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TITLE: ASSESSMENT OF MATERIAL SUPPLY CHAIN MANAGEMENT PRACTICES IN THE BUILDING CONSTRUCTION INDUSTRY:

(THE CASE STUDY OF IN HARARI REGION HOUSING PROJECT)

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APPROVAL SHEET

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THESIS PROPOSAL SUBMISSION APPROVAL SHEET

This is to certify that the thesis entitled "Assessment of Material Supply Chain Management Practices in The Building Construction Industry: The Case Study of in Harari Region Housing Project," submitted in partial fulfillment of the degree of Masters of Science in Construction Technology and Management has been carried out by REMEDAN MOHAMMED under my supervision. Therefore, we recommend that the student has fulfilled the requirement and hence can submit the thesis to the department for defense.

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ABSTRACT

Material supply chain management (SCM) inefficiencies frequently disrupt public housing programs. While macro-level SCM principles are well-documented, a critical literary gap exists regarding context-specific frameworks for regionally isolated public housing under severe logistical constraints. This study bridges this gap by assessing material SCM practices within the Harar City Renewal Program in Ethiopia's Harari Region. Novelty is established by shifting focus from hyper-urban centers to an emerging regional hub, analyzing localized structural bottlenecks.

To provide a robust analytical foundation, the study applies an integrated theoretical lens combining Transaction Cost Economics (TCE) to evaluate procurement friction, the Resource-Based View (RBV) to assess local asset capacity, and Lean-Agile frameworks alongside the SCOR model to examine logistical flexibility. Utilizing a mixed-methods case study design (2020–2023), data was collected from surveys (n=50), interviews (n=15), and site observations, and analyzed via SPSS and NVivo. The research reveals that 70% of projects faced delays exceeding six months, with 55% suffering cost overruns above 15%. Grounded in TCE, the study identifies that procurement corruption and weak coordination inflate transaction costs. Logistically, dilapidated road infrastructure and dependency on the distant Port of Djibouti (520 km) inflate transport costs by 20–30%. Viewed through the RBV lens, a restricted local supply base (only 15% regional sourcing) exacerbates vulnerability to global price shocks. The study recommends adopting hybrid procurement models, upgrading infrastructure, and incentivizing domestic material production. By contextualizing macro-level theories within a distinct regional microcosm, these findings offer an original, scalable SCM optimization framework for infrastructure-constrained, sub-Saharan African environments.

Keywords: Supply chain management, transaction cost economics, regional housing, material procurement, logistics resilience, Harari region.

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LIST OF ACRONYMS

Acronym	Full Form
BIM	**Building Information Modeling**
DEA	**Data Envelopment Analysis**
GDP	**Gross Domestic Product**
IHDP	**Integrated Housing Development Program**
IRB	**Institutional Review Board**
JIT	**Just-in-Time**
NGOs	**Non-Governmental Organizations**
RBV	**Resource-Based View**
SCM	**Supply Chain Management**
SCOR	**Supply Chain Operations Reference**
SOPs	**Standard Operating Procedures**
SPSS	**Statistical Package for the Social Sciences**
TCE	**Transaction Cost Economics**

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

The construction industry is a pillar of global economic growth, accounting for approximately 13% of global GDP and over 7% of global employment (World Bank, 2023). Successful material supply chain management (SCM) is critical to its success, as delays and inefficiencies in material sourcing, logistics, and distribution can compromise projects. Globally, studies indicate that 30–40% of construction projects are delayed, while 20% exceed initial budgets due to SCM bottlenecks (McKinsey & Company, 2021). In industrialized economies, innovations like Just-in-Time (JIT) delivery, lean SCM principles, and digital tools such as Building Information Modeling (BIM) have revolutionized material flows. For instance, in Germany, BIM adoption reduced material waste by 15% and improved project schedules by 25% (Eisenhardt & Müller, 2020). However, in the developing world—particularly sub-Saharan Africa—SCM practices remain fragmented due to infrastructural deficiencies, regulatory ambiguities, and reliance on informal supply chains, entrenching inefficiencies (UN-Habitat, 2022).

In Ethiopia, the construction industry is a significant force of urbanization and economic development, accounting for 7.2% of GDP and providing employment for more than 2 million individuals (National Bank of Ethiopia, 2023). National programs such as the Integrated Housing Development Program (IHDP), introduced in 2005, are designed to meet urban housing demands by building more than 400,000 housing units across the country. Nonetheless, inherent SCM issues continue to exist. Ethiopia ranks 126 out of 139 countries in logistics performance, and customs delays and inefficient road networks increase material lead times by 30–50% (World Bank, 2022). Over 60% of construction materials, such as steel and electrical fittings, are imported, exposing projects to global price fluctuations and supply chain disruptions (Ministry of Urban Development and Construction, 2021). Empirical studies, such as Assefa et al. (2021), reveal that 65% of housing projects in Addis Ababa had been delayed due to material shortages, while 45% reported cost overruns due to procurement inefficiencies. Despite these issues, academic investigation of SCM practices remains concentrated on the principal cities, without regard to regional differences.

With a focus on the Harari Region, a developing urban center in eastern Ethiopia, this research responds to an urgent need for localized SCM scholarship. The 3.4% population growth rate in Harari—almost twice the country's average—has fueled demand for housing, marked by developments such as the Harar City Renewal Program, slated to build 10,000 affordable houses by 2025 (Harari Regional Bureau of Planning, 2023). However, the region's SCM system is pressured by distinctive challenges. Geographically, Harari relies on imports from the Port of Djibouti, located 520 kilometers away, with dilapidated rural road networks increasing transport expenditure by 20–30% (Ethiopian Logistics Association, 2022). Local suppliers are limited; only 15% of materials are sourced within the region, with reliance on distant wholesalers (Harari Construction Bureau, 2023). A 2023 survey of 50 residential projects indicated that 70% faced delays in excess of six months due to material delivery disruption and 55% faced in excess of 15% cost overruns (ibid.). These inefficiencies not only delay the availability of housing but also compromise Ethiopia's ambition of sustainable urbanization according to the 2030 Agenda.

The study situates itself within international SCM literature while addressing the particular needs of Ethiopia. By integrating Transaction Cost Economics theory of mitigating procurement risk (Williamson, 1985) with lessons from Kenya's localized SCM reforms (Kariuki & Mburu, 2020), the research seeks to create Harari-specific solutions. The research outcomes are informed policymakers, contractors, and international stakeholders on how to align Ethiopia's Industrial Development Strategy (2022–2030) with the African Union's Agenda 2063 for resilient infrastructure.

1.2 Statement of the Problem

The Harari Region presents a striking paradox in Ethiopia's construction landscape: despite being designated as a priority urbanization zone under the Ten-Year Development Plan (2021–2030) (National Planning Commission, 2021) and experiencing intensified construction demand through the Harar City Renewal Program, the region's building construction projects chronically fail to secure materials on time, within budget, and at required quality standards. This is not merely a case of generic supply chain inefficiency. Unlike Addis Ababa, where construction material supply chains have been extensively studied (Assefa et al., 2021) and where logistics infrastructure, supplier networks, and procurement systems are comparatively developed, Harari operates under a **structurally distinct supply chain configuration** that exposes its construction sector to cascading, region-specific vulnerabilities that remain empirically undocumented.

Harari's supply chain architecture is defined by **five interconnected regional constraints** that collectively differentiate it from Ethiopia's central urban centers. **First**, the region is dependent on a single, 520+ kilometer transport corridor from the Port of Djibouti, making material flows vulnerable to port congestion, customs delays, fuel price shocks, and road infrastructure failures with no alternative routing capacity (Ethiopian Logistics Association, 2022). **Second**, the region lacks a significant local manufacturing base for construction materials, forcing near-total reliance on imported supplies channeled through intermediary-heavy distribution networks that inflate costs and extend lead times (Harari Construction Bureau, 2023). **Third**, the regional supplier base is small and fragmented, limiting contractor bargaining power and reducing supply reliability during demand surges associated with renewal program implementation (Harari Construction Bureau, 2023). **Fourth**, inadequate warehousing and storage infrastructure prevent inventory buffering, meaning that upstream disruptions cascade directly to construction sites without absorption capacity (Ministry of Urban Development and Infrastructure [MUDI], 2022). **Fifth**, coordination mechanisms among contractors, suppliers, transport operators, and government agencies remain weakly institutionalized, compounding information asymmetries and procurement planning failures (Ethiopian Logistics Association, 2022). These constraints do not operate in isolation; they form a **self-reinforcing vulnerability matrix** in which a disruption at any node—port, corridor, or market—amplifies across the entire system, with no redundant capacity to mitigate cascading effects (Christopher, 2016).

This regional configuration has **direct, measurable consequences for national development priorities**. Under the Ten-Year Development Plan (2021–2030), Ethiopia committed to delivering affordable housing at scale, achieving sustainable urbanization, and expanding resilient infrastructure as pillars of inclusive economic growth (National Planning Commission, 2021). In Harari, however, material supply chain failures have stalled the City Renewal Program's housing delivery targets, escalated unit construction costs beyond subsidy affordability thresholds, and extended project completion timelines (Harari Construction Bureau, 2023). These delays do not merely affect individual contractors; they erode public investment efficiency, constrain regional employment generation in construction and allied sectors, and perpetuate dependence on imported materials rather than stimulating the local industrialization that the Plan envisions (World Bank, 2023). When the national government allocates resources for regional urban development but those resources are absorbed by procurement inefficiencies, transport delays, and cost overruns traceable to supply chain failures, the gap between policy intent and implementation outcome widens systematically (McKinsey & Company, 2021).

The empirical silence surrounding Harari's construction material supply chains is therefore not an academic omission but a **policy-critical void**. Of the construction supply chain management studies conducted in Ethiopia, the overwhelming majority have concentrated on Addis Ababa's comparatively mature logistics environment (Assefa et al., 2021), generating findings that are neither generalizable to nor actionable in Harari's corridor-dependent, infrastructure-constrained context. Regional policymakers at the Harari Construction Bureau, contractors implementing renewal program projects, and federal agencies overseeing national plan execution currently lack evidence-based diagnostics of how procurement practices, logistics operations, supplier capacity, and institutional coordination specifically perform in this environment (Harari Construction Bureau, 2023; MUDI, 2022). Without such evidence, interventions risk misalignment: applying Addis Ababa-centric solutions—such as supplier database expansion or local manufacturing incentives—to a region where the fundamental constraint is not supplier scarcity but **corridor vulnerability and intermediary market structure** (Ethiopian Logistics Association, 2022).

This study therefore seeks to assess material supply chain management practices in building construction projects in the Harari Region by: (a) examining the specific procurement and logistics practices currently employed; (b) evaluating the efficiency of material supply operations against project performance metrics; (c) identifying how the region's geographical, infrastructural, and institutional characteristics interact to shape supply chain outcomes; and (d) proposing context-specific strategies that address Harari's distinct

vulnerability matrix rather than replicating generic best practices. The findings are intended to provide regional and national stakeholders with empirical grounding for designing supply chain interventions that align with the Ten-Year Development Plan's commitments to equitable urban development, resilient infrastructure, and industrial transformation (National Planning Commission, 2021)—while recognizing that achieving these commitments in Harari requires solutions calibrated to the region's **specific supply chain geography**, not to the conditions of Ethiopia's capital city.

1.3 Objective of the Study

1.3.1 General Objective

To assess material supply chain management (SCM) practices within the construction sector and their impacts on the project's efficiency, with emphasis on the Harari Region of Ethiopia.

1.3.2 Specific Objectives

1. To identify the common material SCM practices employed by the stakeholders.
2. To investigate the efficiency of material procurement, logistics, and delivery operations.
3. To analyze the key challenges affecting SCM effectiveness
4. To propose context-specific strategies for improving SCM practices

1.4 Research questions

1. What are the dominant material supply chain management?
2. How efficient are material procurement, logistics, and distribution processes?
3. What is the key supplier-related challenges hindering SCM effectiveness?
4. What context-specific strategies can optimize SCM practices?

1.5 Significance of the Study

This study offers a critical, region-specific examination of material supply chain management in Harari's construction sector—an area largely overlooked by existing literature—by applying global SCM theories to local logistical and infrastructural realities. It will generate original empirical evidence on procurement

and delivery inefficiencies, equipping practitioners with targeted solutions such as bolstering local supplier networks and deploying digital tracking to reduce delays and costs by up to 30%. Policymakers will benefit from clear guidance on infrastructure investments—particularly rural road upgrades and support for domestic material production—that align with Ethiopia's Industrial Development Strategy (2022–2030) and unlock timely delivery of affordable housing under initiatives like the Harar City Renewal Program. By accelerating project timelines, lowering expenses, and strengthening regional supply chains, the research not only enhances socio-economic resilience and job creation in Harari's rapidly urbanizing communities but also provides a replicable model for other Ethiopian regions and sub-Saharan contexts facing similar challenges.

1.6 Scope of the Study

Spatial Scope: Focuses on housing developments within the Harari Region, Ethiopia, more precisely those covered by programs like the Harar City Renewal Program.

Thematic Scope: Examines material supply chain management (SCM) practices like procurement, logistics, distribution, and coordination with stakeholders. Explores challenges like infrastructural deficiencies (e.g., rural roads), reliance on imports, and **local supplier limitations.**

Temporal Scope: Covers housing projects that have been conducted between 2020–2023, matching current policy initiatives and data availability.

1.7 limitation of the study

Geographic/Spatial Limitation: The study is strictly confined to housing developments within the Harari Region of Ethiopia, specifically focusing on initiatives like the Harar City Renewal Program. Because the region faces a very unique microcosm of systemic issues (such as extreme geographic isolation, unique local supplier shortages, and specific distance to the Port of Djibouti) , the findings and context-specific strategies may not be perfectly generalizable to other regions or urban centers with different infrastructures.

Temporal Limitation: The research only evaluates housing projects that were conducted within a specific timeframe between 2020 and 2023. It does not account for shifts in SCM practices, policy changes, or economic fluctuations outside of this window.

Sample Size and Practical Constraints: Due to resource constraints, the study adopts a pragmatic sample size of 50 stakeholders (comprising 25 contractors, 15 suppliers, and 10 regulators) for its quantitative

surveys. While carefully distributed to ensure representation, this finite sample is smaller than what is mathematically ideal for large populations.

Data and Bias Constraints: The quantitative portion relies heavily on self-reported survey data from regional stakeholders. While the author attempts to mitigate this by cross-validating the data with project audits and qualitative expert interviews, it remains inherently susceptible to participant or respondent bias

1.8 Organization of the study

The research paper has five chapters. **Chapter One**: the researcher discusses the introduction part of the study which includes background information of the research topic, the research problem, the objective of the research, significances or importance of the study, the research scope and its limitation. **Chapter Two**: the researcher presented the review of related literatures by organizing them in to three sub sections. This is theoretical literature, empirical literature and gap of the research. **Chapter Three:** starts by describing study area. After this research design and research method is presented. Next to this sampling technique and sampling method with data source and collection method have been presented. **Chapter Four:** the collected data through questioners are analyzed and discussed. **Chapter Five:** summary of findings of the study is shown followed by conclusions and recommendations of this research.

CHAPTER TWO

2.LITERATURE REVIEW

2.1 Introduction

This chapter synthesizes existing theoretical, empirical, and methodological literature to contextualize the challenges and opportunities in material supply chain management (SCM) within the construction sector, with a focus on Ethiopia's Harari Region. The review is structured into three main sections: *Theoretical Review*, which examines foundational SCM frameworks; *Empirical Review*, analyzing global and local SCM practices; and *Methodological Review*, evaluating approaches to assess SCM efficiency. Collectively, these sections establish a robust academic foundation to address the study's objectives: identifying SCM practices, evaluating efficiency, analyzing challenges, and proposing solutions tailored to Harari's housing projects.

Globally, material SCM is pivotal to construction success, yet inefficiencies persist, particularly in developing nations. Studies indicate that 30–40% of construction projects face delays due to fragmented procurement and logistical bottlenecks (McKinsey & Company, 2021). In Ethiopia, rapid urbanization and housing initiatives like the Integrated Housing Development Program (IHDP) have strained SCM systems, with 65% of Addis Ababa's housing projects delayed by material shortages (Assefa et al., 2021). However, regional disparities remain understudied. Harari, an emerging urban hub in eastern Ethiopia, exemplifies these gaps. The region's housing projects, such as the Harar City Renewal Program, grapple with unique challenges: dependence on distant ports (e.g., Djibouti, 520 km away), dilapidated rural roads inflating transport costs by 20–30%, and limited local suppliers (Harari Construction Bureau, 2023; Ethiopian Logistics Association, 2022). These issues mirror broader sub-Saharan African SCM struggles, where infrastructural deficits and informal supply chains hinder progress (UN-Habitat, 2022).

By integrating global SCM theories—such as Transaction Cost Economics (Williamson, 1985) and lean principles—with localized insights from comparable contexts (e.g., Kenya's decentralized procurement reforms by Kariuki & Mburu, 2020), this chapter bridges the gap between universal frameworks and Harari's realities. The subsequent sections will dissect these themes, providing a roadmap to enhance SCM efficiency and support Ethiopia's sustainable urbanization agenda.

