JCBM

ISSN 2521-0165
Volume 8, Number 1, June 2025

JOURNAL OF CONSTRUCTION BUSINESS & MANAGEMENT

http://journals.uct.ac.za/index.php/jcbm/index

JCBM

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ABOUT JCBM

The **Journal of Construction Business and Management (JCBM)** is an open access journal published bi-annually by the University of Cape Town Libraries, South Africa. The Journal is hosted by the Construction Business and Management Research Group of the University of Cape Town. The journal aims to explore the experience of construction industry stakeholders and trends in the global system. It aims to publish peer reviewed and highly quality papers emanating from original theoretical based research, rigorous review of literature, conceptual papers and development of theories, case studies and practical notes. The journal also welcomes papers with diverse methodological research approaches including qualitative, quantitative, and mixed methods. Contributions are expected from academia, public administrators, professionals in the public sector and private practice (such as contracting organizations and consulting firms) and other related bodies and institutions (such as financial, legal and NGOs).

The scope of **Journal of Construction Business and Management (JCBM)** covers but is not limited to construction management and project delivery, strategic management, decision making, skills development, organizational practices and procedures in construction business. The specific areas in construction management, sustainability in construction and project delivery include project planning/feasibility studies, procurement, resource management, international construction, ethical issues, industrial relations, legislative requirements and regulations, construction education, information and communication technologies, housing policies, and urban design and development. Strategic management in construction covers risk management, quality management, resilience and disaster management, cultural and societal management, project life cycle management, and knowledge creation and management. Among issues in construction organizational practices and procedures covered are business development strategies, human resources and career development, continuous professional development, leadership systems, marketing strategies, gender issues and corporate social responsibility.

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Navigating Construction Challenges, Claims, Contracts, Materials and Consumer Choices in Emerging Markets

Editorial June 2025

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Introduction

Welcome! This is Issue 1 of Volume 8 of the Journal of Construction Business and Management. The Issue brings together diverse studies that examine emerging-market contexts and how they shape construction management practice. Studies reported in the focus on topical issues ranging from contract drafting and claim handling to material choices and drivers of consumer behaviour. The papers collectively highlight the interdependencies among legal frameworks, project governance, market dynamics, and sustainability imperatives that define emerging markets and developing-country construction landscapes. These articles were contributed by 14 authors from Nigeria, South Africa, Sri Lanka, Tanzania, Thailand and the United Kingdom.

Discussion of the papers

Nyezi (2025) builds their work on a South African context (Grid Electronics vs SM Structures) as they distinguish special damages from general damages in construction contracts. The case note outlines how courts allocate damages in cases of delays and incomplete performance. It also highlights the need for precise contract drafting to allocate risk and clarify what constitutes general versus special damages, including the limits of recovery for rental costs. Practical implications for practitioners revolve around the need to ensure clarity in drafting damage clauses and consider cost-of-completion versus diminution-in-value approaches when quantifying damages.

Hammond (2025) examines the state of participation of women in construction employment and education in South Africa. The study also elicits potential roles of women in digital technologies in enhancing the industry. Stakeholders would find interest in the study's commentary as it contextualises gender dynamics within a broader socio-technical agenda, highlighting barriers and opportunities for women in construction leadership and technical roles, with implications for policy and industry practice.

In Sri Lanka, Manokararajah *et al.* (2025) examine the claims management challenges faced by small and medium-sized contractors during economic upheavals. The study identifies skill gaps, documentation deficiencies, and inadequate delay analysis as key drivers of claims risk, offering strategies to strengthen record-keeping, contractual knowledge, and stakeholder collaboration to build resilience in crises.

Moreover, Alao *et al.* (2025) evaluate end-user decision-making processes for cement brands in a developing-country setting. They found that the choice of cement is shaped by corporate responsibility, technical support, and product attributes. This paper highlights the intersection of supply-chain dynamics, brand reputation, and user perceptions in material selection, with implications for marketing, procurement, and sustainability benchmarking.

Last but certainly not the least, Mahame *et al.* (2025) provide regional insights on sustainable construction materials and practices in Tanzania. The study examines economic and environmental considerations around sustainable construction materials (SBMs) and broader regional determinants for their adoption in housing construction. They report on how economic viability, local availability, and policy contexts influence the uptake of SBMs, and underline the need for context-specific cost-benefit analyses and policy instruments to promote the choice of sustainable materials for construction works.

Conclusion

This issue of the Journal of Construction Business and Management advances our understanding of construction management in emerging markets by connecting legal doctrine with project execution, material choices, and consumer behaviour. The issue provides insight into construction challenges, claims, contracts, materials and consumer choices in emerging markets. The papers collectively remind us that successful construction outcomes depend not only on technical know-how but on sound governance, transparent market dynamics, and policy environments that are inclusive and forward-looking. We congratulate and commend the authors for their work and invite readers to engage with the findings as they navigate the complex and evolving terrain of construction in emerging markets.

We thank the authors for their contributions, the reviewers for their thorough evaluation of the papers and the editorial board for their continued support. We encourage further submissions that extend these themes, especially comparative studies, policy evaluations, and practitioner-led case studies that illuminate the path towards improved resilience, efficiency, and sustainable construction in emerging markets.

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Journal of Construction Business and Management

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When Rome is Only Half-Built: Construction Contracts and Special Damages

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Received 17 January 2025; received in revised form 01 February 2025, 12 March 2025, 24 April 2025; accepted 25 May 2025
https://doi.org/10.15641/jcbm.8.1.1740

1. Introduction

Disputes between employers and contractors have had a long history in construction projects. To borrow from the metaphor in the title, imagine if the builders of the Colosseum had used mudbrick instead of rock, delayed the completion of the arena, and the Romans had to pay thousands of gold coins to rent an amphitheatre because of the delay. While a steel warehouse in Midrand is not precisely the Colosseum, similar circumstances were at the centre of a recent dispute between a steel structure manufacturer – Quandomanzi Investments (trading as SM Structures) and its client – Grid Electronics. The case in question is *Grid Electronics vs Quandomanzi Investments (Pty) Limited t/a SM Structures* [2024], referenced as ZAGPJHC 633 in the South Gauteng High Court, South Africa.

Using the *Grid Electronics* case as a backdrop, this paper examines the distinction between general and special damages in construction contracts. Set in a South African Contract Law context, the paper provides an analysis of contractor defaults that may result in costs that constitute general damages, *as oppos*ed to those that are categorised as special damages and are not ordinarily imputed against contractors. Furthermore, the paper examines instances in which a contractor may be held liable for special damages. In *Grid Electronics*, the court had to rule on whether the employer was entitled to special damages after a delay by the contractor in completing the structure resulted in the former having to rent alternative premises. The defendant, Quandomanzi Investments (trading as SM Structures), failed to fulfil all its obligations under a contract for the construction of a structure for Grid Electronics. As a result, the latter incurred costs of over half a million Rand, comprising additional rental paid to its landlord due to the delay, and the costs of procuring additional building material. In its application, Grid Electronics sought to hold SM Structures liable for both amounts as general damages. Ultimately, the court ruled in favour of Grid Electronics and awarded general damages in respect of the costs incurred in procuring additional building materials. However, it dismissed the claim in respect of the rental amount, holding that this constituted special damages.

This case note adopts a doctrinal approach to investigating the conceptual and practical differences between general and special damages. Using a combination of case law and contract standards that apply locally in South Africa and to international construction, and persuasive academic texts, this case note analyses of the court's approach to determining: (i) the quantum in claims for general damages, (ii) whether a loss resulting from a breach in a construction contract amounts to general or special damages, and (iii) when, in the event that special damages are proven, the defaulting party is deemed liable.

2. Background

In October 2019, Grid Electronics entered into a contract with SM Structures, in terms of which SM Structures would construct a portal frame steel structure on Grid Electronics' premises. Grid Electronics intended to use the premises to operate its automotive sound and accessories business. Of significance to the case is the fact that this was intended to be a move from the premises that Grid Electronics had been renting.
The parties agreed that the structure would be completed by 1 December 2020, and that SM Structures would be paid a total contract price of R435,500 for the work, staggered as follows:

i. 30% of the contract price upon placement of the order;

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ii. 60% on delivery of the structure on site, no later than 31 October 2019;
iii. 5% on completion of the frame, no later than 29 June 2020; and
iv. 5% on completion of installation and erection of the frame.

According to the contract, SM Structures was required to roof the structure with a special type of high-quality galvanised roof sheeting, specifically 0.5mm thick IBR Chromadek. This would later become a key issue in the dispute between the parties.

The first payment, an amount of R115,000, had already been paid to SM Structures prior to the conclusion of the agreement. SM Structures met the next milestone, which was the delivery of the structure, and Grid Electronics paid the second tranche, an amount of R276,150, at the end of October 2019. Upon completion of the frame, Grid Electronics paid R21,775, being the first of the two 5% tranches, at the end of June 2020. A balance of R21,775 remained, which was to be paid upon the installation and erection of the frame. Grid Electronics refused to make the last payment, alleging that SM Structures had breached the contract, as the latter had failed to complete the installation of the structure and had not supplied enough of the Chromadek roof sheets.

A dispute ensued, and Grid Electronics approached the court, claiming contractual damages of R147,756.60 as fair and reasonable compensation for the additional roof sheeting it had to purchase. This amount constitutes general damages; that is, damages that ordinarily follow from such a breach. Grid Electronics claimed a further amount of R428,506.08, being the additional rental it had to pay to its then landlord between 1 December 2020 and 31 March 2021 due to the delay in completing the structure on its new premises. This amount represents special damages; that is, damages that would not be expected to ordinarily flow from the kind of breach in question.

SM Structures conceded that Grid Electronics had indeed suffered general damages. What then remained for the court to decide, in relation to general damages, was the quantum. A more complex inquiry was required in respect of special damages. Despite initially claiming the rental paid due to the delay as special damages, counsel for Grid Electronics would later claim, in written heads of argument and the closing argument before the court, that this amount also represented a claim for general damages. The court had to determine whether the amount constituted general or special damages and whether Grid Electronics would be entitled to compensation if the amount constituted special damages.

3. Discussion

As a point of departure, it is important to note that the determination of damages resulting from defective performance need not always be a matter for a court to decide. When parties negotiate a construction contract, they may pre-agree on an amount to be paid for damages in the event of a delay or if the structure fails to meet the required performance or completion criteria. Liquidated damages are often stated as a rate or amount per day/week of delay in scheduled completion, while performance liquidated damages are stated as a fixed amount for each criterion the structure fails to meet. For present purposes, an example of delay liquidated damages would be the parties agreeing that SM Structures would pay a specified amount for each unit of time (such as weeks or months) that it fails to complete its performance. Parties seeking to include such clauses in their contracts are advised to consult the FIDIC *Conditions of Contract for Plant and Design-Build (Yellow Book)*, often used for projects of this nature, for standard-form delay and performance liquidated damages clauses. There is no indication from the ruling in the present case that the contract contained such a clause. In the absence of such a clause, the courts had to settle the parties' disputes on all matters relating to damages.

South African law distinguishes between general damages and special damages. The reason, which shall become apparent in the discussion below, is provided in *Holmdene Brick Works (Pty) Ltd v Roberts Construction Co Ltd* (173/75) [1977] ZASCA 61 as being:

"To ensure that undue hardship is not imposed on the defaulting party the defaulting party's liability is limited in terms of broad principles of causation and remoteness…"

4. 3.1 General damages

General damages are those damages that flow naturally and generally from the kind of breach that has been committed, and which the law presumes the parties contemplated would probably result from such a breach (Christie, 2024). In the event of a breach that results in general damages, the defaulting party is liable to the other party for the value of the loss incurred by the latter. McLauchlan (2019) describes the claim for general damages as a remedy intended to place the injured party in the position it would have been in had the other party performed as agreed. In the present case, general damages refer to the costs that Grid Electronics incurred to remedy the defective performance of SM Structures.

With counsel for SM Structures having conceded that Grid Electronics suffered general damages, the court did not have to decide whether Grid Electronics had incurred general damages due to SM Structures' failure to complete the installation of the roof structure. Both parties accepted that the costs of purchasing the shortfall of the galvanised roof sheeting constituted general damages. SM Structures submitted that the general damages amounted to R75,458.50, while Grid Electronics sought damages to the sum of R122,012.60. The court had to determine the amount for which SM Structures would be liable.

There are two prominent methods used in determining general damages, namely, the cost-of-completion-or-repair method and the diminution-in-value method (Haywood, 2003). The cost-of-completion-or-repair method seeks to place the injured party in a contract – in this case, the employer – in the position it would have been in had the counterparty, the contractor, fully performed its obligations under the contract. Using this method, damages are calculated by determining the cost to the employer of completing or repairing the defective work. In contrast, the damages under the diminution of value method are calculated by subtracting the market value of the object of the contract following the defective performance, from the market value it would have had if the defaulting party had fully performed its obligations. The latter method may result in complexities due to the need for expert appraisals in relation to market value, potential subjectivity associated with them, and associated cost implications (Sonnemans, 2017). As such, courts often use the comparatively simpler cost-of-completion-or-repair method when determining damages.

In this case, the court employed the cost-of-completion-or-repair method, which involved determining the costs incurred to complete the structure following the defective performance of SM Structures. The court multiplied the number of short-supplied Chromadek sheets by the unit cost and arrived at an amount of R125,393.45 as the cost of remedying the defective performance rendered by SM Structures. From this amount, the court deducted the last portion of the contract price, being the R21,775 that Grid Electronics had not paid, leaving a total of R103,618.45. It is this amount that the court deemed SM Structures to be liable for as general damages. With this finalised, the court then had to make a determination in respect of special damages.

This method aligns with the approach adopted by the Appellate Division in *Holmdene Brick Works, supra*, where a brick manufacturer supplied a construction company with defective bricks. The construction company used the bricks in the construction of walls that subsequently had to be demolished due to the crumbling bricks. Having suffered costs related to the demolition and reconstruction of the walls, the construction company sued the brick manufacturer for damages. The court held that the construction company had used the bricks for the very purpose that bricks are ordinarily used for, and that the demolition of a wall due to crumbling bricks was a natural and foreseeable consequence. As such, the costs incurred due to the manufacturer's breach amounted to general damages. In deciding the quantum of general damages, the court then had to determine the costs incurred by the construction company in demolishing and reconstructing the walls. This amount, R27,086.24, was deemed to be the amount required to place the construction company in the position it would have been in had the manufacturer fully performed its obligations.

3.2 Special damages

Special damages are losses that are not the natural result of a breach and are deemed, in law, to be too remote, unless there are exceptional circumstances (Peel, 2015). A defaulting party is deemed not liable for special damages unless exceptional circumstances exist.

With Grid Electronics having changed its claim from general to special damages in respect of the rental amount, the court had first to determine whether the additional rent paid due to a delay in completion constituted general or special damages; and if it constituted special damages, whether Grid Electronics would be entitled to claim special damages in the circumstances.

In answering the first question, the court referred to the ruling in *Shatz Investments (Pty) Ltd v Kalovyrnas Ltd* (156/74) [1976] ZASCA 4, where the Appellate Division laid out the distinction between general and special damages. The court differentiated between:

“(a) those damages that flow naturally and generally from the kind of breach of contract in question and which the law presumes that the parties contemplated would result from such a breach, and

(b) those damages that, although caused by the breach of contract, are ordinarily regarded in law as being too remote to be recoverable, unless, in the special circumstances attending the conclusion of the contract, the parties actually or presumptively contemplated that they would probably result from its breach.”

While Hutchison and Pretorius (2022) define special damages as being “all damages that cannot be classified as general damages”, the wording from *Shatz Investments* is instructive in the determination of special damages. Point (b) above proffers a three-step test for special damages. First, it must be determined that the plaintiff, Grid Electronics, in this case, suffered a loss. Secondly, the plaintiff's loss must be a result of the defendant's breach. The third step requires a determination of whether the loss is considered too remote to be recoverable. If a loss resulting from a breach fits the criteria above, then it is deemed to constitute special damages. There is, however, an exception applicable in special circumstances where the parties contemplated or are presumed to have contemplated that such a loss would probably result from the breach in question. This exception forms part of the test for determining whether a defaulting party will be liable for special damages, as further expounded below.

The court held that a plaintiff's obligation to pay additional rent to its landlord is not a loss that generally flows from a defendant's breach of a contract for the supply of materials and the rendering of related services. Rather, such a loss is one that incidentally or indirectly affects other business affairs of the plaintiff. As a result, the court ruled that Grid Electronics' claim in respect of the rental amount was too remote and, thus, amounted to special damages.

Having ruled that the claim was one for special damages, the court then had to establish whether the exception applied in the circumstances. South African law of contract imposes two requirements that must be satisfied for a defendant to be liable for special damages (Diamond, 2016). First, the parties must have contemplated that the damage in question would probably result from the causative breach. Secondly, the parties must have concluded the contract based on their knowledge of the probable consequences of the breach. Only if the loss satisfies the above criteria can a plaintiff be entitled to a claim for special damages.

The ruling in *Shatz Investments*, although not specifically related to construction disputes, demonstrates the requirement that the parties must have contemplated the damages and acted with such knowledge. In *Shatz Investments,* a fast-food shop sued its landlord for loss of goodwill and profits resulting from the landlord's breach and subsequent cancellation of the lease between the two. The Appellate Division, in confirming an order granting special damages, held that at the time of concluding the contract, *both* parties were aware *and* acted with knowledge that cancellation of the lease would result in the store losing access to customers and a substantial amount of goodwill. The court, while acknowledging that these were not damages that naturally flowed from such a breach, held that the landlord must have contemplated that such a loss would result from his breach *and* had entered into the contract with such knowledge. Accordingly, it awarded special damages in favour of the lessee.

Similarly, the court in *Grid Electronics* had to determine whether, at the time of the contract's conclusion, there were any special circumstances indicating that both parties had contemplated that the damages in question would likely result from such a breach. If the parties contemplated that a delay in completing the structure would likely result in Grid Electronics paying additional rent, and they concluded the contract based on that knowledge, then SM Structures would be liable for the resulting special damages. The court found that no such special circumstances existed, stating that:

"…when Grid Electronics and SM Structures – especially the latter – concluded the agreement there must not only have been common knowledge that such a loss would ensue on breach of the contract, but the parties must have entered into the contract on the basis of such knowledge. In other words, the parties (especially SM Structures) must have understood that, in the event of the completion of the structure being delayed, Grid Electronics would be forced to continue renting alternative premises…"

It is unlikely that a contractor would conclude a contract based on the knowledge that, if the completion of the structure were to be delayed, the contractor would be liable for the employer's rental costs – costs possibly exceeding the actual contract price. The court held that, on a balance of probabilities, SM Structures would not have, with such knowledge, entered into the contract with Grid Electronics. Consequently, the court found that, unlike in *Shatz Investments*, there was no evidence of special circumstances in which the parties had contemplated that such damages would likely result from the breach in question. Accordingly, the court dismissed the claim for special damages and granted only general damages of R103,618.45 plus interest, as the reasonable cost of remedying the defective performance of SM Structures.

4. Conclusion

This judgment reaffirms the contract law principle that, for a claim for special damages to succeed, the parties to a contract must have had prior common knowledge of the probable result of the breach and acted based on such knowledge. Only in such circumstances will the defaulting party be deemed to have agreed to bear the consequential loss. The judgment is also instructive in relation to the approach taken by South African courts in determining the quantum in claims for general damages.

Further, the approach taken by the court in *Grid Electronics* encapsulates several contract law principles that transcend construction contracts. Among these is a reaffirmation of the *parol evidence* rule, in that, except in exceptional cases, courts will not accept extrinsic evidence when adjudicating contract disputes. In this case, as there was no express provision in the contract regulating special damages, the court sought – on a very limited basis – to determine if there was any extrinsic evidence indicating that the parties likely contemplated that special damages would likely flow from the breach in question. This is what is referred to as the ambiguity exception to the *parol evidence* rule. The very name of the exception emphasises the importance of expressly and effectively regulating the terms of a construction contract, or any contract for that matter. It is crucial that damages and any other key terms are unambiguously stated to provide clarity regarding the risk allocation between parties without requiring judicial intervention. Lastly, and linked to the above, the ruling is an enforcement of the *pacta sunct servanda* principle, or the "agreements must be kept" rule. Much like the *parol evidence* rule, this rule emphasises the importance of clearly stated contract provisions, especially those relating to risk allocation and the consequences of a breach. Parties will be held to the terms they have contracted to; and in construction contracts, where damages resulting from breaches and disputes may amount to millions, it is crucial that parties clearly define the terms they will be held to. The following section proffers a solution centred around crisp drafting of contracts, and specifically, effective risk allocation.

5. Recommendations

Special damages, by virtue of the fact that they do not ordinarily flow from a particular breach, present a clear risk of unforeseen liability for parties to any contract. The consequences of such liability may be dire for the defaulting party. The *Grid Electronics* case serves as an apt demonstration of this. Here, the contractor entered into a contract worth R435,500, but could have, if special circumstances existed, found itself losing R428,506.08 of that to a claim for special damages. The risk is even more amplified in larger construction projects. While R428,506.08 is no small change, it pales in comparison to the millions – even billions – of Rand worth of special damages that a defaulting party may find itself liable for in large-scale construction projects. It is, therefore, important for parties to construction contracts to ensure they are adequately protected from the risk of liability for special damages. An effective way to achieve this is to have a clearly defined regime for the treatment of special damages in the contract. To this end, construction contracts often include provisions that expressly exclude liability for special damages. Below is an example of such a provision.

"In no event shall any party be liable to the other party for any special, incidental, indirect, consequential, or punitive damages whatsoever (including, but not limited to, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or in connection with this agreement."

The effect of the above sample clause is that, even if special damages are proven, the parties have agreed in advance to exclude liability for them. There is, of course, no one-size-fits-all solution, and parties may agree to tailor such a clause to suit their unique circumstances. The express exclusion of special damages in construction contracts is not without its drawbacks. While it is important to protect parties from risk that is considered too remote, it does not address the risk that the non-defaulting party may still suffer losses due to the breach. How, then, is the non-defaulting party's risk mitigated?

One way to mitigate the non-defaulting party's risk is by including carve-outs to the exclusion of liability for special damages. These may include – on the part of the defaulting party – gross negligence, wilful misconduct, fraud, reckless conduct, or any other conduct that the parties agree should vitiate the exclusion of liability. The ultimate intention of such carve-outs is two-fold. First, it is to incentivise the parties to conduct themselves in a manner that reduces the risk of breaching the contract, and, by extension, the likelihood of the consequential damages that may result from such breaches. Secondly, it is to provide the non-defaulting party with recourse and entitle it to special damages in the event that such damages result from the defaulting party engaging in conduct such as fraud, gross negligence, or wilful breach. In this regard, the above sample clause may be augmented as follows:

"In no event shall any party be liable to the other party for any special, incidental, indirect, consequential, or punitive damages whatsoever (including, but not limited to, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or in connection with this agreement, other than in the case of liability arising from:

i. fraud;
ii. gross negligence;
iii. wilful breach of this agreement;
iv. reckless misconduct;
v. a breach of the National Building Regulations and Building Standards Act; or
vi. abandonment

by a party (the defaulting party)."

