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# CRITICAL REVIEW OF SUDANESE CONSTRUCTION INDUSTRY

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**ABSTRACT**

The Sudanese Construction Industry (SCI) is essential to national development but faces persistent structural and operational challenges that limit its contribution. GDP performance is constrained by fragmentation, the absence of a central ministry, and chronic project underperformance including delays, cost overruns, and quality deficiencies. Following the dissolution of the Ministry of Works and Public Affairs, regulatory responsibilities became dispersed across multiple bodies, leading to inconsistent standards, weak enforcement, and limited strategic coordination. This study presents a critical review of empirical literature on the SCI, identifying entrenched inefficiencies across seven categories: Economic, Technical and Technological, Knowledge and Awareness, Regulatory and Policy, Cultural and Behavioral, Governance and Management, and Market. The findings reveal that these barriers are interconnected, forming reinforcing feedback loops that sustain low productivity and systemic underperformance. Given the complexity of these challenges, isolated reforms are deemed insufficient. Scholars and practitioners advocate for comprehensive institutional transformation, particularly through the establishment of a centralized Construction Industry Development Board to coordinate policy, standardize practices, and drive long-term improvement. Future research is needed to develop context-specific strategies aligned with national construction goals to enhance sector

**KEYWORDS:** Sudanese Construction Industry, performance, Institutional Fragmentation.

## 1. INTRODUCTION

The construction industry is one of the most significant and influential sectors in the global. It provides the physical foundation upon which societies function, enabling economic

activity, social development, and technological progress, contributing approximately 10% to the GNP in industrialized nations (Navon, 2005). It creates the physical backbone for economic activities and improves quality of life by providing essential services like transportation, healthcare, and education. Technological advancements, continue to enhance the industry's efficiency and sustainability.

The Sudanese Construction Industry (SCI) is pivotal for national development but faces significant challenges that hinder its performance. These include poor project management, a lack of skilled staff, inefficient execution, and notably, the absence of effective Performance Measurement Systems (PMSs) (Ibrahim et al., 2024; Elshaikh et al., 2021; Bilal, 2019). This lack of structured monitoring leads to delays, cost overruns, poor quality, and a lack of accountability (Ankrah & Proverbs, 2005). Other obstacles include economic instability, political unrest, and coordination failures among stakeholders.

We will examine the prevailing articles in Sudanese construction industry, applications, and researches in existing literature, as well as their associated limitations. Next, we will propose potential areas for future research to improve the practicality of the Sudanese construction industry. The insights

provided by this study are expected to benefit both industry professionals and researchers, offering valuable guidance for improving Sudanese construction sector.

### 1.1 Sudanese Construction Industry

The Sudanese construction industry is a vital engine for socio-economic development, responsible for providing the physical infrastructure necessary for health, education, and transportation. While it accounts for a significant portion of the country's gross capital formation and GDP, the industry faces severe challenges rooted in political instability, economic deterioration, and a lack of modern managerial practices. The body of research on the Sudanese construction industry reveals a sector of substantial economic importance contributing approximately 4% to GDP, providing significant employment, and delivering essential infrastructure yet one plagued by pervasive, systemic, and interconnected challenges that severely constrain its developmental potential (Mohamed, 2015; Elkhalifa, 2015; Dongla, 2018a).

**Sudan faces severe** problems in its construction sector including: high construction costs; costs overrun; delays; lack of skilled labor; reliance on imports and low quality of construction work. The relative importance of these problems and the interrelation among them have never been examined in depth. No doubt, prioritizing these problems and understanding the interaction between them is crucial for the development of the CI.

Construction industry in Sudan suffers from the high level of taxes and fees on the production, transportation, and sales of building materials, taxation, custom duties, zakat, highway taxes, and provincial fees beside other types of fees contribute to the high prices of building materials (Elkhalifa & Shaddad 2008).

### 1.2 The structure of the SCI and Key players

There is no doubt that, construction industry cannot be successful without adequate organization and strong support of the government and all stake holders, there are some government entities for organizing and developing the engineering sector, consultant and contractors, the most related entities are: Sudanese Engineering Council, Organizing Council for Consultancy Firms, Organization Council for Engineering Works Contractors and Sudanese Contractor Association.

#### 1.2.1 Sudanese Engineering Council

The Sudan Engineering Council (SEC), established in 1977 under the first Engineering Council Act of 1978, serves as the primary regulatory body governing the engineering profession and construction industry in Sudan. Its mandate encompasses the organization and promotion of the profession, control of practice standards, and guidance to competent bodies on engineering matters.

**Policy Framework:** The SEC operates under the Engineering Council Act, which empowers it to regulate professional practice, enhance manpower preparation and training, and ascertain that curricula and qualification standards across engineering faculties and technical institutions meet required standards. The Council has developed internal regulations and established six standing committees to discharge its responsibilities effectively.

**Regulatory Structure:** The engineering ladder comprises four categories; engineer, technician, engineering technician, and skilled labor each with three levels requiring specific regulations and standards. The Council maintains an engineering register documenting names and levels of all registered professionals. Engineering and technical institutions seeking graduate registration must submit their curricula, teaching staff qualifications, and external examiner lists for approval.