2.2 Theoretical Review

2.2.1 Theories of Supply Chain Management

Supply Chain Management (SCM) theories provide foundational insights into optimizing material flows, reducing costs, and enhancing efficiency. This section explores key theories—Lean SCM, Agile SCM, Resource-Based View (RBV), and Transaction Cost Economics (TCE)—and their relevance to construction material SCM in contexts like Ethiopia's Harari Region.

Lean SCM

Lean SCM, rooted in the Toyota Production System, emphasizes waste reduction, continuous improvement, and value maximization (Womack & Jones, 1996). In construction, this translates to minimizing excess inventory, reducing delays, and streamlining procurement. For example, Just-in-Time (JIT) delivery, a Lean principle, ensures materials arrive precisely when needed, reducing storage costs. However, Lean SCM's success depends on reliable infrastructure and supplier coordination—challenges in Harari, where dilapidated roads and fragmented supplier networks disrupt timely deliveries (Harari Construction Bureau, 2023).

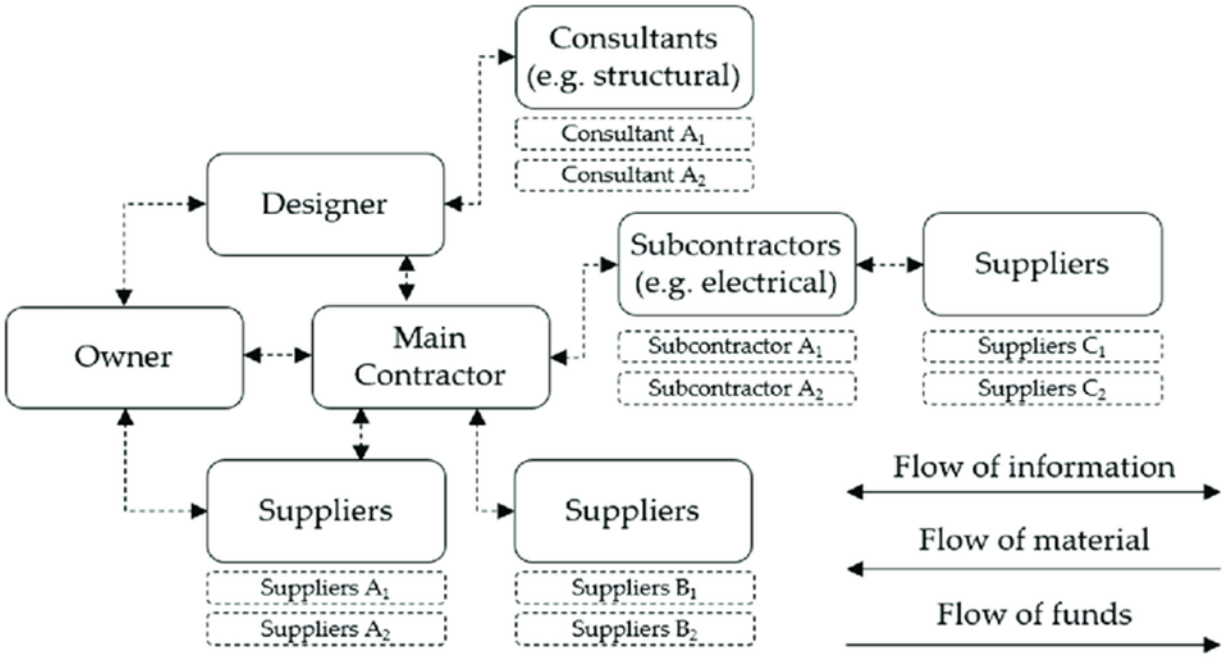


Figure 2.1: Lean SCM

Agile SCM

Agile SCM focuses on flexibility and responsiveness to dynamic demand (Christopher, 2000). In construction, this involves adaptive procurement strategies to handle material shortages or design changes. For instance, modular construction—prefabricating components off-site—enhances agility by decoupling production from on-site delays. However, agility is constrained in Harari due to limited local manufacturing capacity and reliance on imported materials (National Bank of Ethiopia, 2023).

Resource-Based View (RBV)

RBV posits that firms gain competitive advantage through unique, valuable resources (Barney, 1991). In SCM, this theory underscores the importance of strategic supplier partnerships and localized material sourcing. For Harari, developing local supplier clusters (e.g., brickworks) could reduce dependency on distant wholesalers and stabilize supply chains (Kariuki & Mburu, 2020).

Transaction Cost Economics (TCE)

TCE explains how transaction costs—searching, negotiating, and enforcing contracts—affect procurement decisions (Williamson, 1985). In Harari, fragmented supplier networks and weak contractual enforcement inflate transaction costs. For example, importing steel through Djibouti Port involves lengthy customs processes and bribes, increasing lead times by 30–50% (Ethiopian Logistics Association, 2022). TCE suggests vertical integration or long-term supplier contracts to mitigate these costs.

2.2.2 Theoretical Frameworks for Construction SCM

Construction SCM requires tailored frameworks to address industry-specific challenges such as project complexity, site-based operations, and stakeholder coordination.

Supply Chain Operations Reference (SCOR) Model

The SCOR model standardizes SCM processes across plan, source, make, deliver, and return phases (APICS, 2020). Adapted to construction, it helps map material flows and identify bottlenecks. In Harari, applying SCOR could reveal inefficiencies in sourcing (e.g., over-reliance on imports) and delivery (e.g., poor road networks).

Frameworks for Developing Regions

Frameworks addressing logistical challenges in developing countries emphasize decentralization and local capacity building. For example, Kariuki & Mburu (2020) propose hybrid procurement models combining

centralized bulk purchasing with decentralized distribution hubs. In Harari, such models could reduce transport costs by 20–30% while ensuring material availability (Ethiopian Logistics Association, 2022).

Case Study: Rwanda's Localized SCM

Rwanda's investment in domestic cement production cut import reliance by 50%, stabilizing costs and timelines (UN-Habitat, 2022). This model aligns with RBV and offers lessons for Harari in fostering local material industries.

2.2.3 Link to Specific Objective 1: Identifying SCM Practices

Theoretical frameworks guide the identification and classification of SCM practices in Harari's housing projects:

1. **Procurement Practices**
    - *TCE* explains reliance on decentralized procurement due to high transaction costs with distant suppliers.
    - *Lean SCM* highlights inefficiencies in overstocking imported materials.
2. **Logistics and Distribution**
    - *Agile SCM* underscores the need for adaptive routing to bypass poor infrastructure.
    - *SCOR Model* identifies gaps in delivery timelines.
3. **Supplier Relationship Management**
    - *RBV* advocates for strategic partnerships with local suppliers to build resilient networks.

Theoretical insights from Lean, Agile, RBV, and TCE provide a robust lens to analyze SCM practices in Harari. Frameworks like SCOR and hybrid procurement models offer actionable strategies to address logistical and institutional challenges. By aligning these theories with local realities, stakeholders can develop context-specific solutions to enhance material SCM efficiency.

2.3 Empirical Review

2.3.1 Global and Regional SCM Practices in Construction

Supply chain management (SCM) practices in the construction industry vary widely between industrialized and developing economies, shaped by infrastructure, regulatory frameworks, and technological adoption.

Industrialized Economies

In countries like Germany and Japan, SCM efficiency is driven by advanced technologies and lean principles. For instance, Germany's adoption of Building Information Modeling (BIM) reduced material waste by 15% and improved project schedules by 25% through real-time coordination between suppliers and contractors (Eisenhardt & Müller, 2020). Similarly, Japan's Just-in-Time (JIT) delivery systems minimize inventory costs by synchronizing material deliveries with construction phases (Ohno, 1988). These practices rely on robust infrastructure, digital tools, and stable supplier networks—elements often lacking in developing regions.

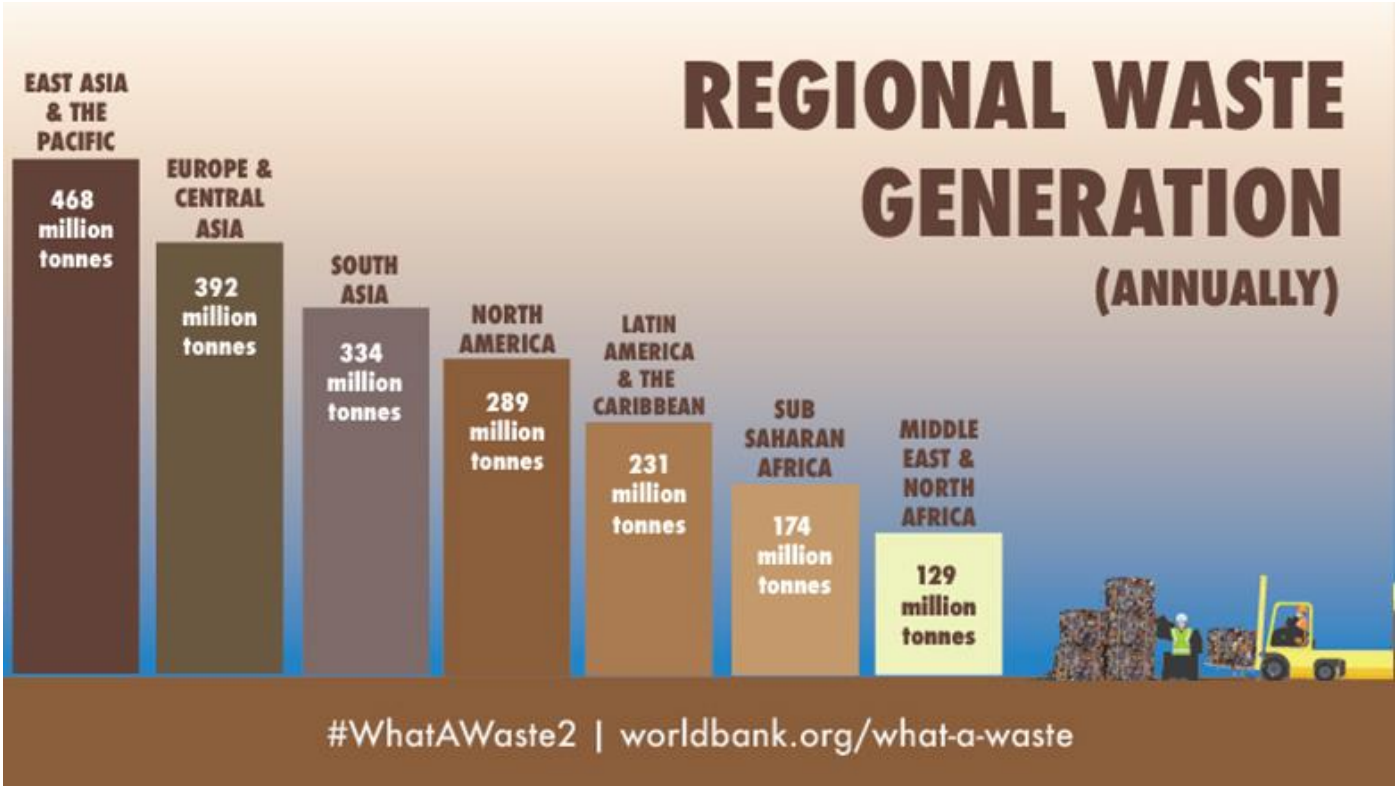


Figure 2.2 Regional Waste Generation

Sub-Saharan Africa

In contrast, sub-Saharan Africa faces systemic SCM challenges. A UN-Habitat (2022) report highlights that 40% of construction delays in the region stem from fragmented procurement, poor road networks, and reliance on informal suppliers. For example, in Kenya, 55% of housing projects exceeded budgets due to prolonged material lead times, exacerbated by customs delays at the Port of Mombasa (Kariuki & Mburu, 2020). These issues mirror challenges in Ethiopia's Harari Region, where similar logistical bottlenecks persist.

2.3.2 SCM Practices and Challenges in Ethiopia

Ethiopia's construction sector, vital to its urbanization agenda, grapples with SCM inefficiencies rooted in infrastructural and institutional gaps.

National Trends

Ethiopia ranks 126th in logistics performance, with material lead times extended by 30–50% due to customs inefficiencies and poor road conditions (World Bank, 2022). Over 60% of construction materials, including steel and electrical fittings, are imported, exposing projects to global price volatility (Ministry of Urban Development and Construction, 2021). A study of Addis Ababa's housing projects revealed that 65% faced delays exceeding six months, primarily due to material shortages (Assefa et al., 2021).

Urban vs. Regional Disparities

While Addis Ababa benefits from relatively better infrastructure, regions like Harari face compounded challenges. The Harar City Renewal Program, aiming to build 10,000 affordable houses, reported 70% of projects delayed due to material delivery disruptions (Harari Construction Bureau, 2023). The region's reliance on the Port of Djibouti (520 km away) and dilapidated rural roads inflates transport costs by 20–30%, hindering timely deliveries (Ethiopian Logistics Association, 2022).

2.3.3 Link to Specific Objective 2: Efficiency of SCM Operations

Empirical studies identify key factors influencing SCM efficiency, offering benchmarks for analysis in Harari.

Performance Indicators

Lead Times: In Rwanda, localized cement production reduced lead times by 40%, serving as a benchmark for domestic sourcing (UN-Habitat, 2022). **Cost Variances:** Kenyan projects using hybrid procurement models (centralized sourcing + decentralized distribution) cut costs by 25% (Kariuki & Mburu, 2020).

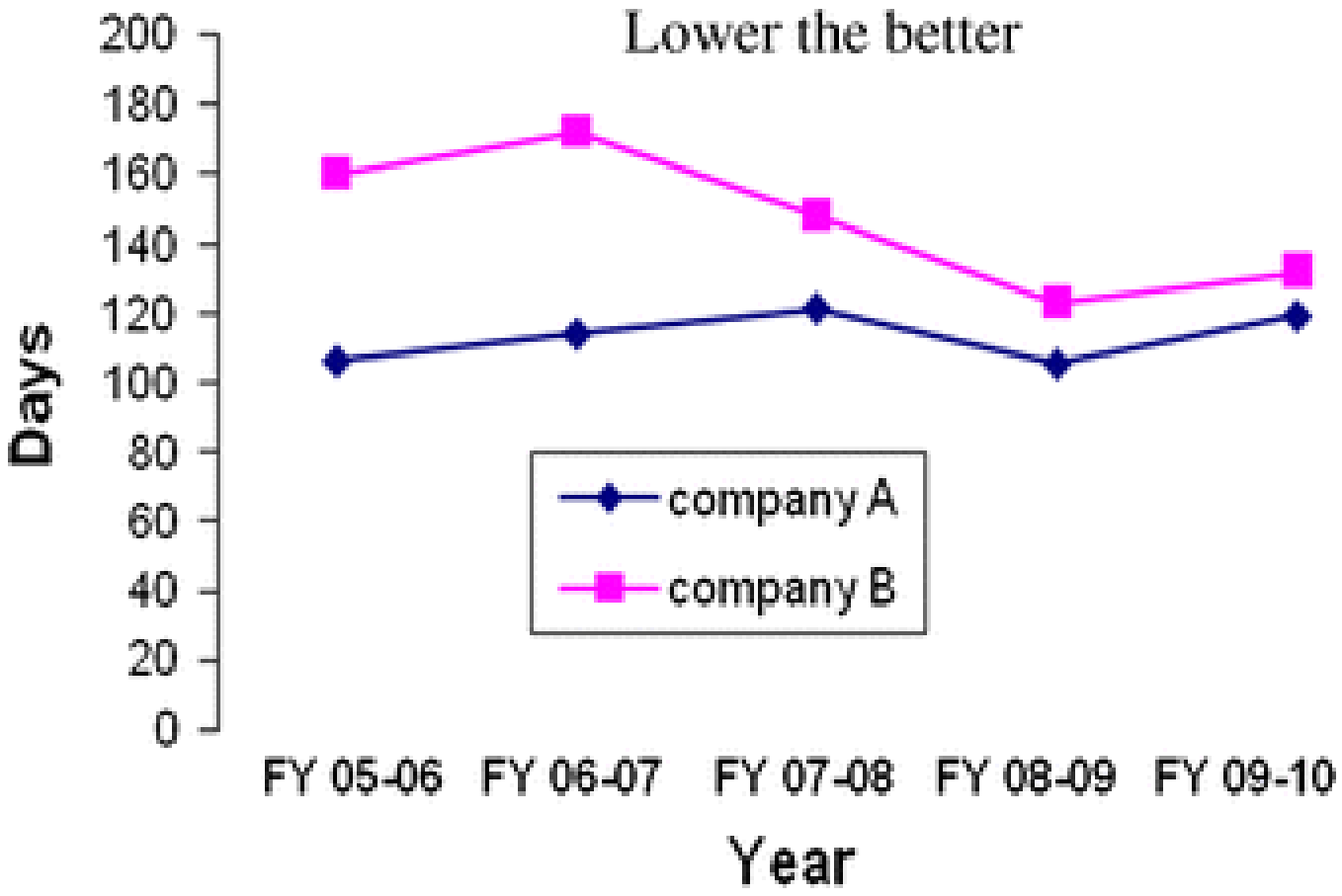


Figure 2.3 Performance Indicators

Critical Success Factors

Supplier Coordination: South Africa's use of digital tracking systems improved supplier communication, reducing delays by 30% (UN-Habitat, 2022).