The above carve-outs are not an exhaustive list, and the parties may include any other acts or conduct they deem necessary, as the context requires.

In drafting exclusions of liability, parties to a construction contract – or any contract for that matter – must take caution not to include limitation clauses that are unclear, or which may be interpreted by the courts as unfairly one-sided, or limitations of liability that are precluded by law. South African courts, while reluctant to limit parties' rights to contract as they wish, have previously set aside limitation clauses in such cases. For example, in *Belet Industries CC v MTN Service Provider (Pty) Ltd* (936/2013) [2014] ZASCA 181, the Supreme Court of Appeal set aside a limitation clause on the grounds that it was ambiguous when read in the context of the agreement as a whole. While the exclusion of liability was upheld in *Barkhuizen v Napier* (CCT72/05) [2007] ZACC 5, the Constitutional Court noted that there may be circumstances in which an exclusion of liability could be set aside on the grounds that it violates public policy. To mitigate this risk, parties to construction contracts should seek guidance from local and international contract forms such as the FIDIC *Conditions of Contract for Plant and Design-Build*, the NEC 4 Engineering and Construction Contract (ECC) and the Joint Building Contracts Committee (JBCC) Agreements, and utilise or amend the damages clauses therein as applicable to their needs. For example, Clause 17 of the FIDIC *Conditions of Contract for Plant and Design-Build* contains an express exclusion of indirect damages, subject to certain caveats. In order to effectively regulate the position, parties may, as proposed in the sample clause above, amend this clause to suit their specific circumstances. Each of the aforementioned contract forms contains similar clauses.

Ultimately, it is a balancing act between protecting parties from liability that is too remote to have been contemplated, while also ensuring that non-defaulting parties are not unfairly prejudiced. Parties to construction contracts should ensure that special damages are adequately and unambiguously specified in the contract.

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JCBM (2025) 8(1) 7-13

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

State of Women's Employment and Education in South Africa

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Portal Publishing

https://doi.org/10.15641/jcbm.8.1.1894

Abstract

DEEP-IDEA SA Workshop provided an update on the British Commission-funded research project between the Universities of Plymouth, Reading, and Cape Town, focusing on the inclusion of women in construction and the potential positive impact of digital technology. This keynote speech commenced with a visualisation of the beautiful, rural countryside of the Eastern Cape during the late 1960s. Exclusion from mathematics and science subjects applied to all black Africans; additional limitations existed on women, for example, limitations of movement and job opportunities; and the legal status of minors, reversed only by the 1996 final Constitution. Applying cultural-historical activity theory provides insight into progress made, but also the magnitude of the challenge that faced South Africa in 1994, persisting to date. Women now fulfil a range of roles, many at management level, particularly evident in the banking sector, administrative roles, and within the police service. In the construction sector, however, fewer women are employed, although in the informal construction sector, which has grown slightly faster than the formal sector, women have established and lead construction companies. Nationally, women constitute 51% of the population. In education, females have overtaken males at the secondary school level, and now predominate in tertiary enrolment. Registration of women is limited in areas of: electrical infrastructure, engineering, architecture and built environment. Exclusion from mathematics (as opposed to mathematics literacy) and science limits entry to technical qualifications. The unemployment level remains a source of concern, with youth between 15 and 24 years of age at 62.4%, disproportionately affecting young women. The Presidential Youth Initiative, part of the Basic Education Employment Initiative, recommenced in 2025 to offer 200,000 school assistant opportunities. These statistics provide the agenda for participant discussion, including obstacles to mathematics provision.

Keywords: Young women, employment, education, cultural-historical activity theory, historical legacy

1. Background to Workshop

DEEP-IDEA SA refers to the Digital Equity Enabling Platform for Inclusivity, Diversity, Equality, and Accessibility in the South African construction industry. The research partnership of Dr Oladinrin and Dr Alencastro, both of the School of Art, Design and Architecture, Faculty of Arts, Humanities and Business, Plymouth University, UK and Professor Windapo of the Construction Economics and Management Department within the Engineering and Built Environment Faculty of the University of Cape Town (Oladinrin et al., 2025) is supported by the British Council. This workshop explores strategies to advance digital equity within the South African construction industry. The scope includes examining existing digital divides, identifying barriers to inclusive participation, and showcasing innovative tools and practices that foster inclusivity, diversity, equality, and accessibility in construction-related education, practice, and policy. The comparative research of Dr Rana, of Construction Management, University College of Estate Management, Horizons, Reading, UK (Rana et al., 2025) provides insight into the exclusion of women in Brazil, despite their achieving higher education. This article derives from the keynote speech, which contrasts the historical legacy with the current status of South African women in education and employment, and is supplemented by additional relevant references.

2. Introduction - the South African historical context

Time-travel back in time, to the mid- to late 1960s, during the apartheid era in South Africa. We are

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travelling to the Eastern Cape. For those who have never been there, we find rolling green hills, covered in lush, green vegetation, and with homesteads dotted around the hills. Looking for water, we go down to a river running down through a gorge to the sea. When we reach the sea, we find a wide sandy beach with rocky outcrops. Looking out to sea, we would likely see a pod of dolphins swimming past. In this beautiful, rural countryside, there is a young woman whom we will name Nomusa. A young woman who walked with other school children from the area across the countryside to reach school, and had probably achieved what in those years was a Standard five pass – now Grade 7. Nomusa would like to find work in one of the towns or cities, such as Gqeberha (then Port Elizabeth), eThekwini (then Durban), or Cape Town.

However, there were obstacles a young woman would encounter:

- First, she would not be able to travel without the express written permission of her husband or father, but they would probably be away from home, working in the coal, gold, or other mines.

- Second, if Nomusa did manage to reach town, as some young women did travel without permission, what employment was available to her? Jobs were restricted by apartheid-defined race, but also by sex. Women – all women, including the privileged women, were excluded from many jobs. Nomusa could, however, work as a Domestic Worker or as a Nanny.

- Third, Nomusa would not have been able to conclude a legal contract without the signature of her husband or another male relative. All women – including privileged women - were not legally considered adults, and so could not conclude a legal contract alone.

Now, we look around to consider this room and recognise where we are currently. We are in a room with many women, many with tertiary education, who are legally able to conclude contracts. The example above was used because this address explores the realities of women in education and employment today, and particularly to highlight the challenges for women within the context of the construction sector. The theoretical approach considers all aspects through the lens of Cultural-Historical Activity Theory (CHAT). We commence with the historical context as it provides us with insight into how we got here, and addresses the social and cultural contexts from the perspective of the object of our activities, and the constraints within which we work.

The example of Nomusa highlights the legal constraints within which women existed, not so many years ago, with restrictions on movement, educational quality, and opportunities to earn an income. Equality – in theory – was attained officially, with the *Bill of Rights,* which is Chapter 2 of the *Constitution* (Republic of South Africa, 1996). There are too many to list in this context, but South Africa has also signed a range of International Conventions; African Union (AU) and Southern African Development Corporation (SADC) Protocols; and introduced a range of statutes to provide equality of opportunity and protection to women. For those interested in pursuing the statutory and policy documents (Commission for Gender Equality, 2023). There is no doubt that we have made progress, but it is erratic, and we need to work towards ensuring that any steps moving us forward are maintained. Returning to the question of how we got here, the introductory vignette ensures that we acknowledge that we have made progress, but equally, that we do not underestimate the size of our challenge, as it existed in 1994, and continues to date.

3. Where are we now?

We may use observation: in addition to all the women present today, let us consider what we observe outside these walls.

In preparation for this address, some recent experiences are noted and reported as follows:

- When visiting my local police station to have documents certified, a young woman Constable assisted us. I observed another Constable walk through, and she stopped to talk to a third woman, who looked like the senior, although I could not see her badge.

- At my local bank, the majority of employees are women, including those in senior positions, and the Security Guard at the entrance was also female.

- At my local Hypermarket, virtually all the cashiers and customer care employees are women, although the management is mainly male.

- Driving on the way to the shopping mall, there was the usual line of male roadside work-seekers on the pavement, some carrying paint rollers, some spirit levels, and some sitting on the ground playing a board game, while they wait.

These simple observations present our first indication of the differences between economic sectors.Therefore, it is useful to consider our national demographic statistics. Once we have that picture, we can compare the breakdown by sex in levels of education and employment.

3.1. South African national demographic structure

Our national demographic picture is drawn from the Mid-year 2025 Population Estimates, provided by Statistics South Africa (StatsSA), which put the national population at 63.1 million, of which 51% are women. The nation has grown by 6 million since 2002

(StatsSA, 2025b). Figure 1 Illustrates the national demographic breakdown in 5-year steps, illustrating the predominantly young population:

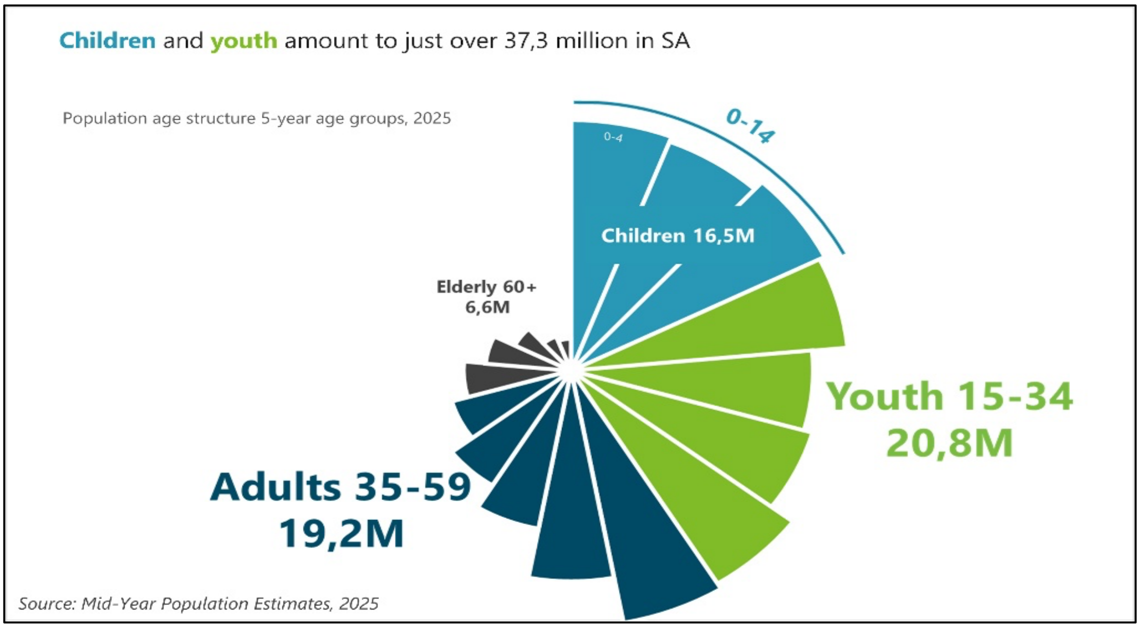

Figure 1: National demographic breakdown in 5-year steps (Maluleke, 2025a: 9)

Figure 1 shows that the group of most interest to us is aged 15-34 – the group we assume will be in further and higher education, or moving into employment. Looking further into the StatsSA information, specifically relating to women, we note that there is a drop in the number of children that a woman is predicted to have – fertility drops from an average of 2.78 children per woman in 2008, to 2.21 in 2025 (StatsSA, 2025b: 2).

Why is this significant? A drop in female fertility – internationally - appears to correlate with an increase in the level of women's education. The World Bank has investigated whether this is simply a correlation or whether there is a causal link. A World Bank Blog article is useful because it derives from research in African countries, concludes that there is a causal link between increasing female access to education and a reduction in childbearing (Pradhan, 2015).

3.2. National statistics on education

In South Africa, everyone has a right to basic education, as stated in the Adult Basic Education (AET) Act (Republic of South Africa, 1996). Additionally, since 2022, all Early Childhood Development Centres (ECD) have been transferred from the Department of Social Development to the Department of Basic Education. The COVID-19 pandemic delayed the transfer of responsibility; but the concept of the transfer: is included in the *National Development Plan 2030 (Republic of South Africa, 2011);* gave effect to a decision of the African National Congress in 2015, and President Ramaphosa mentioned the transfer in the 2019 State of the Nation Address, for full details of transfer see (Parliamentary Monitoring Group, 2022). The intention is to provide a better foundation to give effect to the human right that all children should be allowed to develop to their full potential, for details confirming the contribution of ECD to later success in life (United Nations Children's Fund (UNICEF), n.d.).

The StatsSA Census figures for 1996 and 2022 illustrate the improvements made in education overall. Table 1 illustrates the overall national improvement in levels of education.

Table 1: Improvements in national educational levels, particularly secondary education

1996	2022	1996	2022	1996	2022	1996	2022
No schooling, Primary/less		Some Secondary		Completed Secondary		Post-school	
47.5	19.5	31.1	31.6	13.8	35.4	6.6	12.7
StatsSA Census 1996 & 2022 - in percentages							

(StatsSA, 2024: 15)

Table 2 shows the level of attainment in Tertiary education by sex, in percentages.

to 38.3% in 2011, and to 48.8% in 2022 (StatsSA, 2024: 18)

Table 2: Improvements in the balance of males and females at the Tertiary education level

1996	2022	1996	2022
Male		Female	
8.6	12.3	6.7	13.1
StatsSA Census 1996 & 2022 - in percentages. Female attainment closed the gap and slightly surpassed males			

(StatsSA, 2024: 17)

What subjects are women studying in tertiary education?

The StatsSA Census 2022 highlights that women remain in the minority in specific fields. Particularly of relevance to the construction sector are: Electrical Infrastructure, Engineering, Architecture and the Built Environment. Table 3 illustrates. What are the national figures on women currently registered in further and higher education?

Although progress has been made in the levels of educational achievement, the South African national unemployment statistics remain a persistent source of depression for all. The latest StatsSA 2025 Quarterly Labour Force Survey (QLFS) provides the figure of 32.9% unemployed, with the expanded rate at 43.1% (StatsSA, 2025a: 8). The following Figure 2 illustrates comparative growth in the formal and informal sectors:

The formal sector, which has traditionally provided the

Table 3: Fields of education by sex, in percentages, illustrating where females are in the minority

Fields of education	Male	Female
Electrical Infrastructure	82	18
Security & Intelligence Services	68.4	31.6
Military Sciences	75.8	24.2
Engineering	80.6	19.4
Architecture & Built Environment	70.6	29.4
Computer & Information Sciences	61.5	38.5
Philosophy, Religion & Theology	66.1	33.9
Agriculture Agricultural Operations & Related Sciences	64.9	35.1

(StatsSA, 2024: 44)

3.3. The statistics on employment by sector

In 1996, only 21.4% of the working-age population had at least completed Secondary education; this increased

majority of employment opportunities, accounted for 68.1% in the first quarter of 2025, decreased by 245,000, but the informal sector increased by 17000.

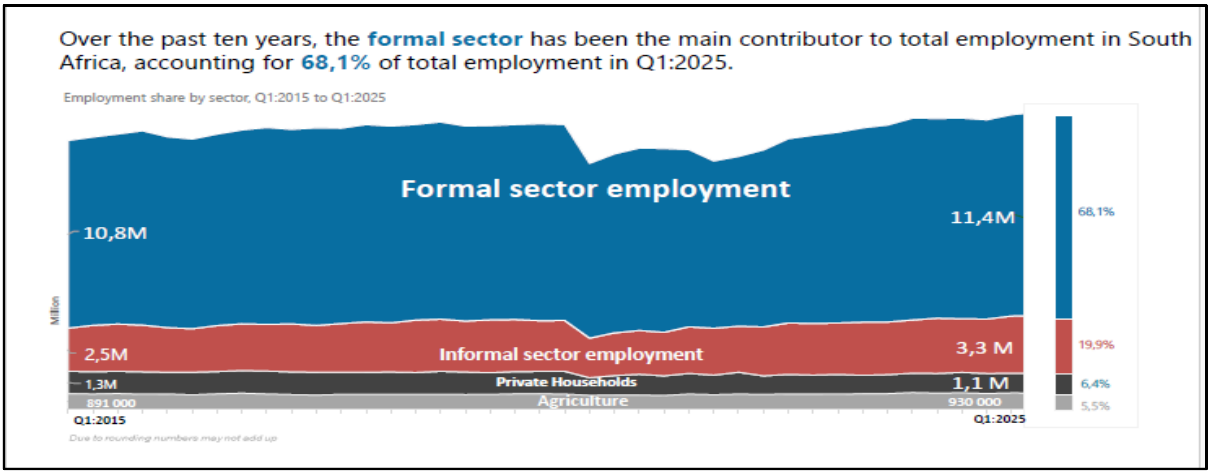

Figure 2: Comparison of formal and informal sectors, illustrating the growth of the latter sector (Maluleke, 2025b: 13)

There are regular debates among economists about the size of the informal sector, with many viewing the informal sector as the new site of business, particularly in banking, wholesale, and retail. The nature of the construction sector remains a significant source of employment, including sub-contracting of a range of artisan roles, as well as labour and semi-skilled roles, providing income for a range of roadside work-seekers (Hammond et al., 2016).

The graduate unemployment rate increased to 11.7%; however, that is still significantly less than the unemployment rate for those with a "matric" (Grade 12), and for those with less than Grade 12, the percentages are 34.9% and 39%, respectively. The key unemployment rate is that rate for youth between 15 and 34 years, which stood at 36.9% in 2015, but has increased to 46.1% in 2025 Q1. Figure 3 below provides a detailed breakdown, illustrating the challenge of youth unemployment for those between the ages of 15 and 34.

Blade Nzimande, noted that although access to education by women has improved, the labour market continues to prioritise employment of males, and within employment that pay discrimination against women persists (Siebritz, 2022). An initiative specifically focused on youth, the Presidential Youth Employment Initiative (PYEI), which forms part of the Basic Education Employment Initiative (BEEI), was implemented in 2020 across all nine provinces. One of the most popular interventions was that of education assistants and general school assistants (Siebritz, 2023). This PYEI intervention was reintroduced in 2025 as phase V, with a target of 200,000 job opportunities, and an increased focus on reading and literacy (Government Communications and Information System (GCIS), 2025).

3.5. Considering employment and education together.

Looking at our picture on education, women are now more likely to pursue tertiary education, but are not participating in the science, technical, and engineering

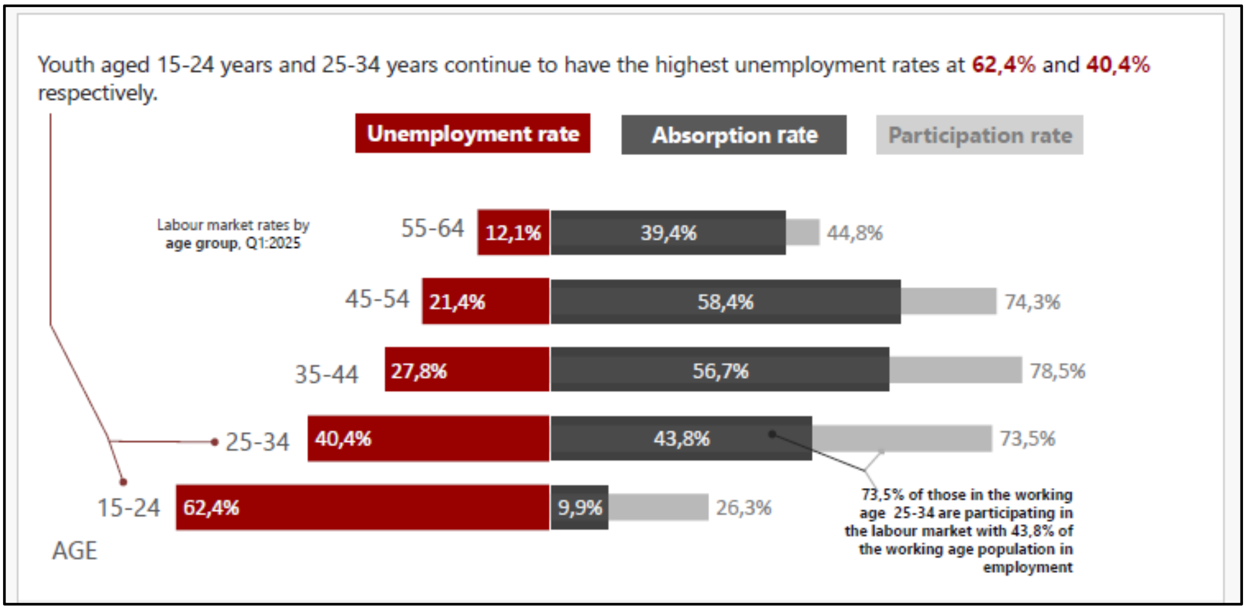

Figure 3: Youth Unemployment by age range with absorption and participation rates

3.4. Unemployment rates of women

The QLFS for Quarter 1 2025 records that the construction sector had reduced by 119000 jobs (Maluleke, 2025b: 31). Young persons between the ages of 15-24 and 25-34 have the highest unemployment rates. Additionally, young females aged 15-24 years: 37.1% were not in employment, education or training (NEET) in this quarter, which is a 1.0% percentage point increase from the comparative Quarter 1 of 2024 (Maluleke, 2025b: 27).

The following media reports indicate the focus on women in employment and some of the initiatives implemented. In a speech to the Ministerial Higher Health Roundtable on Youth Health and Wellness, the (then) Minister of Higher Education and Training,

type programmes. Does that constitute an answer as to why women predominate in some sectors more than others, and is this the main factor in the construction sector?

From some informal research, conversations and anecdotal reports, these are some minor observations. One factor that immediately emerges is the gatekeeper effect. This is not new, but it continues. The gatekeeper may be the owner of a small business, for example, a franchise. While at some petrol stations, we can find women filling vehicles. Speaking with local petrol attendants and forecourt management, one response I had was that the management prefers for women to work as cashiers.

In larger organisations where we find Human Resource people conducting the recruitment, one reservation about young women is that they may require maternity leave. I have recently been pursuing the situation for young women on Learnerships (for international visitors, Learnerships lead to an occupational qualification – comparable to apprenticeships). Theoretically, on Learnerships, young women are entitled to maternity leave. However, several complications arise, including payments into the Unemployment Insurance Fund to which learners on Learnerships are now entitled, and practical questions of how to accommodate the knowledge component of the qualification when the others have completed the programme.

A surprising negative view I experienced some time ago, when trying to consider a woman for a forklift driver position: the person objecting was the union shop steward, who, in all seriousness, advised me that women could not drive forklifts because it would prevent them from becoming pregnant.

