metrics. Yet, the lower scores for tools such as Green Mark, Embodied Carbon Calculator, and EEWS highlight significant areas for improvement, especially in advanced environmental monitoring and carbon accounting. To foster a truly sustainable construction sector, industry stakeholders must invest in training programmes and awareness campaigns that broaden practitioners' knowledge of these less recognised but equally vital tools. Enhancing familiarity with a diverse range of assessment frameworks will enable construction professionals to implement holistic sustainability strategies, addressing not only environmental impacts but also social and economic dimensions, thus supporting South Africa's broader sustainable development goals.

Table 1. Descriptive analysis of sustainability assessment tools results.

Sustainability assessment tools	Mean	Std. Deviation	Rank

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Building Environmental Assessment Method (BEAM)	3.12	1.344	1
Green Building Index (GBI)	3.07	1.234	2
Life Cycle Assessment (LCA)	3.04	1.303	3
Leadership in Energy and Environmental Design (LEED)	2.97	1.314	4
Building Research Establishment Environmental Assessment Method (BREEAM)	2.96	1.205	5
Sustainable Building Assessment Tool (SBAT)	2.95	1.232	6
Sustainability Accounting Standard Board (SASB)	2.93	1.358	7
Living Building Challenge (LBC)	2.89	1.254	8
Excellence in Design for Greater Efficiencies (EDGE)	2.88	1.264	9
Green Star South Africa	2.87	1.289	10
Carbon Trust Standard for Construction	2.82	1.294	11
Global Real Estate Sustainability Benchmark (GRESB)	2.79	1.229	12
Ecological and Environmental Warning System (EEWS)	2.78	1.305	13
Embodied Carbon Calculator (WSP Global)	2.73	1.384	14
Green Mark	2.71	1.303	15
Estidama Pearl Rating System (EPRS)	2.71	1.353	16
Electronic Product Environmental Assessment Tool (EPEAT)	2.70	1.290	17
Green Rating for Integrated Habitat Assessment (GRIHA)	2.70	1.326	18
Comprehensive Assessment System for Built Environment Efficiency (CASBEE)	2.68	1.241	19
Selo Ambiental Colombiano para las Edificacionis (SACE)	2.66	1.295	20
Green Globes	2.64	1.306	21
Alta Qualidade Ambiental (AQUA)	2.63	1.307	22
Green Star Australia	2.58	1.267	23
Indian Green Building Council (IGBC)	2.54	1.268	24
Haute Qualité Environnementale (HQE)	2.52	1.348	25
Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB)	2.44	1.245	26

3.3 Results from Exploratory Factor Analysis

As shown in Table 2, the KMO measure of sampling adequacy achieves a high value of 0.952, exceeding the recommended minimum value of 0.6. Bartlett's test of sphericity is also statistically significant (less than 0.05), thus supporting the factorability of the correlation matrix. The data is subjected to PCA (with varimax rotation). The eigenvalue is set at the conventional high value of 1.0. Table 3 extracts two (2) factors with eigenvalues exceeding 1.0. The scree plot in Fig. 1 also reveals the excluded factors by indicating the cut-off point at which the eigenvalues level off. The total variance explained by each of the extracted factors is as follows: Factor 1 (19.407%) and Factor 2 (1.160%). The extracted factors account for approximately 79 percent of the total cumulative variance.

Table 2. KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.952
Bartlett's Test of Sphericity	Approx. Chi-Square	4054.085
	df	325
	Sig.	<0.001

Table 3. Rotated Factor Matrix.

Sustainability assessment tools	Factors	
	1	2
Green Rating for Integrated Habitat Assessment (GRIHA)	0.930	
Electronic Product Environmental Assessment Tool (EPEAT)	0.927	
Selo Ambiental Colombiano para las Edificacionis (SACE)	0.922	
Alta Qualidade Ambiental (AQUA)	0.921	
Carbon Trust Standard for Construction	0.919	
Estidama Pearl Rating System (EPRS)	0.917	
Excellence in Design for Greater Efficiencies (EDGE)	0.906	
Ecological and Environmental Warning System (EEWS)	0.905	
Sustainability Accounting Standard Board (SASB)	0.900	
Embodied Carbon Calculator (WSP Global)	0.899	
Living Building Challenge (LBC)	0.897	