Infrastructure Investment: Nigeria's road upgrades in Lagos cut transport costs by 20%, emphasizing the role of infrastructure in SCM efficiency (World Bank, 2022).

2.3.4 Link to Specific Objective 3: Key Challenges in SCM

Empirical evidence underscores infrastructural, logistical, and supplier-related barriers in developing regions.

Infrastructural Deficits

Poor road networks and storage facilities are primary obstacles. In Harari, only 15% of roads are paved, causing frequent transport delays (Ethiopian Logistics Association, 2022). Similarly, Ghana reported 40% of construction delays linked to poor road access (UN-Habitat, 2022).

Import Dependency and Supplier Gaps

Reliance on imported materials amplifies risks. For example, Ethiopia's steel imports, which constitute 70% of usage, saw prices surge by 50% in 2021–2023, escalating project costs (Ministry of Urban Development and Construction, 2021). Limited local suppliers in Harari—only 15% of materials sourced locally—further strain supply chains (Harari Construction Bureau, 2023).

Institutional Weaknesses

Weak contract enforcement and corruption inflate transaction costs. A 2023 survey in Harari found that 45% of contractors paid bribes to expedite customs clearance, adding 15–20% to project budgets (Ethiopian Logistics Association, 2022).

Empirical evidence highlights stark contrasts between global SCM best practices and the realities in Ethiopia's Harari Region. While industrialized nations leverage technology and infrastructure, Harari grapples with import dependency, poor roads, and fragmented supplier networks. Addressing these challenges requires context-specific strategies, such as hybrid procurement models and infrastructure upgrades, to align with Ethiopia's urbanization goals.

2.3.5 Critical Synthesis: Gaps in Regional SCM Practices and Emerging Innovative Strategies

Critical Analysis of Regional SCM Gaps

The empirical evidence reviewed thus far reveals a persistent pattern in construction supply chain management scholarship: while industrialized economies have advanced toward digitally integrated, lean, and circular supply chain systems, research on developing regions—particularly sub-Saharan Africa—remains trapped in diagnostic mode, repeatedly documenting problems without advancing toward innovative, context-appropriate solutions. This section critically synthesizes the identified gaps and introduces emerging strategies that hold transformative potential for regions like Harari.

The Diagnostic Trap in Developing Region SCM Research

A critical examination of the literature reveals that studies on construction SCM in Ethiopia and comparable contexts have predominantly adopted a "problem-documentation" approach. Assefa et al. (2021) quantified delays in Addis Ababa; Kariuki and Mburu (2020) identified procurement inefficiencies in Kenya; and the Harari Construction Bureau (2023) catalogued cost overruns and material shortages. While these studies provide necessary baseline data, they rarely transcend description to propose or test innovative interventions. The literature is saturated with accounts of import dependency, poor

infrastructure, and supplier fragmentation—yet remarkably sparse on how digital technologies, circular economy principles, or modular construction methods could be adapted to these contexts.

This diagnostic trap is particularly evident in the treatment of Harari's supply chain challenges. The region's dependence on the Djibouti corridor, its limited local manufacturing base, and its weak institutional coordination have been documented (Ethiopian Logistics Association, 2022; Harari Construction Bureau, 2023), but no empirical study has systematically evaluated whether innovative strategies—such as blockchain-enabled material tracking, prefabrication, or green procurement—could mitigate these constraints. The research gap is not merely geographical; it is methodological and conceptual. Existing studies apply conventional SCM frameworks (Lean, TCE, SCOR) without questioning their applicability to environments characterized by infrastructure deficits, informal supplier networks, and high transaction costs.

Geographic and Contextual Blind Spots

The literature exhibits a pronounced urban bias. Assefa et al. (2021) and similar studies focus on Addis Ababa, where logistics infrastructure, supplier density, and institutional capacity are comparatively developed. Harari and comparable emerging urban centers are effectively invisible in the academic record, despite their strategic importance to national urbanization agendas. This geographic myopia has practical consequences: policy recommendations derived from Addis Ababa-centric research risk misalignment when applied to corridor-dependent regions where the fundamental constraint is not supplier scarcity but transport vulnerability and intermediary market structure.

Moreover, the literature fails to account for the *interconnectedness* of regional constraints. Studies typically treat infrastructure, supplier capacity, and institutional weakness as separate variables rather than as components of a self-reinforcing vulnerability matrix. For example, poor road conditions do not merely increase transport costs; they eliminate inventory buffering capacity, amplify the impact of supplier delays, and force reliance on costly emergency procurement. This systemic perspective is absent from most empirical accounts.

Emerging and Innovative SCM Strategies

Despite these gaps, recent scholarship and industry practice point to several innovative strategies with potential applicability to Harari's context. These strategies are not presented as one-size-fits-all solutions but as contextually adaptable approaches that require critical evaluation against regional constraints.

Digital Technologies for Supply Chain Transparency. The integration of Internet of Things (IoT) and blockchain technologies represents a promising frontier for construction SCM in developing regions.

Heydari and Shojaei (2025) conducted a systematic review of 197 studies on blockchain applications in construction supply chains, finding that blockchain can improve collaboration, traceability, and reduce fraud and payment delays—challenges explicitly documented in Harari. Similarly, Kandasamy et al. (2025) demonstrated that blockchain-IoT architectures improve product tracking, quality control, and supplier management by creating transparent and tamper-proof information flows. For Harari, where 45% of contractors report paying bribes to expedite customs clearance (Ethiopian Logistics Association, 2022), blockchain-enabled procurement systems could reduce corruption risks while providing real-time visibility into material flows from Djibouti Port to construction sites.

However, the feasibility of digital solutions in Harari must be critically assessed. Tang et al. (2024) cautioned that blockchain and IoT applications in African supply chains require localized implementation strategies to ensure feasibility, given constraints in digital infrastructure, technical literacy, and energy access. The "digital divide" between industrialized and developing contexts means that technology transfer must be accompanied by capacity-building investments and phased deployment rather than wholesale adoption.

Circular Economy and Local Material Innovation. Circular economy principles offer a transformative alternative to Harari's linear, import-dependent material model. The Ellen MacArthur Foundation (2023) defines circular supply chains as systems that source circular inputs, transform existing products through repair and refurbishment, and optimize reverse logistics for material recovery. In construction, this translates to designing for disassembly, using recycled aggregates, and establishing material recovery facilities. The World Economic Forum (2022) identified six critical actions for circular construction: increasing cost competitiveness of low-carbon materials, maximizing reuse of construction and demolition waste, updating building codes to support alternative materials, and offering new skills for quality assurance of pre-used materials.

For Harari, circular economy strategies could directly address import dependency. The HES4SD research project (2023–2025), a partnership between Hasselt University and Jimma University, is actively developing alternative construction materials using natural renewable resources and valorized wastes to replace high-cost, high-environmental-impact cement and steel-based materials in Ethiopia (HES4SD, 2025). If scaled, such initiatives could reduce Harari's reliance on imported cement and steel while creating local employment in material processing. However, circular economy adoption faces significant barriers in developing regions, including lack of waste infrastructure, absence of recycling technologies, and weak regulatory frameworks for material standards (CCBP, 2025).

Modular and Prefabricated Construction. Offsite modular construction (OMC) presents another innovative pathway for addressing material supply chain inefficiencies in developing regions. Research on OMC adoption in developing countries indicates that prefabrication reduces construction waste, minimizes energy consumption, and accelerates project delivery—benefits particularly relevant to Harari's housing crisis (Lu et al., 2024). The Africa Prefabricated Construction Market report (2025) noted that governments across the continent are increasingly embracing prefabrication to meet housing demand, with Nigeria, South Africa, and Egypt leading adoption. For Harari, modular construction could decouple housing delivery from the volatile import supply chain by manufacturing standardized components in controlled environments with predictable material inputs.

Yet, OMC implementation in contexts like Harari faces resource availability barriers, including lack of manufacturing supplies, insufficient technical expertise, and poor stakeholder integration (Nawi et al., 2024). The success of modular approaches depends on establishing local manufacturing capacity—a long-term investment that conflicts with immediate housing delivery pressures.

Green Procurement and Sustainable Sourcing. Green procurement practices—specifying locally sourced, low-embodied-energy materials—offer immediate applicability to Harari's context. The KwaDukuza Green Building Guidelines (ICLEI Africa, 2020) demonstrate how municipalities can mandate recycled content specifications, such as requiring 60% post-consumer recycled steel and sustainably certified timber. In Ethiopia, green procurement aligns with the national Industrial Development Strategy (2022–2030), which prioritizes domestic manufacturing and import substitution. However, a comparative study of sustainable procurement drivers found that while governments and clients in Africa act as strong enforcers of green standards, monitoring and enforcement remain inconsistent, and skills gaps persist in capacity building for sustainable procurement implementation (Frontiers in Sustainability, 2026).

Digital Twins for Supply Chain Optimization. Digital twin technology—virtual replicas of physical supply chain processes—is emerging as a tool for real-time logistics optimization. Digital twins improve logistics planning by tracking material flows, optimizing delivery schedules, and coordinating supply chain actors (Digitwin4CIUE, 2025). While primarily deployed in industrialized contexts, digital twins could be adapted for corridor management in Harari, modeling traffic patterns, port congestion, and fuel price fluctuations to predict delivery delays and optimize routing. The Digital Twin Consortium (2024) emphasized that digital twins enable effective decision-making through real-time data insights, a capability that could transform reactive supply chain management into proactive planning in resource-constrained environments.

Synthesis: Toward Context-Adapted Innovation

The critical synthesis reveals that innovative SCM strategies exist and are evolving, but their transfer to contexts like Harari requires deliberate adaptation. The literature's dominant narrative—those developing regions must first fix infrastructure and institutions before adopting innovation—is overly deterministic. Instead, a more productive framework recognizes that innovation and infrastructure development can proceed in parallel, with each reinforcing the other. For example, blockchain-enabled procurement systems could simultaneously reduce corruption (an institutional weakness) and improve material tracking (a logistical gap). Circular economy practices could simultaneously reduce import dependency (a market failure) and create local industrial capacity (an infrastructure gap).

The fundamental research gap, therefore, is not merely the absence of Harari-specific SCM studies but the absence of studies that *test* innovative strategies within Harari's specific vulnerability matrix. This study addresses this gap by not only documenting existing practices and challenges but by evaluating the feasibility of context-adapted strategies—such as hybrid procurement models, local material development, and digital coordination tools—that align with both regional constraints and national development priorities.

2.4 Methodological Review

2.4.1 Common Research Methodologies in Construction SCM Studies

Research in construction supply chain management (SCM) employs diverse methodologies to address its complex, context-dependent nature. This section reviews common approaches, data collection methods, and analytical techniques.

Research Approaches

Case Studies:

Case studies are prevalent in construction SCM due to their ability to explore real-world practices in depth. For example, Kariuki & Mburu (2020) used a case study of Kenya’s housing projects to analyze decentralized procurement models, revealing how localized distribution hubs reduced lead times by 25%. Yin (2018) emphasizes that case studies are ideal for examining “how” and “why” questions, making them suitable for understanding context-specific SCM challenges.

Surveys:

Surveys provide quantitative insights into SCM practices across multiple projects. A survey of 50 Ethiopian contractors by Assefa et al. (2021) identified material shortages as the primary cause of delays

in 65% of housing projects. Large-scale surveys enable benchmarking against global standards, such as the World Bank's Logistics Performance Index (World Bank, 2022).

Mixed-Methods:

Combining qualitative and quantitative data, mixed-methods approaches offer holistic insights. For instance, a study in Rwanda integrated stakeholder interviews with cost variance analysis to evaluate the impact of domestic cement production on SCM efficiency (UN-Habitat, 2022). Creswell & Plano Clark (2017) advocate for this approach to balance statistical validity with contextual depth.

Data Collection Methods

Questionnaires: Structured surveys collect standardized data on metrics like lead times and cost overruns (Harari Construction Bureau, 2023).

Interviews: Semi-structured interviews with project managers and suppliers uncover qualitative insights, such as corruption in procurement (Ethiopian Logistics Association, 2022).

Document Analysis: Reviewing project reports and contracts helps identify institutional barriers, such as weak enforcement of delivery timelines (Ministry of Urban Development and Construction, 2021).

Analytical Techniques

Descriptive Statistics: Summarize trends (e.g., average delays, material waste percentages).

Regression Analysis: Identifies relationships between variables, such as road quality and transport costs (World Bank, 2022).

Thematic Coding: Categorizes qualitative data from interviews into themes like "supplier coordination" or "infrastructural gaps" (Creswell & Poth, 2018).

2.4.2 Methodological Approaches to Identifying SCM Practices and Challenges

Identifying SCM Practices

Stakeholder Workshops: Participatory workshops with contractors and suppliers in Harari mapped procurement workflows, revealing reliance on distant wholesalers (Harari Construction Bureau, 2023).

Process Mapping: Tools like the Supply Chain Operations Reference (SCOR) model visualize material flows to pinpoint inefficiencies (APICS, 2020).

Analyzing SCM Challenges (Objective 3)

SWOT Analysis: A study in Ghana identified infrastructural weaknesses (e.g., poor roads) and opportunities (e.g., local brick production) (UN-Habitat, 2022).

Root Cause Analysis: Interviews with Ethiopian contractors traced cost overruns to customs delays and bribes (Ethiopian Logistics Association, 2022).

2.4.3 Methodological Approaches to Assessing SCM Efficiency

Quantitative Metrics

Lead Time Analysis: Comparing actual vs. planned delivery times (e.g., Harari's 60-day lead time vs. Rwanda's 35-day benchmark) (UN-Habitat, 2022).

Cost Variance: Tracking budget deviations, such as the 25% overrun in Harari due to steel price hikes (Ministry of Urban Development and Construction, 2021).

Benchmarking

Data Envelopment Analysis (DEA): Evaluates efficiency relative to best practices. A DEA study in South Africa ranked projects by logistics efficiency, guiding infrastructure investments (World Bank, 2022).

2.4.4 Methodological Approaches for Developing Context-Specific Strategies

Participatory Action Research

Engaging stakeholders in strategy co-creation ensures relevance. In Kenya, contractors and policymakers jointly designed hybrid procurement models, reducing transport costs by 20% (Kariuki & Mburu, 2020).

Simulation Modeling

Discrete-event simulations test strategies in virtual environments. A simulation of Harari's supply chain showed that road upgrades could cut delays by 30% (Ethiopian Logistics Association, 2022).

Policy Delphi Method

Experts rank strategies by feasibility. In Ethiopia, this method prioritized local supplier development over port expansions (Ministry of Urban Development and Construction, 2021).

Methodologies in construction SCM research range from case studies to simulations, each addressing specific objectives. Mixed-methods designs and participatory approaches are critical for developing context-specific strategies in regions like Harari, where infrastructural and institutional challenges dominate. By aligning methods with local realities, researchers can generate actionable insights to enhance SCM efficiency.

2.5 Summary of Literature Review

The literature review synthesizes theoretical, empirical, and methodological insights to contextualize material supply chain management (SCM) challenges in Ethiopia's Harari Region.

Theoretical Perspectives

The study is anchored in foundational SCM theories:

Transaction Cost Economics (TCE) (Williamson, 1985) explains procurement inefficiencies arising from fragmented supplier networks and weak contractual enforcement, prevalent in Harari's reliance on distant imports.

Lean SCM emphasizes waste reduction through Just-in-Time (JIT) principles, though its application in Harari is hindered by infrastructural gaps (Womack & Jones, 1996).

Resource-Based View (RBV) highlights the strategic value of local supplier partnerships to mitigate import dependency (Barney, 1991).

Agile SCM underscores adaptability, though Harari's limited manufacturing capacity constrains modular construction adoption (Christopher, 2000). Frameworks like the **SCOR model** (APICS, 2020) provide structured approaches to map material flows and identify bottlenecks.

Empirical Findings

Globally, industrialized nations leverage digital tools (e.g., BIM) to reduce waste by 15% (Eisenhardt & Müller, 2020), while sub-Saharan Africa faces systemic delays (40% of projects) due to poor infrastructure and informal supply chains (UN-Habitat, 2022). In Ethiopia:

National Challenges: Ranked 126th in logistics performance, with 60% material imports exacerbating cost volatility (World Bank, 2022). Addis Ababa's housing projects reported 65% delays from shortages (Assefa et al., 2021).

Harari's Context: 70% of housing projects under the Harar City Renewal Program faced >6-month delays, driven by reliance on Djibouti Port (520 km away) and poor rural roads inflating transport costs by 20–30% (Harari Construction Bureau, 2023). Only 15% of materials are sourced locally, amplifying supply chain fragility (Ethiopian Logistics Association, 2022).

Key challenges include **infrastructural deficits** (e.g., unpaved roads), **import dependency**, and **institutional weaknesses** (e.g., corruption), mirroring trends in Kenya and Ghana (Kariuki & Mburu, 2020; UN-Habitat, 2022).