In construction, from personal experience of informal contractors, it is notable that many informal contractors will talk with pride about their fathers and grandfathers, who have worked in construction before them, particularly stressing that they were quality conscious, and would require sub-contractor builders or artisans to redo work that was not to standard. Is it the depth of legacy that women lack in integrating into construction?

One area of research into gatekeeping that is more limited is what exactly constitutes workplace culture, and how does that impact employment?

4. Conclusion

Overall, unemployment remains a key issue; however, the informal sector continues to grow despite all obstacles. Women are enrolling for tertiary qualifications more than men, but what are the obstacles to them enrolling for the science and technology programmes? Is it the subjects they are offered at school? One of the current debates is whether too many students are enrolling for Mathematics Literacy instead of pure Mathematics. Does the apartheid legacy linger in the form of resistance to – rather than statutory exclusion from – Mathematics and Science?

These statistics and questions provide a background for further discussions and presentations on progressing towards a digital transformation.

"Dream big and aim higher" – anonymous.

Note from post-speech discussion

A workshop participant pointed out that many students are not able to study pure mathematics because some schools do not have teachers able to deliver the subject. Therefore, the systemic exclusion from mathematics in basic education is one of the factors prolonging exclusion from technical and engineering careers.

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JCBM (2025) 8(1) 14-29

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Construction Claim Management among Small and Medium-Sized Contractors: A Case Study of Sri Lanka amidst its Financial Crisis

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Received July 8, 2024; received in revised form October 4, 2024; January 5, 2025; May 23, 2025; accepted July 11, 2025
https://doi.org/10.15641/jcbm.8.1.1560

Abstract

This study reviews construction claims management among Small and Medium-sized Contractors (SMCs) in developing countries, focusing on Sri Lanka during its financial crisis. Economic crises intensify the sector's inherent risks and complexities, increasing claims and delaying project delivery for SMCs. The research identifies deficiencies in current claims management practices and suggests strategies for improvement during such events. A mixed-method approach, including literature reviews, surveys, and expert interviews, explores claim types, origins, and the specific impacts of exceptional events on SMCs. The findings highlight challenges such as skill shortages, gaps in contractual knowledge, insufficient delay analysis, inadequate documentation, high staff turnover, and poor negotiation and communication. To address these issues, the study proposes strategies such as implementing robust record-keeping systems, improving contractual knowledge through staff training, and fostering better collaboration and communication with project stakeholders to enable SMCs to manage claims effectively during economic crises. This research provides practical suggestions to improve claims management practices and build resilience for future crises, contributing to the stability and development of the construction industry in similar contexts.

Keywords: Construction claims, Economic crises, Small and Medium Contractors, Sri Lanka, Claim management.

1. Introduction

Construction claims are formal requests, commonly made by contractors, for time extensions or cost compensations, often arising from contract ambiguities, delays, or additional work, due to the involvement of multiple stakeholders (Reta et al., 2019; Shaikh et al., 2020). Effective claims management is crucial for ensuring fairness, controlling costs, minimizing delays, and resolving disputes in construction projects, ultimately contributing to their successful and timely completion (Umar & Ochigbo, 2024; Ssegawa & Keakile, 2023). From the contractor's perspective, the preparation and submission of claims require substantial evidence and documentation, making the process intricate and demanding (EL-Ghrory et al., 2019). Failure to substantiate reasonable claims can lead to additional costs and misallocation of resources, further complicating project management (Taofeeq et al., 2019).

The construction industry is characterized by its complexity, as each project demands distinct methods, techniques, and approaches, which in turn generate a range of risks that can influence project quality, cost, and schedule (Oke et al., 2023). In Sri Lanka, these challenges are further intensified during economic crises influenced by high inflation and the impacts of COVID-19. The pandemic disrupted construction activities, resulting in delays and additional costs, leading to numerous claims for extensions and compensation (Aceris Law, 2020). High inflation has caused abrupt price rises and currency devaluation, making it difficult for contractors to claim compensation for price escalations due to the exclusion of price escalation clauses in several tenders that violate National Procurement Guidelines (CIOB, 2021).

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SMCs play a crucial role in the construction sector, generating employment and contributing significantly to economic development (Ranadewa et al., 2018). However, SMCs in Sri Lanka face numerous challenges, including financial constraints, resource limitations, and a lack of technical expertise, impacting their ability to manage claims effectively (Tezel et al., 2020; Jayasanka et al., 2021). The economic crisis has led to increased claims due to government regulations, material shortages, and other unpredictable events, placing additional strain on SMCs' already limited resources (Jayasanka et al., 2021).

The difficulties SMCs face in claim management are compounded by their limited institutional knowledge and fewer resources compared to larger organizations (Ssegawa & Keakile, 2023). Issues such as lack of skilled staff, poor record-keeping, inadequate documentation, and insufficient delay analysis further hinder their ability to manage claims effectively (EL-Ghrory et al., 2019; Jayasanka et al., 2021). High staff turnover and poor negotiation and communication skills exacerbate these challenges, making it difficult for SMCs to substantiate claims and secure fair compensation (Hansen & Rostiyanti, 2019).

Despite the importance of claim management, there is a notable lack of studies focusing specifically on SMCs, particularly within the context of developing countries like Sri Lanka. In light of this gap, there is a critical need to enhance the claim management processes of SMCs, especially during periods of economic crises, such as the COVID-19 pandemic. This study aims to identify the deficiencies in the existing claims management practices and propose strategies to improve them, particularly during exceptional events. Addressing these challenges is crucial to prevent disputes, ensure project continuity, and enhance the resilience of SMCs. By focusing on the specific issues faced by SMCs, this research will provide valuable insights and practical recommendations to improve claims management processes. Ultimately, this study aims to increase the success rate of claim submissions for SMCs in Sri Lanka, thereby contributing to the overall stability and development of the construction industry in developing countries during financial crises and other exceptional events.

2. Literature review

2.1. Small and Medium-Sized Contractors in Sri Lanka

SMCs are essential to the economic infrastructure of developing countries, providing employment and driving innovation (Ye & Tekka, 2020). They contribute to product innovation, research and development, and poverty reduction (Ahiawodzi & Adade, 2012). According to the Construction Industry Development Authority (2015), an organization with a grade between C2 to C6 falls under the category of SMCs for Sri Lanka. The construction sector is widely considered one of the riskiest business sectors, particularly challenging for SMCs in Sri Lanka (Ranadewa et al., 2018). SMCs typically lack the manpower, financial resources, and knowledge required to adopt new technologies and effective development plans compared to large contracting organizations (Agwu, 2014; Hosseini et al., 2016). For SMCs, the most critical challenges include project delays, budget overruns, excessive resource use, construction waste, and poor construction quality (Handayani, 2017). Additionally, high interest rates, limited access to capital, and dramatic increases in energy costs are constant threats faced by SMCs in the industry (Ranadewa et al., 2018).

2.2. Construction Claims

Construction claims are requests made by one of the contracting parties, typically the contractor, for compensation for losses incurred due to the other party's failure to fulfil contractual obligations (Likhitkar, 2022). Claims are a common cause of disagreement between contractual parties in construction projects and can divert significant resources both financially and in terms of staff time from ongoing projects (Sibanyama et al., 2012). A contractor may claim additional compensation due to alterations in the contract, while an employer may seek compensation for additional work not adhered to by the contractor (El-Wakel, 2006). Many project stakeholders view construction claims as unpleasant and disruptive aspects of a project (Shah et al., 2014). The number of claims in construction projects is increasing, making effective claims management essential to avoid disputes and ensure project completion (Apte & Pathak, 2016). Claims can be categorized into several types, including contractual claims, extra-contractual claims, ex-gratia claims, and quantum meruit claims. As shown in Table 1 (Appendix 1), many factors cause claims in projects (Bakhary et al., 2015).

2.3. Claim Management

Claim management involves the coordination of stakeholders for evaluating and resolving claims to ensure fair compensation and avoid disputes (Kululanga et al., 2001). The claim management process includes identification, notification, substantiation, documentation, presentation, and negotiation (Zaneldin, 2006). Effective claim management is crucial for maintaining project timelines and budgets, especially during exceptional events that disrupt normal operations. Table 2 (Appendix 1) summarizes the major issues associated with the claim management process in the construction industry.

In the Sri Lankan context, the six stages of construction claim management are followed as they are, but with slightly different terms (Piyumra & Disaratna, 2023).

Further to the authors, the absence of a standardized format in claim documentation requires contractors to utilize past experiences, reusable project knowledge, and a collaborative organizational culture to effectively manage the process.

2.4. Exceptional Events and Their Impact on Construction

The COVID-19 pandemic and periods of extraordinary inflation have had profound effects on the construction industry, causing delays, cost overruns, and increased claims. The pandemic, classified as a force majeure event, disrupted construction activities worldwide, necessitating extensions of time and additional cost claims (Shaughnessy et al., 2020). It led to severe disruptions globally, resulting in project suspensions, job losses, and bankruptcies in the construction sector (Gamil et al., 2022).

Despite the world having experienced significant pandemics before, no one was prepared for COVID-19, highlighting the need for robust claim management practices to navigate such events (Vithana et al., 2020). Inflation, particularly in material prices, poses another significant challenge, affecting project costs and timelines. The fluctuating prices of materials and the resulting cost overruns necessitate adjustments and claims for price escalations (Oghenekevwe et al., 2014).

2.5. Issues in Claim Management Practices

The construction industry faces numerous challenges in managing claims effectively. Key issues include a lack of awareness among site staff, inadequate documentation, and poor negotiation skills. These deficiencies often lead to disputes and financial losses for contractors (Tochaiwat & Chovichien, 2004).

Hayati et al. (2019) stated that the contracting environment is relatively more competitive with a larger number of players and narrow profit margins. Contractors bid for projects with underestimated contract amounts to sustain in the industry (Shah et al., 2014). Oyediran (2006) highlighted that the inflation rate can significantly affect the economic accruals or rate of return for contractors, resulting in a loss of profit. Effective claim management practices are essential to mitigate these impacts and ensure financial stability for contractors during exceptional events.

Effective management of construction claims is critical for the success of construction projects, particularly for SMCs in developing countries. The challenges posed by exceptional events like the COVID-19 pandemic and extraordinary inflation necessitate a robust and adaptive claim management system. Addressing the identified issues in claim management practices can significantly improve project outcomes and resilience in the face of future crises.

3. Methodology

This study employed a mixed-methods research design, integrating quantitative and qualitative approaches to address the research objectives comprehensively. A mixed-method approach is particularly effective for investigating complex research problems, as it combines the depth of qualitative data with the broader generalizability of quantitative data, thereby providing a comprehensive understanding of the research subject (Gerzso & Riedl, 2024). As part of this research, the mixed-methods design facilitated identifying and prioritizing key issues in construction claim management through quantitative surveys, enabling the development of a clear hierarchy of challenges encountered by SMCs. Concurrently, qualitative expert interviews provided in-depth, context-specific insights, allowing for the formulation of tailored solutions that address the distinct conditions of Sri Lanka's construction industry. This integrative approach combined the statistical rigor of quantitative analysis with the contextual richness of qualitative findings, ensuring robust and applicable recommendations.

Quantitative data was collected using a structured questionnaire survey to identify and rank the types and causes of claims experienced by SMCs in Sri Lanka since the emergence of COVID-19. A snowball sampling method was used to reach a diverse respondent base. The survey captured the frequency and relative importance of different claim types and causes. Complementing the quantitative data, qualitative data was obtained through semi-structured interviews with industry experts. These interviews provided in-depth insights into the issues faced in current claim management practices, and strategies to overcome these issues. Purposeful sampling was employed to select participants based on their expertise and experience in claim management.

The Relative Importance Index (RII) method was employed to analyse the quantitative data, allowing for the ranking of claim types, causes, and related issues based on their frequency and perceived importance. This method provided a clear understanding of the most critical challenges in claim management. The RII values were calculated using the formula $RII = \sum W / (A * N)$, where W is the weight assigned to each factor, A is the highest weight, and N is the total number of respondents.

Qualitative data from the semi-structured interviews was analysed using content analysis, allowing for a detailed examination of the responses to identify key themes and patterns. This systematic approach ensured the research objectives were effectively met, providing a comprehensive understanding of the claim management practices among SMCs in Sri Lanka and proposing strategies to enhance these practices during exceptional events. The findings were validated through triangulation of data sources and methods, ensuring the reliability and validity of the research results.

4. Findings and Discussion

The findings presented in this section are derived from a comprehensive data collection process involving experienced professionals in construction claim management and SMCs, gathered through the questionnaire survey, followed by semi-structured expert interviews.

4.1. Phase One: Questionnaire Survey

The first phase involved a questionnaire survey focusing on types of claims, causes for claims since the emergence of COVID-19, and the importance of effective claim management for SMCs in Sri Lanka. A total of 45 adequately filled questionnaires were returned out of those administered, achieving a response rate of 38%. The response rate of 38% is considered adequate given the severe financial crisis during the survey period, where many SMCs had halted operations or were facing extreme difficulties, making it challenging for the professionals associated with them to participate in non-essential activities like surveys within a limited time frame. This response rate aligns with similar studies conducted during economic crises. For example, a study on the impact of COVID-19 on SMEs in China reported a response rate of just 10.7%, yet statistically confirmed with no significant non-response bias within the sample (Du et al., 2022). The respondents included a range of professionals such as Quantity Surveyors, Senior Quantity Surveyors, Project Managers, Contract Administrators, Contract Managers, and Directors, with varied years of experience in the construction industry and claim management as illustrated in Table 3.

The survey primarily concentrated on professionals employed by SMCs despite the financial crisis, rather than those with only prior experience in SMCs. Consequently, the respondent profile itself reflected a significant challenge faced by SMCs in retaining staff amid ongoing skill emigration and competition with larger organizations, resulting in a composition predominantly of those with less than 10 years of experience.

4.1.1. Types of Claims and Their Frequency of Occurrence

Table 1: Respondents Profile of Questionnaire Survey

Profile	Questionnaire Surveys		
	Variables	**Number of Respondents**	**Percentage**
Designation of the Respondents	Quantity Surveyor	8	17.78 %
	Senior Quantity Surveyor	11	24.44 %
	Project Manager	5	11.11 %
	Contract Administrator	10	22.22 %
	Contract Manager	7	15.56 %
	Directors	4	8.89 %
Working Experience Of Respondents	Below 3 years	11	24.44 %
	3 to 6 years	14	31.11 %
	6 to 9 years	13	28.89 %
	10 years or more	7	15.56 %

Table 2: Types of Claims

No	Code	Types of Claims	RII	RANK
1	T1	Extension of Time (EOT) Claims	0.89	1
2	T2	Acceleration Claims	0.61	6
3	T3	Different site condition Claims	0.56	9
4	T4	Contract Termination Claims	0.60	7
5	T5	Force Majeure Claims	0.72	4
6	T6	Contract ambiguity Claims	0.58	8
7	T7	Loss of Productivity Claims	0.62	5
8	T8	Price Escalation Claims	0.85	2
9	T9	Disruption Claims	0.83	3
10	T10	Ex-Gratia Claims	0.55	10

The survey identified and ranked the types of claims submitted by SMCs using RII analysis as illustrated in Table 4.

The results indicate that "Extension of Time (EOT) Claims" were the most frequently submitted claims with an RII of 0.89. This high frequency can be attributed to the widespread project delays caused by the COVID-19 pandemic, which necessitated extensions of project timelines.

"Price Escalation Claims" were the second most frequent, with an RII of 0.85. The economic instability and high inflation rates during the pandemic significantly increased construction costs, making price escalation claims common. "Disruption Claims" followed closely with an RII of 0.83, reflecting the interruptions in construction activities due to lockdowns and other COVID-19-related restrictions.

Other notable claims included "Force Majeure Claims" (RII 0.72) and "Loss of Productivity Claims" (RII 0.62). These claims highlight the broader impact of the pandemic on construction productivity and the invocation of force majeure clauses due to unprecedented disruptions.

Conversely, "Ex-Gratia Claims" had the lowest RII of 0.55, indicating that employers rarely granted these claims to SMCs. The low frequency of ex-gratia claims suggests a reluctance from employers to provide additional compensation beyond contractual obligations.

Additional claims identified by respondents, not listed in the initial questionnaire, included "Loss of Overhead and Profit Claims," "Claims Related to Common Law," "Claims Related to Delayed Payments/Interest," "Variation Claims," and "Suspension Claims." These additional claims underline the varied nature of issues faced by SMCs during the pa

4.1.2. *Causes of Claims*

The survey also ranked the causes of claims using RII analysis as illustrated in Table 5.

Table 3: Causes of Claims

No	Code	Cause of claims	RII	RANK
1	C1	Material Shortage	0.86	1
2	C2	Contractor financial problems	0.80	5
3	C3	Changes in government regulations and laws	0.80	4
4	C4	Suspension of work	0.72	11
5	C5	Delay caused by contractor	0.73	10
6	C6	Difficulty in the delivery of construction materials	0.78	7
7	C7	Delay in payments by owner	0.79	6
8	C8	Unexpected changes in exchange, interest, and inflation rate	0.83	3
9	C9	Changes in material & labor costs	0.85	2
10	C10	Poor planning and management by contractor	0.66	14
11	C11	Idling plant and equipment	0.71	12
12	C12	Additional demurrages paid on transit of materials,	0.64	15
13	C13	Extended site preliminaries	0.76	9
14	C14	Variations	0.78	8
15	C15	Termination of works	0.64	16
16	C16	Specifications & drawings inconsistencies	0.58	18
17	C17	Design errors or omissions	0.56	19
18	C18	Change in sequence of work	0.67	13
19	C19	Discrepancies between contract documents	0.62	17

The most frequent cause was "Material Shortage" with an RII of 0.86. The pandemic disrupted supply chains globally, causing significant delays in the delivery of construction materials and leading to frequent claims related to material shortages.

"Changes in Material & Labor Costs" was the second most frequent cause with an RII of 0.85. The economic instability during the pandemic led to sharp increases in material and labor costs, resulting in numerous claims for cost adjustments. "Unexpected Changes in Exchange, Interest, and Inflation Rates" followed closely with an RII of 0.83, highlighting the financial volatility experienced during this period.

Other significant causes included "Contractor Financial Problems" (RII 0.80), "Changes in Government Regulations and Laws" (RII 0.80), and "Delay in Payments by Owner" (RII 0.79). These causes reflect the broader economic challenges faced by SMCs during the pandemic, including financial strain, regulatory changes, and delays in receiving payments from project owners.

On the lower end of the scale, "Specifications & Drawings Inconsistencies" (RII 0.58) and "Design Errors or Omissions" (RII 0.56) were identified as less frequent causes of claims. These results suggest that while design and specification issues do occur, they were not as prevalent as other causes during the pandemic.

4.1.3. Quality of Existing Claim Management Practices

The survey results revealed significant dissatisfaction with the current claim management practices among SMCs in Sri Lanka as shown in Figure 1.

A substantial 49% of respondents rated the quality of existing claim management practices as "Poor," while 15% rated it as "Very Poor." Notably, no respondents rated the quality as "Excellent," indicating widespread recognition of deficiencies in current practices.
The dissatisfaction can be attributed to several factors. These include a lack of skilled staff, poor documentation practices, inadequate communication, and insufficient contractual knowledge. These issues are compounded by high staff turnover, which further hampers the ability of SMCs to manage claims effectively.

The high percentage of respondents rating the claim management practices as poor or very poor underscores the urgent need for improvements in this area. Addressing these deficiencies is critical to enhancing the ability of SMCs to navigate exceptional events such as the COVID-19 pandemic and to ensure fair compensation and project continuity.

4.2. Phase Two: Semi-Structured Expert Interviews

The second phase of data collection involved semi-structured interviews with industry experts to identify existing issues in the claim management practices of SMCs in Sri Lanka and to gather ideas for improving these practices. Eleven experts with extensive experience in the construction industry and claim management participated in these interviews. The

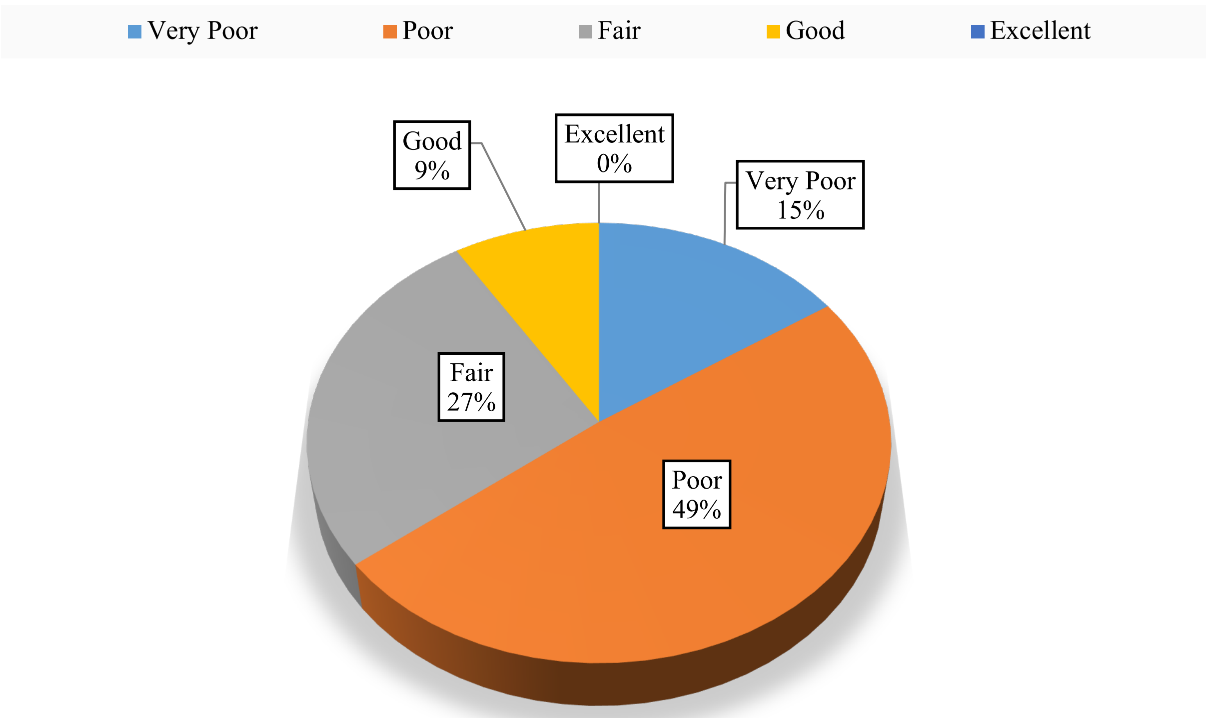

Figure 1: Quality of Existing Claim Management Practices

Table 4: Respondents Profile of Expert Interviews

Profile	**Expert Interviews (E1 to E11)**		
	Variables	**Number of Respondents**	**Percentage**
Designation of the Respondents	Managing Director	2	18.18 %
	Director	4	36.36 %
	Contract Administrator	4	36.36 %
	Senior Cost Manager	1	9.10 %
Industrial Working Experience Of Respondents	Below 10 years	1	9.10 %
	10 to 20 years	3	27.27 %
	20 to 30 years	2	18.18 %
	30 years or more	5	45.45%
Claim Management Experience	Below 10 years	3	27.27 %
	10 to 20 years	1	9.10 %
	20 to 30 years	5	45.45%
	30 years and more	2	18.18 %

participants in the qualitative interviews were selected using purposive sampling to ensure that only individuals with relevant expertise in construction claim management participated. This approach allowed us to engage with professionals who have direct experience with the issues faced by SMCs in Sri Lanka, ensuring the data gathered was highly relevant and insightful. The findings from these interviews provide a deeper understanding of the deficiencies in current practices and suggest practical recommendations for improvement. The profile summary of respondents who participated in the expert interviews is presented in Table 6.