#### 1.2.2 Organizing Council for Consultancy Firms (OCCF)

The Organizing Council for Consultancy Firms (OCCF), established in 1999 as a government entity under the Council of Ministers, serves as Sudan's primary regulatory body governing the consultancy profession across multiple sectors. Its mandate encompasses registration and classification of consultancy firms, identification of consultancy areas, establishing competition frameworks for consultancy service awards, setting professional ethics codes,

and defining registration criteria. Qualified individuals or groups may establish firms in fields including Engineering, Information Programming, Architecture, Environment, Agriculture, Industry, Finance, Economics, Administration, and Law, either independently or jointly. Registered firms are authorized to prepare preliminary and feasibility studies, provide planning and design services, prepare detailed execution documents, conduct environmental impact assessments, evaluate organizational performance and financial positions, and render other prescribed services. Firms must employ academically qualified founders with Council-approved professional standards, include relevant experts, specialize in their registered fields, and maintain appropriately equipped headquarters in Sudan.

### 1.2.3 Organization Council for Engineering Works Contractors (OCEWC)

The Organization Council for Engineering Works Contractors (OCEWC), established in 2003 under the Council of Ministers, serves as Sudan's primary regulatory body governing the contracting sector. Its mandate encompasses two core functions: registration and classification of contractors, and organization and development of the contracting industry. Registration criteria require contractors to be legally registered, demonstrate technical capability through equipment and machinery, possess financial capacity, employ qualified staff including engineers and technicians, and maintain a permanent office. The classification system evaluates contractor capability according to defined criteria, assigning grades based on work category and maximum contract value, thereby enabling clients to select appropriate contractors, ensuring fair competition among graded firms, minimizing tender price discrepancies, and encouraging continuous contractor development. Crucially, registration with OCEWC is mandatory for bidding on any government project, establishing the Council as the gatekeeper for public sector construction procurement.

### 1.2.4 Sudanese Contractor Association

The Sudanese Contractors Association, initially registered as part of the business union in 2000 before becoming a separate entity in 2007, serves as the primary professional body representing contracting firms in Sudan. Its multifaceted objectives encompass contributing to infrastructure development and GDP growth, fostering partnerships with government, civil society, and international associations, establishing transparent competition criteria for the sector, protecting members' legal rights and intellectual property, upgrading member skills and knowhow, and representing members domestically and internationally through expeditions, workshops, seminars, and engagements with financial institutions. The Association operates under an administrative structure led by a general assembly that periodically elects a ten-person executive committee by free election in accordance with

workers' union laws and regulations. As of 2019, the Association registered approximately 3,800 members, reflecting its significant role in organizing and advancing the contracting sector in Sudan

## 2. Methodology

The study first explored the trends and distribution of the articles, in scholarly construction industry studies from 2008 to 2026. The data was gathered through searches on Google Scholar, given its wide coverage and access to peer-reviewed online academic journals and books (Singh et al. 2022). The study used terms such as "construction industry in Sudan. See Table 1 for detailed search terms for trend exploration.

**Table 1: Chronological Summary of Sudanese Construction Industry Research (2008–2026)**

| Year | Authors (Selected) | Number of Studies | Document Title / Focus Area |
|---|---|---|---|
| **2008** | Elkhalifa, A. A., & Shaddad, M. Y. | 1 | The building materials industry and housing sector in Sudan |
| **2011** | Elkhalifa, A. A. (2011) | 1 | The construction industry of Sudan: Potentials and challenges |
| **2012** | Omran et al. | 1 | Project Performance in Sudan Construction Industry |
| **2014** | Hakami & Yousif; Bilal, H. E. T., & Shaddad, M. Y. | 2 | The critical factors of project management in Sudanese construction projects; An assessment of the performance of the Sudanese construction industry projects |
| **2015** | *Mohamed, M. B. I.*; Mohmed, S. A., & Sulieman, H. A.; *Mohamed, A. A.*; Eltayb, S. A. E.; *Elkhalifa, A.*; Suleiman, T. G.; *Salah, A. M. A.* | 7 | A study of project delay in Sudan construction industry; Designing a framework for Sudanese construction industry; Applicability of earned value technique in the construction industry in Sudan; Evaluation of the application of modern management systems in the construction industry in Sudan; The magnitude of barriers facing the development of the construction and building materials industries in developing countries; The construction industry in Sudan: A reconnaissance study of challenges and solutions; Factors influencing construction projects performance in Sudan |
| **2016** | Suliman & Adlan; Awad; Awad, I. M. O. Khair, K., Elhaj, H. F. A., Mohamed, Z. B., & Mohammad, R. | 3 | Effect of project performance on organization performance in Sudanese construction industry; Applying lean construction concepts to construction industry in Sudan; Causes and effects of delay factors in road construction projects in Sudan |

| | | | |
|---|---|---|---|
| **2017** | Osman, A. T. E. M., & Ahmed, Y. H.; Own Alla, M. Y., & Hassan, A. S. | 2 | Estimate of labor productivity in Sudanese construction industry; Organization culture impact on Sudanese construction project performance |
| **2018** | Ahmed, Y. D., Alasad, E. A. O., & Ahmed, Y. H.; Dongla, M. A. M-a.; Dongla, M. A. M-b | 3 | Standardizing methods of measurement for earthworks and in situ concrete works in Sudanese construction industry; Construction industry and economic diplomacy; Development of the Sudanese construction industry using dynamic modelling |
| **2019** | Bilal, H. | 1 | Dilemmas of performance in the Sudanese construction industry |
| **2020** | Amin, Y. M. H., Omer, Y. A., & Hassan, M.; Ibrahim, A., & Abdelatif, A. O.; Badawi, Y. M. H., Ahmed, Y. H., Sharafeldin, N. K., & Taber, E. N. M.; Elkhalifa, A.; Ali, M. S. M., & Eltayeb, A. A.; Elzaki, E. E. E. | 6 | Application of quality assessment system in Sudanese construction industry; Challenges facing building information modelling in construction industry in Sudan; Price adjustments in the Sudanese construction industry; Investigating the causality relationship between construction flows and aggregate economy: Evidence from Sudan; ). Risk management of construction projects in Sudan; Overheads and their impact on construction cost in Sudan |
| **2021** | Elshaikh, E. A. M., Mahmoud, S. Y. M., Omar, A., Noureldin, A., & Alkamil, K. | 1 | Key performance indicators in the construction industry in Khartoum, Sudan |
| **2023** | Diyab, W. D. A., & Zakaria, S. M. A. | 1 | Obstacles of the construction industry in Red Sea State |
| **2026** | Dongla, M., & Khalafalla, M. | 1 | Modeling policy and resource dynamics in the construction sector of developing countries |