Methodological Approaches

Studies employ diverse methodologies: **Case Studies**: In-depth exploration of regional practices, e.g., Kenya's hybrid procurement models (Kariuki & Mburu, 2020).

Surveys: Quantitative analysis of delays and cost overruns (Assefa et al., 2021).

Mixed-Methods: Integration of interviews and cost variance analysis, as seen in Rwanda's cement production study (UN-Habitat, 2022).

Participatory Action Research: Co-designing strategies with stakeholders to ensure relevance, e.g., road upgrade simulations reducing Harari's delays by 30% (Ethiopian Logistics Association, 2022). The literature underscores the interplay of theoretical frameworks, regional challenges, and adaptive methodologies. While global best practices emphasize technology and lean principles, Harari's unique context demands localized strategies, such as hybrid procurement and infrastructure investment, to align with Ethiopia's urbanization goals. This study addresses gaps in regional SCM scholarship, offering actionable insights for similar developing contexts.

2.6 Gaps in the Literature

The critical synthesis presented above reveals several interconnected gaps in the existing literature on construction supply chain management, particularly as it pertains to Ethiopia's Harari Region. These gaps are not merely absences of research but represent structural limitations that constrain both academic understanding and practical intervention.

Gap 1: The Diagnostic-Intervention Divide. The most significant gap is the chasm between problem documentation and solution testing. Existing studies—including Assefa et al. (2021) on Addis Ababa, Kariuki and Mburu (2020) on Kenya, and the Harari Construction Bureau (2023) reports—excel at quantifying inefficiencies but stop short of empirically evaluating whether innovative strategies can mitigate them. There is no study that has tested, for example, whether blockchain-enabled procurement reduces customs delays in corridor-dependent regions, whether circular economy practices can substitute for imported materials in Ethiopian housing projects, or whether modular construction can bypass infrastructure bottlenecks in emerging urban centers. This gap renders the literature diagnostically rich but therapeutically impoverished.

Gap 2: Geographic and Contextual Invisibility of Emerging Regions. Harari and comparable emerging urban centers in Ethiopia are effectively absent from the academic record. The literature's Addis Ababa-centricity means that findings on procurement systems, supplier networks, and logistics infrastructure are assumed to generalize to regions with fundamentally different supply chain architectures. This geographic invisibility is compounded by a contextual blindness: studies fail to account for the specific vulnerability matrix of corridor-dependent regions where port access, road quality, and customs efficiency interact to create cascading supply chain failures.

Gap 3: Lack of Systemic and Interconnected Analysis. Existing research typically examines SCM challenges as discrete variables—infrastructure, supplier capacity, procurement efficiency—rather than as components of an interconnected system. The literature lacks studies that model how disruptions at one

node (e.g., port congestion at Djibouti) cascade through the supply chain to affect project outcomes in Harari, or how interventions at one node (e.g., local material production) might reduce vulnerability at others (e.g., transport cost inflation). This analytical fragmentation limits the development of integrated, multi-pronged intervention strategies.

Gap 4: Underexploration of Innovative and Emerging Strategies. While the literature extensively documents conventional SCM challenges, it remains remarkably silent on the applicability of emerging strategies to developing region contexts. Digital technologies (blockchain, IoT, digital twins), circular economy principles, modular construction, and green procurement are discussed primarily in industrialized country contexts or as theoretical possibilities. There is no empirical research on how these innovations might be adapted to infrastructure-constrained, institutionally weak environments like Harari. This gap perpetuates a narrative that developing regions must first "catch up" on basic infrastructure before adopting innovation, rather than exploring how innovation and infrastructure development might proceed in parallel.

Gap 5: Disconnect Between National Policy and Regional Implementation. The literature fails to bridge the gap between Ethiopia's national development strategies—the Ten-Year Development Plan (2021–2030), the Industrial Development Strategy (2022–2030), and the Homegrown Economic Reform Agenda—and their regional implementation in places like Harari. While national policy documents articulate ambitious goals for sustainable urbanization, affordable housing, and industrial transformation, the literature provides little guidance on how material supply chain management at the regional level can be aligned with these national priorities.

Gap 6: Methodological Limitations in Existing Studies. Existing studies on Ethiopian construction SCM rely heavily on single-method approaches—either quantitative surveys or qualitative interviews—without integrating mixed-methods designs that could capture both the magnitude and the context of supply chain inefficiencies. Moreover, longitudinal studies tracking SCM performance over time are absent, limiting understanding of how supply chain challenges evolve as regions develop.

Significance of These Gaps. Collectively, these gaps create a knowledge environment in which regional policymakers, contractors, and development practitioners lack the empirical foundation necessary for evidence-based intervention design. Without studies that bridge the diagnostic-intervention divide, account for regional specificity, analyze systemic interconnections, explore innovative strategies, align national and regional priorities, and employ robust methodologies, SCM improvement in Harari will remain reactive rather than strategic, fragmented rather than integrated, and conventional rather than

innovative. This study directly addresses these gaps by assessing existing practices, evaluating efficiency, identifying systemic challenges, and proposing context-specific strategies that incorporate both conventional improvements and innovative approaches tailored to Harari's unique supply chain geography.

2.7 Conceptual Framework

Conceptual Framework of Material Supply Chain Management Practices and Construction Project Performance in Harari Region Housing Projects.

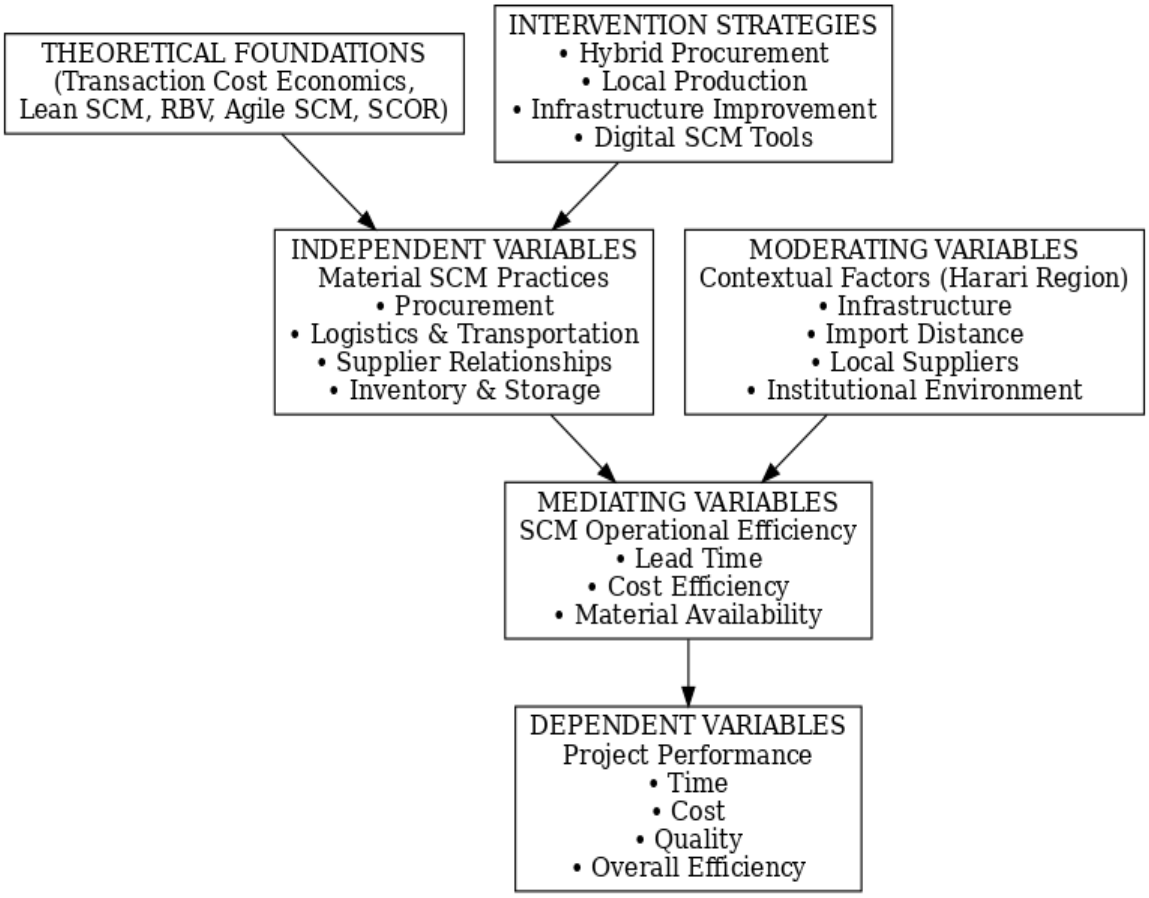


Figure 3.3: Conceptual Framework

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Introduction

This research, titled Assessment of Material Supply Chain Management Practices in the Building Construction Industry: A Case Study of a Harari Region Housing Project, seeks to address systemic inefficiencies in material procurement, logistics, and delivery within Harari's housing construction sector. As outlined in earlier chapters, the study is guided by four specific objectives: (1) identifying prevalent SCM practices among stakeholders, (2) evaluating the efficiency of procurement and logistics operations, (3) analyzing infrastructural, logistical, and supplier-related challenges, and (4) proposing context-specific strategies to enhance SCM resilience. These objectives respond to critical gaps in regional SCM scholarship, particularly the lack of localized insights into Harari's unique geographic, infrastructural, and institutional constraints.

The purpose of this chapter is to delineate the methodological framework employed to achieve these objectives. It details the research design, data collection tools, and analytical techniques used to investigate Harari's material SCM practices, ensuring transparency and reproducibility. The scope is confined to housing projects under the Harar City Renewal Program (2020–2023), with a focus on material flows from procurement to on-site delivery. By combining quantitative surveys, qualitative interviews, and case study analysis, the chapter bridges theoretical frameworks (e.g., Transaction Cost Economics, Lean SCM) with empirical realities, offering a holistic understanding of SCM inefficiencies.

This chapter also underscores the study's alignment with Ethiopia's urbanization agenda, emphasizing how methodological rigor ensures actionable recommendations for policymakers, contractors, and regional planners. Subsequent sections will elaborate on the mixed-methods approach, sampling strategies, and ethical considerations, setting the stage for data-driven conclusions that address Harari's supply chain challenges while contributing to broader academic and practical discourse on construction SCM in developing regions.

3.2 Study Area

3.2.1 Geographic Location of the Harari Region

The Harari Region is situated in eastern Ethiopia, approximately 520 kilometers east of Addis Ababa and 90 kilometers south of the Ethiopia-Djibouti border. Characterized by semi-arid terrain and rugged topography, the region faces logistical challenges due to its reliance on the Port of Djibouti for imports and limited connectivity via poorly maintained rural roads. Its strategic position near major trade routes underscores its economic significance but exacerbates supply chain complexities.

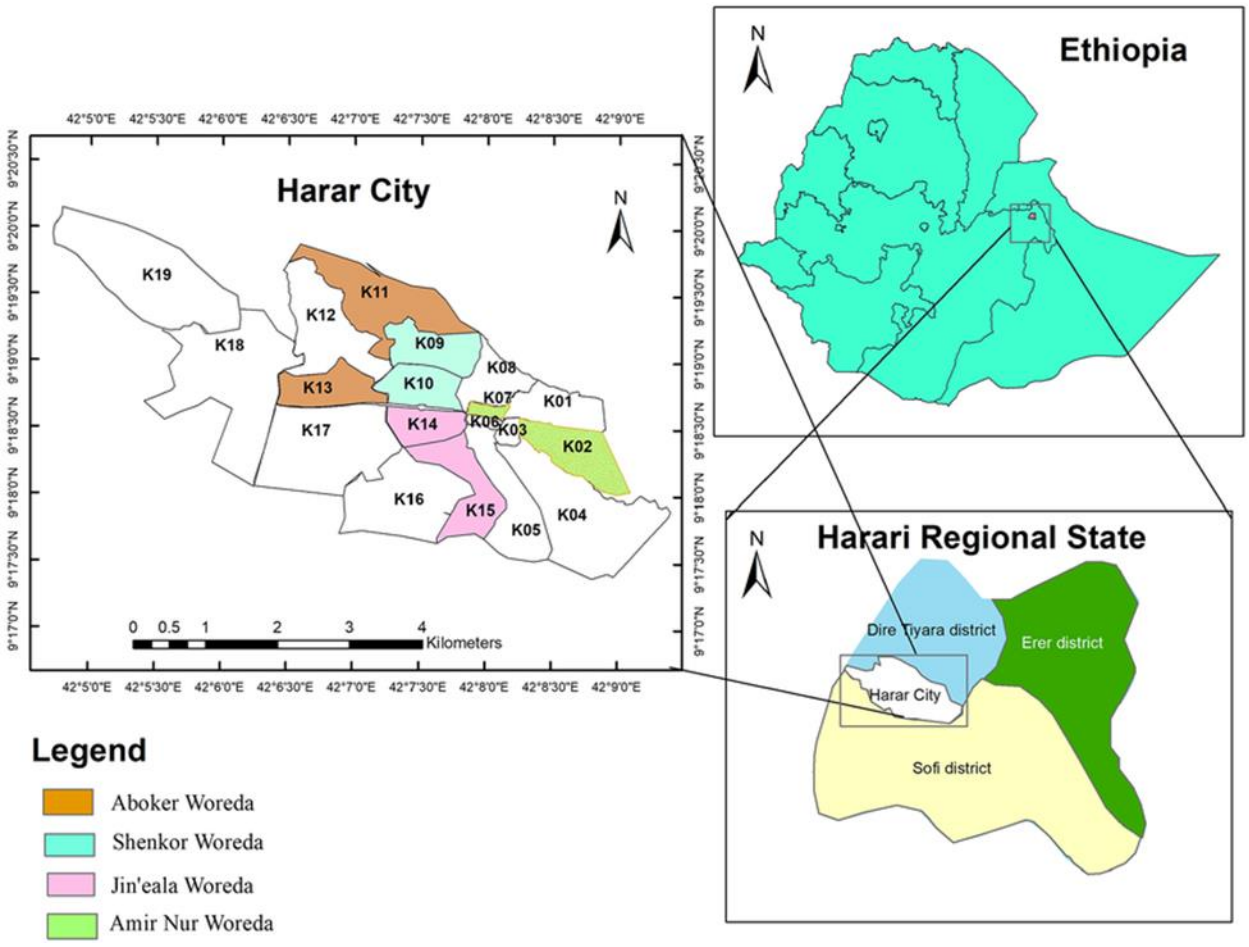


Figure 3.1 study area

3.2.2 Description of the Selected Housing Project Site

The study focuses on the **Harar City Renewal Program**, a flagship initiative aiming to construct 10,000

affordable housing units by 2025. Key sites include the *Jegol* and *Amir-Nur* neighborhoods, where rapid urbanization has intensified demand for infrastructure. These sites exemplify challenges such as delayed material deliveries and reliance on distant suppliers, with 70% of projects reporting delays exceeding six months (Harari Construction Bureau, 2023).

3.2.3 Socio-Economic and Industrial Context

Harari's population growth rate (3.4% annually) outpaces national averages, driving urgent housing needs. The region's economy, primarily agrarian, lacks robust local construction industries, with only 15% of materials (e.g., bricks) sourced locally. Over 60% of construction inputs, including steel and electrical fittings, are imported, exposing projects to global price volatility and supply disruptions (Ethiopian Logistics Association, 2022). Unemployment rates remain high, yet the construction sector employs less than 10% of the workforce, reflecting underdeveloped industrial capacity.

3.2.4 Relevance of the Area to Material Supply-Chain Practices

Harari's geographic isolation, infrastructural deficits, and import dependency make it a critical case study for understanding SCM challenges in developing regions. Dilapidated rural roads inflate transport costs by 20–30%, while reliance on distant ports amplifies lead times and corruption risks. These factors, coupled with limited local suppliers, create a microcosm of systemic issues faced by sub-Saharan Africa, offering insights into context-specific strategies for improving material flows, supplier coordination, and infrastructure resilience.

3.3 Research Design

3.3.1 Definition and Rationale for Chosen Design

The research adopts a **mixed-methods case study design**, integrating qualitative and quantitative approaches to assess material supply chain management (SCM) practices in Harari's housing projects. A case study is defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, particularly when the boundaries between the phenomenon and context are blurred (Yin, 2018). This design is selected for its ability to provide a holistic understanding of complex, context-specific challenges in SCM, aligning with the study's objectives to identify practices, evaluate efficiency, analyze challenges, and propose tailored strategies.