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Haute Qualité Environnementale (HQE)	0.893	
Green Mark	0.883	
Indian Green Building Council (IGBC)	0.877	
Global Real Estate Sustainability Benchmark (GRESB)	0.860	
Comprehensive Assessment System for Built Environment Efficiency (CASBEE)	0.852	
Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB)	0.849	
Green Star Australia	0.845	
Leadership in Energy and Environmental Design (LEED)	0.828	
Life Cycle Assessment (LCA)	0.827	
Green Globes	0.811	
Building Environmental Assessment Method (BEAM)		0.374
Green Star South Africa		0.357
Sustainable Building Assessment Tool (SBAT)		0.328

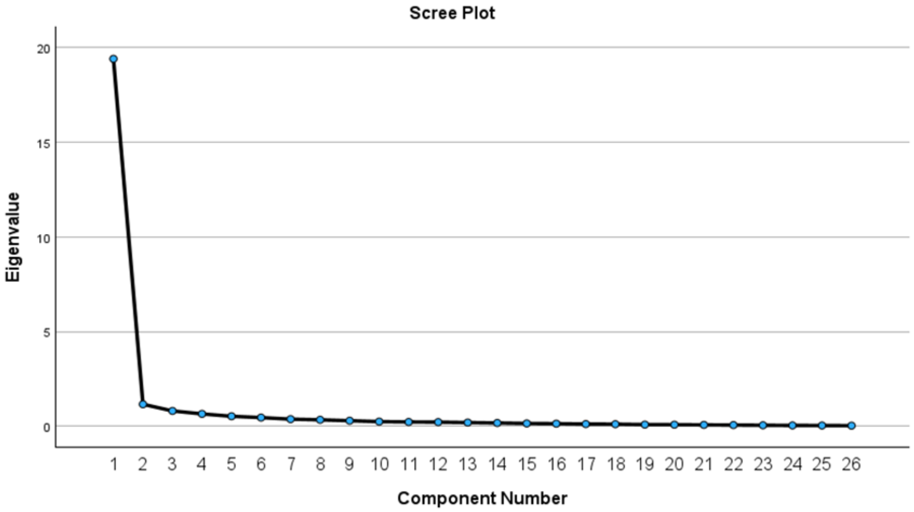

Fig. 1. Scree plot

Table 4. Pattern Matrix.

Factors	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	**19.407**	74.643	74.643	19.407	74.643	74.643
2	**1.160**	4.460	79.103	1.160	4.460	79.103
3	0.807	3.103	82.206			
4	0.650	2.499	84.705			
5	0.524	2.017	86.723			
6	0.455	1.751	88.473			
7	0.372	1.432	89.905			
8	0.338	1.300	91.205			
9	0.290	1.114	92.319			
10	0.243	0.934	93.253			
11	0.223	0.858	94.111			
12	0.216	0.832	94.944			
13	0.193	0.742	95.685			
14	0.171	0.657	96.342			
15	0.146	0.562	96.904			
16	0.134	0.516	97.420			

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17	0.114	0.437	97.857
18	0.107	0.411	98.268
19	0.084	0.325	98.593
20	0.080	0.308	98.901
21	0.070	0.267	99.169
22	0.061	0.234	99.403
23	0.049	0.189	99.592
24	0.041	0.157	99.749
25	0.037	0.141	99.891
26	0.028	0.109	100.000

Principal axis factoring revealed the presence of two (2) factors with eigenvalues above 1, as shown in Table 3. The following interpretations were made based on examining the inherent relationships among the variables under each factor. Factor 1 was sustainability certification-related, and Factor 2 was green building rating systems-related. The names given to these factors were derived from closely examining the variables within each factor. The constituent indicators of each of the two factors extracted are explained below, with a detailed description of how each was described within the focus group sessions.

Factor 1 (sustainability certifications-related): As presented in Table 3, the twenty-one (21) extracted for factor 1 were Green Rating For Integrated Habitat Assessment (93%), Electronic Product Environmental Assessment Tool (92.7%), Selo Ambiental Colombiano Para Las Edificacionis (92.2%), Alta Qualidade Ambiental (92.1%), Carbon Trust Standard for Construction (91.9%), Estidama Pearl Rating System (91.7%), Excellence in Design for Greater Efficiencies (90.6%), Ecological and Environmental Warning System (90.5%), Sustainability Accounting Standard Board (90%), Embodied Carbon Calculator (89.9%), Living Building Challenge (89.7%), Bnhaute Qualité Environnementale (89.3%), Green Mark (88.3%), Indian Green Building Council (87.7%), Global Real Estate Sustainability Benchmark (86%), Comprehensive Assessment System for Built Environment Efficiency (85.2%), Deutsche Gesellschaft Für Nachhaltiges Bauen (84.9%), Green Star Australia (84.5%), Leadership in Energy and Environmental Design (82.8%), Life Cycle Assessment (82.7%), and Green Globes (81.1%). Factor 2 (green building rating systems-related): The three (3) extracted for factor 2 were Building Environmental Assessment Method (37.4%), Green Star SA (35.7%), and Sustainable Building Assessment Tool (32.8%) as presented in Table 3.