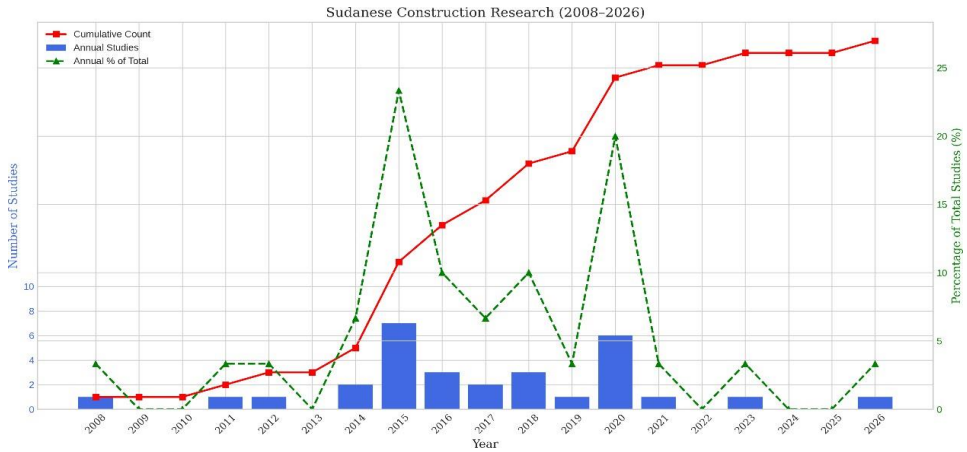


**Figure 1. Trends of studying Sudanese construction industry based on the annual number of studies in Google Scholar search. The graph illustrates the number of studies that utilized SCI, along with the overall count of relevant literature (indicated by the dotted line)**

**Columns:** Number of studies per year (Count), **Blue bars** → Annual studies, **red solid line** → Cumulative count, **Green dashed line** → Percentage contribution, Left **Y-axis:** Study count, **Right Y-axis:** Percentage of total studies.

The figure illustrates that research on the Sudanese construction industry has followed an irregular yet gradually expanding trajectory between 2008 and 2026. Early scholarly output was limited, with only sporadic publications appearing before 2014. Two notable surges occurred in 2015 and 2020, each contributing a significant portion of the total research activity. Despite these peaks, several years recorded no publications, reflecting inconsistent academic engagement with the sector. Overall, the cumulative pattern indicates slow but steady growth, driven by periodic increases rather than sustained annual productivity.

## 2.1 Critical Review of the Literature

The methodology for this study is a selective literature review, consistent with the framework proposed by Colombo et al. (2009). The process involved a targeted review of titles, abstracts, and citations to curate a corpus of literature capable of summarizing historical and contemporary research, delineating major thematic categories, and facilitating a critical analysis. To ensure a valid exploration of the status of SCI, a wide cross-section of publications was considered, resulting in a final review of 30 studies in total. The articles will be reviewed by subject:

### 2.1.1 Project Performance and Measurement

**Pervasive Poor Performance**: Multiple studies confirm systematically deficient performance across all measurement categories. Bilal and Shaddad (2014) found overwhelming stakeholder dissatisfaction with a mean rating of only 2.28/5, with time management scoring lowest among Key Performance Outcomes (KPOs) and training lowest among Key Performance Indicators (KPIs). Bilal (2019) corroborated these findings, reporting mean scores of 2.43 for KPOs and 2.31 for KPIs.

**Performance Factors**: Salah (2015) identified 34 factors affecting project performance across seven categories *(Cost factor, Time factor, Quality factor, Productivity factor, Client satisfaction factor, Health and Safety factor, and Innovation and learning factor)*. Leadership skills (Client satisfaction factor) for project managers ranked highest (RII=0.91), followed by availability of experienced personnel (0.90) and resource availability (0.89). Omran et al. (2012) found that 90% of projects exceeded budgets and experienced schedule delays, with 53.8% rated as having poor safety programmes.

**Performance Frameworks**: Mohmed and Sulieman (2015) developed a sophisticated measurement model identifying seven latent variables: resources, project management

capabilities, external factors, strategic decisions, relationships, project performance, and organization performance. Suliman and Adlan (2016) demonstrated that project profitability strongly correlates with financial perspective (0.966), while customer satisfaction influences customer perspective outcomes.

**Key Performance Indicators**: Elshaikh et al. (2021) identified top project-level KPIs including team experience, customer satisfaction, safety, and training, while company-level KPIs encompassed stability, employee satisfaction, and continuance training.