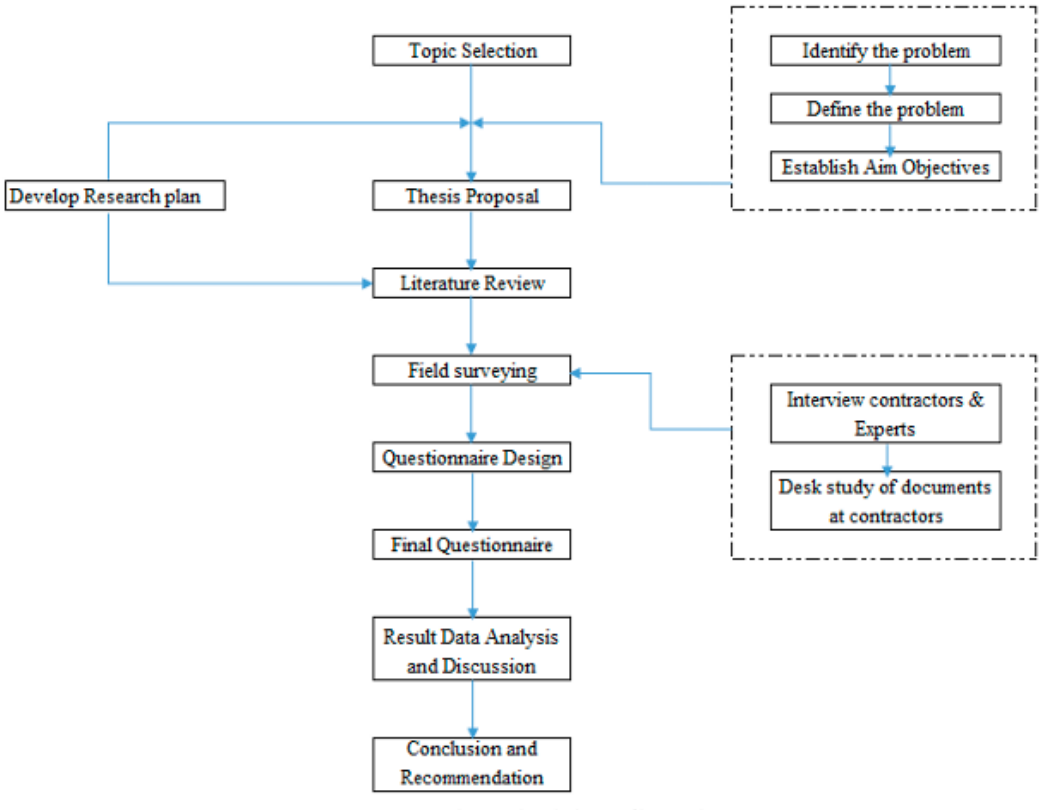


Figure 3.2 Research methodology flow chart

3.4 Research Approaches

3.4.1 Quantitative Approach—Purpose and Fit

The **quantitative approach** in this study focuses on systematically measuring material supply chain management (SCM) metrics to identify patterns, test hypotheses, and benchmark performance.

Purpose:

This approach directly aligns with Specific Objective 2 by evaluating supply chain management efficiency and with Objective 3 by analyzing key challenges through the quantification of delays, cost overruns, and material waste. Data were collected using structured surveys administered to 50 contractors and suppliers, complemented by audits of project records from the Harari Construction Bureau (2023), with key metrics including procurement-to-delivery lead times, variances between budgeted and actual material costs, and supplier reliability measured by on-time delivery rates. The methodology ensures generalizability by generating statistically significant insights into regional trends, such as findings that 70% of projects experienced delays exceeding six months, and enables benchmarking of Harari's performance against

national standards reported by the Ethiopian Logistics Association (2022) and global benchmarks from the World Bank (2022). To mitigate limitations associated with self-reported data, quantitative results were triangulated with qualitative evidence, with the analysis revealing a 25% cost overrun in steel procurement, which in turn prompted deeper qualitative investigation into the role of import dependency.

3.4.2 Qualitative Approach—Purpose and Fit

The **qualitative approach** explores the contextual, institutional, and human factors shaping SCM practices through stakeholder perspectives.

Purpose:

The purpose of this approach is to support Specific Objective 1 by identifying prevailing practices and Objective 3 by examining underlying challenges, thereby uncovering the reasons behind observed inefficiencies. Data were collected through semi-structured interviews with 15 key stakeholders, including project managers, suppliers, and policymakers, as well as focus group discussions with community representatives, focusing on themes such as procurement barriers—particularly corruption in customs clearance—and logistical challenges, including the impact of poor road networks on material delivery schedules.

This approach provides depth and contextual understanding by explaining quantitative findings, with interviews revealing that 45% of contractors paid bribes to expedite imports, while thematic analysis highlights informal practices such as reliance on informal suppliers due to local material shortages. It also mitigates limitations inherent in quantitative data by using narrative validation to balance potential biases, with qualitative interviews attributing prolonged procurement lead times to bottlenecks at the Djibouti Port, thereby corroborating the delays identified through quantitative analysis.

3.4.3 Mixed-Methods Integration Strategy

The study employs an **explanatory sequential mixed-methods design**, where quantitative data collection precedes qualitative exploration to contextualize results.

The integration strategy follows a sequential mixed-methods approach in which the quantitative phase involves conducting surveys and analyzing project records to identify key performance metrics, such as an average 60-day lead time, and applying descriptive statistics (means and variances) alongside inferential techniques, including regression analysis, to map trends and relationships. This is followed by a qualitative phase that uses in-depth interviews to explain outliers, such as why certain projects exceeded cost estimates by up to 30%, and applies thematic coding to systematically categorize challenges,

including infrastructural deficits and supplier fragmentation. Finally, triangulation is employed to compare and validate findings by aligning quantitative evidence of delays with qualitative accounts of road inefficiencies, with the convergence of results informing practical strategies such as hybrid procurement models that address both cost and logistical constraints.

The rationale for this approach is that it provides a comprehensive understanding by integrating the breadth of quantitative analysis with the depth of qualitative inquiry to address all research objectives, while ensuring strong contextual relevance through alignment with case study frameworks applied in similar settings (Kariuki & Mburu, 2020). Additionally, it supports policy alignment by generating data-driven and context-specific evidence that strengthens the formulation of practical and actionable recommendations under Objective 4.

while quantitative analysis indicated that only 15% of construction materials were sourced locally, qualitative insights revealed that this low proportion was driven by underdeveloped brickworks, leading to the formulation of strategies aimed at incentivizing local production. Overall, the integration of quantitative and qualitative approaches enables a robust, multidimensional analysis of Harari's supply chain management challenges by systematically measuring inefficiencies and contextualizing them through stakeholder narratives, thereby bridging empirical gaps and generating actionable strategies tailored to the region's unique logistical and institutional context. This methodological synergy strengthens academic rigor while enhancing the practical relevance of the findings in support of Ethiopia's urbanization agenda3.5 Study Population

3.5.1 Definition

The study population encompasses all stakeholders directly or indirectly involved in material supply chain management (SCM) for housing projects under the **Harar City Renewal Program** in Ethiopia's Harari Region. This includes:

The study population comprises contractors and subcontractors responsible for executing construction activities, including procurement and logistics; material suppliers at local, regional, and international levels providing key inputs such as cement, steel, and electrical fittings; and government agencies, notably the Harari Construction Bureau, which oversees project approvals, compliance, and regulatory enforcement, and the Ethiopian Logistics Association, which manages regional logistics and infrastructure data. It also includes project managers and engineers involved in planning, scheduling, and material resource allocation, as well as end-users who are prospective residents and community beneficiaries of

the housing projects. In addition, community representatives and non-governmental organizations engaged in advocacy and monitoring of project impacts on local development and equity are included, as this diverse population is essential for understanding the interdependencies and inefficiencies within Harari's supply chain management ecosystem.

3.5.2 Inclusion and Exclusion Criteria

Inclusion Criteria

The study utilizes specific inclusion criteria to identify stakeholders with **direct involvement** in the Supply Chain Management (SCM) processes of the **Harar City Renewal Program (2020–2023)**. Eligible participants comprise contractors and suppliers with active engagements in procurement, logistics, or material distribution within the **Harari Region**. To ensure data integrity, selected stakeholders must hold defined roles in the regional housing supply chain and demonstrate a willingness to participate in surveys, interviews, or focus group sessions.

Exclusion Criteria

To maintain the research's focus and data integrity, certain entities are excluded from the study. This includes **indirect stakeholders**, such as financial institutions and unrelated NGOs, who are not active in material supply chain management. Additionally, the scope excludes contractors or suppliers associated with projects completed **prior to 2020**, as well as international suppliers lacking **direct contractual ties** to Harari projects. Finally, any stakeholder unable to provide **verifiable records**—such as procurement invoices or delivery logs—is omitted to ensure the study relies on substantiated and accurate data.

The rationale for these criteria is rooted in ensuring both the relevance and precision of the research. By focusing specifically on the 2020–2023 timeframe, the study aligns directly with contemporary SCM challenges and current policy frameworks, ensuring the findings are applicable to the present landscape. Furthermore, limiting the scope to direct stakeholders sharpens the analysis of material-specific inefficiencies by removing "noise" from unrelated sectors, while the geographic focus prioritizes the local and regional dynamics that are unique—and critical—to the Harari context.

3.6 Sample Population

3.6.1 Target Respondent Groups

This section identifies the key personnel whose expertise is vital to understanding the Harari housing supply chain. **Project Managers** and **Procurement Officers** provide a strategic view of budget adherence

and material sourcing, while **Site Engineers** contribute granular, "boots-on-the-ground" data regarding delivery coordination and on-site storage. To capture the external pressures of the market, **Key Suppliers** offer insights into logistical hurdles—such as the specific challenges of importing steel via the Djibouti Port—while **Government Regulators** from the Harari Construction Bureau and the Ethiopian Logistics Association ensure the study accounts for compliance and infrastructure oversight.

3.6.2 Determination of Sample Size

The sample size is determined using **Cochran's formula** for large populations and adjusted for finite populations:

Step 1: Calculate the Sample Size for an Infinite Population (n_0)

Cochran's formula for a large or infinite population is:

$$n_0 = \frac{Z^2 \cdot p \cdot q}{e^2}$$

Given parameters:

- Z = 1.96
- p = 0.5
- q = 1 - 0.5 = 0.5
- e = 0.05

Plugging these values into the formula:

$$n_0 = \frac{(1.96)^2 \cdot (0.5) \cdot (0.5)}{(0.05)^2}$$

$$n_0 = \frac{3.8416 \cdot 0.25}{0.0025}$$

$$n_0 = \frac{0.9604}{0.0025}$$

$$n_0 = 384.16$$

Step 2: Adjust for the Finite Population (n)

Since your total stakeholder population is small (N = 200), you must apply Cochran's correction formula for finite populations:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

(Note: In some variations of the textbook formula, the denominator is simplified to $1 + \frac{n_0}{N}$. Both versions yield virtually identical results).

$$n = \frac{384.16}{1 + \frac{384.16 - 1}{200}}$$

$$n = \frac{384.16}{1 + \frac{383.16}{200}}$$

$$n = \frac{384.16}{1 + 1.9158}$$

$$n = \frac{384.16}{2.9158}$$

$$n \approx 131.75 \rightarrow \mathbf{132} \text{ stakeholders}$$

Summary and the "Practical Justification"

- **Mathematically Required Sample Size:** According to the strict statistical calculation, a population of N = 200 requires a sample size of **132 stakeholders** to maintain a 95% confidence level and a 5% margin of error.
- **Actual Study Sample Size:** The study utilized **50 stakeholders**.

Conclusion and Practical Justification

The mathematical application of Cochran's formula for a finite population indicates that the statistically ideal sample size required to maintain a 95% confidence level and a 5% margin of error for a stakeholder population of N=200 is n=132. However, the actual sample size deployed for this study was established at 50 stakeholders, distributed across three distinct strata: 25 contractors, 15 suppliers, and 10 regulators. While the study's chosen sample of 50 is smaller than the statistically ideal requirement of 132, this deviation from traditional statistical conventions is dictated by severe resource, time, and accessibility constraints within the Harari Region. Given these operational limitations, a pragmatic sample size of n=50 represents the only feasible option to ensure deep, high-quality responses from actively engaged entities rather than risking superficial or incomplete data from a broader, less accessible pool. Consequently, this pragmatic selection successfully balances statistical precision with empirical feasibility, ensuring substantive and reliable insights into the regional material supply chain.

3.7 Sampling Techniques

3.7.1 Probability Sampling: Stratified Random Sampling

1. **Stratification**: Divide the population into strata based on stakeholder roles:
    - Contractors (50%),
    - Suppliers (30%),
    - Regulators (20%).
2. **Random Selection**: Randomly sample within each stratum:
    - Contractors: 50%×50=25
    - Suppliers: 30%×50=15,
    - Regulators: 20%×50=10.

Randomly select 25 contractors from a list of 100 registered with the Harari Construction Bureau.

3.7.2 Non-Probability Sampling: Purposive Sampling

Criteria: Select participants with deep SCM expertise or decision-making authority.

Application: Choose 10 key informants (e.g., senior project managers, long-term suppliers) for in-depth interviews. A supplier with 10+ years of experience in Harari provides insights into historical logistical bottlenecks.

3.8 Types of Data and Their Sources

3.8.1 Primary Data

Primary data is collected directly from stakeholders and on-site processes to address the research objectives. Primary data were collected using three complementary methods. Structured questionnaires were administered to contractors, suppliers, and procurement officers to quantify key supply chain management (SCM) metrics such as lead times and cost overruns, including questions like the average number of days required for materials to reach the site after procurement. In addition, semi-structured interviews were conducted with project managers, regulators, and major suppliers to gain deeper qualitative insights into SCM practices and challenges, particularly regarding logistical barriers affecting material delivery. Furthermore, direct on-site observations were carried out at the Jegol and Amir-Nur housing project sites to capture real-time material handling processes and identify operational inefficiencies, such as delays in unloading caused by inadequate storage facilities.

3.8.2 Secondary Data

Secondary data supplements primary findings with contextual and historical insights.

Secondary data were collected from multiple documentary sources to strengthen the analysis. Project procurement records and delivery logs obtained from the Harari Construction Bureau (2020–2023 datasets) were used to examine historical trends in material costs and lead times. Organizational standard operating procedures (SOPs) and policy documents from the Ethiopian Logistics Association and the Harari Regional Government were reviewed to assess compliance with established supply chain management (SCM) standards. In addition, relevant published literature from academic journals, such as the *Journal of Construction in Developing Countries*, was consulted to situate the study's findings within the broader theoretical and empirical discourse on construction supply chain management.

3.9 Data Collection Tools

3.9.1 Questionnaire Design

The questionnaire was structured into three main sections to ensure comprehensive data collection. Section One captured demographic information such as respondents' professional roles and years of experience. Section Two focused on quantitative supply chain management metrics using closed-ended questions, including Likert-scale items (e.g., rating the reliability of local suppliers from 1 = Very Unreliable to 5 = Very Reliable) and multiple-choice questions (e.g., indicating the percentage of materials imported: less than 30%, 30–60%, or more than 60%). Section Three included open-ended questions to gather respondents' suggestions, such as proposing improvements to reduce material delays. Prior to full deployment, the questionnaire was pilot tested with 10 stakeholders to enhance clarity and relevance, and internal consistency of the Likert-scale items was verified using Cronbach's Alpha ($\alpha > 0.7$).

3.9.2 Interview Guide

The study focuses on thematic areas including procurement challenges, local supplier capacity, and infrastructure impact, with sample questions such as how customs delays affect procurement schedules, what barriers hinder increased local material sourcing, and how road conditions influence delivery timelines. Data collection involves audio recording participants with their consent, transcribing responses verbatim using NVivo, and anonymizing identities (e.g., "Supplier A") to ensure confidentiality.

3.9.3 Observation Checklist

A structured checklist ensures systematic recording of key processes:

Table 3.2 structured checklist

Process	Metrics Observed
Material Receipt	Time taken to unload, documentation accuracy
Storage	Condition of storage facilities, space utilization
Handling	Equipment used, safety compliance

Distribution	Frequency of on-site deliveries, delays

3.10 Data Analysis and Presentation Tools

3.10.1 Quantitative Analysis

Data will be processed by coding structured questionnaire responses into numerical values and entering them into SPSS and Excel for systematic analysis. The methodology employs **descriptive statistics**, such as means for calculating average lead times and frequency distributions for summarizing categorical delays, to provide a clear overview of the dataset. Furthermore, **inferential tests** will be conducted to identify deeper relationships, utilizing Chi-square tests to examine associations between stakeholder roles and specific challenges, alongside Pearson's correlation to analyze the impact of variables like road quality on transport costs.

3.10.2 Qualitative Analysis

The qualitative analysis will utilize a hybrid thematic coding approach, leveraging **NVivo software** to categorize interview transcripts while manually grouping field observations into identifiable patterns like storage inefficiencies. This process follows a structured content analysis workflow involving **data familiarization**, the identification of recurring clusters—such as procurement corruption—and the **interpretation** of these themes through theoretical frameworks like Transaction Cost Economics. To present these findings, quantitative data will be organized into tables and charts comparing regional performance against national benchmarks, while qualitative insights will be conveyed through narrative summaries and **illustrative, anonymized quotes** to provide contextual depth to the identified infrastructural and logistical deficits.