The expert panel consisted primarily of senior-level professionals, with extensive industry experience, where 63.63% had over 20 years of experience in both the construction industry and claim management.

4.2.1. *Issues in Claim Management Practices in Sri Lanka*

The study conducted on SMCs in Sri Lanka reveals significant challenges across various stages of the claim management process, including Claim Identification, Claim Notification, Claim Substantiation, Claim Documentation, Claim Presentation, and Claim Negotiation.

4.2.1.1. *Claim Identification*

Claim identification entails “timely” and “accurate” identification of a construction claim (Kululanga et al., 2001). One of the most significant challenges identified in the claim identification stage is the failure to interpret contract terms and conditions accurately. According to most respondents (E1, E3, E5–E11), this issue is particularly critical for SMCs, often preventing them from submitting eligible claims. This challenge was highlighted as a result of a major issue resulting from lack of knowledge and the fear of damaging relationships with employers (E1, E3, E5-E11). This finding aligns well with Banwo et al. (2015) who discovered that inadequate knowledge and fear among staff during contracts executions as the common causes of contractual terms and conditions misinterpretation.

Further, the study results attribute failure to identify claims due to the lack of awareness among site staff resulting from insufficient training in claim identification (E7, E8, E10, E11). Most respondents attributed this issue to hiring unqualified claim detectors to save money (E8, E10, E11). Our study results are in line with Bakhary et al. (2015) who discovered that lack of qualified staff, awareness and training among staff always impede claim identification during contract executions. Finally, ambiguous responsibility and procedures were also cited as an issue that led to failure to identify claims (E7, E8, E10, E11).

4.2.1.2. *Claim Notification*

Construction claims notification entails notifying or alerting the other party of a potential claim in a non-adversarial manner (Sawyer & Gillott, 1990). Our results revealed claim notification as a challenge faced during execution of construction projects in Malaysia leading to extension of project execution time and high workload (E9, E10). Several respondents (E1-E4, E7, E8, E11) reported that site personnel and the head office had trouble communicating project information, changes owing to improper channels leading to staff ignoring mandatory project deadlines

4.2.1.3. *Claim Substantiation*

Claim substantiation involves establishing the legal and factual grounds on which the claim is to be based (Kululanga et al., 2001). The claim substantiation stage revealed several critical issues, including the unavailability of records, with most respondents (E4) noting poor record-keeping as a significant problem. This is also identified as a major issue during claim substantiation in the Malaysian construction industry (Bakhary et al., 2015). The failure to establish contractual or legal grounds for claims was also emphasized by many respondents, who attributed this to a lack of competence among staff. Problems with claim quantification were recognized by some respondents, while others found it manageable.

Inadequate time to thoroughly perform claim examination due to high workload was highlighted by E5, E6 and E7, though others disagreed, arguing that it is the contractor's responsibility to meet deadlines. The insufficiency of computerized machines for facilitating calculations was noted by some respondents, although others deemed it non-essential. A lack of knowledge among staff in delay analysis was strongly highlighted, with many respondents pointing out the absence of training and reluctance to invest in necessary software as major contributing factors.

4.2.1.4. Claim Documentation

In the claim documentation stage, ineffective record-keeping was identified as a significant issue by almost all respondents, who emphasized the need for proper documentation once a notice is issued to the Engineer. The documented facts are the glue that holds the legal framework together and the claim will be rejected if these hard facts are inadequate or unsatisfactory (Kululanga et al., 2001). The inaccuracy of recorded information was similarly highlighted. The absence of a proper computerized documentation system was debated, with some respondents finding manual systems sufficient and others advocating for computerized records. The inaccessibility of documents due to high staff turnover and restricted access to confidential data was also noted as a problem.

The failure to CVI was seen by many respondents as a critical issue, though some disagreed, viewing it as a contractor's responsibility. In the case of the quantitative study on ranking the issues in claim management practices in the Malaysian construction industry, this is identified as the most prominent one during the claim documentation (Bakhary et al., 2015). Poor records and documentation to support claims were highlighted by most respondents, who noted that the recent outsourcing of claim experts has begun to address this issue.

4.2.1.5. Claim Presentation

The claim presentation stage revealed issues such as the absence of a standard format for claim submission, with respondents noting that this complicates the preparation process. Some argued for the necessity of a flexible approach based on claim type. Poor documentation quality, often due to inadequate language skills, was also highlighted by many respondents. Additionally, difficulties in understanding presentation reports were attributed to poor language use, though some found claims generally understandable.

4.2.1.6. Claim Negotiation

Based on a study conducted by Zaneldin (2006), negotiation is used to settle 77% of construction claims in the United Arab Emirates (UAE). In the claim negotiation stage, disagreements during negotiations were noted by many respondents as a prevalent issue, often stemming from both the contractor and employer sides same. Inadequate or unsatisfactory evidence to support claims was also highlighted, with many respondents emphasizing the lack of sufficient evidence as a significant problem. Clear evidence is required for the defendant to comprehend and subsequently accept the claim submission (Hansen & Rostiyanti, 2019). Poor negotiation skills were universally agreed upon as an issue, attributed to inadequate contractual knowledge among staff.

Adversarial relationships with other parties were discussed, with respondents noting contractors' reluctance to take adversarial stands due to fear of future job repercussions. The issue of inadequate time for good negotiation was debated, with some respondents citing workload pressures and others disagreeing. Difficulty in settling without litigation or arbitration was noted by some respondents, who highlighted the tendency to avoid litigation due to its high costs, preferring amicable settlements.

4.2.1.7. Additional Issues

Several additional issues were identified, including the ignorance of site staff in recognizing claim events, poor use of language, lack of proper administration, poor coordination between the site and head office, and reluctance to complete the full claim management process due to cost and time constraints. High staff turnover, poor use of IT in claim management, and financial constraints were also noted as critical barriers.

4.2.2. Strategies to overcome the existing SMCs' claim management practice

Figure 2 depicts the overview of the strategies to overcome the existing SMCs' claim management practice. As per the findings and issues identified through expert interviews, the main problem in the SMCs' existing claim management is the failure to interpret contract terms and conditions and the inability to recognize claim events. To overcome this challenge E4 highlighted that SMCs need to employ key staff with expertise or adequate knowledge in contract administration and a deep understanding of all the clauses in the respective form of contract. Key staff with these skills could be Quantity Surveyors or Project Managers involved in the particular project, tasked with monitoring the project from the beginning to adopt a proper mechanism according to the contract conditions. This can improve claim management by early identification of claim events and timely notification, enhancing overall awareness.

Effective management of construction claims requires a sound understanding of their causes in relation to the contractual terms underpinning such claims (Hansen &

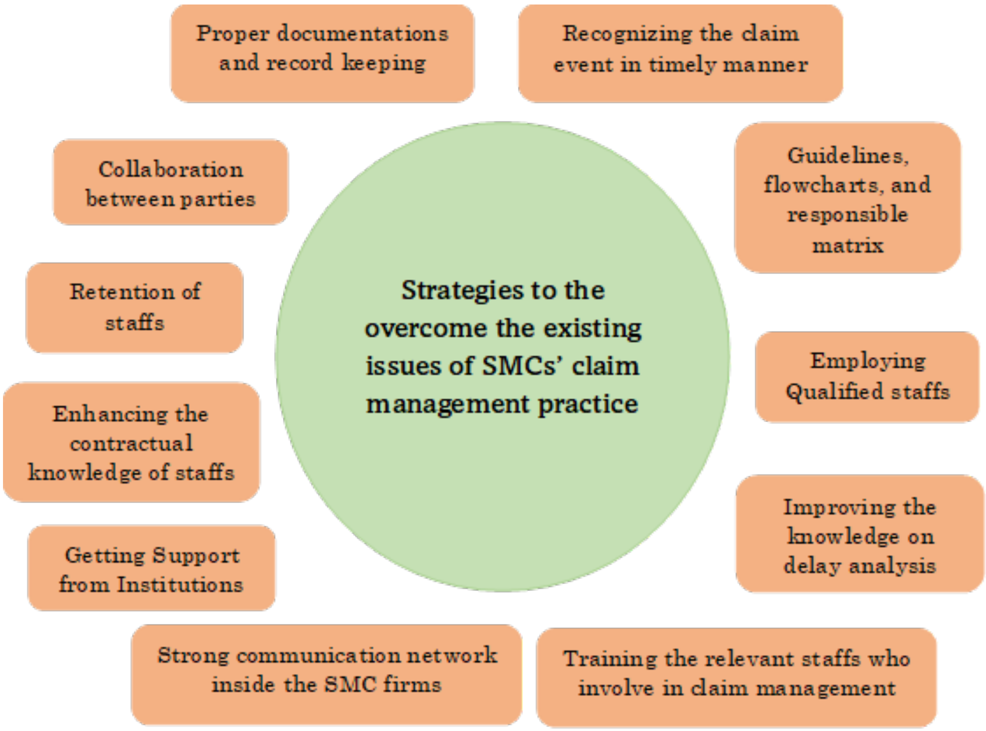

Figure 2: Strategies to overcome the issues in existing SMCs' claim management practice

Rostiyanti, 2019). Our results revealed that stated that one of the main issues for SMCs is the lack of contractual knowledge among staff. Therefore, to overcome such challenges, respondents (E1 and E3) advise project executioners to enhance the contractual knowledge of existing staff rather than hiring a third party or a claims specialist. This is also emphasized in the study by Lew et al. (2013), as the people process is more crucial than the strategy or operational process towards construction claims management.

It was also reported that in SMCs, most staff do not have a proper understanding of the contract itself. It was reported (E5) that most SMCs sign contracts without thoroughly reading them yet once claims occur, they need to refer to them. During the construction phase, the staff responsible for claims might have thought some events were claim events but could not submit the claims because the conditions of the contract were unfavourable, as they had interpreted before reading the clauses properly. E5 recommends that to overcome such future challenges, staff involved in signing and negotiating these contracts and claims need to thoroughly read and understand all the applicable clauses before signing the contract to have a good understanding of the terms and conditions during the contract.

Further it was recommended that (E6) that at least one key staff member with expertise in contract administration needs to be employed in SMC firms. This expert should explain or conduct workshops for the site staff on claim management, including how to identify claims, notify them, and what records need to be maintained. In this regard, Bakhary et al. (2020), codified the important role of the training programs provided by the professional organizations on enhancing the skill of staff in this aspect, which may be more crucial for SMCs without many high-skilled staff. Additionally, SMCs need to manage their claims with subcontractors and suppliers. Hence, E6 suggests that having a claim management framework within the company would assist in managing claims. E7 criticized that staff in SMCs do not have much awareness of contracts and are not clear about the claim procedures specified in the contract. This can be improved through awareness programs run by Sri Lankan construction regulatory bodies or relevant institutes to improve their chances of succeeding in claims.

SMCs need to keep track of written records, images, emails, paper notices, articles, and circulars. E4 highlighted that this needs to be compiled from day one of the project, which could improve the success rate of claims. The study conducted by Bakhary et al. (2020), also emphasized this as one of the important strategies towards successful claim management in construction projects. With current technology, it is easier to keep updating these records compared to the past days of the Sri Lankan construction industry. E6 emphasized the importance of site records, whether needed for claims or not; they should be maintained properly so that any required information can be easily extracted from the site records. Therefore, staff should not skip standard practices that need to be done on-site.

E5 emphasized the importance of maintaining records and correspondences in improving the existing claim management practice. These items are essential when preparing a claim. Getting timely CVI needs to be practiced by SMCs because, during claim preparation, contractors might say instructions were given by the engineer, but there is no CVI to prove it. Thus, it is important to get the CVI in a timely manner to substantiate the claim. Additionally, E5 believes that maintaining a separate documentation system for variations could improve the SMCs' existing claim management process because variations often lead to claims in the construction sector. When an engineer issues a variation order, it might disrupt the contractor's workflow, likely causing a delay that leads to a claim. Therefore, a separate system is required to monitor and manage variations.

E10 stated that whether manual or computerized, all bookkeeping needs to be systematic and accessible. E10 also said that contemporary records must be maintained properly on-site. E9 added that all site records should be recorded and maintained properly, whether useful for substantiating a claim or not, and site staff must comply with this task. E11 and E3 believe that digitized record-keeping through a cloud-based system would enhance existing claim documentation practices. E3 suggested that implementing BIM (Building Information Modelling) and integrated Project Delivery (IPD), in line with the proposal by Lew et al. (2013), in future projects would significantly ease the claim management process.

5. Conclusion

This study examined claim management practices among SMCs in Sri Lanka during exceptional events such as the COVID-19 pandemic and periods of extraordinary inflation. It addressed a novel area of research by focusing on the unique challenges faced by This study examined claim management practices among SMCs in Sri Lanka during exceptional events

This study examined claim management practices among SMCs in Sri Lanka during exceptional events such as the COVID-19 pandemic and periods of extraordinary inflation. It addressed a novel area of research by focusing on the unique challenges faced by SMCs in managing claims during crises. The study identified major causes of claims through a literature review and validated them using questionnaire surveys specific to the Sri Lankan context amidst financial crises. Key causes included material shortages, changes in material and labor costs, fluctuations in exchange rates, interest rates, and inflation, contractor financial problems, changes in government regulations and laws, and delays in payments by owners.

The research further revealed several deficiencies in current claim management practices through quantitative and qualitative data analysis. Key issues included a lack of skilled staff, inadequate documentation, poor communication, and insufficient contractual knowledge across all stages of the claim management process—identification, notification, substantiation, documentation, presentation, and negotiation. To address these issues, practical and context-specific strategies were developed based on semi-structured expert interviews. These strategies include employing and retaining qualified staff, enhancing contractual knowledge through training, developing internal communication systems, promoting collaboration, and implementing robust documentation and record-keeping systems.

While this study contributes to a previously underexplored area, particularly concerning SMCs' claim management practices during crises, it has certain limitations. The findings are context-specific to Sri Lanka, and the limited availability of prior studies on SMCs during exceptional events posed challenges for direct comparisons. However, the use of expert insights and empirical data ensured a robust investigation. Future research can build upon this work by exploring claim management practices in other regions. Such studies can refine and validate the proposed strategies, advancing the understanding and application of claim management strategies in diverse contexts.

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Appendix 1

Table 5: Causes of Claims

Causes of claims	References
Employer/ Employer's representative related factors	
Delay caused by owner	[2]
Delay in payment	[1],[2],[3],[4],[6], [7]
Change of client`s requirement	[1],[5]
Owner's financial difficulties to fund the project	[1]
Site possession with obstacles (license, land occupation, etc.)	[6]
Delay in handing over the site.	[3], [7]
Continuous change orders by the owner	[6],[7]
Change/Variation orders	[2],[3],[4],[5],[6]
Oral change order (failure to give written instruction)	[1],[2]
Late issue of instruction	[3]
Slow decision making	[6]
Delay in approval of completed work	[7]
Acceleration of works	[3],[7]
Delays of shop drawings approval by owner's representative	[7]
Contractor related factors	
The delay caused by the contractor	[1],[2],[3],[7]
Re-work due to design errors by the contractor	
Poor planning and management by the contractor	[1], [2],[4],[6],[7]
Contractor financial problem	[2], [7]
Poor quality of contractor's work	[2],[3],[7]
Estimating errors	[5]
Inadequate site investigation	[3]
External factors	
Volatility of construction materials prices in local markets	[2],[5], [6], [7]
Force majeure	[2],[6],[7]
Difficulty in the delivery of construction materials	[6],[7]
Extreme weather conditions	[4],[6],[7]
Third-party interference	[3], [7]
Changes in government regulations and laws	[2],[5],[6],[7]
Changes arising out of statutory, local authority sources	[5],[7]
Unforeseen ground conditions	[3],[4],[6]
Contract documents related factors	
Poorly written contracts and ambiguities	[1], [2],[3],[6],[7]
Inadequate contract documentation	[1],[5]
Variations between estimated and actual quantities	[1],[2],[3]
Specifications and drawing inconsistencies	[2],[3],[4],[5]
Design errors or omissions	[2],[4]
Discrepancies between contract documents	[1],[6]
Contractual relationship-related factors	
Parties are generally more aware of their rights and relatively more litigious.	[5]
Lack of coordination and communication among parties	[1],[2],[6],[7]
Awarding bid to the lowest bidder	[5],[6],[7]

Causes of claims	**References**
Termination of contract by one party	[2],[6],[7]
Suspension of work by one party	[2],[6],[7]
Insufficient time for bid preparation and inadequate investigation before bidding	[5],[7]
Project related factors	
Change the scope of the project.	[7]
Different subgrade condition	[7]
Complex execution of the project	[7]
Issues of change in site location or conditions	[6],[7]
[1] (Reta et al., 2019), [2] (Zaneldin, 2020), [3] (Mishmish & El-Sayegh, 2018), [4] (Shaikh et al., 2020), [5] (Hayati et al., 2019), [6] (Enshassi et al., 2009), [7] (Al-Qershi & Kishore, 2017)	

Table 6: Issues in the Claim Management Process

Stages	Issues in the Claim Management Process	Reference
Claim identification	Lack of awareness of site staff to detect a claim	[1], [3] [4] [5], [6]
	Lack of skilled staff for detecting construction claim	[1], [2], [3], [4] [5], [6]
	Ambiguous responsibility and procedures	[1],[4], [5], [6]
	Inadequate time due to high workload	[1], [3], [4], [5], [6]
	Failure to interpret contract terms and conditions	[1], [2], [3], [4],[5], [6]
Claim notification	Failure to comply with claim notification procedures	[1], [3], [4], [5], [6]
	No standard form is used for preparing the notice	[1], [3], [4], [5], [6]
	Inadequate time to thoroughly prepare the notice due to high workload	[1], [3], [4], [5], [6]
	Poor communication/instruction to proceed with submitting the notice	[1], [3], [4], [5], [6]
Claim Substantiation	Unavailability of records used to analyze and estimate the potential recovery	[1], [3], [4], [5]
	Failure to establish legal/Contractual grounds for claims	[1], [2], [3], [4], [5]
	Problem with quantification of claims	[1], [3], [4], [5]
	Lack of knowledge for staff in delay analysis	[1], [3], [4], [5]
	Inadequate time to thoroughly examine due to high workload	[1], [3], [4], [5]
	Insufficient computerized machine to facilitate the calculation	[1], [3], [4], [5]
Claim Documentation	Failure in Confirmation of Verbal Instruction (CVI)	[1], [3], [5], [6]
	Ineffective record-keeping system	[1], [3], [4], [5], [6]
	Inaccurate recorded information	[1], [2], [3], [4], [5], [6]
	Poor records and documentation to support claims.	[1], [6]
	No standard form used to record project activities	[1], [3], [4], [5], [6]

Stages	Issues in the Claim Management Process	Reference
	Inaccessibility or unavailability of documents when needed	[1], [4], [5], [6]
	No proper computerized documentation system	[1], [3], [5], [6]
Claim Presentation	No standard format for a claim submission	[1], [3], [4], [5], [6]
	Inaccessibility of relevant documents to submit along with the claim	[1], [3], [4], [5], [6]
	The presentation/report made is difficult to understand	[2], [6]
Claim Negotiation	Disagreements arise during negotiations.	[1], [2], [3], [4], [5]
	Inadequate or unsatisfactory evidence to convince other parties	[1], [3], [4], [5], [6]
	Poor negotiation skills	[1], [2], [3], [4], [5] [6]
	Adversarial relationships with other parties	[1], [3], [4], [5]
	Inadequate time due to a high workload for good negotiation	[1], [3], [4], [5], [6]
	Difficulty in settling without any litigation or arbitration	[1], [2], [3], [4], [5], [6]
	There is a tendency to protect own interest	[6]
[1] (Enshassi et al., 2009), [2] (Asuquo et al., 2020), [3] (Hayati et al., 2019), [4] (Nor Azmi et al., 2018), [5] (Bakhary et al., 2015), [6] (Hansen & Rostiyanti, 2019)		

JCBM (2025) 8(1) 30-47

JCBM

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Factors Influencing End–User Decision on the Purchase of Brands of Cement

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Received February 1, 2025; received in revised form February 9, 2025; May 21, 2025; July 30, 2025; accepted August 21, 2025
https://doi.org/10.15641/jcbm.8.1.1724

Abstract

Cement is one of the most essential construction materials used as a binder in mortar or concrete. This research determined factors influencing end–users' decisions to purchase cement brands. The objectives of the study were to identify prevailing cement brands in the study area and the purchase decision factors. This research sourced data through a questionnaire survey. Two hundred and three (203) questionnaires were administered to construction industry professionals randomly sampled from a list of active sites on Lafarge Cement Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) Sales Excellence archive (as at March 2023), with one hundred and nineteen (119) returned (58.6% return rate). Findings revealed the most prevalent cement brand to be DanCem (AHP eigenvalue = 0.39). This is followed by the Lafarge brand – both Elephant Classic and Elephant Supaset cement (0.23). The most prominent factor influencing end–users' decision to purchase cement brand(s) is the company responsibility (Eigenvalue = 11.23), which explains 28.8% of the total Variance in the initial 39 itemised factors. The cement and cement properties follow this. However, the role of technical assistance was highlighted as germane to end-users' purchase decisions. The research also recommends further studies on the socio-ecological dimensions of cement for sustainable development and supply chain management.