### 2.1.2 Project Delays

**Delay Prevalence and Causes:** Mohamed (2015) documented that construction permits require 16 procedures over 270 days, ranking Sudan 167$^{th}$ globally. Major delay causes include material price fluctuations, shortages, inaccurate time estimation, construction errors, and improper planning.

**Road Construction Delays**: Khair et al. (2016) identified five delay categories: contractor-related, consultant-related, owner-related, government regulations-related, and external factors. Cost overrun was the most significant effect (RII=0.840), followed by time overrun (0.780), dispute (0.680), and abandonment (0.590).

### 2.1.3 Management Systems and Practices

**Modern Management Application:** Eltayb (2015) found inconsistent application of modern management techniques, with safety management identified as critically weak. Areas of good application included information availability and inter-departmental coordination, while cost control rated only acceptable.

**Critical Management Factors**: Hakami and Yousif (2014) identified ten critical factors *(Quality control tools, Development of personnel, Leads and Lags, Variance Analysis, Responsibility assignment matrix, Performance Reviews, Organizational Commitment, Risk plans, Schedule Compression, and Work Breakdown Structure)* requiring improvement, including quality control tools (2.27), personnel development (2.32), and variance analysis (2.53). Overall project management performance was calculated at 64.2%.

**Earned Value Management**: Mohamed (2015) found that while 75% of engineers understood Earned Value Management (EVM) principles, implementation remained moderate (62.5% occasional application). Primavera P6 was recognized as the most valuable software (77% of respondents).

**Lean Construction**: Awad (2016) revealed that 73% of engineers had no knowledge of lean construction, yet 73% expressed high potential to work in lean environments. Primary workflow barriers were delays in project financing (56.7%) and material delivery (53.3%).

### 2.1.4 Quality Management

**Quality Assessment Systems:** Amin, Omer, and Hassan (2020) identified lack of standardization as the most significant barrier to quality assessment (Average Index 3.72). Currently, 41.67% rely on engineer

experience, while only 25% utilize formal systems. Quality problems affect 72.22% of public sector projects compared to 27.78% of private projects.

**Standardization Deficits**: Ahmed, Alasad, and Ahmed (2018) found substantial lack of awareness and absence of any adopted standard method of measurement, leading to claims and disputes. The study developed comprehensive measurement tables for earthworks and in-situ concrete works.

### 2.1.5 Labor Productivity

Osman and Ahmed (2017) found that only 8.7% of companies utilize standard labor productivity manuals. Labor costs constitute 40-60% of total project costs. The five highest-ranked factors negatively affecting productivity were; lack of experience, absenteeism, incomplete drawings, change orders, and lack of required equipment. The study developed a Labor Estimate Factor methodology for improved cost planning.

### 2.1.6 Economic and Financial Challenges

**Economic Volatility:** Elkhalifa (2020) demonstrated a one-way causal relationship: economic growth leads construction growth, not vice versa. The sector is growth-dependent rather than growth-initiating. Official statistics (4% GDP contribution) significantly underestimate actual sector size.

**Price Adjustments**: Badawi et al. (2020) documented that post-secession of South Sudan (2010) eliminated 80% of foreign exchange resources. Financial legislations (2016-2018) changed exchange rates from 6.8 to 47 SDG/USD, dramatically increasing material prices. Most contractors lacked knowledge in preparing proper price adjustment claims.

**Overhead Costs**: Elzaki (2020) found that total overheads constituted 30.65% of basic project costs. Planning effectiveness ranked as most critical factor (mean 4.72/5). Bonds and guarantees represented 55% of construction stage overheads, with advance payment guarantees alone accounting for 62.81% of guarantee costs.

**Risk Management**: Ali and Eltayeb (2020) identified inflation (56.4%), exchange rate fluctuation (52.2%), and delayed payments (52.2%) as top risks. Seven of the top eight risk factors were financial. No formal risk management exists in most construction companies.

### 2.1.7 Regulatory Framework and Institutional Challenges

**Regulatory Fragmentation:** Dongla (2018a) traced governance evolution from the Single

Body System (1904-1994) under the Ministry of Public Works to the Multi-Fragmented System (1994-present) with responsibilities dispersed across numerous entities. Regulation of the sector ranked as the most critical factor among sixteen influencing the industry.

**Comprehensive Barriers**: Elkhalifa (2015) ranked 61 barriers, with economic and political instability (6.07), lack of strategic planning (5.99), and weak socio-economic conditions (5.88) highest. The building materials industry contributes merely 0.238% to GDP despite employing 12.7% of industrial labor.

**Systemic Challenges**: Dongla and Khalafalla (2026) identified five interconnected challenge categories: regulatory (overlapping mandates), workforce (skill shortages), materials supply (import fluctuations), financial access (high inflation), and project management (inadequate planning). Simulation results indicate regulatory reform could reduce delays by 32%, while workforce investment could decrease cost overruns by 28%.

**Regional Obstacles**: Diyab and Zakaria (2023) found inflation (92.9%), material price fluctuations (89.2%), and exchange rate changes (81.3%) as most critical in Red Sea State. Contractor non-compliance with schedules (82%) and bid sorting problems (79.2%) were also significant.

**Organizational Culture**: Own Alla and Hassan (2017) established that organizational culture dimensions significantly correlate with project performance. Team communication showed significant negative relationships with cost factors ($\beta = -0.490$) and defects ($\beta = -0.361$).

### 2.1.8 Industry Overview and Strategic Recommendations

**Historical Context:** Elkhalifa (2011) documented the industry's inevitable role in socio-economic development, with urbanization increasing from 6.8% (1950) to 40.8% (2005). The sector experienced extreme fluctuations, achieving 161.4% growth in 1998, yet GDP contribution declined from 4.7% (1982- 1998) to 2.7% (1999-2009).