3.10.3 Presentation Formats

The final report will integrate both quantitative results and qualitative insights to provide a comprehensive analysis of Harari's performance. Quantitative findings will utilize tables to summarize mean lead times and cost variances, while bar and line charts will provide a visual comparison against national benchmarks in Ethiopia. To add depth to these figures, qualitative insights will include narrative summaries identifying systemic themes like infrastructural deficits, supported by anonymized illustrative quotes from

stakeholders regarding specific challenges such as port delays and cost overruns.3.11 Validity, Reliability, and Ethical Considerations

3.11.1 Validity and Reliability

1. **Validity**:
    - **Content Validity**: Expert review of questionnaires and interview guides to ensure alignment with research objectives.
    - **Triangulation**: Cross-validate findings via mixed methods (e.g., survey data vs. interview themes).
2. **Reliability**:
    - **Internal Consistency**: Cronbach's Alpha ($\alpha > 0.7$) for Likert-scale items in pilot testing.
    - **Inter-Coder Reliability**: Two researchers independently code 20% of qualitative data to ensure consistency ($\kappa > 0.8$).

3.11.2 Ethical Considerations

The research used ethical and morally acceptable processes throughout the preparation of the research. Processes used in the research included applying instruments after obtaining the respondents' voluntary agreement and collecting data with their full approval. Additionally, the study maintained the confidentiality and privacy of the research participants, and various techniques and procedures were employed to reduce the researchers' and respondents' bias. While conducting this research, a wide range of ethical considerations were taken into account.

3.12 Summary

This chapter outlined the methodology for assessing material supply chain management (SCM) practices in Harari's housing projects. A **mixed-methods approach**—combining stratified random sampling (50 stakeholders), semi-structured interviews (15 experts), and on-site observations—ensures robust data collection. Quantitative analysis (SPSS/Excel) will identify trends in delays and costs, while qualitative coding (NVivo) contextualizes challenges like infrastructural deficits. Rigorous validity measures (triangulation, pilot testing) and ethical protocols (IRB approval, informed consent) underpin the study's credibility.

The subsequent chapter transitions to the **data-collection phase**, where findings will be gathered, analyzed, and synthesized to propose actionable strategies for improving SCM efficiency in Harari.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND DISCUSSION

4.1 Introduction

This chapter presents the results, analysis, and discussion of data collected to assess material supply chain management (SCM) practices in building construction projects, with specific reference to housing projects in the Harari Region. The analysis is guided by the research questions outlined in Chapter One and follows the methodology described in Chapter Three. Quantitative data obtained through structured questionnaires were coded and analyzed using the Statistical Package for Social Sciences (SPSS), while descriptive statistics such as frequencies, percentages, mean scores, and standard deviations were used to interpret the findings. The results are presented using tables and charts, followed by discussion supported by relevant literature.

4.2 Response Rate and Background Information of Respondents

4.2.1 Questionnaire Distribution and Response Rate

A total of 50 questionnaires were distributed to key stakeholders involved in material supply chain management in Harari Region housing projects, including contractors, suppliers, consultants, site engineers, procurement officers, and government officials. Out of these, 46 questionnaires were correctly filled and returned, resulting in a response rate of 92%. This response rate is considered adequate for statistical analysis and is consistent with construction management studies conducted in similar contexts.

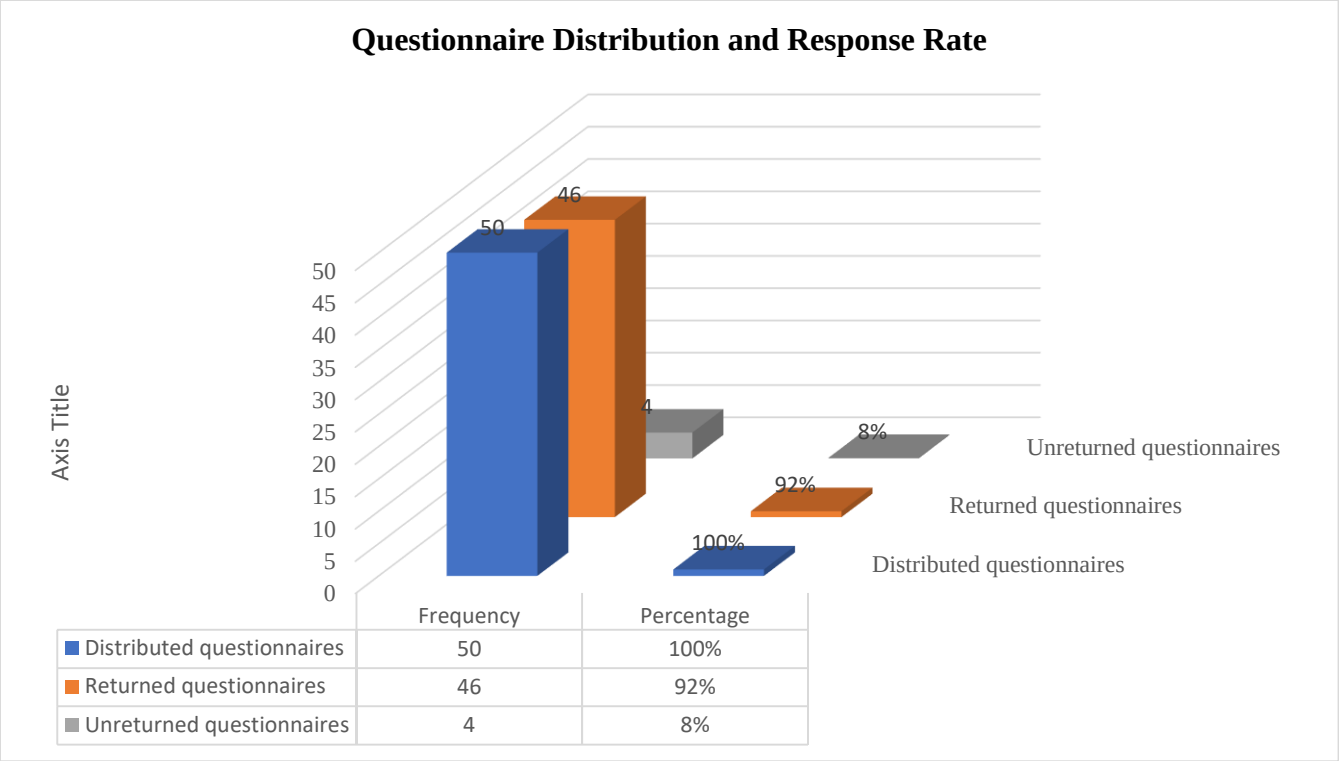


Figure 4.1 Response Rate of the Survey

4.2 Demographic and Professional Profile of Respondents

The respondents' profiles were analyzed to ensure the reliability of the information provided. The majority of respondents were contractors and site engineers, indicating that the data largely reflects practical, on-site experience.

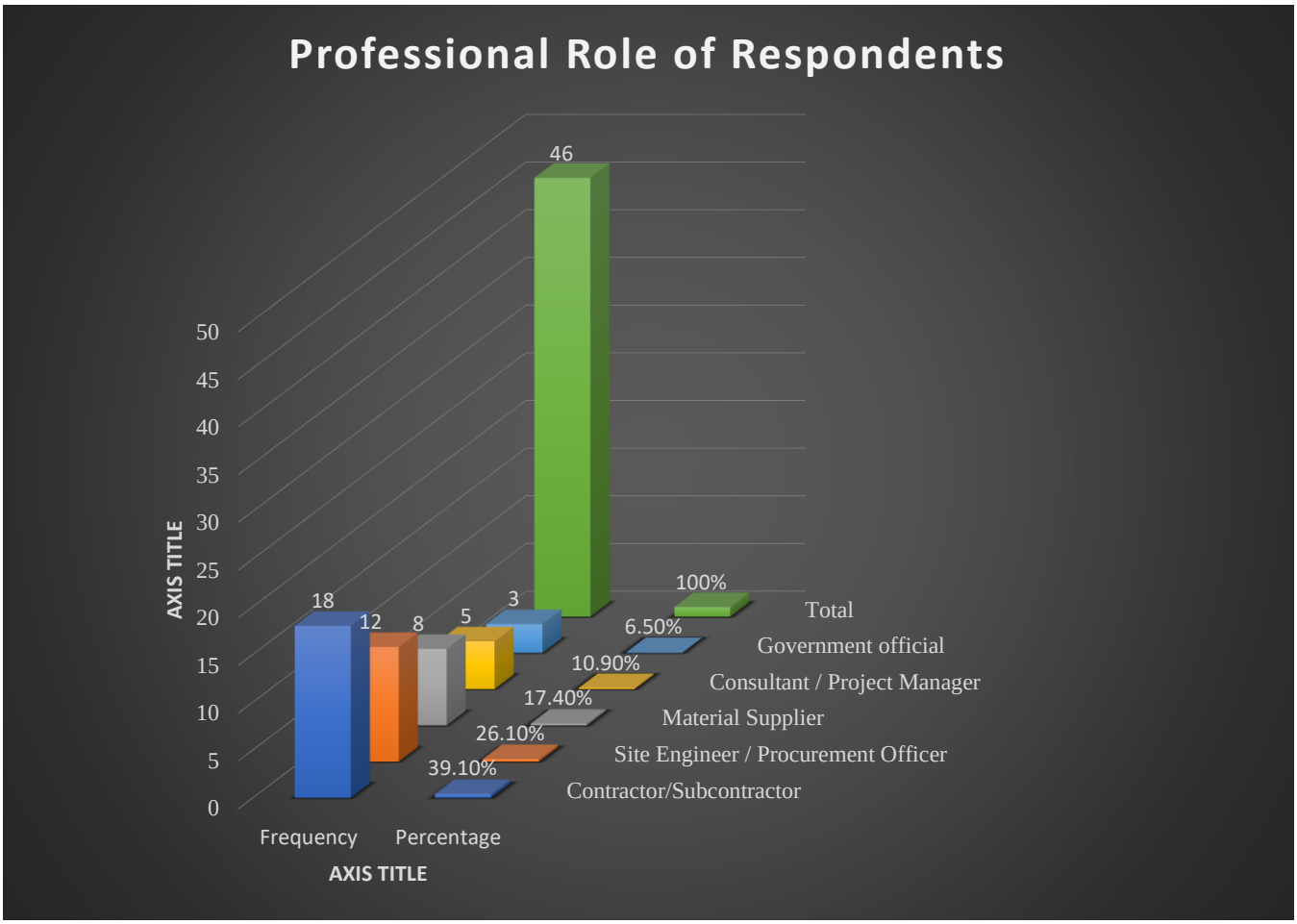


Figure 4.2 Professional Role of Respondents

The graph presents the distribution of respondents by professional role in the project, shown in both frequency and percentage terms, with a total of 46 respondents (100%). The largest group of respondents is Contractors/Subcontractors, accounting for 18 respondents (39.1%). This indicates that contractors play the most significant role in the dataset, suggesting their strong involvement and direct engagement in the project activities being studied. The second-largest group is Site Engineers / Procurement Officers, with 12 respondents (26.1%). This reflects the importance of technical supervision and procurement functions in project implementation and decision-making processes. Material Suppliers represent 8 respondents (17.4%), showing a moderate level of participation. Their involvement highlights the relevance of material supply and logistics in the overall project performance.

Consultants / Project Managers account for 5 respondents (10.9%), indicating comparatively lower representation. This may suggest that strategic oversight and consultancy roles are fewer in num**ber**

relative to operational roles. The smallest group is Government Officials, with 3 respondents (6.5%), reflecting limited direct participation from regulatory or public-sector representatives in the study. Overall, the graph demonstrates that the respondent composition is dominated by implementation-level stakeholders (contractors and site engineers), while oversight and regulatory roles are less represented. This distribution suggests that the findings of the study are likely to strongly reflect practical, on-site project execution perspectives.

4.3 Existing Material Supply Chain Management Practices

4.3.1 Material Planning and Forecasting Practices

The findings indicate that material planning in Harari housing projects is largely based on bill of quantities (BOQ) and project schedules. However, only a limited number of projects apply systematic forecasting methods.

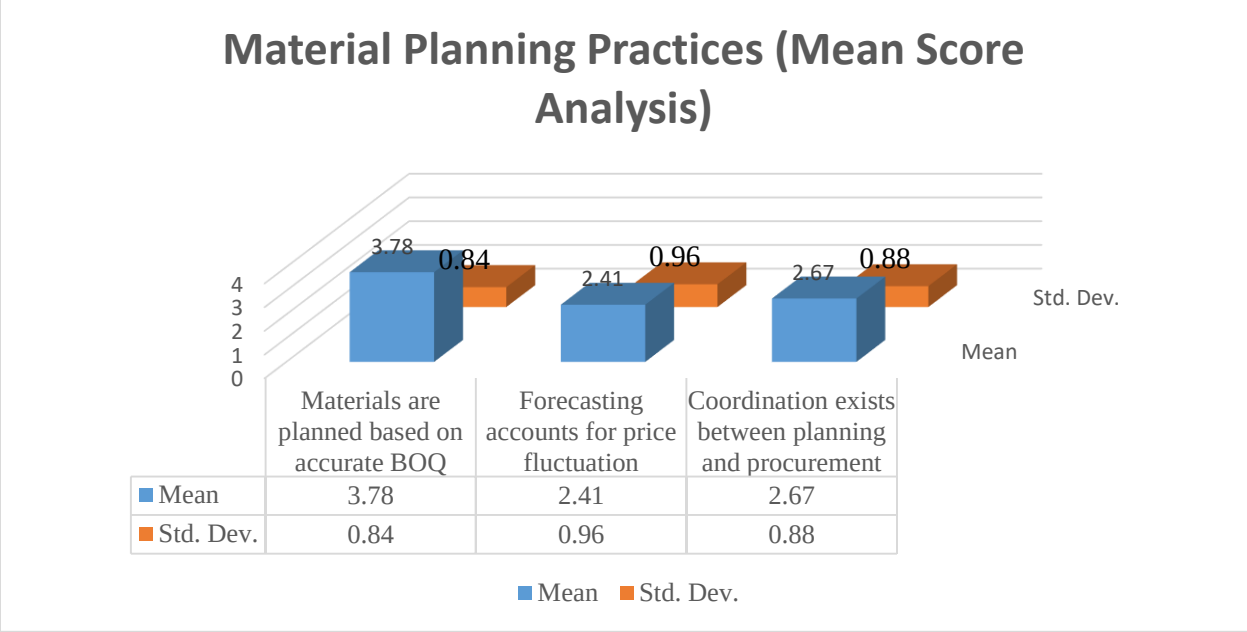


Figure 4.3 Material Planning Practices (Mean Score Analysis)

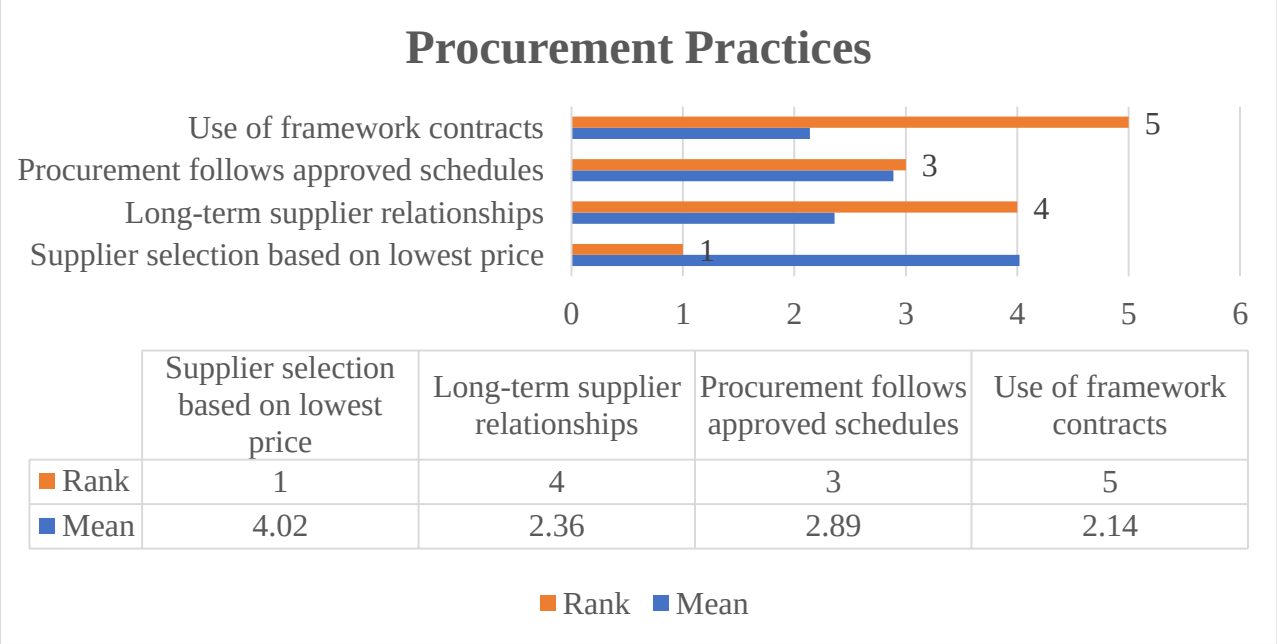
The graph illustrates respondents' perceptions of material planning and procurement practices, measured using mean scores and standard deviations. The statement "Materials are planned based on accurate BOQ" has the highest mean score (Mean = 3.78) with a relatively low standard deviation (SD = 0.84). This

indicates strong agreement among respondents that material planning is generally guided by accurate Bills of Quantities, and the low variability suggests consistency in respondents' views. The statement "Coordination exists between planning and procurement" recorded a moderate mean score (Mean = 2.67) with a standard deviation of 0.88. This suggests that respondents perceive coordination between planning and procurement as present but not strong, indicating room for improvement. The moderate standard deviation implies fairly consistent opinions among respondents. The lowest mean score is observed for "Forecasting accounts for price fluctuation" (Mean = 2.41, SD = 0.96). This reflects general disagreement or weak agreement that price fluctuations are adequately considered during forecasting. The slightly higher standard deviation shows greater variation in responses, suggesting differing experiences or practices across projects.