Keywords: Cement, End-Users, Technical Assistance, Brand, Decision, Construction

1. Introduction

Cement is one of the most essential construction materials used as a binder in mortar or concrete. Its global production is estimated to reach 4.83 billion tons by 2030 (Miraki *et al.*, 2022). This production rate results in the consumption of about 1.5 tonnes of limestone and clay per ton of cement. There are twelve (12) registered cement manufacturing companies contributing a total of 58.9 MMT per year in Nigeria (Etim *et al.*, 2021). According to United Capital (2019), cement companies operating in Nigeria include: Dangote Cement Plc – DanCem (with a Nigerian installed capacity of 29.3 MMT), Lafarge Africa Plc (10.5 MMT), BUA Group (including CCNN) (8.0 MMT), Purechem Industries Limited (a cement company based in Ogun State with 900,000 MT). Dangote Cement is available in three grades: 32.5R, 42.5R, and 52.5R, with the 32.5R grade proposed for plastering, low-rise structures, and masonry. High-rise projects and big facilities can profit from the higher grades. All Dangote types of cement available in the market are Portland limestone cement. According to Lafarge's website, its premium cement brands include Elephant Classic, UNICEM, Ashaka, Elephant Supaset, and Powermax. The grade on the bag label is 32.5R, although the website does not disclose the exact strength rating of Elephant Classic and Unicem. Medium-strength concrete, suspended slabs, masonry (blocks, building, plastering, mortar), and reinforced concrete were all recommended. All Lafarge cement products offered in Nigeria's open markets also use Portland Limestone cement.

As a result of the increasing population, sustaining the availability of cement from a range of vendors throughout the federation is currently an issue for

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Figure 1: Cement Brands dominating the Lagos Island and Lagos Mainland Market

consideration, as this is affected by demand and supply imbalance, especially for residential purposes, which holds a higher demand compared to non-residential ones (Mojekwu *et al.*, 2013). Since its inception, between 1954 and 1967, the availability or supply of cement has been insufficient to meet the ever-increasing demand for cement because of its uniqueness as a binder for building components. Indeed, cement has different uses for homes, bridges, multi-storey structures, concrete works, stucco, and bricks (Kilani, 2021). As far as cement is concerned, attracting customers is mandatory (Kumar & Srivastava, 2022), yet end-users have specific expectations of branded cement in terms of quality, price, packaging, and promptness of delivery, among other factors. It is a common and desirable practice for end–users to compare the characteristics of competing alternatives before making a final decision (Balabanis & Siamagka, 2017). This is particularly true of construction and construction industry-related wares that operate by a whole different process of financing, marketing, and sales when compared to other manufacturing industries. (Han *et al.*, 2021). The authors reiterated that it may not be possible to directly prescribe results and findings in the manufacturing disciplines to the construction industry. Hence, discipline-specific studies are needed. While products such as hybrid electric vehicles and solar water heaters (Kumar et al., 2019) are relevant, results from such studies may not be directly entrenched in the construction industry (Han *et al.*, 2021). To this end, Dattaray (2017) examined factors that determine customer preference for cement brands. The study focused on dealers and retailers, rather than end–users. Chouhan *et al.* (2016) sampled end users, but a total of 42 responses were considered too small for conclusive judgment. Bonney *et al.* (2022) examined these same factors from a study population of 1000 private homeowners and construction/building companies within four major cities in Ghana. The study considered eight brands available in the Ghanaian cement market. The twelve factors (or attributes ranked), though central, are not exhaustive considering the myriad of factors influencing end–users' choice of cement brand. Sunmola *et al*. (2021)'s use of consumer trust as an explanatory variable for Dangote Cement brand communication is laudable, yet it is strictly a marketing perspective. Kalumikiza (2022) also examined factors influencing the brand of cement purchased as an objective of his study; sampling "key informants in the cement sector". The research, however, was narrowed down to pricing as a dominant factor. The author used only frequencies and percentages to analyse data. Furthermore, Ebitu (2014) examined the marketing strategies of United Cement and how they affect end–users' satisfaction in Calabar, while Nartey (2012) investigated Tema metropolis customers' perception of Dangote cement acceptability to determine clients' perception of product sturdiness, factors to consider before actual purchase, and management strategies for promoting sales. Both Ebitu (2014) and Nartey (2012), however, focused on only a brand of cement. Similarly, Maity (2014) opined that customers lack a basic understanding of the technical aspects of cement and so gather information from external sources. Thus, cement manufacturing companies are now engaging the services of architects, builders, and civil engineers to assist their sales team on these technical aspects and to solve problems faced by end users on-site while using cement. Services rendered by this team of professionals include education on safety precautions while working on site, giving out safety kits, assisting end-users with cement usage and applications, i.e., trial mixes (*Lafarge* Cement End-User Market Discovery Survey, 2022).

However, the literature has not emphasised the role of technical assistance or builders' input, nor has it explored the extent to which this has impacted the sales of cement companies. However, Ivanova and Smetanina's (2016) discussion on the target-oriented generation of awareness among customers and consumers; and commodity positioning resonates thoughts on this role together with specific tasks attributed to the role e.g. end-user discovery research survey, blockmakers' engagement on quality standards, end-user enlightenment on cement product differentiation and advantage of one brand over another, engaging real estate and property development companies on the application of cementitious adhesives and related products etc. The researcher's definition of technical assistance is summed up thus. Further, there is a reference level of a dearth of education of end–users on cement products, and also a lack of positive feedback for the excellence of cement sold (Chang *et al.*, 2011).

There is also a lack of understanding of consumer behaviours in purchasing socio-ecological products, coupled with a dearth of knowledge on environmentally, socially, and economically sustainable products (Weniger *et al.*, 2023). The authors reported highly individualised sustainability-related criteria, varying from one consumer to another, from a review of the literature. Still, these and many more research studies on cement products have focused on marketing aspects, viz, price, and have neither delved into a compendium of factors nor examined the Builder's input (or the impact of building professionals' technical support) on sales of cement. Hence, this study identifies cement brands available in Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) and examines factors influencing end–users' decision to purchase particular brand(s) of cement. There is a need to assess if end-users are prepared to accept cement products for cement companies to continue to operate.

The study identifies cement brands often used by respondent professionals on their sites and examines end-users' perceptions of cement brands' acceptability in relation to factors influencing the choice of a particular brand of cement. This direction, according to Weniger *et al.* (2023), is an initial evaluation of end-users' current state of knowledge and influences (i.e. motivations) for purchase decisions of building products that precede the possibility of determining consumer behaviour and communications on sustainable products. The research would help establish a rule of thumb for the number of persons likely to purchase each brand of cement regularly and periodically (i.e. market share), to prioritise end–users' factors for choosing cement brands and how to address their queries. This will boost the company's image and promote the product. Hence, this research seeks to proffer answers to some of these questions: what brand(s) of cement are available and commonly used on building sites in Lagos Island and Mainland; what are the factors influencing end-users' decision to purchase particular brand(s) of cement in the study area; how important is the factor of the role of technical assistance among factors influencing end – users' purchase decision. This is aimed at enhancing sales and cement product improvement.

2. Literature Review

2.1. Definition of cement

The Romans coined the term "cement" to describe masonry built of coarse aggregates and burnt limestone as a binder, similar to modern concrete. *Cementum* was the name given to a pneumatic binder made from volcanic ash and broken brick additions mixed with burning limestone (Wietek, 2021). It has been around for almost two thousand years and is arguably the most well-known building material (Ridi *et al.*, 2011). Cement is used in the production of building blocks and concrete. It is a low-value, bulk material. Portland cement grades 32.5 and 42.5 are sold in 50kg packets (or bags). Cement encompasses a wide range of compounds with adhesive and cohesive properties, which makes it capable of bonding materials such as mineral fragments into a compact whole.

On the other hand, cement is a term that is commonly used to describe adhesives that are used to keep stones, bricks, tiles, and other materials together and affix them to a base in the construction of buildings and other civil works (Akers, 2001). The majority of these adhesives are lime-based and best known as calcareous cement(s). When mixed with water, the particles of this form of finely powdered cement set into a hard mass. Setting and hardening are the consequences of hydration, i.e. the chemical reaction of cement components with water. Cement is one of the most widely used materials in the construction industry. In construction, the cement used can be characterised as being either hydraulic or non-hydraulic, depending upon the ability of the cement to be used in the presence of water (Edwards, 2005). Hydraulic cement is that which sets and hardens by chemical reaction with water and is capable of doing so underwater. The chemical reaction results in hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows setting in wet conditions or underwater and further protects the hardened material from chemical attack (e.g., Portland cement). Non-hydraulic cement will not set in wet conditions or underwater; instead, it sets as it dries and reacts with carbon dioxide in the air (Edwards, 2005). Some aggressive chemicals can attack it after setting.

2.2. Cement manufacturing process

The manufacturing process of cement involves mining, crushing, grinding of raw materials (principally limestone and clay), blending of raw meal, calcining the materials in a rotary kiln, cooling the resulting clinker, mixing the clinker with gypsum, milling, storing, bagging the finished cement and distribution (Kolawole, 2011). The raw materials for manufacturing cement can be divided into four basic components: lime (calcareous), silica (siliceous), alumina (argillaceous), and iron (ferriferous). Approximately 1450 kilograms (kg) of dry raw materials are required to produce one tonne (1000 kg) of cement. Approximately 35% of the raw material weight is removed as carbon dioxide (CO_2) and water vapour. The introductory chemistry of the cement manufacturing process begins with the decomposition of clay minerals into SiO_2 and Al_2O_3, and the calcination of calcium carbonate ($CaCO_3$) at about 900 °C to leave calcium oxide (CaO, lime), liberating CO_2. This is followed by the clinkering process, in which the CaO reacts at high temperatures (typically 1450 °C) with silica, alumina, and ferrous oxide to form the silicates, aluminates, and ferrites of calcium. The resultant clinker is then milled together with gypsum and other additives to produce cement (Kolawole, 2011).

2.3. Carbon print impact on the cement-manufacturing environment

Nigeria's building sector is adjudged one of the major emitters of carbon dioxide in the country, owing to activities such as the use of heavy machinery and equipment such as bulldozers, excavators and cranes, burning of wood and charcoal on construction sites for cooking and heating, and cement manufacture. According to Liu et al. (2020), approximately 8% of the world's carbon dioxide emissions are exclusively attributable to the cement sector (Labaran, Musa, Mathur and Saini, 2024). This global scenario is explained by a quadratic fit between CO_2 emissions versus GDP per capita, with the prospect of a carbon footprint reduction in 2030. Hence, control measures to achieve this fit include lowering the clinker ratio, sustaining a good fuel mix (also the type of fuel), increasing the thermal substitution ratio (i.e. the use of alternative fuels, especially biomass through agricultural waste), energy-efficient kilns, carbon capture and storage systems (Kumari *et al.,* 2024).

Lafarge Cement reported a net CO_2 performance of 575kg/tonne in 2017 (-0.3% as against 2016). The report showed 151,786 and 127,300 tonnes of waste-derived resources in 2017 and 2016, respectively. Air emissions such as dust (i.e. particulate matter-PM), NO_x and SO_2 were at 244, 2817 and 1414 tonnes, showing a 22% reduction from 2016 numbers (Lafarge Africa Sustainability Report, 2017). These exact numbers for Dangote Cement read 38%, 42% and 14% decrease in PM, NO_x and SO_x absolute emissions per tonne of clinker in 2023 (Dangote Cement Plc Annual Report and Accounts, 2023). The leading cement-producing company boasts of a 184% increase in co-processed waste as an alternative fuel (446 Ktonnes in 2023 compared to 157 in 2022); while Lafarge reported increased use of geocycle model alternative fuels in kilns up to 45% of energy resource in Ewekoro 1 and 35% in Sagamu. Dangote Cement Plc also reported a net CO_2 of 13 kg/tonne from continuous emission monitors in scope one emission and 1.89 tonnes of waste recycled (Dangote Cement Plc Annual Report and Accounts, 2023). The company, being guided and regulated by the Global Cement and Concrete Association (GCCA), recorded an 11% improvement in sustainability training, a 2.2% reduction in CO_2 emissions (17.7 - 17.4 MMT), a 25% increase in social investment and tax payment of ₦166,129 million (this is compared to ₦150,766 million in 2022). According to Dangote Cement Plc Annual Report and Accounts (2023), total Corporate Social Responsibility (CSR) spending equals ₦2,355,586,868.43 in 43 projects and 6696 beneficiaries.

2.4. Types of cement

Types of cement include neat Portland Cement (PC) (yearly global output of around 3.8 million cubic meters); Portland Pozzolan Cement (PPC) (i.e. pozzolanic clinker ground with Portland cement; or fine pozzolan and used with gypsum or calcium sulphate) (Shaw, 2012); Rapid Hardening Cement (with higher lime content, higher C_3S content, and finer grinding, for quicker removal of formwork and to boost construction speed and save formwork costs); Quick setting cement (Shaw, 2012); Low Heat Cement (increased amount of C_2S and below 6% tricalcium aluminate (C_3A)) for mass concrete construction (Świtała et al., 2018); Sulphates Resisting Cement SRC (in canal linings, culverts, retaining walls, and siphons (Woodward, 2004); Blast Furnace Slag Cement (clinkers with around 60% slag); High Alumina Cement (A bauxite-lime mixture melted and mixed with clinker - 3.5 hours initial set time and 5 hours final setting time for concrete subjected to extreme temperatures, frost, or acidic action (Shaw, 2012); White Cement (Sumaila, 2014); Coloured cement (5 -10% mineral pigments and normal cement); Air Entraining Cement (Clinker plus air-entraining compounds such resins, glues, sodium salts of sulphates, and other indigenous air-entraining agents for improving workability and frost resistance in concrete that has a lower water-cement ratio) (Woodward, 2004); Expansive Cement for grouting Anchor bolts and prestressed concrete ducts are typically grouted using this cement (Shaw, 2012); Hydrographic Cement (composed up of water-repellent chemicals).

2.5. Properties of cement

To ensure a level of consistency between cement-producing plants, certain chemical and physical limits are placed on cement. A variety of standards and specifications define these chemical limits. For instance, Portland cement and blended hydraulic cement for concrete in the U.S. conform to the American Society for Testing and Materials (ASTM) C150 (Standard Specification for Portland Cement), C595 (Standard Specification for Blended Hydraulic Cement) or C1157 (Performance Specification for Hydraulic Cement).

The British types of cement conform primarily to the British/European Standard BS EN 197-1 and BS EN 197-5, which provides a test method that is necessary for the choice of cement, especially the type and/or strength class to ensure durability depending on exposure class and type of construction.

2.6. Chemical composition of cement

Lime (CaO), silica (SiO_2), and alumina (Al_2O_3) are the three major oxide compositions responsible for influencing the various properties of cement. An increase in lime content beyond a particular value makes it difficult to combine completely with other compounds. Consequently, free time will exist in the clinker and will result in unsound cement. An increase in silica content at the expense of alumina and ferric oxide makes the cement difficult to fuse and form clinker (Kolawole, 2011). Other chemical composition in cement other than these principal oxides includes iron oxide (Fe_2O_3), magnesia (MgO), sulphur trioxide, soda/or potash ($Na_2O + K_2O$) (Akers, 2001).

2.7. Physical properties of cement

Physical properties of cement include fineness, soundness, consistency, setting time, compressive strength, the Heat of hydration, loss on ignition, specific gravity (or relative density), Bulk density, and chemical shrinkage, amongst others. Most of these physical tests are carried out using mortar or paste created from the cement. This testing confirms that cement can perform well in concrete; however, the performance of concrete in the field is determined by all of the concrete ingredients, their quantity, as well as the environment, and the handling and placing procedures used.

2.7.1. Fineness

The degree of hydrolysis, which is critical for the rate of strength gain, is controlled by the fineness or particle size of Portland cement. The greater the surface-to-volume ratio of a particle, the more surface area is available for water-cement interaction per unit volume. Cement particles are typically less than 45 microns in size, with an average particle size of approximately 15 microns. Surface area per unit mass is used to calculate fineness. The Wagner turbid meter test, the Blaine Air-permeability test, a 45-micrometre sieve, or an electronic particle size analyser can all be used to determine fineness (American Society for Testing and Materials, 2012).

2.7.2. Soundness

This is the tendency of a hardened cement paste to maintain its volume after it has set. Cement samples containing high quantities of hard charred free lime or magnesia are unsound. The autoclave expansion test is used to verify the cement's soundness (Richardson & Carrielies, 2012).

2.7.3. Consistency

The ability of a cement paste to flow is referred to as consistency. For evaluating cement specimens, regular consistency pastes must be created. When the lever of the Vicat instrument penetrates a paste by 10 mm, it is deemed to have a normal consistency (Richardson & Carrielies, 2012; Kolawole, 2011).

2.7.4. Setting Time

The curing period of cement is one of its most important properties since it dictates how much time the contractor has to lay and complete the concrete. The initial setting time refers to the amount of time it takes for the paste to lose its fluid or plastic properties once it is wet. The time it takes for the cement paste to reach a certain level of hardness to sustain a weight, on the other hand, is referred to as the final setting time. The Vicat device or the Gillmore needles are used to determine the setting time (Kolawole, 2011).

2.7.5. Compressive Strength

It is the most common strength test. A test specimen (40mm) is taken and subjected to a compressive load until failure. The loading sequence must be between 20 seconds and 80 seconds. Because cement strength varies over time, it is sometimes referred to as three-day, seven-day, or twenty-eight-day strength.

2.7.6. Heat of hydration

When water is added to cement, the reaction that takes place is called hydration. Hydration generates Heat, which can affect the quality of the cement and also be beneficial in maintaining curing temperature during cold weather. However, when heat generation is high, especially in large structures, it may cause undesired stress. The Heat of hydration is affected most by C_3S and C_3A present in cement, and also by water-cement ratio, fineness, and curing temperature. The Heat of hydration of Portland cement is calculated by determining the difference between the dry and the partially hydrated cement (obtained by comparing these at the 7th and 28th days). This is measured using a conduction calorimeter (Curuksu, 2018).

2.7.7. Loss on ignition

At temperatures ranging from 900 to 1000 °C (1650 to 1830 °F), a defined-weight cement sample is heated to a consistent weight. The weight loss of the pattern due to heating is then calculated. A significant loss in ignition indicates rehydration and carbonation. This could be a result of improper storage, degradation, or adulteration (more than 3 per cent) (Curuksu, 2018).

2.7.8. Specific gravity (relative density)

In concrete mix proportioning, specific gravity is usually necessary. The particle density of PC ranges from 3.1 to 3.25 megagrams per cubic meter (calculated by removing air between particles). OPC's relative density is considered to be 3.15. Le Chatelier's equipment is used to determine the density of cement (Curuksu, 2018).

2.7.9. Bulk density

By dividing the mass of cement particles and the air between them by the volume of the cement sample, the

Bulk density can be calculated. Ordinary Portland cement has a Bulk density of 830 kg/m^3 to 1650 kg/m^3. This test may be performed using two beakers with the same amount of cement. One beaker's cement is gently vibrated, leading to a volume decrease (Cooper & Schindler, 2011).

2.7.10. Chemical shrinkage

Chemical shrinkage measurement is another convenient way to track hydration kinetics. Because cement hydration products take up less space than the starting elements (cement and water), a moisturised cement paste will absorb water in direct proportion to its hydration level. Depercolation of the capillary porosity can significantly reduce the permeability of the cement paste, limiting its imbibition rate below that required to maintain saturation during the hydration process, except for low w/c ratio pastes (about 0.4). Using a coverage factor of 2, the highest extended error in the computed chemical shrinkage was initially slated to be 0.001mL/g of cement (Di Bella *et al.*, 2017)

2.8. Strength grades of cement

There are two primary cement grades, namely grade 32.5 and grade 42.5.

32.5 grade is a general-purpose cement suitable for all construction works. It has a low heat of hydration, which makes it suitable for plastering/rendering, block making, and concrete works. 32.5 grades of cement available in Nigeria's cement market are: Elephant Classic, Unicem, Ashaka Cement, Dangote, and Falcon (Sumaila, 2004).

42.5 grade has a high heat of hydration and is suitable for precast concrete, heavy concrete works, and block making. 42.5 grades of cement available in Nigeria's cement market are: Elephant Supaset, Powermax, Dangote 3X (i.e. DanCem), Blockmaster, and BUA. It is noteworthy that the designation N or R that follows the strength grade rating refers to the speed of strength development (i.e. Normal and Rapid, respectively). It indicates the speed at which a cement brand attains a large proportion of its strength rating after (say, three and a half days) when cured as appropriate.

2.9. Theoretical underpinning

The study identifies cement brands often used by respondent professionals on their sites. It examines end-users' perceptions of cement brands' acceptability in relation to factors influencing the choice of a particular brand of cement. This is to enhance sales and cement product improvement. Its theoretical underpinning includes the application of relationship quality dimensions (Hennig-Thurau & Klee, 1997) and the role of technical support to expose end-users to the functionality of cement products and enlightenment on cement product differentiation to manage sales outcomes outrightly. Hennig-Thurau and Klee (1997) conceptualised relationship quality to buoy assertions of a direct empirical association between satisfaction and core company goals or outcomes (e.g. customer retention and sales). This concept functions to reduce cost and uncertainties in the purchase of products, thereby building a higher confidence level in buyers and fulfilling other social needs, such as attractive packaging of cement and the brand name/image's implication for customers' identity, and even end-users' self-actualisation. Hennig–Thurau *et al.* (2002) stressed the general agreement that satisfaction, trust, and commitment to the relationship with the service firm or manufacturing company brand are key components of relationship quality. It is noteworthy that retaining a client costs a tenth of the cost of obtaining a new one (Sunmola *et al.*, 2021).

Customers' trust and consequent repeated buying potential have been used to explain cement brand communication; a binder for business and relationship (Sunmola et al., 2021). The researcher has observed this to be critical to cement business in a 5½ year site engagement. Relationship quality dimensions drive the cement business. It is a laudable approach to the question of what end-users stand to gain for identifying with a cement brand's range of products over time, because retailers are usually next to wholesalers in the event of reward programs from cement companies. The important place of end-users in the relationship quality framework needs to be prioritised.

2.10. Factors contributing to end users' decision to purchase particular brand(s) of cement

Factors contributing to end users' decision to purchase particular brand(s) of cement include quality (Uggla, 2006), price (Kalumikiza, 2022), influence by others (Maity, 2014), advertising (Aaker, 2008), packaging for product preservation, attractive packaging and complex branding impression to forestall counterfeiting and product differentiation (Kotler and Armstrong, 2013; Oliver, 2009), convenience or easy access i.e. availability (Lin and Chang, 2003) distribution channel i.e. local dealer and retailer, self – decision and influencer recommendation (Maity, 2014), after sales support services (Onu and Adegbola, 2018), brand awareness (Sunmola et al., 2021; Świtała et al., 2018), sales promotion (buy and win, spell and win etc.), end-of-year fringe benefits, premiums, coupon, temporary price discounts, letters to trade, proforma invoice and trade shows (Oliver, 2009), market conditions (natural market zone) (Sumaila, 2004), transportation and handling costs, proximity of wholesale or retail outlet to end – user's site (Shaw, 2012), and Corporate social responsibility (CSR) to enhance cement companies' image (Babalola, 2012). According to *Lafarge* Cement End User Market Discovery Survey (2022), factors contributing to end – users' choice include availability, price, strength, colour of cement, good finishing of building unit produced with cement, good workability, dries faster, provision of credit facility and flexible terms of payment, brand name or image, proximity or nearness of cement outlet to end – users' jobsite, promptness of delivery, good working relationship between company's representative and buyer (or end – user), provision of technical support, reputation of supplier (or credit worthiness), value creation through provision of additional services such as estimating for materials and labour for building works, assisting retailers to deplete cement stock by sourcing more end – users' site and blockmaking jobsites, attendance in Blockmakers' Association Meetings to carry out cement trial mixes, carrying out cement and mortar trial mixes at renown Estates and Property Developers' office buildings and thus fostering partnership for increased sales and direct site sales initiative. Business ethics, full cement bags, addressing complaints (feedback) of end-users over time, strong presence of retail outlets, and brand dominating the target market at the moment, are other factors that emanated from the end–user market discovery (*Lafarge* Cement End-User Market Discovery Survey, 2022).