**Comprehensive Solutions**: Suleiman (2015) provided detailed recommendations across financial, administrative, contractual, and regulatory domains, including price stabilization, establishing technical specifications, activating professional bodies, and reforming dispute resolution mechanisms.

**Strategic Direction**: Dongla (2018a) recommended establishing a Sudanese Construction Industry Development Board (SCIDB) as a central executive agency. Simulation of an integrated approach targeting regulation**,** competitive environment, and technology transfer projected.

## 3. Factors & constraints influencing SCI

The Sudanese construction industry is influenced by a complex, interconnected set of factors

that shape its performance and developmental trajectory. Based on synthesis of previous research (Elkhalifa, 2012; Ofori, 2007; Dongla (2018a) and expert consultations, **sixteen critical factors** have been identified *(Transfer of Technology, Competitive Environment, Regulation for the Sector, Foreign Direct Investment, Macroeconomic indicators, Engineering Education, Production of constructions inputs materials, Human resource and employment, Training and Capacity Skill, Migration of Engineers and Technician, Loss of Physical Infrastructure, Order of Law, Structuring System, Globalization, Imbalance of private/public sectors, Research and Development)*. These **factors** align with the **seven barrier categories** *(Economic, Technical and Technological, Knowledge and Awareness, Regulatory and Policy, Cultural and Behavioral, Governance and Management, and Market)* observed in other developing countries, though they manifest with specific local characteristics in Sudan.

### 3.1 Economical Barriers

Macroeconomic instability is the primary economic constraint. **Inflation affects over 90% of projects** in some regions (Diyab & Zakaria, 2023). Sudan lost 80% of foreign exchange reserves; subsequent currency devaluation (6.8 to 47 SDG/USD) dramatically increased material prices (Badawi et al., 2020). The sector is **growth-dependent** (4% GDP contribution) rather than growth-initiating (Elkhalifa, 2020). Top risks are financial: inflation (56.4%), exchange fluctuation (52.2%), and delayed payments (52.2%), yet **no formal risk management exists** in most firms (Ali & Eltayeb, 2020).

### 3.2 Technical and Technological Barriers

Technology transfer is severely limited, with **80% of companies at BIM Level 1**, indicating minimal digital adoption (Ibrahim & Abdelatif, 2020). Modern management application is inconsistent; overall project management performance is only 64.2% (Hakami & Yousif, 2014). **Lean construction awareness**

**is critically low**-73% of engineers have no knowledge of it (Awad, 2016). The building materials industry contributes merely 0.238% to GDP despite employing 12.7% of industrial labor (Elkhalifa, 2015).

### 3.3 Knowledge and Awareness Barriers

Critical **shortages of skilled labor** and inadequate workforce development persist (Elkhalifa, 2015). Engineering education lacks practical management training (Yahia et al., 2013). Only **8.7% of companies use standard labor productivity manuals** (Osman & Ahmed, 2017). No standard method of measurement exists, leading to claims and disputes (Ahmed, Alasad, & Ahmed, 2018). Most contractors lack knowledge to prepare price adjustment claims

following currency devaluation (Badawi et al., 2020).

### 3.4 Regulatory and Policy Barriers

**Regulation is the most critical factor** among sixteen influencing the industry (Dongla, 2018a). Since the Ministry of Construction's dissolution (1994), a **multi-fragmented system** with overlapping mandates has created coordination failures. Construction permits require 16 procedures over 270 days-ranking Sudan 167th globally (Mohamed, 2015). Legal frameworks suffer weak enforcement and a large grey economy (Peng & Shekshnia, 2001).

### 3.5 Cultural and Behavioral Barriers

The industry exhibits **resistance to new methodologies**, preferring traditional methods despite limitations. Organizational culture significantly impacts performance; poor team communication correlates with cost overruns ($\beta = -0.490$) and defects ($\beta = -0.361$) (Own Alla & Hassan, 2017). Safety culture is weak-53.8% of projects have poor safety programmes (Omran et al., 2012). Bid sorting problems (79.2%) and schedule non-compliance (82%) are major obstacles (Diyab & Zakaria, 2023).

### 3.6 Governance and Management Barriers

**Fragmentation among numerous entities** (state ministries, Dams Implementation Unit) creates weak governance (Dongla, 2018a). Project management is critically deficient: 90% of projects exceed budgets and experience delays (Omran et al., 2012). Stakeholder dissatisfaction is widespread (mean 2.28/5) (Bilal & Shaddad, 2014). Lack of standardization is the most significant barrier to quality assessment (Average Index 3.72), with 72.22% of quality problems in public projects (Amin, Omer, & Hassan, 2020).

### 3.7 Market Barriers

The **grey economy distorts market dynamics**, undermining formal sector participants (Peng & Shekshnia, 2001). Materials markets face high transportation costs and regional price variations. Skilled labor migration has accelerated, depleting expertise. Financial market access is constrained bonds and guarantees represent 55% of construction stage overheads (Elzaki, 2020). GDP contribution declined from 4.7% (1982-1998) to 2.7% (1999-2009) (Elkhalifa, 2011).

These barriers are highly interconnected. Simulation indicates **regulatory reform could reduce delays by 32%**, while **workforce investment could decrease cost overruns by 28%** (Dongla & Khalafalla, 2026). Strategic recommendations include establishing a **Sudanese Construction Industry Development Board (SCIDB)** and implementing comprehensive reforms across financial, administrative, contractual, and regulatory domains (Dongla, 2018a; Suleiman, 2015).