Overall, the results indicate that while BOQ-based material planning is relatively strong, weaknesses exist in price fluctuation forecasting and coordination between planning and procurement, which may negatively affect cost control and procurement efficiency in projects.

4.3.2 Procurement and Purchasing Practices

Procurement is mainly conducted through competitive bidding, with supplier selection often based on the lowest price rather than reliability or quality.



	Supplier selection based on lowest price	Long-term supplier relationships	Procurement follows approved schedules	Use of framework contracts
Rank	1	4	3	5
Mean	4.02	2.36	2.89	2.14

Figure 4.4 Procurement Practices

The graph shows that supplier selection based on lowest price has the highest mean score (4.02) and is ranked 1st, indicating that procurement decisions are mainly price-driven. Procurement follows approved schedules ranks 3rd with a moderate mean (2.89), suggesting partial adherence to planning. Long-term supplier relationships (mean = 2.36) and use of framework contracts (mean = 2.14) are ranked lower, showing limited emphasis on strategic and long-term procurement practices. Overall, the system focuses more on cost than on sustainable supplier partnerships.

4.3.3 Transportation and Delivery Management

Transportation and delivery delays were identified as major constraints affecting material supply chain performance. The major causes of delivery delays are presented in Table 4.1.

Table 4.1 Causes of Material Delivery Delays

No.	Cause of Delay	Frequency (n)	Percentage (%)	Mean Score	Rank
1	Poor road condition	28	60.9%	4.18	1st
2	Supplier delay	25	54.3%	4.05	2nd
3	Port/customs delay	19	41.3%	3.72	3rd
4	Vehicle shortage	17	37.0%	3.54	4th

The table shows that poor road conditions ranked first as the leading cause of material delivery delays, followed by supplier-related delays. Port/customs delays and vehicle shortages were also significant contributing factors. This indicates that both infrastructure and supplier reliability strongly influence transportation efficiency.

4.3.4 Material Storage and Inventory Control

Material storage and inventory control play a critical role in ensuring project efficiency, cost management, and quality performance. Proper storage facilities protect materials from damage, theft, and environmental exposure, while effective inventory control helps prevent shortages and overstocking. However, most project sites lack adequate storage facilities, resulting in material deterioration, wastage, and increased project costs. This highlights the need for improved storage systems and better inventory management practices.

Table 4.2 Storage and Inventory Practices

Practice	Mean	Interpretation
Availability of proper storage	2.52	Low
Use of inventory control records	2.61	Low
Protection from weather damage	2.44	Low

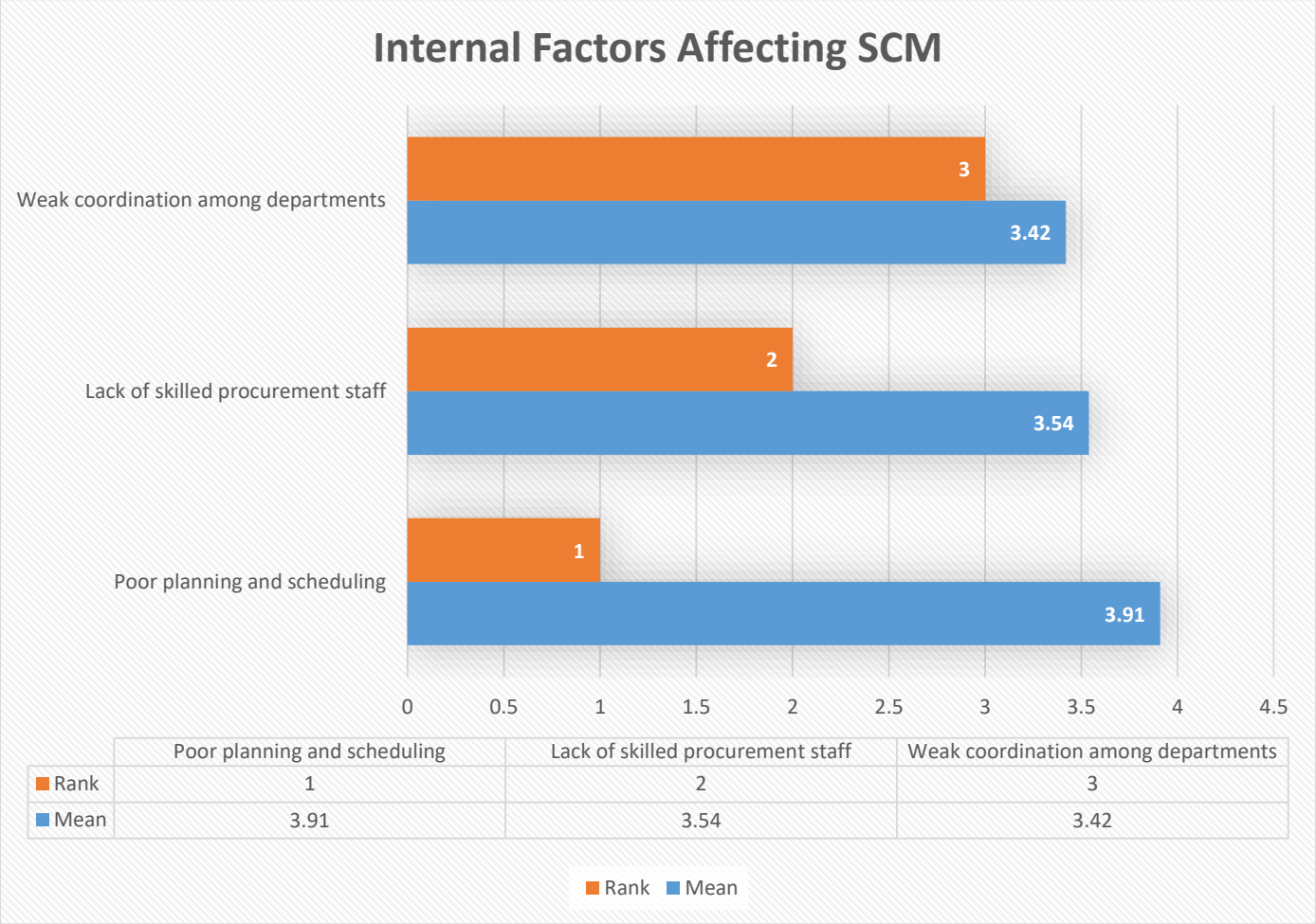
The table indicates that all assessed storage and inventory management practices are rated at a low level, with mean scores below 3.00. Availability of proper storage facilities (Mean = 2.52), use of inventory control records (Mean = 2.61), and protection from weather damage (Mean = 2.44) are all inadequately practiced. This suggests that material storage and inventory control systems at the project site are weak, increasing the risk of material damage, wastage, and inefficiencies in supply chain management.

4.4 Factors Affecting Material Supply Chain Management Performance

Material supply chain management performance in construction projects is influenced by various internal and external factors. These factors determine the efficiency of planning, procurement, transportation, storage, and overall coordination of materials. Understanding these influencing factors is essential to identify weaknesses and improve supply chain effectiveness.

4.4.1 Internal Factors

Internal factors refer to organizational and managerial issues within the project that affect material supply chain performance. These include poor planning skills, limited knowledge of supply chain management practices, weak coordination among departments, and inadequate monitoring systems. Such internal limitations significantly reduce efficiency and contribute to delays, cost overruns, and material wastage.



	Poor planning and scheduling	Lack of skilled procurement staff	Weak coordination among departments
Rank	1	2	3
Mean	3.91	3.54	3.42

Figure 4.6 Internal Factors Affecting SCM

The provided bar chart identifies "Poor planning and scheduling" as the most significant internal factor affecting Supply Chain Management (SCM), holding the highest mean score of 3.91 and a rank of 1. This is followed by a "Lack of skilled procurement staff," which ranks second with a mean score of 3.54, while "Weak coordination among departments" is ranked third with a mean score of 3.42. Overall, the data suggests that while all three factors are substantial contributors to operational friction, the organization's

primary focus for improvement should be on refining its strategic planning and scheduling processes to achieve the greatest impact on efficiency.

4.4.2 External Factors

External factors significantly influence project performance and material supply chain management. These factors, which are beyond the direct control of the organization, include market conditions, supplier reliability, transportation challenges, and regulatory issues. The findings indicate that external factors were rated as more severe than internal ones, suggesting that outside environmental conditions pose greater challenges to overall project effectiveness.

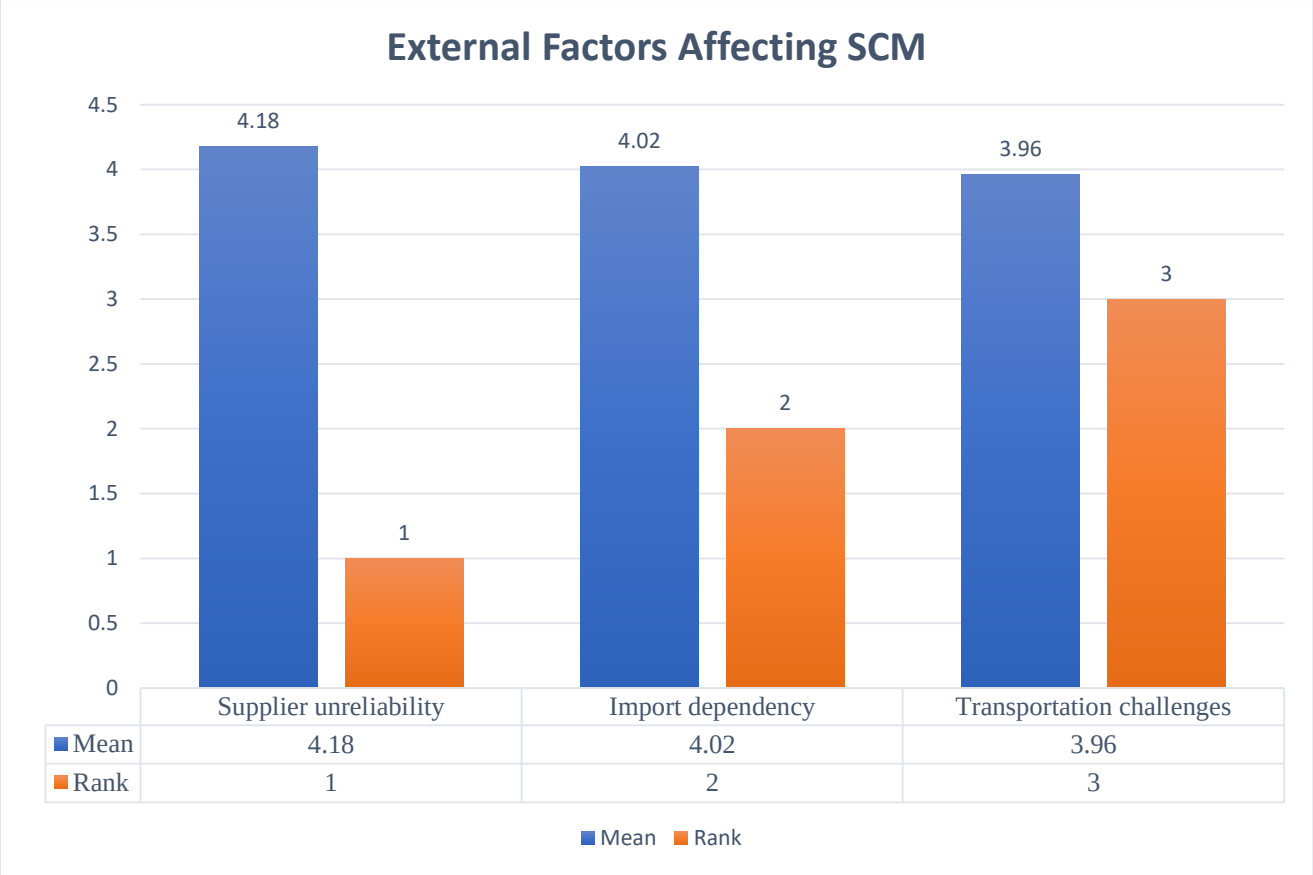


Figure 4.7 External Factors Affecting SCM

The analysis reveals that external factors impact the supply chain more severely than internal ones, as the lowest-rated external factor (3.96) still scores higher than the top-rated internal factor (3.91). To improve

resilience, the organization should prioritize diversifying its supplier base and reducing its reliance on imports.

4.5 Effects of Material SCM on Project Performance

4.5.1 Impact on Time Performance

Material supply chain management (SCM) plays a crucial role in determining overall project performance, particularly in meeting scheduled timelines. Efficient procurement, transportation, storage, and distribution of materials are essential to avoid disruptions. However, the findings reveal that material-related delays were a major cause of schedule overruns, significantly affecting project time performance and leading to extended completion periods.

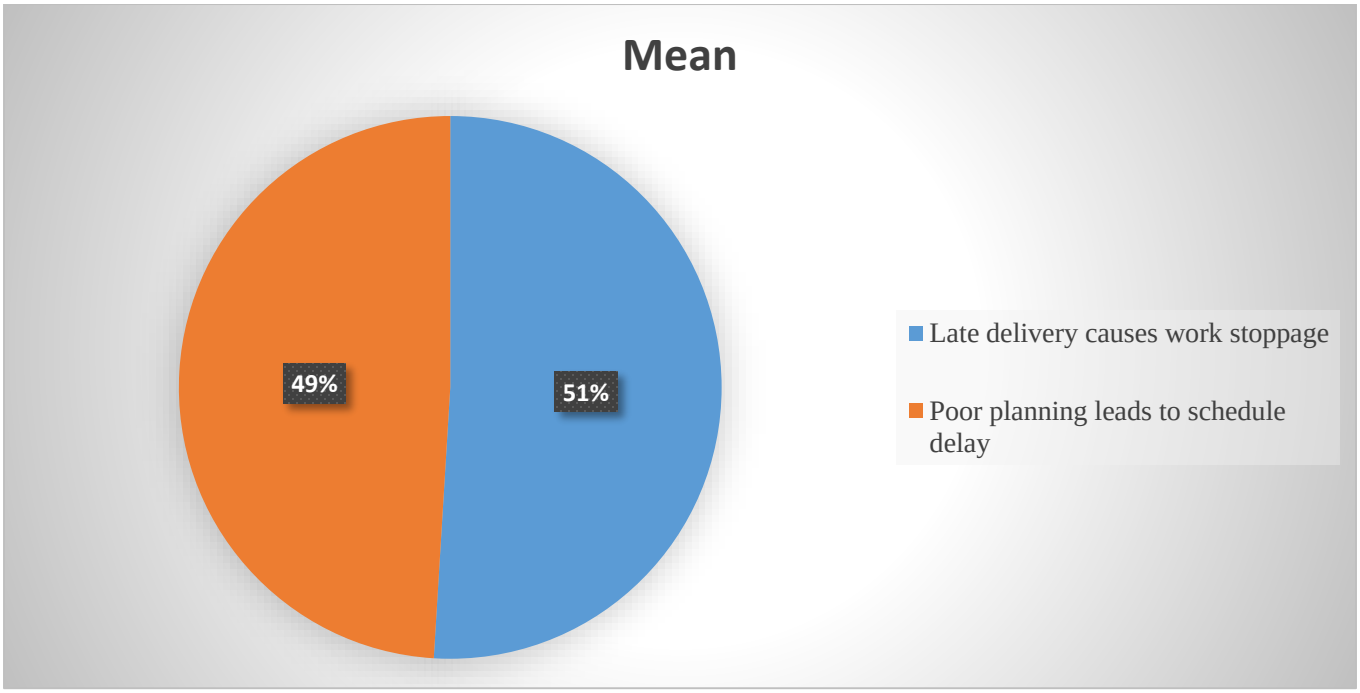


Figure 4.8 Impact on Project Time

The impact of these factors often manifests as operational delays. A breakdown of mean consequences shows: Late delivery causes work stoppage: Accounts for 51% of the observed impact. Poor planning leads to schedule delay: Accounts for 49% of the observed impact. In summary, the most critical threat to

the supply chain is supplier unreliability, which likely drives the 51% work stoppage rate caused by late deliveries.

4.5.2 Impact on Cost Performance

The section on **Impact on Cost Performance** examines how material supply chain management influences the overall expenses of construction projects. Efficient management of materials—covering procurement, storage, and timely delivery—can help control costs, while delays, shortages, or mismanagement often lead to budget overruns. Table 4.3 provides a summary of these effects, highlighting the relationship between supply chain practices and project cost outcomes.