3. Research Methodology

The research utilised primary and secondary data. The research method summed up the study population, sample size, sampling technique, data analytical method, and discussion of results. The research examined factors influencing end–users' decision to purchase brand(s) of cement from information elicited from building construction professionals. A total of 203 copies of the questionnaire were randomly administered to end – users i.e. construction professionals conveniently sampled from a list of active sites on Lafarge Cement Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) Sales Excellence archive (as at March 2023) with one hundred and nineteen (119) returned implying 58.6% return rate. The fraction of active sites for the three selected sales teams relative to the nine teams that make up the study area equals 203/648, i.e. a third of the total active sites. These three teams were conveniently sampled to cover the island and mainland of the study area. The questionnaire was divided into three sections: general information, including the respondent's demographics, professional inclination, and experience level in the construction industry. The second section comprises prevailing brand(s) of cement in Lagos Island and the Mainland cement market.

In contrast, the last section comprises factors influencing the choice of cement brand(s) in the study area. General information of respondents was designed as nominal and multiple-choice, and identification of prevailing brand(s) of cement was designed as a pairwise scale on the Analytical Hierarchy Process (AHP), with the five common brands noticeable in the market paired against themselves to have ten pairings (i.e. a 5x5 matrix). The AHP pairing scale rates 1,3,5,7 and 9. 1 representing equal importance i.e. a pair of measures compares (or competes) equally in importance; 3 representing moderate importance; 5 for high importance; 7 for very high importance and 9 means extreme importance i.e. for a pair of cement brand, one brand (on the left-hand side) is "extremely favoured" when compared to the brand on the right-hand side; as perceivably weighed by respondents. Thirty-nine factors influencing end–users' choice of cement brand(s) were ranked on a Likert scale of 1 – 5 in increasing level of importance; with 1 representing unimportant, 2 representing low importance, 3 representing substantial importance, 4 representing high importance, and 5 representing very high importance. The general information was analysed using frequencies and percentages, and the prevalent brands of cement were ranked using the AHP priority eigenvector. In contrast, cement purchase decision factors were analysed using the mean score and factor analysis to group the factors and determine the prevailing cement brand(s).

The essence of AHP is the decomposition of a decision problem, while the principal assumption is that the goal is attainable through the fulfilment of partial goals leading to the overall objective. All variant solutions submitted to analysis satisfy the expectations, but to various degrees. The extent to which a given decision variant fulfils the goal depends on the degree of fulfilment of the main criteria and adequately grouped partial criteria (Szafranko, 2017). A hierarchy model composed of several levels (e.g. 4) is constructed to evaluate alternative options. Then, all criteria on the same given level are pairwise compared against the goal for their importance and the values derived from comparisons are entered into a comparison or judgment matrix A. The number of compared pairs that make up the matrix depends on the number of defined criteria. The diagonal of the matrix is composed of values equal to one because it comprises comparisons of each criterion to itself (aij =1 for i=j). At the same time, components aji are the reverse of aij. Logically, all aij>0. Decision-making is achieved through three integrated stages in a logical sequence: development of a hierarchy model (determination of criteria), assessment of the criteria on a nine-point scoring scale and evaluation and ranking of the variants by assigning to them priorities, while also taking into consideration the vectors of partial criteria. The advantage of the AHP Scale is that it compares two decision elements (or criteria) at a time, thus making the decision maker more focused. Consequently, the accuracy and reliability of the response are improved. The AHP pairwise scale gives every compared element a match against every other element on the list, thus making the perception of respondents more accurate on a fundamental scale; unlike if the elements were to stand solely and rated in a relative importance index (Saaty, 2001; Ramoutar K. & Syan, 2009). The fundamental scale is a one-to-one mapping between the criteria (i.e. choices) available to the decision maker (Oladapo, 2011). In comparing criterion A to criterion B, a decision maker may determine, using the scale, that A is highly favoured as paired with B and assign a relative value of 9 to A. This means that the relative value of B to A is 1/9. The judgments on pairs of criteria are presented by an n x n matrix, by adding relative values from all pairs across the total responses obtained.

Cement purchase decision factors were analysed using mean score rating and standard deviation according to equations (1) and (2).

$$\textbf{Mean Score}\ (\boldsymbol{MS}) = \frac{\textit{sum of all variables}}{\textit{frequency of all variables}} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$Standard\ Deviation(SD) = \frac{\sqrt{\Sigma f(X-\bar{X})^2}}{\Sigma f} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

4. Results and Discussion

4.1. Profiling

The profiles of the respondents and organisations were investigated based on the respondents' opinions and presented in Table 1 (Appendix 1).

4.2. Cement brands

Findings from Bonney *et al.* (2022) revealed that DanCem ranked 3/8 and 2/8 in consumer awareness and preference, respectively, in Ghana; while Dattaray (2017) reported stiff competition among prevalent brands in Cuttack and Bhubaneswar, with the Lafarge brand ranking low in preference when compared to local brands in India. According to Kalumikiza (2022) in Malawi, 43% of 33% not using the predominant brand (67% overall end-usage) use DanCem. Thus, ranking two out of seven (2/7) brands identified by the author, though with low numbers (14%).

4.3. Factors contributing to end–users' decision in cement purchase

Table 3: Total Variance Explained - Factors influencing end–users' decision to purchase cement

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.232	28.801	28.801	4.408	11.302	11.302
2	3.232	8.287	37.088	4.061	10.413	21.715
3	2.451	6.284	43.373	3.906	10.015	31.731
4	2.033	5.214	48.586	3.668	9.405	41.135
5	1.534	3.933	52.519	2.981	7.645	48.780
6	1.504	3.856	56.376	2.962	7.596	56.376

The study factored thirty-nine (39) factors contributing to end–users' decision to cement purchase to reduce them to principal components. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy test carried out showed that the data collected were adequate for the analysis, and Barlett's test of sphericity (p = 0.000) was highly significant. The total Variance explained by the resulting six (6) factors extracted via principal component analysis with eigenvalues greater than 1.500 is shown in Table 3. By considering a cut-off point for the score loading with an absolute value greater than 0.400, the components and the corresponding critical factors loading are presented in Table 4 (Appendix 1). The extracted six (6) components explain approximately 56.4% of % variability in the original thirty (39) factors. The rotation sums of squared loadings revealed the percentage of variables accounted for by extracted components as listed in a uniformly distributed manner of 11.30%, 10.41%, 10.02%, 9.41%, 7.65%, and 7.60%.

Research findings support the position of the company's responsibilities; in carrying out timely market discovery surveys and promptly addressing

Table 2: Priority vector for the second (iteration) inconsistent matrix

		Eigenvalues	Rank
DanCem	2819.79	0.39	1
Classic	1647.76	0.23	2
Supaset	1616.77	0.23	2
BUA	712.06	0.10	4
Purechem	419.04	0.05	5
	7215.42	**1.00**	

feedback from the end–users of the cement product, extending fringe benefits to end–users (as they do retailers) at the end of each business year, partnering with research institutes and sponsoring research, periodic intervention programs for interlocking block and kerb-makers and concrete electric poll-makers. Weniger *et al.* (2023) corroborated findings by stating that companies need to reach out to consumers with comprehensive information, including information on the sustainability of products through the use of sustainability certificates and labels, among others. The authors also reported the need to reward positive buying and consuming behaviours or changes in consumer attitude based on how these behaviours influence sustainable living and the inclusion of sustainability-related criteria in a purchase decision. This view also defines company responsibilities. Mishra and Sharestha (2019) noted that non-availability of the desired brand (as an unpredictable factor) modifies the actual choice made by an end – user i.e. if cement is available (Mean = 4.28, Rank 3) - availability is a factor of cement and cement properties (cement strength (4.34, Rank 1), good workability (4.30, Rank 2), dries faster (4.08, Rank 5), weighty or full bags (4.03, Rank 7); features such as consistency, instant or fast drying, packaging, distribution and prompt delivery method (3.81, Rank 9) become predominant expectations from the end – users (Murugan & Ganapathi, 2012). In line with this, Ivanova and Smetanina (2016) noted the socio-ecological dimension of the cement industry. However, they reported Russian respondents who could not afford environmentally friendly houses (building materials) because of high prices. Besides, the authors affirmed that the environmental friendliness of construction/finishing materials is not among the values of the piloted respondents. Retail factors comprising good working relationship with the retailer (3.77, Rank 11) and reputation of retailer (3.76, Rank 12) are also held as store brand variables in impacting the choice of end–users (with twice the deviation from the least ranked to deviation from cement strength). Store familiarity, viz. Store image is an important determinant of the choice of end-users (Diallo *et al.*, 2013).

Furthermore, sales representatives and technical assistants selling directly to construction sites are an overlap between the retail factor and the technical assistance factor (3.71, Rank 14). This is in line with providing additional services for renowned Estates & Property Developers to boost sales (3.50, Rank 18) and the attendance of sales representatives and technical assistants in Blockmakers' Association Meetings to carry out cement and mortar trial mixes to attract customers (3.45, Rank 21). This aspect of technical support is a key focus of this research. It can also be captured in Ivanova and Smetanina's (2016) role involving the target-oriented generation of awareness among customers and consumers, and commodity positioning. This, according to the authors, will result in new methods and techniques for the distribution of construction products in the retail market as well as motivate end-users on the sociological dimension of these construction materials.

Household name/brand currently dominating the market ranked 10th (Mean=3.79). The gap between the dominance of the Dangote brand (as the major brand across the length and breadth of Nigeria between 2021 and 2024) and other major players in the Nigerian cement industry remains (Sunmola *et al.*, 2021). The authors found awareness, familiarity, and image (being elements of brand communications) to be predictors of customers' trust, with the brand image having the least positive coefficient of the three (Pitso, Ligaraba, and Chuchu, 2023). For the authors and marketing-wise, trust binds businesses and relationships in transactions. Digital advertisement, the use of celebrities in promoting brands, and creativity in packaging cement (as it relates to marketing) ranked 29, 39, and 37. This agrees with Bonney *et al.* (2022), Mishra and Sharestha (2019), and Pitso, Ligaraba, and Chuchu (2023), who reported that advertisement and sales promotion do not play a significant role in the end–users' preferences and cement purchase decisions. For both authors, respondents also downplayed the factor of price in purchase decisions. As shown in Table 3, the provision of credit facility of payment Rank 38), favourable and flexible terms of payment and doing business (Rank 35), and discounted or subsidised price (for focus or sensitive markets) (Rank 32); all of which are price concerns ranked least – in mean scores and initial eigenvalue of 1.53 compared to 11.23 for factor of company responsibility.

4.4. Summary of factors and corresponding mean score

The first component (factor with total initial eigenvalue of 11.23) is mainly correlated with Company responsibility. It comprises involvement in Corporate Social Responsibility (0.461), partnering with research institutes (such as Nigerian Building and Road Research Institute - NBRRI etc) (0.460), proforma invoice (0.539) and offering fringe benefits to end – users at the end of each business year; amongst others (0.657).

The second factor is correlated with cement properties (eigenvalue = 3.23). It comprises cement strength (0.721, Rank 1), good workability (0.563, Rank 2), availability (0.714, Rank 3), dries faster (0.675, Rank 5), full bags (0.604, Rank 7), amongst others.

The third factor is correlated with retailing (eigenvalue = 2.45). It comprises a good working relationship with the retailer (0.619, Rank 11), the reputation of the supplier (retailer) (0.484, Rank 12), proximity of retail outlet to site (0.672, Rank 12), Sales representative

(Technical Assistant) selling cement directly to site (0.459, Rank 14); amongst others.

The fourth factor is correlated with marketing (eigenvalue = 2.03). It comprises "household name/brand currently dominating the market (0.569, Rank 10) and company innovation on product differentiation (0.556, Rank 18). Results showed that use of celebrities (0.580, Rank 39), digital advertising (0.792, Rank 29), and creativity in the packaging of cement products do not contribute to end–users' decision–making, relative to other factors independently.

The fifth factor is correlated with price (eigenvalue = 1.53). However, the standard deviation of price as an independent factor (1.2233) is the fourth highest (>1.0000); in the group with provision of credit facility of payment (0.449, SD = 1.3433, Rank 38), use of celebrities (SD = 1.3268), discounted or subsidised price (0.489, SD = 1.3094, Rank 32). This indicates that the opinions of respondents are diverse and varied. Hence, there is no margin of agreement from respondents on price as a factor in cement purchase.
The sixth factor is correlated to technical assistance (eigenvalue = 1.50). It comprises a company identifying with renowned estate developers such as Adron Homes (0.608, Rank 19) and attendance of Technical Assistants in the Blockmaker's Association meeting (0.602, Rank 21).

4.5. Role of Technical Assistance

The research found that the role of Technical Assistance (TA) in end-use is unpopular among respondent construction professionals who are more used to the 'sales representative' or 'marketing' description (with 5.2% variance explained compared to 3.9% for TA). Factors such as estimating for building materials and labour, and end-users' market discovery surveys, which require technical inputs, ranked 30th and 27th, respectively. Carrying out cement and mortar trial mix and attendance of Technical Assistants in Blockmakers' bi-weekly or monthly Association Meetings ranked 22nd and 21st respectively; while the company identifying with renowned Estates and Property Developers and Technical Assistants selling directly to end–users' sites to boost sales representatives' monthly quota ranked 18th and 14/39.

5. Conclusion

This research determined factors influencing end–users' decision to purchase cement brand(s) by first identifying prevailing cement brands in the study area, then the factors of the purchase decision. The research sourced data through a questionnaire survey (203) administered to construction industry professionals randomly sampled from a list of active sites on Lafarge Cement Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) Sales Excellence archive (as of March 2023) with one hundred and nineteen (119) returned; 58.6% return rate. Findings revealed that:

i. The most prevalent cement brand is DanCem (AHP eigenvalue = 0.39). The Lafarge brand seconds this – both Elephant Classic and Elephant Supaset cement have an eigenvalue of 0.23. BUA cement ranked fourth (0.10) while Purechem ranked least (0.05).
ii. The most prominent factor influencing end–users' decision to purchase cement brand(s) is the factor of company responsibility (Eigenvalue = 11.23), which explains 28.8% of the total Variance in the initial thirty-nine (39) itemised factors. This is followed by factors of cement and cement properties (strength, good workability, availability, dries faster, full bags, and good finishing (Mean = 4.24, Rank 4). Promptness of delivery to the point of use is also prominent (Mean = 3.81, Rank 9).
iii. The factors of company responsibility and self-decision in cement are the predominant influences in end–users' decisions to purchase cement.

6. Recommendations

The following recommendations are germane to the smooth running of the cement industry:

- Manufacturers should also pay attention to end-users and reward them accordingly, as they do wholesalers and retailers. Blockmakers feel undermined by cement companies.
- The study can help cement manufacturers become strategic in optimising their profits while also incorporating green practices into the manufacturing process of cement to protect the ecosystem.
- Cement companies' sales excellence and other associated departments should initiate timely market discovery surveys in order to keep pace with consumers' preferences and feedback on the range of products stocked and used.
- Cement companies should improve the career paths for field agents, engineers, and builders.
- The study is useful in motivating cement companies to assist in the sustainable development of the built environment. Hence, involvement in Corporate Social Responsibilities (CSR) should be seen as entrenched in the researcher's findings on company responsibility.
- Cement-making companies should do more publicity about their CSR activities (as part of their marketing strategies) to boost patronage.

7. Implications of Research for Stakeholders in the Cement Business

The current production rate of cement accelerates the depletion of natural resources, which results in the consumption of about 1.5 tonnes of limestone and clay per ton of cement (Miraki *et al*., 2022). Hence, there is a need to strongly emphasise and incorporate sustainability concerns (Sheth & Parvatiyar, 2021). Thus, further studies could examine the socio-ecological dimensions of cement for sustainable development, both in the context of businesses and the construction industry. The ratio of the company's haulage cost for cement to the end-user price, and its association with the availability of cement, could also be examined.

The findings of the research stress the need to increase technical input and improve cement properties (product quality) ahead of marketing concerns and promotion (Bonney *et al*., 2022; Pitso, Ligaraba, and Chuchu, 2023). This will ensure end-users have value for money and a transformative experience in the purchase and use of cement. Furthermore, retailing and relationship quality factors such as good working relationships with the retailer, the reputation of the supplier (retailer), the proximity of retail outlets to sites, and the jurisdiction of sales representatives/technical assistants to sell directly to the construction site are key for the research. This link between retail, technical support, and relationship quality dimensions is a theoretical basis for the research (Hennig-Thurau & Klee, 1999). It results in entrepreneurship, self-actualisation, and mission-driven outcomes (Sheth & Parvatiyar, 2021).
The question of how cement companies reduce complexity in buying situations comes to the fore because different buyers have different criteria for what constitutes the best alternative (Sheth & Parvatiyar, 1995; Hennig–Thurau *et al.*, 2002). Thus, product availability in sufficient quantities (rank 3), competitive pricing (rank 6), and a good transportation system for prompt delivery to the site (rank 9) must be leveraged to maintain smooth running and sanity in the industry. The industry has been blighted with numerous and recurring instances of payment for cement (in tons) without delivery, one month or more after.

Lastly, affordability of cement is an ensuing discussion on everyday blockmaking and building construction sites with prevailing realities such as lack of provision of credit facility of payment (rank 38), absence of favourable and flexible terms of payment and doing business (rank 35) and absence of discounted or subsidised price (for focus or sensitive markets) (rank 32). The business transitioned over the past six years and recapitalised, just like the Nigerian banking sector in 2005. This calls for a further overview of the supply chain and factors of haulage and transportation of cement.

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Appendix 1

Table 1: General information of respondents

N = 119	**Frequency(f)**	**Per cent (%)**
Sex		
Male	93	78.2
Female	26	21.8
Age (Years)		
36-45	46	38.7
26 -35	42	35.3
46-55	14	11.8
18-25	10	8.4
Above 56	7	5.9
Respondents' professional qualifications		
MNIOB	29	24.4
MNIQS	10	8.4
MNSE	6	5.0
MNIA	6	5.0
FNIOB	2	1.7
CIPM	1	0.8
CIPS	1	0.8
REDAN	1	0.8
No qualification	63	52.9
License/Registration with Council		
CORBON	29	24.4
QSRBN	10	8.4
COREN	6	5.0
ARCON	6	5.0
Not licensed/registered	63	52.9
Highest educational qualification		
BSc.	46	38.6
HND	33	27.7
MBA/M.Arch/M.Sc	31	26.1
ND	9	7.6
Respondent's area of specialisation		
Building	57	47.9
Civil Engineering	20	16.8
Quantity Surveying	16	13.4
Architect	10	8.4
Service (M&E) Engineering	8	6.7
Land Surveying	8	6.7
Category of respondent		
Project Site Engineer	50	42
Estate Developer & Facilities Manager	30	25.2
Individual Home Builder (IHB)	23	19.3
Blockmaker	16	13.4
Year of work experience		
6-10	42	35.3
1-5	37	31.1
11-15	26	21.8
16-20	7	5.9
Above 25	4	3.4
21-25	3	2.5
Types of projects		
Bungalow	53	44.5
Duplex	75	63.0
Commercial/Offices/Plaza	40	33.6

N = 119	Frequency(f)	Per cent (%)
Multi-storey buildings	29	24.4
Institutional/Schools/Hospital	24	20.2
Roads/Bridges/CVE Works	17	14.3
Electricity substation foundation/concrete poles	1	0.8

Table 4: Factors influencing end–users' decision to purchase cement

Factors	Loading	Mean	SD	Rank
Company				
• Company Involvement in Corporate Social Responsibility	.461	3.34	1.1892	**25**
• Partnering with research institutes (such as NBRRI, etc.)	.460	3.32	1.1345	**26**
• Issuing proforma invoices bearing the company labels and headlines to customers	.539	3.20	1.0860	**33**
• Provision of additional services such as estimating for building material and labour, market survey, etc	.692	3.23	0.9780	**30**
• Promptly addressing feedback from the end–users on-site to the company on the cement product.	.753	3.43	1.0622	**23**
• Timely market discovery surveys	.600	3.30	0.9962	**27**
• Offering fringe benefits to end–users at the end of each business year	.656	3.10	1.1818	**36**
• Intervention for interlocking block and kerb makers, and concrete electric pole makers	.657	3.25	1.1140	**28**
Cement				
• Availability of cement	.714	4.28	0.9381	**3**
• Dries faster	.675	4.08	0.8980	**5**
• Cement strength	.721	4.34	0.8159	**1**
• Good workability	.563	4.30	0.8978	**2**
• Promptness of delivery to the site	.592	3.81	1.0024	**9**
• Bags always full	.604	4.03	0.9472	**7**
Retailing				
• Good finishing	.622	4.24	0.8534	**4**
• Good colour/appearance	.446	3.52	1.0802	**16**
• Brand name/image	.727	3.67	1.0978	**15**
• Proximity of retail point or depot to the site	.672	3.76	1.0633	**12**
• Carrying out a cement and mortar trial mix	.589	3.44	1.0548	**22**
• Good working relationship with the retailer	.619	3.77	1.0770	**11**
• Reputation of the supplier (retailer)	.484	3.76	1.0248	**12**
• Sales Representative/Technical Assistant selling directly to the construction site.	.459	3.71	1.0427	**14**
Marketing				
• Years since the establishment of the cement company	.716	3.47	1.2131	**20**
• Digital advertisement	.792	3.24	1.1121	**29**
• Use of celebrities to promote a brand	.580	2.63	1.3268	**39**
• Creativity in packaging cement products	.528	3.08	1.1467	**37**
• Company innovation and cement product differentiation	.556	3.50	1.0567	**18**
• Cement brands currently dominating the market	.569	3.79	0.8913	**10**
Price				
• Price	.449	4.06	1.2233	**6**
• Provision of a credit facility for payment	.730	3.03	1.3433	**38**
• Favourable and flexible terms of payment and doing business	.770	3.18	1.0708	**35**
• Discounted or subsidised price (for focus or sensitive markets)	.489	3.22	1.3094	**32**
• Incentive for the prompt delivery of cement to the site	.594	3.23	1.1157	**31**

Factors	Loading	Mean	SD	Rank
Technical Asrenownedce				
• Company identifying with renowned Estates & Property Developers (e.g. Adron Homes) and carrying out cement/mortar trial mix	.608	3.50	0.9989	**18**
• Company sponsoring annual conferences/AGM of professional bodies	.740	3.20	0.0937	**34**
• Attendance of Sales Representatives (Technical Assistants) in Blockmakers' Association Meetings	.602	3.45	0.9633	**21**

JCBM (2025) 8(1) 47-62

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Evaluating the Economic Impact of Alternative vs. Conventional Construction Materials for Residential Projects in Tanzania: Integrating Environmental and Social Criteria

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Received January 30, 2025; received in revised form February 10, 202; May 13, 2025; May 17, 2025; July 22, 2025; accepted August 19, 2025
https://doi.org/10.15641/jcbm.8.1.1752

Abstract

Previous research in Tanzania has focused on comparing the mechanical and environmental properties of sustainable building materials (SBMs) with those of their conventional counterparts; however, there remain limited contributions in assessing the economic impacts associated with this trend. This significantly hinders the adoption of SBMs in residential construction, as economic viability remains a critical factor in material selection in developing countries, such as Tanzania. Using cost-benefit analysis (CBA), this study addresses this gap by evaluating the economic viability of SBMs in comparison to conventional materials for residential building projects in Tanzania, while considering environmental and social factors. To achieve this aim, a comparative analysis of two material alternatives, namely compressed stabilised earth blocks (CSEBs) and conventional concrete blocks, was conducted based on predefined criteria, including cost, local availability, and ease of use. Findings reveal that CSEB walls are approximately 18% more cost-effective than concrete blocks, offering enhanced constructability and reducing environmental impact, rendering them a highly recommended option for sustainable residential construction. The novelty of this study lies in the application of CBA, which is predicated on developing unit rates per unit scale through a cost breakdown, enabling stakeholders to adjust cost components at a granular level for informed decision-making. Practically, this study provides a cost-based decision-making framework for selecting SBMs in Tanzania while promoting awareness through suggesting an improved format of price list that integrates sustainable alternatives. However, the study is limited by its focus on a specific region and materials, as well as the qualitative treatment of environmental and social criteria. Future research should expand the analysis to include broader aspects, thereby better elucidating the overall suitability of SBMs in diverse contexts.