## 4. Construction Industry in Different Countries

A range of countries including the United Kingdom, Germany, the United States, South Korea, Turkey, Malaysia, the United Arab Emirates, and Saudi Arabia have achieved considerable success in addressing construction sector challenges. The selection of specific cases for this research was guided by two criteria: demonstrated leadership and a proven record of effective sectoral reform, and contextual relevance to the conditions prevailing in Sudan. Accordingly, the experiences of the United Kingdom, Malaysia, and Saudi Arabia were selected for detailed examination

### 4.1 UK Construction Sector Experiences

The UK construction industry is a central pillar of the national economy, employing over 3 million workers and playing a critical role in delivering housing, infrastructure, and public services. It is widely recognized as "a cornerstone of the national economy and a key driver of growth" (House of Commons Library, 2019). Economically, the industry contributes approximately 6.5% of UK GDP (Kulakov, 2024). This substantial economic footprint highlights the importance of addressing the sector's ongoing challenges. Structurally, the industry is highly fragmented, comprising around 300,000 enterprises (House of Commons Library, 2019). Governance responsibilities are distributed across multiple bodies, creating complexity and coordination difficulties. A major recent reform is the establishment of the Building Safety Regulator (BSR) as the single construction regulator, introduced to strengthen the building safety regime following the Grenfell Inquiry (MHCLG, 2026). The BSR operates alongside the Health and Safety Executive (HSE), the Construction Industry Training Board (CITB), Local Authority Building Control (LABC), and professional institutions such as The Royal Institution of Chartered Surveyors (RICS) and The Royal Institution of British Architects (RIBA) (Maer, 2012). The sector also has a long history of institutional reviews, including the Construction Sector Deal and the Farmer Review. However, research indicates that productivity challenges stem less from fragmentation and more from low capital intensity and the limited use of integrated, in-house production models (Kulakov, 2024). Innovation efforts such as offsite construction have often amounted to "re-branding" rather than genuine transformation, with progress constrained by risk aversion and economic instability that discourages investment in automation and robotics (Dunlop Taylor, 2020; Pan et al., 2004).

### 4.2 Malaysia Construction Sector Experiences

The Malaysian construction industry is a strategically significant sector governed by a dedicated Ministry of Works (KKR) and primarily regulated by the Construction Industry

Development Board (CIDB), which oversees industry development and contractor registration. In 2024, the construction industry contributed approximately **5.6%** to Malaysia's GDP. With increased government investment, the sector is expected to maintain an annual growth rate of **6–7%** over the next five years Department of Statistics Malaysia (DOSM). The sector's national vision aims to position Malaysia "among the world's highest performers" in construction excellence (CIDB, 2006). Economically, construction has demonstrated a strong positive correlation with Malaysia's GDP growth, with its contribution steadily increasing since 2005 (Binti Saleh, 2008). In 2017, the value of construction work rose by 11.2%, driven largely by civil engineering (Zid et al., 2020). The government's 13th Malaysia Plan (2026–2030) reinforces this role with an allocation of RM430 billion for infrastructure and development. Structurally, the industry is highly fragmented, fueling intense price-based competition that often results in unrealistically low bids, cost overruns, and disputes. The sector also relies heavily on foreign labor approximately 31% of the workforce primarily from Indonesia and Bangladesh, due to lower wages and greater flexibility (CIDB, 2010). Low local participation, driven by poor wages and negative perceptions of construction work, further exacerbates this dependency (Binti Saleh, 2008). The industry is further shaped by chronic safety failures. Construction accounted for over 40% of Malaysia's industrial fatalities between 2011 and 2016, with 106 deaths recorded in 2016 alone (DOSH, 2017; Zid et al., 2020). Underreporting is severe, with NIOSH estimating that more than 80% of accidents go unreported, reflecting systemic weaknesses in safety management and regulatory enforcement (NIOSH, 2017; DOSH, 2017).

### 4.3 Saudi Arabian Construction Sector Experiences

The Saudi Arabian construction industry is undergoing an unprecedented phase of expansion, driven primarily by Vision 2030, which positions the sector as a central engine of national transformation (Almutairi et al., 2023). This growth is fueled by a pipeline of large-scale giga-projects including NEOM, the Red Sea Project, and Qiddiya, alongside major investments in housing, infrastructure, and urban development. As one of the world's fastest-growing construction markets, the sector is simultaneously confronted with significant challenges, like regulatory complexity, and the need to embed sustainability and circular economy principles into its rapid development (Thomas, 2025; Almutairi et al., 2023). Economically, the construction sector contributes approximately 5% of Saudi Arabia's GDP and employs more than 3.5 million workers, with expatriates comprising over 88% of the workforce (Almutairi et al., 2023). Vision 2030 has unlocked more than SAR 12 trillion (USD 3.2 trillion) in planned investment, underscoring the sector's strategic importance.