4. Discussion

The study underscores a significant gap in the awareness and practical application of sustainability assessment tools (SATs) among South African construction professionals, which could impede the industry's progress toward sustainable development. Despite frameworks such as BEAM, GBI, and LEED, the moderate mean scores indicate that many professionals have limited familiarity with these tools, which affects their ability to implement sustainable practices effectively (Häkkinen & Belloni, 2011). The findings reveal that awareness levels vary across professional groups and regions, with quantity surveyors showing the highest familiarity. However, overall, there remains a pressing need for targeted education and training initiatives to bridge these knowledge gaps. Given South Africa's challenges, such as water scarcity, energy shortages, and socio-economic inequalities, enhancing professional understanding of SATs is critical. As Kibert (2016) notes, sustainable construction practices are essential for mitigating environmental impacts and advancing social equity, and this can only be achieved if professionals are adequately equipped with the necessary knowledge and skills.

Furthermore, the regional focus of the research on the Eastern Cape highlights the disparity in sustainability awareness between urban and less urbanised areas, suggesting that awareness and training programmes should be intensified in regions outside major cities. The data also points toward a need for stronger policy enforcement and industry-wide standards to promote the adoption of SATs. International tools like LEED and BREEAM have been influential globally (Azhar et al., 2011), but their limited recognition in South Africa signifies a gap that policymakers and industry leaders must address. As Cole (2005) emphasises, integrating these frameworks into industry standards and building codes can significantly enhance their uptake. To achieve this, the industry must focus on embedding sustainability principles into education curricula and professional development programs, thereby fostering a culture that values and prioritises sustainable practices. Increasing awareness and understanding of SATs will ultimately be vital for aligning South Africa's construction industry with global sustainability standards and achieving long-term socio-economic and environmental resilience.

The overall findings make it clear that awareness alone is insufficient; there must be a concerted effort to translate knowledge into practice through policy support, industry collaboration, and capacity building. As suggested by Zuo and Zhao (2014), industry-wide adoption of SATs can be accelerated through incentives, training programs, and stricter enforcement of sustainability requirements. This is especially important in a country like South Africa, where environmental and socio-economic challenges demand innovative and sustainable solutions. The construction sector can significantly contribute to sustainable urban development, resource efficiency, and social equity by fostering a deeper understanding of these tools and integrating them into everyday practice. The study emphasises that closing the awareness gap is fundamental to fostering a sustainability-oriented industry capable of delivering environmentally responsible and socially equitable outcomes in South Africa.

5. Conclusion and Recommendations

This study highlights the current state of awareness and understanding of sustainability assessment tools (SATs) among construction professionals in the South African industry, especially within the Eastern Cape Province. While tools such as BEAM, GBI, and LCA are relatively more recognised, there remains a notable gap in familiarity with other internationally and locally developed frameworks like LEED, BREEAM, and Green Star South Africa. It is evident that although professionals acknowledge the importance of sustainability in construction practices, the practical implementation of SATs remains limited. This limitation is primarily driven by insufficient awareness, technical knowledge, and weak enforcement of policies supporting sustainability. These gaps hinder the industry’s ability to fully adopt sustainable development principles vital for addressing South Africa’s environmental and socio-economic challenges. Therefore, increasing awareness and enhancing capacity among industry practitioners is crucial for fostering sustainable construction practices that align with global standards.

To address these gaps, it is essential to enhance education and training programs by integrating comprehensive modules on sustainability assessment tools within university curricula and ongoing professional development initiatives. Strengthening government and industry policies is equally important, ensuring that adopting SATs becomes mandatory for construction projects supported by clear guidelines and incentives. Industry-wide awareness campaigns and targeted workshops should be conducted across regions to improve familiarity with various SATs, emphasising their benefits and practical application. Establishing specialised training centres and technical support units will further assist professionals in understanding and effectively implementing these tools. Developing localised assessment frameworks tailored to South Africa’s specific environmental, social, and economic contexts will also promote more relevant and accessible sustainability practices. Finally, fostering ongoing research into barriers practitioners face and continuously monitoring industry progress will help refine strategies, ensuring that sustainability becomes an integral part of the construction sector’s growth.

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