Keywords: Alternative building materials, Cost-Benefit Analysis, Residential Building Projects, Social and Environmental Criteria, Tanzania

1. Introduction

The construction industry faces an urgent mandate to adapt in response to global climate change and rapid urbanisation, two challenges that collectively put pressure on resources and escalate environmental impacts (UNEP, 2022). Climate change manifests in rising global temperatures, resource scarcity, and increasingly severe weather events, all of which underscore the need for sustainable construction practices. Simultaneously, urban populations are projected to grow significantly, with an estimated 68% of the global population living in urban areas by 2050, up from 55% in 2017 (The World Bank, 2021). This rapid urbanisation is intensifying housing demand, especially in the fast-growing cities of developing countries, revealing the limitations of traditional, resource-intensive construction methods that contribute

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approximately 39% of global CO_2 emissions and consume over 40% of the world's raw materials each year (UNEP, 2022). As nearly 2 billion new homes are anticipated by 2100 to accommodate urban growth, adopting innovative, eco-friendly building materials has become a priority (UN, 2017).

In East Africa, efforts to promote sustainable materials are emerging. For instance, Rwanda has adopted adobe bricks for urban housing (RHA, 2022), demonstrating how locally sourced materials can balance economic, social, and environmental considerations (MDG, 2019). Similarly, Tanzania has demonstrated its commitment to improving living standards and promoting sustainable housing solutions through various initiatives. The establishment of the Institute of Building Research (IBR) exemplifies this effort, with a mission to provide innovative, cost-effective construction technologies suited to local needs (IBR, 2024).

However, while previous studies in Tanzania have explored the mechanical and environmental properties of various sustainable and conventional building materials such as concrete blocks, volcanic rocks, and CSEBs (Hatibu *et al.*, 2015; Jung *et al.*, 2019; Moses *et al.*, 2020; Sabai *et al.*, 2013), there remain limited contributions in assessing their economic impacts relative to conventional building materials. This limitation hinders the broader adoption of sustainable materials in residential construction, as economic viability remains a critical factor in material selection in developing countries like Tanzania (Mahame *et al.*, 2024). Although alternative materials cover a variety of options, this study focuses explicitly on Compressed Stabilised Earth Blocks (CSEBs) as the primary alternative, and concrete blocks as the conventional counterpart, due to their widespread use and relevance in Tanzanian residential construction.

This study addresses this gap by evaluating the economic viability of alternative building materials in comparison to conventional materials for residential building projects in Tanzania, while balancing environmental and social factors. The specific objectives of the study are to:

1. Assess the suitability of selected alternative building materials for residential building projects.

2. Compare cost variance between conventional and alternative materials

3. Suggest an enhanced building materials price list format that implements alternative materials and reflects sustainability criteria

Using cost-benefit analysis (CBA), the study integrates environmental and social criteria to provide a comprehensive economic evaluation. The findings aim to inform policymakers, enhance awareness, and propose an elaborate price list of materials to the National Construction Council (NCC) to support the implementation of sustainable materials.

2. Literature review

2.1. Overview of alternative building materials

Historically, building materials have undergone significant evolution. According to Kibert (2016), vernacular architecture primarily relied on simple, locally available natural resources that required minimal processing, such as adobe, bamboo, and timber. These locally sourced materials were abundant, cost-effective, and well-suited to the cultural and environmental contexts of their regions. Ross and Dru (2010) further note that these materials offered a sustainable construction approach, characterised by low energy demands and minimal ecological disruption. However, with the arrival of industrialisation, the landscape of construction materials transformed dramatically, as Gann and Barlow (1996) observed.

The industrialisation and urbanisation of the 19^{th} and 20th centuries marked a significant shift in construction practices, favouring modern materials such as concrete, steel, and plastics (Vagtholm *et al.*, 2023). While these materials enabled rapid urban development and large-scale infrastructure projects, their energy-intensive production processes and dependence on non-renewable resources significantly contributed to global carbon emissions and waste generation, raising concerns about their environmental sustainability (Gann & Barlow, 1996). In response to these challenges, growing concerns over climate change, resource depletion, and environmental degradation have reignited interest in alternative building materials. These materials, characterised by renewability, recyclability, and low embodied energy, offer promising solutions for sustainable construction (Ngowi, 2001). For example, CSEBs, made from locally sourced soil, reduce transportation emissions and resource depletion (Waziri *et al.*, 2013), while bamboo, with its rapid growth cycle, provides an efficient renewable substitute for timber (Patil & Patil, 2017).

In the Tanzanian context, prior studies have explored the environmental benefits of alternative building materials but have mainly overlooked their economic implications. For instance, Hatibu *et al.* (2015) analysed the energy and carbon intensities of mud bricks (adobe bricks) and soil cement interlocking bricks compared to conventional materials like burnt clay bricks and solid concrete blocks, concluding that the alternatives significantly reduce carbon emissions and environmental degradation. However, the study did not assess the cost implications of these materials relative to their conventional counterparts. Similarly, Jung *et al.* (2019) investigated the geochemical properties of volcanic rocks from Oldoinyo Lengai, highlighting their ability to recycle carbon and mitigate emissions. However, like Hatibu *et al.* (2015), this study also failed to examine the economic feasibility of incorporating volcanic rocks into construction. These gaps underscore the need for integrated assessments that combine environmental and cost-benefit analyses to facilitate the practical adoption of sustainable materials. This study seeks to address this gap by evaluating both the economic and environmental impacts of alternative building materials in Tanzania, providing a comprehensive foundation for informed decision-making.

2.2. Economic Viability of Building Materials

The cost of building materials plays a pivotal role in material selection, particularly in low- and middle-income countries where affordability often dictates decision-making (Ernest *et al.*, 2022). Conventional materials, such as concrete blocks, are frequently regarded as cost-effective due to their widespread availability and well-established supply chains (Nilimaa, 2023). However, this perception shifts when lifecycle costs are considered, as SBMs like CSEBs can offer significant long-term savings (Elahi *et al.*, 2021). Unni and Anjali (2022) argue that the economic viability of SBMs stems from their ability to reduce operational costs and enhance building resilience. While these materials may involve higher upfront expenses, they are shown to yield substantial long-term benefits, including lower maintenance costs and extended durability.

Globally and regionally, the economic evaluation of building materials has emphasised cost-effectiveness, lifecycle costs, and resource efficiency. For instance, Ohemeng and Ekolu (2020) conducted a comparative analysis in South Africa, demonstrating that recycled concrete aggregates could achieve cost savings of approximately 40% while reducing environmental impacts by 97% compared to natural aggregate concrete. Similarly, Puri *et al.* (2016) assessed cost trends in bamboo construction. They found that it can be 40% less expensive compared to partition brick walls, positioning bamboo as an affordable alternative for budget-conscious builders.

Despite their contributions, these studies reveal notable gaps in context-specific applicability. Ohemeng and Ekolu (2020) do not address the generalizability of their findings beyond South Africa, where factors such as material availability, labour costs, and supply chain efficiencies may differ significantly from other contexts, such as Tanzania. Likewise, although Puri *et al.* (2016) highlight the affordability of bamboo construction, the study lacks specificity regarding the traditional wall materials used as a basis for comparison, leaving uncertainties about the precise magnitude of its cost advantages.

To bridge these gaps, this study undertakes a comprehensive cost assessment of alternative building materials within the Tanzanian context. By evaluating their comparative cost benefits relative to conventional options and incorporating environmental and social considerations, this research aims to provide a more nuanced understanding of the economic viability of sustainable materials in a low-income, resource-constrained setting.

2.3. Environmental and Social Criteria in Material Selection

Globally, the discussion on SBMs tends to prioritise environmental metrics such as carbon footprints, embodied energy, and resource efficiency (Pham *et al.*, 2020). The latter author continues that factors dominate sustainability assessments due to their measurability and widespread standardisation. In contrast, social criteria—such as cultural acceptance, local availability, and community empowerment—are often marginalised in material selection discussions, despite their importance in achieving holistic sustainability (Mahame *et al.*, 2024 and Phoya and Nyange, 2022). This imbalance restricts the ability to address broader human-centred dimensions of sustainability, particularly in contexts like Tanzania, where construction practices are closely tied to socio-economic dynamics.

In Tanzania, materials such as soil-cement interlocking bricks and earth bricks have demonstrated significant potential for social impact (Moses *et al.*, 2020). By promoting local job creation, skill development, and self-reliance, these materials reduce dependence on expensive, energy-intensive imports, offering a pathway to community-based economic empowerment (IBR, 2024; Moses & Mosha, 2020; Hatibu *et al.*, 2015). However, these social benefits are frequently overshadowed by the dominance of environmental considerations in material evaluation frameworks (Mba *et al.*, 2024). While studies often emphasise the carbon savings and resource efficiency of such materials, there remains a critical need for research that evaluates their cultural acceptance and ability to address the diverse needs of marginalised groups (Mahame *et al.*, 2024). As Ramos (2024) highlights, social benefits—such as inclusivity, affordability, and alignment with local practices—are inherently more complex to quantify and integrate into standardised evaluation frameworks. Consequently, their consideration in material selection processes is inconsistent and context-dependent. This study seeks to address this gap by integrating both social and environmental criteria into material selection processes. By considering factors like cultural acceptance, local availability and accessibility, and community empowerment alongside carbon and resource efficiency, this research aims to offer a more comprehensive framework for sustainable construction in Tanzania.

2.4. Cost-Benefit Analysis as a Framework

Cost-Benefit Analysis (CBA) is widely recognised as a valuable tool for evaluating the feasibility of projects by comparing their projected costs and benefits. According to Hayes (2024), CBA provides a structured approach to determining whether a decision is worthwhile, particularly in construction, where resource allocation and financial efficiency are critical. Butković *et al.* (2023) emphasise that over the past two decades, CBA has become a primary tool in both academic literature and business practices for evaluating large-scale infrastructure and construction projects. Similarly, Landau (2023) highlights its utility in enabling project managers and stakeholders to make informed decisions about project viability. Vindana (2024) further elaborates that CBA can help assess direct and indirect financial gains, as well as intangible benefits such as enhanced productivity and environmental sustainability.

In the context of SBMs, CBA plays a crucial role in evaluating both initial and long-term financial implications. While these materials often have higher upfront costs, their long-term benefits—including lower energy consumption, reduced maintenance, and extended lifespan—frequently offset the initial investment (TheBuildChain, 2023). For example, sustainable materials with superior thermal insulation properties can significantly reduce heating and cooling expenses over a building's lifecycle (Dickson & Pavía, 2021). As Unni and Anjali (2022) argue, a comparative cost-benefit analysis of sustainable and conventional materials is essential for achieving both affordability and sustainability in housing.

Numerous studies have explored the cost-effectiveness of SBMs. Orekanti (2013) analysed the production costs of stabilised soil blocks compared to burnt bricks, positing that the local availability of soil could reduce construction costs by minimising transportation expenses. However, this study focused solely on production costs and did not extend to the costs of constructing entire buildings with these materials. In a separate analysis, Unni and Anjali (2022) demonstrated that houses built with CSEBs were 13% cheaper than those constructed with red-fired bricks. While insightful, this study relied on fixed construction costs and did not provide a detailed cost breakdown, limiting its practical applicability for budget adjustments.

In Tanzania, Moses and Mosha (2020) found that constructing a building with soil-cement interlocking bricks and sisal concrete roofing tiles reduced costs by 40% compared to using sand-cement blocks and corrugated iron sheets. Similarly, NHBRA (2016) reported a 40% cost reduction when using soil-cement interlocking bricks. However, these studies did not specify the basis of comparison or provide detailed rate build-ups, raising questions about the reliability of their conclusions.

This study builds upon these findings by employing a detailed cost-benefit analysis to evaluate the economic impacts of commonly used sustainable materials compared to conventional counterparts in residential projects. By addressing the limitations of previous studies, such as the lack of comprehensive cost breakdowns and context-specific data, this research aims to provide more actionable insights for construction stakeholders.

2.5. Limitations in NCC Material Price Lists for Sustainable Construction

In Tanzania, the absence of local building standards and certification systems to assess the environmental compliance of building materials (Nkini *et al.*, 2024), coupled with low levels of awareness and knowledge about sustainable alternatives (Mushi *et al.*, 2023), hinders the effective utilisation of alternative building materials. This challenge was further highlighted by Mahame *et al.* (2024), who identified a lack of awareness and limited knowledge as particularly significant barriers to the effective selection of SBMS. These barriers, alongside regulatory and policy constraints, continue to impede the broader adoption of SBMs in residential construction projects.

Similarly, Nidhin *et al.* (2023) and the United Nations (2009) assert that weak policies and regulatory frameworks are frequently linked to lower levels of awareness and knowledge among stakeholders in the construction industry. Kibert (2016) confirms this relationship, noting that regions with inadequate environmental policies often exhibit limited understanding and adoption of sustainable building materials. The interplay of these factors suggests that addressing awareness and regulatory barriers is critical to improving the selection and use of SBMs.

One practical challenge is the presence of ineffective or insufficiently comprehensive tools or databases to guide stakeholders in understanding and comparing material alternatives. Such tools are critical for providing detailed insights into the sustainability attributes of materials, such as their environmental impact, lifecycle costs, and social benefits (Thormark, 2002). For instance, the most recent price list of materials published by the NCC in 2019 (NCC, 2019) exclusively focuses on conventional materials, offering limited to no guidance on sustainable alternatives. This list, widely used by builders, developers, and policymakers, primarily emphasises financial aspects—specifically initial costs—while neglecting broader considerations of material sustainability. Without robust tools or databases that integrate both financial and other sustainability metrics, stakeholders are left with incomplete information, limiting their ability to make informed, forward-looking decisions.

Table 1: Sample format of the actual price list (Source: NCC, 2019)

Region	Unit	Price (TZS)		
		450mm*250mm*100mm	450mm*250mm*125mm	450mm*3250mm*150mm
Iringa	pc	1,000	1,200	1,500
Mbeya	pc	1,300	1,500	1,500
Songwe	pc	1,200	1,500	1,700
Rukwa	pc	1,000	1,200	1,500
Katavi	pc	1,000	1,200	1,600
Ruvuma	pc	1200	1,400	1,600
Lindi	pc	900	1,000	1,500
Mtwara	pc	900	1,000	1,500

It is important to note that not all materials listed in the NCC price list are entirely unsustainable. However, the exclusion of explicit sustainability metrics or alternative materials limits stakeholders' ability to make informed decisions based on comprehensive evaluation criteria. Table 1 illustrates the existing format of the price list, which primarily focuses on cost factors, offering limited insight into other sustainability attributes of listed materials.

To address these limitations, this study proposes an enhanced framework for the NCC's price list that integrates sustainability metrics alongside financial data. By broadening the scope of the price list to include environmental and social dimensions, stakeholders can make decisions that prioritise long-term benefits, such as resource efficiency, reduced environmental impact, and local community empowerment, rather than solely focusing on initial costs.

3. Methodology

3.1. Introduction

This study adopts a quantitative research approach to evaluate the economic impacts of selecting SBMs compared to conventional materials for residential building projects in Tanzania. This approach facilitates evidence-based decision-making by providing measurable and comparable numerical data, such as costs, environmental and social benefits (Lim, 2024).

3.2. Research Design

A cost-benefit analysis (CBA) framework was selected as the primary method due to its systematic approach to comparing material alternatives based on direct and indirect costs, environmental impacts, and social benefits (Boardman *et al.*, 2011). This framework aligns with Goel and Sharma's (2022) assertion that CBA enables data-driven evaluations to inform stakeholders' decision-making processes. The descriptive research design supports the study's objective by focusing on measurable criteria such as cost and by assessing local availability and ease of use through qualitative and semi-quantitative proxies. Moreover, a comparative analysis of two material alternatives—compressed stabilised earth blocks (CSEBs) and conventional concrete blocks—was conducted, based on pre-defined criteria such as cost, local availability, and ease of use within the specific contexts of Dar es Salaam. This location was selected due to its significance in urbanisation, housing demand, and resource availability (Komu & Ramparsad, 2022). This ensures the analysis captures local nuances relevant to Tanzania's construction industry.

3.3. Steps in Cost-Benefit Analysis

In assessing the economic viability of SBMs (CSEBs) compared to conventional materials within the Tanzanian construction sector, the study adopted a systematic approach based on the methodology outlined by Mishan and Quah (2007). This approach is visually summarised in Figure 1, which illustrates the sequential steps undertaken in the Cost-Benefit Analysis (CBA) process.

The key steps include:

1. Defining scope and objectives– The study examines the economic feasibility of SBMs (CSEBs) compared to conventional materials (concrete blocks) in the Tanzanian construction sector. To this, social and environmental criteria are integrated into the material selection process.

2. Identifying relevant costs and benefits– Relevant factors include material, labour, and plant costs, alongside benefits such as reduced embodied energy, local availability and accessibility, durability, and energy savings. Existing local findings were integrated to evaluate energy and carbon intensities as well as social impacts.

3. Quantifying costs and benefits
    i. Data collection: Conducted in May 2024, materials prices were gathered from local suppliers in Dar es Salaam. The saturation principle ensured adequate representation of variability in costs.

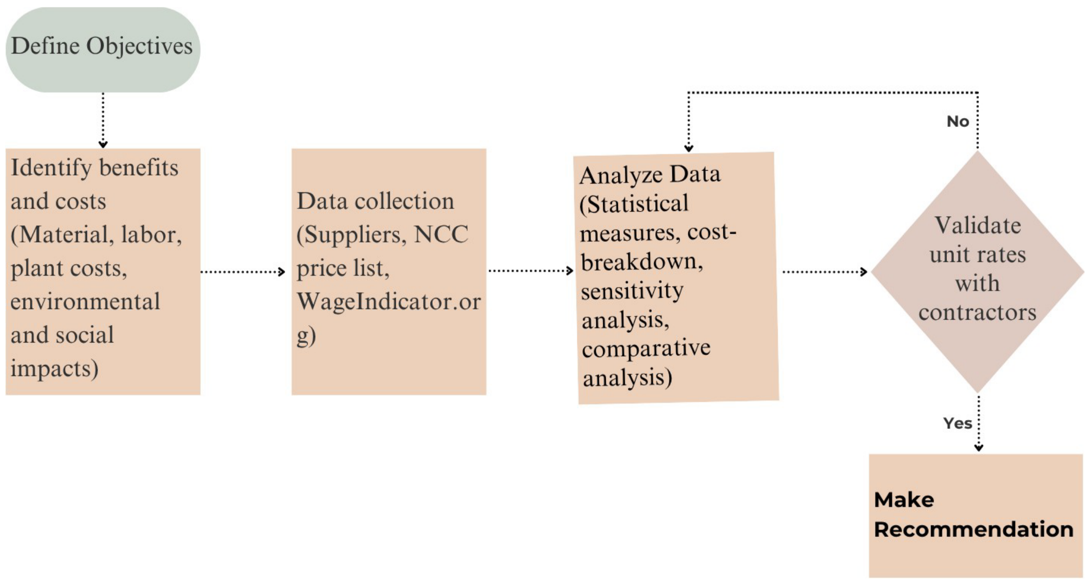

Figure 1: CBA flowchart (Authors)

The saturation principle ensured adequate representation of variability in costs. Labour costs were derived from the updated minimum wage data for construction services in Tanzania, as provided by WageIndicator.org (WageIndicator, 2025). This platform offered consistent and reliable baseline rates applicable to both Dar es Salaam. To account for potential variations, inflation-adjusted plant costs were calculated using the 2019 NCC Price List as a reference. The adjustment process involved applying the annual average inflation rates for Tanzania, sourced from the National Bureau of Statistics (NBS, 2024), ensuring the figures reflect present-day market conditions. This process ensured consistent and representative patterns reflecting the prevailing market conditions. Moreover, it leveraged the 2019 price list report from the National Construction Council of Tanzania (NCC, 2019).

i. Statistical measures: Statistical measures, including mean, median, range, and standard deviation, were employed to assess cost variability, providing insights into the reliability and distribution of data (Moore *et al.*, 2021; Olsen *et al.*, 2010; Newbold *et al.*, 2013).

4. Comparing costs and benefits– The analysis standardises comparisons on a per-square-meter (1 m²) or per-cubic-meter (1 m³) basis (Ashworth & Perera, 2015).

5. Validate unit rates with contractors– This step involved cross-checking the calculated unit rates with local building contractors in Dar es Salaam. This ensured alignment with market practices and validated the practicality of the rates.

6. Making recommendations– Findings inform policy, building practices, and the development of updated price lists incorporating sustainability criteria.