However, the industry remains sensitive to external shocks; the COVID-19 pandemic sharply reduced contract awards, with 2020 recording only SAR 80 billion in new contracts the lowest in years highlighting the sector's exposure to global disruptions and oil price volatility (Almutairi et al., 2023). According to the Real Gross Domestic Product (GDP) statistics for 2025 released by The General Authority for Statistics (GASTAT), the construction sector's contribution was 8.0%. Structurally, the industry is characterized by a mix of major local firms such as Saudi Binladin Group and Nesma & Partners, alongside international contractors like Bechtel. Residential construction accounts for 39.1% of market share, while infrastructure and commercial development continue to expand rapidly. The regulatory environment is multi-layered, administered by bodies including the Ministry of Municipal and Rural Affairs and Housing (MoMRAH), the Saudi Contractors Authority (SCA), MISA, SASO, MHRSD, and the Saudi Building Code National Committee, each overseeing distinct aspects of licensing, standards, labor regulation, and building code enforcement. Recent sectoral experiences reflect both progress and vulnerability. The Modern Construction Initiative has accelerated adoption of BIM, modular construction, and robotics, while Vision 2030 projects increasingly integrate circular economy practices (Saudi Arabia Construction Industry document, 2026; Thomas, 2025). However, COVID-19 exposed systemic weaknesses: over 52% of projects were suspended, productivity declined due to labor mobility restrictions, supply chains were severely disrupted, and medium-sized contractors faced acute financial strain (Almutairi et al., 2023). Efficiency studies from 2013–2022 show improvement but indicate that the sector still relies heavily on efficiency gains rather than technological advancement, with notable regional disparities (Yu et al., 2024). The sector's future competitiveness will depend on strengthening local workforce capabilities, enhancing supply chain resilience, streamlining regulation, and fully embedding digital and sustainable construction practices.

### 4.4 Comparative Analysis

**UK, Malaysia, Saudi Arabia, and Sudanese Construction Industries**

The construction industries of the UK, Malaysia, Saudi Arabia, and Sudan reflect how national context shapes sectoral performance. The UK represents a mature, highly regulated industry facing productivity stagnation and post-Grenfell safety reforms (House of Commons Library, 2019; Kulakov, 2024). Malaysia shows a developing sector marked by fragmentation, foreign-labor dependence, and the country’s highest fatality rates (CIDB, 2006; Zid et al., 2020). Saudi Arabia is undergoing state-driven hyper-growth under Vision 2030 but faces labor, supply chain, and sustainability challenges (Almutairi et al., 2023;

Thomas, 2025). Sudan's industry remains systemically constrained by fragmentation, weak regulation, and economic instability.

**Comparative Analysis Table.**

| Feature | United Kingdom | Malaysia | Saudi Arabia | Sudan |
|---|---|---|---|---|
| **GDP Contribution & Market Size** | ~6.5% of GDP. | ~5.6% of GDP (DOSM) | ~8% of GDP (GASTAT). | ~2–3% of GDP in recent years. Sudan Central Bureau of Statistics |
| **Industry Structure** | Highly fragmented with ~300,000 enterprises, mostly SMEs. Complex governance shared across multiple bodies. Recent centralization of safety regulation under the BSR (House of Commons Library, 2019). | Highly fragmented, with SMEs making up >86% of 66,904 registered contractors. Heavy reliance on formal and informal foreign labour (~31% of workforce) (CIDB, 2012; Kamal et al.). | Heavy reliance on a large expatriate workforce (>88% of 3.5m workers). A mix of local mega-corporations and international firms. No single construction law; administered via multiple enactments (Almutairi et al., 2023). | Highly fragmented with a lack of central coordination. Responsibilities dispersed across numerous bodies after the 1994 dissolution of a central ministry. Relies heavily on expatriate labour (Elkhalifa, 2016; Dongla, 2018). |
| **Key Regulatory Bodies** | **MHCLG** (policy), **BSR** (safety regulator), **HSE** (workplace safety), **CITB** (training), **LABC** (local compliance), **RIBA/RICS** (professional standards). | **KKR** (oversight), **CIDB** (regulation & development), **JKR** (public works), **DOSH** (safety enforcement), **SOCSO** (accident reporting), **NIOSH** (advisory). | **MoMRAH** (urban planning, permits), **SCA** (contractor registry), **MISA** (foreign investment), **SASO** (materials standards), **MHRSD** (labour & Saudization). | **SEC** (engineering profession), **OCCF** (consultancy firms), **OCEWC** (contractor registration), **Sudanese Contractors Association** (professional body). Coordination is weak. |
| **Key Challenges** | Skill shortages, lagging productivity, post- Grenfell regulatory overhaul, fragmented supply chain, low capital intensity (Kulakov, 2024). | Persistent fragmentation, over-reliance on unskilled foreign labour, poor technology adoption, critical safety crisis (highest fatal accident rate) (Zid et al., 2020). | Labour shortages, supply chain vulnerabilities, regulatory complexity, integrating sustainability (Circular Economy), regional disparities in efficiency (Yu et al., 2024). | Pervasive poor performance, chronic delays & cost overruns, extreme economic volatility (inflation, currency), institutional fragmentation, lack of modern systems/technology (BIM) (Dongla, 2018). |

The comparison shows that construction industries share challenges in labor, productivity, and regulation, but their severity is shaped by national context. The UK struggles with post-Grenfell regulatory reform and the shift toward capital-intensive, high-productivity models (Kulakov, 2024). Malaysia faces a safety-productivity paradox driven by foreign-labor dependence and underreported fatalities (Zid et al., 2020). Saudi Arabia's Vision 2030 fuels rapid expansion but exposes supply-chain and workforce vulnerabilities (Almutairi et al., 2023). Sudan remains constrained by political instability and institutional fragmentation, limiting even basic performance improvements.