3.4. Material Selection Criteria

Key criteria for material selection included cost, local availability, and ease of use. Lower material costs can significantly enhance housing affordability for middle- and low-income populations (Carpino *et al.*, 2018 and Oyebanji *et al.*, 2017).

Local availability sourcing reduces transportation costs, supports local economies, and minimises environmental impacts (Mahame *et al.*, 2024). While ease of use improves project timelines and reduces labour costs, it offers practical benefits in resource-constrained settings (Falco *et al.*, 2020).

Based on these criteria, the comparative analysis focuses on CSEBs and conventional concrete blocks.

Concrete blocks dominate the market, comprising 70% of all building materials in Dar es Salaam (Sabai *et al.*, 2013).

CSEBs, which are gaining popularity in sub- Saharan Africa, are increasingly recognised for their cost efficiency, sustainability, and ease of use (ARSO, 2018).

3.5. Analysis

To ensure transparency and precision, the study employs a cost breakdown approach (Brook, 2017), which allows for detailed estimation of initial costs and precise identification of cost-saving opportunities. This approach addresses the higher upfront costs often associated with sustainable materials by highlighting their long-term economic and other benefits *(Mahame et al.*, 2024). Additionally, a sensitivity analysis examined the impact of variations in material and labour costs on total costs. The analysis considered adjustments of ±10% and ±20%, commonly used ranges that reflect the stability of labour/material costs and price fluctuations in Tanzania's construction sector (NCC, 2020a, 2020b). This analysis ensures the reliability of decision-making and accounts for market volatility (Kermanshachi & Pamidimukkala, 2023).

4. Results

This section presents a detailed analysis and interpretation of the study's findings, covering descriptive statistics, unit rates build-up, sensitivity analysis, and comparative evaluation of concrete blocks and CSEBs.

4.1. Descriptive Analysis

The descriptive analysis of this study provides insights into the distribution and variability of unit prices for concrete blocks and CSEBs, based on data collected from a total of 15 suppliers for concrete blocks and five suppliers for CSEBs (Table 2).

Table 2. Descriptive statistics for initial prices of concrete blocks and CSEBs (Authors)

Prices (TZs)	Frequency (f)	$x \times f$	Deviation from mean (x_i–μ)	Squared deviation ((x_i–μ)$^2 \times f$)
1. Concrete Blocks				
1,650	3	4,950	(50)	7,500
1,700	9	15,300	0	0
1,750	3	5,250	50	7,500
Total	**15**	**25,500**		**15,000**
Mean (μ)= Σ $\frac{i}{n}$		1,700		
Standard deviation (σ)= %Σ $\frac{(xi\&\mu)^2}{n}$ i$n				31.62
2. CSEBs				
650	1	650	(60)	3,600
700	2	1,400	(10)	200
750	2	1,500	40	3,200
Total	**5**	**3,550**		**7,000**
Mean (μ)= Σ $\frac{i}{n}$		710		
Standard deviation (σ)= %Σ $\frac{(xi\&\mu)^2}{n}$ i$n				37.41

These descriptive statistics were instrumental in determining the initial prices of the materials, which were subsequently used to calculate their respective unit rates per Square Meter of walling. This approach ensures that the analysis reflects real market conditions and supplier pricing trends, thereby enhancing the reliability of the study's cost comparisons.

Observation: The mean price for concrete blocks is 1,700 TZs with a standard deviation of 31.62 TZs, indicating relatively minor variability across supplier prices and market stability (Agyekum *et al.*, 2018). By contrast, CSEBs have a mean price of 710 TZs, with a slightly higher standard deviation of 37.41 TZs. This reflects a more pronounced price variability, potentially attributable to factors such as variability in raw material composition (e.g., soil and cement ratios) and less mature supply chains (Dominguez *et al.*, 2013). Despite the differences in pricing patterns, both materials share a comparable price range of 100 TZs, highlighting that both markets exhibit a similar price dispersion.

4.2. Unit Rates Build-Up

Apart from considering the standard factors of estimation for materials, labour, and plant inputs for construction works provided in the book 'Estimating and Tendering for Construction Work' by Brook (2017), the following additional considerations were applied to accomplish the estimation task:

1. Size
   i. Concrete blocks: 450 x 200 x 150mm
   ii. CSEBs: 230 x 220 x 115mm

2. Mortar ratio
   i. Concrete block: (1:3)
   ii. CSEBs: (1:4)

3. Material market prices
   i. Portland cement: 25,000TZs/50Kg (Bag)
   ii. Sand: 30,000 TZs/ton`
   iii. Semi-skilled/Mason: 1,641TZs/hour (WageIndicator, 2025)
   iv. Concrete mixer (10/7):
   v. Concrete block: The mean value of 1,700 TZs per block was used due to its representativeness of the market prices (Refer to Table 2).
   vi. CSEBs: The higher price of 750 TZs per block was adopted instead of the mean value of 710 TZs. This decision reflects risk mitigation, such as supply chain variability or increased production costs, particularly as CSEBs are still in the early stages of adoption in Tanzania (Refer to Table 2).

4. Assumptions
   i. The cost of materials includes transportation costs.
   ii. Assume that one mason and one helper can handle 5-7 sq m per day of concrete blocks.
   iii. Assume that a helper works half as long as a mason.
   iv. For CSEBs, mortar is only used on the lowest course and vertical joints, thus requiring a lesser mortar quantity.
   v. Assume the labour cost is equal for both concrete blocks and CSEBs
   vi. Assume all works are carried out without the services of a subcontractor
   vii. All currencies are in Tanzanian Shillings
   viii. Standard allowances for waste, contingency (5%), overheads (15%), and profits (15%) were used.

From Table 3, the calculation of the unit rate for concrete block wall began by determining the rate of 1m^3 of mortar (1:3), which was 284,365 TZs/m^3, factoring in material costs, labour, and plants. For 1m^2 of concrete block walling, 12 blocks were required at 1,700 TZs each, with an additional 10% for waste.
The total labour required included 1.1 hours for a mason and 0.55 hours for a helper, resulting in a final unit rate of 39,960 TZs/m^2, including contingency, overheads and profit allowances.

Similarly, the unit rate for 1m^2 of CSEBs walling (Table 4) was built upon the rate of 1m^3 of mortar (1:4), calculated as 241,043 TZs/m^3, including the material waste allowance. For 1m^2 of walling, 23 blocks were required at 750 TZs each with a 10% allowance for waste. Labour requirements included 0.9 hours for a mason and 0.45 (rounded to hours for a helper, resulting in a final unit rate of 32,747 TZs/m^2, including contingency, overheads and profit percentages.

The overall observation reveals significant economic advantages of CSEBs over concrete blocks. The base unit rate of CSEBs (32,747 TZs/m^2) is 18.05% lower than that of concrete blocks (39,960 TZs/m^2). While this cost advantage exceeds the 13% reported by Unni and Anjali (2022), it is substantially lower than the 40% reported by Moses *et al.* (2020) and NHBRA (2016), and the 41% reported by Orekanti (2013). The latter three studies, however, did not specify the source of their reported percentage advantage or provide the basis of comparison or detailed rate build-ups, which raises questions regarding the reliability of their conclusions. In contrast, Unni and Anjali (2022) conducted their CBA for CSEBs against masonry bricks rather than concrete blocks, as used in the present study, and relied on prevailing field unit rates instead of the cost breakdown methodology employed in this research.

An additional trend observed between Tables 3 and 4 is that the labour required is at least a quarter-hour less to complete one square of CSEB's wall compared to concrete blocks. This observation aligns with broader findings in the literature indicating that sustainable materials often incorporate designs that facilitate ease of use (Falco *et al.*, 2020). Furthermore, this reduced construction time has significant economic implications, as it directly translates into lower labour costs, a crucial consideration for resource-constrained projects.

1.1. enitivity Analysis

To assess the impact of possible price volatility, a sensitivity analysis was performed using adjustments of ±10% and ±20% on key cost components, including cement, sand, concrete blocks, CSEBs, and labour. It is noteworthy that due to the extensive number of tables illustrating the implications for each scenario of potential variation, the manuscript detailing unit-rate tables for all ranges is available in the supplementary files (Sensitivity Analysis) provided for reference. Subsequently, the authors present the summary data and key findings (Figure 1).

For concrete blocks, a 10% cost decrease reduces the unit rate to 35,988 TZs/m^2, whereas a 20% reduction To assess the impact of possible price volatility, a sensitivity analysis was performed using adjustments of ±10% and ±20% on key cost components, including cement, sand, concrete blocks, CSEBs, and labour. It is noteworthy that due to the extensive number of tables illustrating the implications for each scenario of potential variation, the manuscript detailing unit-rate tables for all ranges is available in the

Table 3: Cost breakdown for 1m^2 of solid concrete block wall (Authors)

200 mm thick solid concrete block walling; in cement and sand (1:3) mortar……m 2									
ITEM DETAILS					**ANALYSIS**				**Net Unit Rate (TZs)**
Ref	**Description**	**Qty**	**Unit**	**Rate (TZs)**	**Lab**	**Plt**	**Mat**	**s/c**	
Mat	Mat for 1 m3 of mortal 1:3								
Mat	Cement	0.52	t	400,000			208,000		
Mat	Sand	1.35	t	30,000			40,500		
Mat	Add Waste (7.5% of Mat)						18,638		
Mat	Semi-skilled	3.7	Hr	1,641	6,072				
Plt	Concrete mixer (10/7)	0.5	Hr	22,313		11,156			
Rate for 1:3 mortar					6,072	11,156	267,138		284,365
Now consider the walling.									
Mat	Blocks	12	nr	1,700			20,400		
Mat	Waste 10%	1.2	nr	1,700			2,040		
Mat	Mortar	0.014	m3	284,365			3,981		
Mat	Waste 15%	0.0021	m3	284,365			597		
Lab	Mason	1.10	Hr	1,641	1,805				
Lab	Helper (1:2)	0.55	Hr	821	451				
Sub 1					**2,256**		**27,018**		**29,275**
Add Contingency 5%					113		1,351		1,464
Sub 2					**2,369**		**28,369**		**30,738**
Add overheads 15%					355		4,255		4,611
Add Profit 15%					355.38		4,255.38		4,611
Unit Rate per m2					**3,080**		**36,880**		**39,960**

Note(s): Ref= Reference; Qty= Quantity; Lab= Labor; Plt= Plant/Equipment; Mat= Materials; S/C: Sub-contractor.

Table 4: Cost breakdown for 1m2 of CSEBs wall (Authors)

230mm x 190mm x 115mm CSEB walling; with (1:4) mortar only laid under the lowest course…… m 2									
ITEM DETAILS					**ANALYSIS**				**Net Unit Rate (TZs)**
Ref	**Description**	**Qty**	**Unit**	**Rate (TZs)**	**Lab**	**Plt**	**Mat**	**s/c**	
Mat	Mat for 1 m3 of mortal 1:4								
Mat	Cement	0.39	t	400,000			156,000		
Mat	Sand	1.74	t	30,000			52,200		
Mat	Add Waste (7.5% of Mat)						15,615		
Mat	Semi-skilled	3.7	Hr	1,641	6,072				
Plt	Concrete mixer (10/7)	0.5	Hr	22,313		11,156			
Rate for 1:4 mortar					6,072	11,156	223,815		241,043
Now consider the walling.									
Mat	CSEB	23	nr	750			17,250		
Mat	Waste 10%	2.3	nr	750			1,725		
Mat	Mortar	0.008	m3	241,043			1,808		
Mat	Waste 15%	0.0011	m3	241,043			271		
Lab	Mason	0.90	Hr	1,641	1,477				
Lab	Helper (1:2)	0.45	Hr	821	369				
Sub 1					**1,846**		**21,054**		**22,900**
Add Contingency 10%					184.61		2,105.40		1,145
Sub 2					**2,031**		**23,159**		**24,045**
Add overheads 15%					305		3,474		3,607
Add Profit 15%					304.61		3,473.91		3,607
Unit Rate per m2					**2,640**		**30,107**		**32,747**

Note(s): Ref= Reference; Qty= Quantity; Lab= Labor; Plt= Plant/Equipment; Mat= Materials; S/C: Sub-contractor.

in the supplementary files (Sensitivity Analysis) provided for reference. Subsequently, the authors present the summary data and key findings (Figure 1).

For concrete blocks, a 10% cost decrease reduces the unit rate to 35,988 TZs/m², whereas a 20% reduction lowers it further to 32,017 TZs/m².

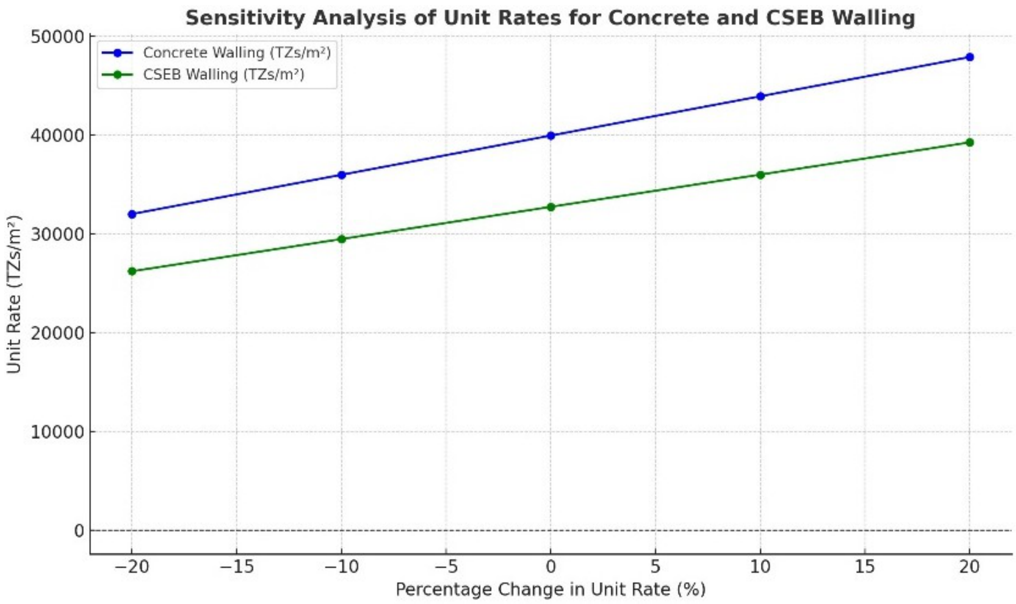

Figure 1: Sensitivity analysis of unit rates for concrete block and CSEBs (Authors)

Conversely, a 10% increase increases the rate to 43,931 TZs/m², and a 20% increase elevates it to 47,903 TZs/m². For the CSEBs, the unit rate decreased to 29,666 TZs/m² (-10%) and 26,386 TZs/m² (-20%). However, a 10% cost increase raises the rate to 36,225 TZs/m², and a 20% increase pushes it up to 39,505 TZs/m².

The findings indicate that CSEBs generally demonstrate greater economic viability compared to concrete blocks, exhibiting lower unit rates across all scenarios examined.

This observation aligns with the research conducted by Islam *et al.* (2020), which concluded that CSEBs are more cost-effective and may provide enhanced price stability in volatile markets, potentially attributable to the utilisation of locally sourced materials and waste products as stabilising agents.

1.2. Summary, Interpretation, and Implications

The findings indicate that:

1. CSEBs are cost-effective: The consistent cost advantage across sensitivity ranges demonstrates their economic viability.

2. Impact of price volatility: Materials and labour prices significantly influence unit rates, suggesting the need for cost control measures in these areas.

3. Policy and practice implications: The adoption of CSEBs can contribute to more economical and sustainable construction practices, aligning with Tanzania's objectives for sustainable housing development.

Furthermore, in a review of the existing literature, multiple studies support the idea that CSEBs offer significant environmental and social advantages compared to concrete blocks. According to Hatibu *et al.* (2015), the embodied energy of concrete blocks is three to four times higher, and their carbon emissions are four to six times greater than those of CSEBs. These disparities are attributed to the localised production of CSEBs and the avoidance of energy-intensive processes such as high-temperature firing (Paul *et al.*, 2024). Moreover, CSEBs yield energy savings of 1.0–2.0 MJ/m² compared to 0.5–1.0 MJ/m² for concrete blocks.

Durability is another notable characteristic of CSEBs, which, when stabilised with cement, lime, or geopolymers, can meet international standards and withstand various environmental conditions (Bogas *et al.*, 2018 and Sore *et al.*, 2018). A minimum cement content of 4% ensures water resistance, while natural fibres such as areca further enhance strength and longevity (Paul *et al.*, 2024). Although concrete blocks can last over 100 years under ideal conditions (Franks, 2023), CSEBs have a lifespan of up to 70 years, rendering them a durable option for sustainable construction (Malkanthi & Perera, 2018).

From a social perspective, CSEBs provide environmentally friendly and cost-effective building solutions that align with global sustainability goals. Their production supports local economies, reduces construction costs, and creates employment opportunities (Latha *et al.*, 2023 and Sadouri *et al.*, 2024). Furthermore, the aesthetic appeal of red soil CSEBs eliminates the necessity for painting, as noted by Hydraform Tanzania (2024).

Although CSEBs may require further optimisation to suit specific project conditions, their lower embodied energy and carbon emissions, coupled with their notable economic and social advantages, make them a promising alternative to conventional concrete blocks in sustainable construction (Table 5).

Table 5: Comparative analysis between concrete blocks and CSEBs (Authors)

S/No.	Parameter	Concrete blocks	CSEB
1	Sizes (mm)	450x250x150mm	230x220x115mm
2	Volume (m^3)	0.016875	0.005819
3	Initial Cost (Tsh/m^2)	39,960	32,747
4	Average Lifespan (years)	100	70
5	Availability	High	Moderately High
6	Ease Of Use	Easy	Easier
7	Energy Savings (Annually)	Moderate	Moderately High
8	Environmental Impact	High	Low
	Recommendation	**Advised with Environmental Caution**	**Highly Recommended**

On the other hand, apart from understanding the economic impacts of sustainable materials compared to conventional construction materials while integrating environmental and social criteria, this study aimed to utilise its results to propose an enhanced format of the price list of materials to the NCC. The proposed price list format (Table 6 in Appendix 1**)** integrates sustainability metrics with financial data, thereby promoting awareness and facilitating informed decision-making for stakeholders.

According to Albarbary *et al.* (2023), integrating sustainability into cost build-up encourages the use of greener materials by highlighting their long-term financial benefits, driving demand for sustainable options, and potentially leading to economies of scale. Myint and Shafique (2024) reported that incorporating sustainability metrics into cost information enables stakeholders to make more environmentally conscious decisions in various sectors, particularly in construction and manufacturing. By considering factors such as embodied energy, carbon footprint, and recyclability potential alongside traditional cost metrics, decision makers can better align their choices with environmental goals (Trappey *et al.*, 2012). Moreover, Robichaud and Anantatmula (2010) expressed that, given the growing emphasis on sustainability, there is a clear need to integrate sustainability considerations into building material pricing guides. Therefore, the incorporation of sustainability aspects into price lists would not only promote a more holistic approach to cost estimation but also ensure that the actual value of materials is considered in building projects.

The following is what to see about the proposed format of the price list:

1. The new format includes both conventional and sustainable materials, clearly labelling each material type. This will;
   i. Enable users to distinguish between conventional and sustainable options easily
   ii. Broaden the range of materials considered, making it easier for stakeholders to explore sustainable alternatives.

2. The new format retains the region-specific approach while ensuring that the information is relevant and accurate for local contexts. This comprehensive view could help list all materials available in a region and indicate their categories.

3. The new format includes crucial information on environmental and social factors. With this comprehensive approach, stakeholders will be able to consider not just the immediate cost but also the long-term benefits and environmental implications.

1.3. Study Limitations

Despite achieving the objectives, this study acknowledges some limitations. The investigation was limited to Dar es Salaam and a specific set of building materials, with a focus on CSEBs and concrete blocks. All of these considerations limit the generalizability of the findings to other materials or contexts beyond the scope of this study. Therefore, future research should expand the range to include a wider variety of materials. Moreover, they should focus on diverse geographical regions of Tanzania to assess how regional differences in material availability, labour costs, and construction practices influence the suitability of sustainable materials. Lastly, future studies should incorporate more robust quantitative data on environmental and social impacts. A more holistic evaluation, such as LCA, would allow for a better understanding of the overall sustainability of alternative building materials.

5. Conclusion

This study aimed to assess the economic viability of SBMs in comparison to conventional materials for residential building projects in Tanzania, while considering environmental and social factors. Through the application of CBA, the study assessed the economic advantages of using CSEBs compared to conventional concrete blocks. These materials were selected based on key criteria including cost, local availability of resources, and ease of use. Moreover, the cost breakdown per 1 Sq.m. was utilised in order to ensure more precise estimations, helps in setting realistic budgets, enables stakeholders to adjust plans to stay within budget, and enhances transparency.

The findings revealed that CSEB walls are approximately 18% cheaper than concrete blocks, easier to construct, and offer significant energy savings with a reduced environmental footprint. Consequently, CSEBs emerged as a highly recommended option for sustainable residential construction, while concrete blocks, although commonly used, are advised with environmental caution due to their higher impact. Beyond understanding the economic implications of sustainable materials, the study used the findings to suggest an enhanced format for the price list of materials to the NCC. By incorporating the cost-efficiency and sustainability of materials like CSEBs, the revised price list could help increase the awareness of sustainable materials, hence promoting more environmentally conscious decisions.

This study offers substantial contributions to advancing sustainable construction practices in Tanzania. By identifying alternative building materials, the research promotes awareness and deepens knowledge of sustainable options, which is crucial for fostering more environmentally conscious decision-making. The proposed enhanced price list of materials not only supports this awareness but also serves as a comprehensive tool for comparing various alternatives, aiding stakeholders in selecting the most suitable materials for their projects. The cost-benefit analysis conducted provides a valuable guide for future research, suggesting the need to expand the range of sustainable materials analysed and explore additional alternatives. Furthermore, the detailed cost breakdown per Sq.m. is highly recommended, as it enables precise budget estimations and helps stakeholders adjust plans while staying within budget.

6. Acknowledgements

This research is funded by the Intra-Africa Mobility Scheme of the European Union in partnership with the African Union under the Africa Sustainable Infrastructure Mobility (ASIM).

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Appendix 1

Table 6: Proposed enhanced price list format (Authors)

REGION: DAR ES SALAAM												
S/No.	**Description**	**Unit**	**Price (TSh)**			**Material Type**	**Lifespan (Years)**	**Availability**	**Ease Of Use**	**Energy Savings**	**Environment Impact**	**Remark**
			450x250 x150mm	**450x250 x125mm**	**450x250 x100mm**							
1	Concrete Block	PC	1,500	1,400	1,300	Conventional	100	High	Highly Usable	Moderate	High	Advised with Environmental Caution
2	CSEB	PC	750	750	750	Sustainable	70	Moderately High	Moderately Usable	Moderately High	Low	Highly Recommended