## 5. DISCUSSION

This review identifies seven principal findings regarding the Sudanese construction industry. First, the sector exhibits systemic underperformance, characterized by consistently poor outcomes across all measured metrics and pervasive stakeholder dissatisfaction. This deficient performance stems partly from regulatory fragmentation following the 1994 dissolution of the central ministry, which created overlapping mandates and inconsistent enforcement. Compounding these governance issues, the industry faces acute economic vulnerability, with financial risks including inflation, currency fluctuation, and payment delays predominating all challenge categories. Internally, persistent management deficits perpetuate inefficiencies, evidenced by low adoption of modern techniques, absence of standardized systems, and critical neglect of safety protocols. The industry's development is further constrained by a pronounced technology gap, marked by minimal Building Information Modeling (BIM) adoption (80% at Levels 0-1), limited formal quality assessment (25% utilization), and no established productivity standards. Critically, these challenges operate as interconnected feedback loops, demonstrating that isolated interventions are insufficient.

The Sudanese construction industry remains systemically trapped in underperformance despite its developmental importance. Three decades of research confirm that pervasive delays, cost overruns, quality failures, and stakeholder dissatisfaction stem from structural, institutional, and economic dysfunctions not isolated operational problems. Regulatory fragmentation constitutes the primary weakness: the 1994 dissolution of the central ministry created dispersed mandates, coordination failures, and inconsistent enforcement. This institutional void, compounded by absent standardization in measurement and quality assessment, perpetuates inefficiency. Economic volatility hyperinflation and currency devaluation exacerbates these weaknesses, with financial risks dominating all challenge

categories. Management deficits further constrain development: minimal BIM adoption, negligible lean awareness, and reliance on experiential practice rather than systematic standards.

These challenges operate as interconnected feedback loops requiring integrated solutions. The unifying recommendation is establishing a Sudanese Construction Industry Development Board to coordinate national strategy and comprehensive reform. Simulation models indicate such reform could increase GDP contribution from 4.0% to 6.2%. Without this institutional transformation, the industry cannot fulfill its potential as an engine of development. The consensus is unequivocal: the problems are systemic, solutions require coordinated reform, and continued inaction perpetuates fundamental underperformance.

## 6. CONCLUSIONS

The critical review of 30 empirical studies on the Sudanese Construction Industry (SCI) spanning 2008– 2026 yields the following, the following:

**Systemic Underperformance:** The SCI is fundamentally underperforming, with deficient outcomes spanning time, cost, quality, and safety dimensions. This underperformance is not exceptional but systematic, affecting the vast majority of projects across the sector. The consistency of poor results across three decades of research indicates deeply embedded structural dysfunctions rather than isolated operational problems.

**Regulatory Fragmentation as Primary Weakness:** The 1994 dissolution of the central Ministry of Works and Public Affairs created an institutional void characterized by overlapping mandates, coordination failures, inconsistent standards, and weak enforcement. This fragmentation constitutes the primary structural weakness perpetuating industry underperformance, as it prevents strategic coordination, consistent regulation, and effective policy implementation.

**Acute Economic Vulnerability:** The SCI remains acutely susceptible to macroeconomic instability, with financial risks dominating all challenge categories. The sector's growth-dependent nature, combined with extreme exposure to inflation, currency volatility, and payment delays, undermines project viability and contractor sustainability. The absence of formal risk management frameworks and price adjustment mechanisms exacerbates this vulnerability.

**Profound Management and Technology Gaps:** The industry suffers from severe management deficits, including low adoption of modern techniques, absence of standardized systems, critical neglect of safety protocols, and minimal digital transformation. These

deficits perpetuate inefficiencies, prevent productivity improvements, and maintain the sector's reliance on experiential practice rather than systematic standards.

**Quality Management Systemic Failures:** Quality management in the SCI is characterized by reliance on subjective experience rather than formal systems, with public sector projects disproportionately affected. The absence of standardized measurement methods undermines contract clarity, dispute resolution, and quality assurance across the project lifecycle.

**Endemic Project Delays:** Project delays are endemic across the SCI, with cost and time overruns as primary consequences. Delay causes span multiple stakeholder categories, indicating systemic coordination failures rather than isolated contractor deficiencies. The prevalence of delays reflects deeper institutional and management weaknesses.

**Interconnected Barrier Dynamics:** The barriers constraining the SCI are not isolated but operate as reinforcing feedback loops. Economic instability, regulatory fragmentation, management deficits, and cultural factors interact to perpetuate low productivity and systemic underperformance. This interconnectedness means isolated interventions are insufficient- integrated solutions addressing multiple barrier categories simultaneously are required.

**Declining Economic Contribution:** Despite historical periods of rapid growth and its fundamental role in urbanization, the SCI's relative economic contribution has declined over recent decades. The building materials subsector, despite significant employment, contributes minimally to GDP, indicating underdeveloped local manufacturing capacity and missed opportunities for import substitution and value addition.

**Institutional Transformation Imperative:** The literature consensus is unequivocal: the problems confronting the SCI are systemic, solutions require coordinated reform through a central development board, and continued inaction perpetuates fundamental underperformance. Establishing a Sudanese Construction Industry Development Board (SCIDB) is essential for coordinating policy, standardizing practices, and driving long-term sectoral improvement. Without this institutional transformation, the industry cannot fulfill its potential as an engine of national development.

**Research-to-Practice Gap:** While the body of SCI research has grown substantially, providing comprehensive diagnosis of constraints, the translation of diagnostic findings into implementable, context- specific strategies remains underdeveloped. Future research must bridge this gap between problem identification and solution development, producing actionable frameworks aligned with national construction goals and tailored to Sudan's specific political, economic, and institutional context.

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