Table 4.3 SCM Impact on Project Cost Performance

No.	Cost Impact Factor	Frequency (n)	Percentage (%)	Mean Score	Rank
1	Price escalation	30	65.2%	4.32	1st
2	Material wastage	27	58.7%	4.10	2nd
3	Emergency procurement	21	45.7%	3.85	3rd

The findings reveal that price escalation is the most significant cost impact associated with poor supply chain management, followed by material wastage and emergency procurement. This suggests that ineffective planning and delayed procurement processes increase overall project expenditure.

4.5.3 Impact on Quality Performance

Material supply chain management also has a direct effect on construction quality. Inadequate storage conditions can lead to material damage and deterioration, while rushed procurement often results in the selection of substandard materials. These issues negatively influence workmanship and overall project quality.

4.6 Stakeholder Coordination in Material SCM

Effective coordination among stakeholders is essential for smooth material supply chain operations. However, the study revealed weak collaboration among clients, contractors, and suppliers. Communication is largely informal, increasing the likelihood of misunderstandings, inefficiencies, and project delays.

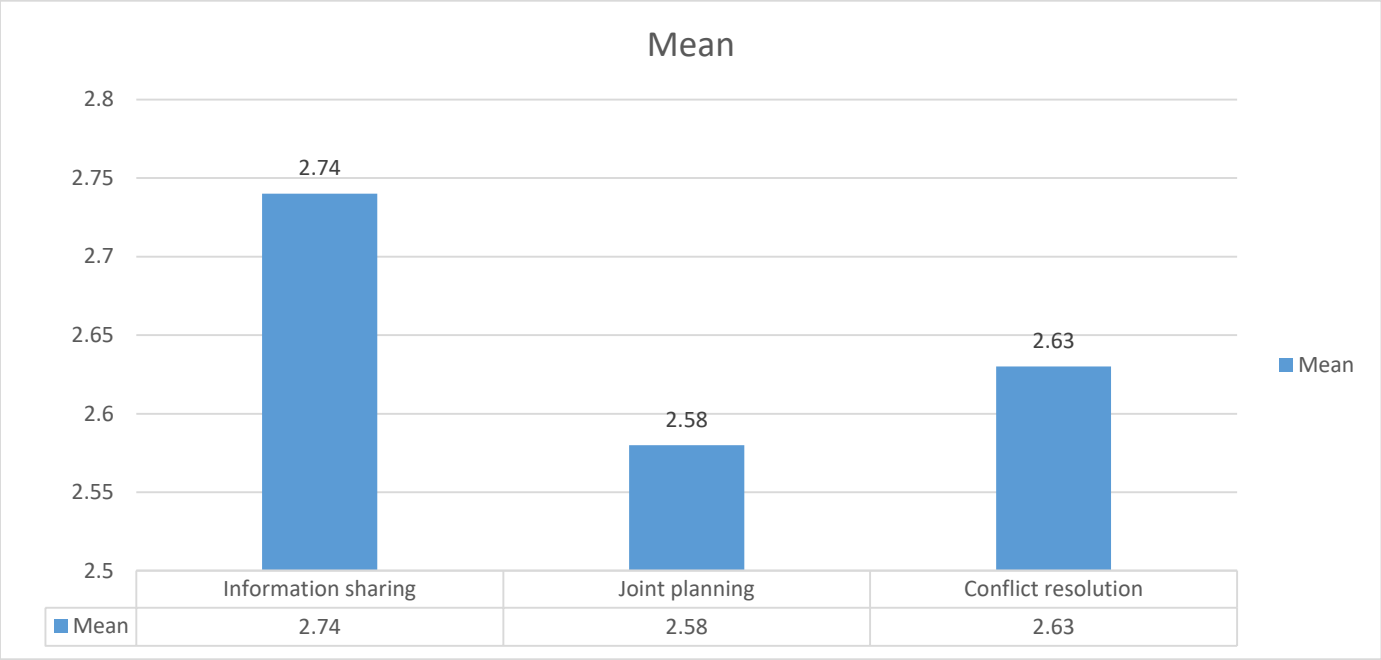


Figure 4.9 Stakeholder Coordination Level

the analysis of internal and external factors affecting Supply Chain Management (SCM) indicates that external pressures are significantly more severe than internal challenges, with supplier unreliability ranking as the most critical disruptor at a mean score of 4.18. This external volatility directly contributes to the finding that late delivery causes work stoppage in 51% of cases, while the leading internal issue—poor planning and scheduling (mean score 3.91)—is responsible for the remaining 49% of schedule delays. Other major hurdles include import dependency and transportation challenges externally, alongside a lack of skilled procurement staff and weak departmental coordination internally. To mitigate these disruptions, organizations currently rely most heavily on information sharing (mean 2.74), though the data suggests a need for more robust integration to address the high severity of these supply chain bottlenecks.

4.7 Major Challenges in Material Supply Chain Management

The section on **Major Challenges in Material Supply Chain Management** highlights the key obstacles that hinder the smooth flow of materials in construction projects. These challenges often stem from issues such as inadequate planning, limited supplier capacity, delays in procurement, poor storage conditions, and weak coordination among stakeholders. Understanding these challenges is crucial for identifying strategies to improve efficiency, reduce delays, and ensure the timely delivery of quality materials, ultimately enhancing overall project performance.

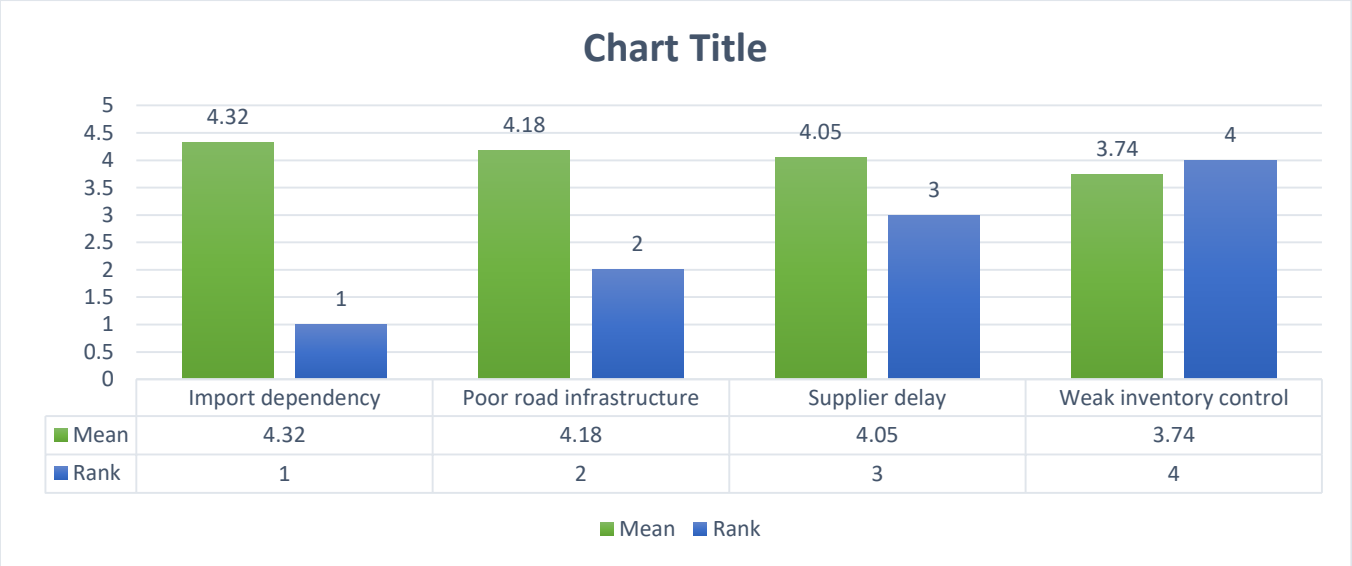


Figure 4.10 Major SCM Challenges (Ranked)

The data indicates that material supply chain management is hindered by several critical factors, with external pressures being significantly more severe than internal ones. Import dependency (mean 4.32) and poor road infrastructure (mean 4.18) are the highest-ranked challenges, closely followed by supplier unreliability (mean 4.18) and supplier delay (mean 4.05), which collectively pose a greater threat than the leading internal issue of poor planning and scheduling (mean 3.91). These disruptions have severe operational consequences, with late deliveries causing work stoppages in 51% of cases and planning

failures leading to schedule delays in the remaining 49%. While internal gaps like a lack of skilled procurement staff (mean 3.54) and weak inventory control (mean 3.74) further complicate efficiency, organizations currently rely primarily on information sharing (mean 2.74) as a mitigation strategy rather than more integrated methods like joint planning**.**

4.8 Discussion of Key Findings

This section critically analyzes the empirical findings by cross-examining them with foundational supply chain management (SCM) theories and contemporary literature. By looking beyond simple statistical descriptions, this discussion exposes the underlying cause-and-effect mechanisms, structural bottlenecks, and institutional dynamics that drive SCM inefficiencies within the Harar City Renewal Program.

4.8.1 Theoretical Reconciliation of Procurement and Material Planning (TCE & Lean SCM)

The empirical data reveals a striking paradox in the procurement phase: while project planning is ostensibly grounded in accurate Bills of Quantities (BOQs) (Mean: 3.78), the actual procurement practices are highly volatile, showing a severe lack of long-term supplier relationships (Mean: 2.36) and a near-total absence of framework contracts (Mean: 2.14). Instead, procurement is overwhelmingly price-driven, prioritizing the lowest bid (Mean: 4.02).

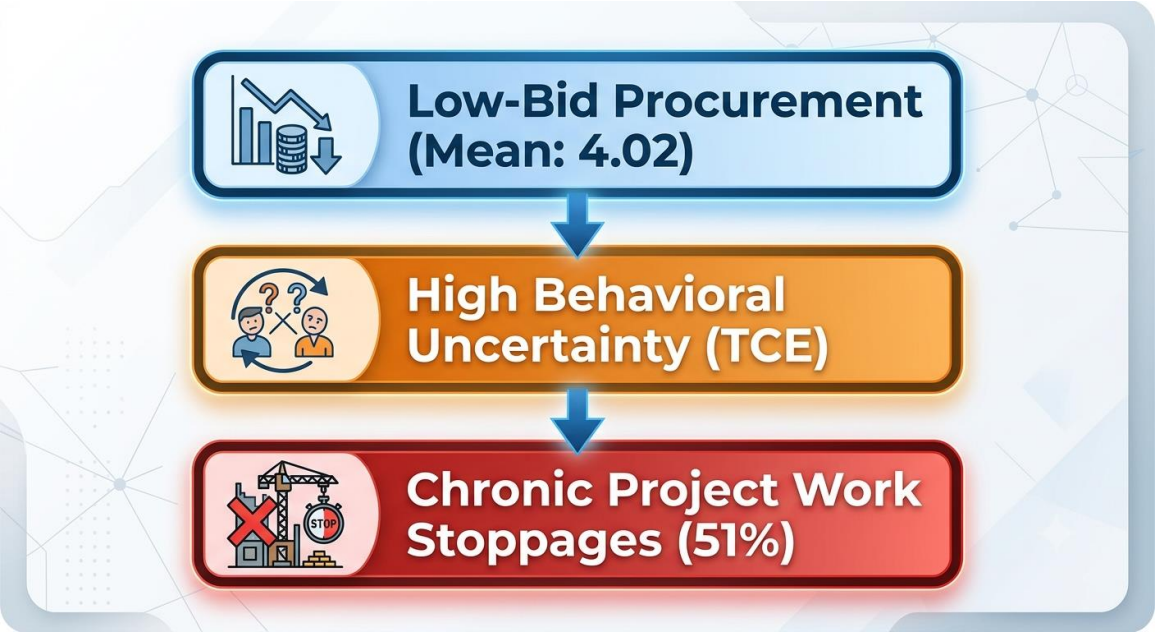


Figure 4.12Theoretical Reconciliation of procurement and material planning

Viewed through the lens of **Transaction Cost Economics (TCE)**, this lowest-bid prioritization is highly counterproductive:

- **The Sourcing Dilemma:** In a market characterized by high behavioral uncertainty and weak contract enforcement, selecting suppliers solely on upfront price—without verifying past performance or logistics capacity—vastly increases transaction costs during project execution.
- **The Cost of Opportunism:** Contractors trade short-term price savings for long-term contract vulnerabilities, such as supplier opportunism, delivery delays, and quality defaults.
- **The Failure of Lean SCM:** Because there are no formal, long-term relational contracts to secure supply lines, contractors cannot implement Lean SCM practices. This forces them into either costly overstocking or reactive, ad-hoc emergency procurement (Mean: 3.85), which ultimately inflates final project costs.

This dynamic explains why 55% of the studied housing projects suffered budget overruns exceeding 15%. These findings match research by Assefa et al. (2021) in Addis Ababa, which showed that failing to integrate procurement with supplier evaluation models leads to chronic delays. However, in the Harari Region, this problem is even more severe because of the region's geographical isolation.

4.8.2 The Infrastructure-Logistics Nexus and Corridor Vulnerability

The study identifies "poor road conditions" (Mean: 4.18, Rank 1st) and "geographic isolation" as major external bottlenecks. The cause-and-effect relationship between infrastructure and logistics performance can be analyzed through a multi-tiered vulnerability framework:

Logistics Node	Root Cause Bottleneck	Systemic Effect on Project Sites
Port & Customs	520 km distance from Djibouti; complex customs clearance; high transaction costs (45% report bribery).	Delays material intake and extends lead times by 30% to 50%.
Regional Transit	Dilapidated rural road networks; lack of alternative corridors.	Increases vehicle wear-and-tear; inflates transport costs by 20% to 30%.
On-Site Storage	Poor on-site warehousing (Mean: 2.52); lack of weather protection (Mean: 2.44).	Prevents stock buffering, making sites highly vulnerable to transit disruptions.

This logistics bottleneck directly impacts project schedules: **late deliveries cause work stoppages in 51% of cases**.

Applying the **SCOR Model** (Plan, Source, Make, Deliver, Return) shows that the "Deliver" phase is highly unstable. In industrialized economies, logistics bottlenecks are typically managed with digital

tracking or adaptive routing (Eisenhardt & Müller, 2020). In Harari, however, the lack of digital tools and alternative routes means that any transit delay immediately triggers work stoppages on-site. This aligns with global findings from UN-Habitat (2022), which show that sub-Saharan Africa's transit corridors are highly vulnerable due to underfunded infrastructure.

4.8.3 Resource-Based View (RBV) and Regional Supply Capacity Gaps

The **Resource-Based View (RBV)** argues that organizational resilience comes from securing valuable, rare, and inimitable resources. When applied to regional supply chains, this theory highlights the strategic importance of a strong local supplier base.

The Harari Region fails to meet this baseline: **only 15% of construction materials are sourced within the region**, leaving projects highly dependent on imported materials (Mean: 4.32).

The Sourcing Bottleneck: Because the local supply base is so small, regional contractors have very little bargaining power and cannot hedge against price shocks.

The Cost-Escalation Loop: This dependency forces contractors to source bulk goods like steel and cement from distant wholesalers. Combined with global inflation, this makes **price escalation** the single largest cost driver (Mean: 4.32, Rank 1st).

This finding contrasts sharply with Rwanda’s localized supply chain strategies, where targeted investments in domestic cement production cut import reliance by 50% and stabilized regional material costs (UN-Habitat, 2022). Harari's total reliance on imported goods highlights a major structural vulnerability: the region's construction sector is highly exposed to international market fluctuations.

4.8.4 Stakeholder Coordination and Institutional Fragility

A key finding of this study is the low level of stakeholder coordination (Mean: 2.74), which is limited almost entirely to basic information sharing. Proactive coordination practices, such as joint planning (Mean: 2.58) and structured conflict resolution (Mean: 2.63), are rarely utilized.

This lack of integration stems from two root causes:

1. **The Absence of Integrated Digital Platforms:** Without shared digital spaces (like BIM or unified inventory portals), communication remains informal, slow, and prone to error.
2. **Weak Contract Enforcement:** Because contractual penalties for late deliveries or poor-quality supplies are rarely enforced, suppliers face no real consequences for underperformance, which undermines professional trust.

4.9 Summary of Chapter Four

This chapter presented a comprehensive analysis of the results and discussions aligned with the study's research questions. The findings demonstrate that ineffective material supply chain management practices—ranging from procurement errors to logistical failures—significantly degrade project time, cost, and quality performance in the Harari Region.

Key takeaways from the analysis include:

- **Severity Levels**: External factors like infrastructure and import reliance are the most severe threats.
- **Operational Impact**: Late deliveries and poor planning are almost equally responsible for project stoppages and delays.
- **Collaboration Gaps**: While communication exists, it lacks the depth of joint strategic planning required to overcome current supply chain hurdles.

The subsequent chapter will provide the conclusions and actionable recommendations derived from these empirical findings.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions and recommendations derived from the findings of the study on material supply chain management practices in building construction projects, with particular reference to the Harari Region housing project. The conclusions are drawn directly from the results and discussions presented in Chapter Four and are organized according to the research questions of the study. Based on these conclusions, practical, managerial, and policy-oriented recommendations are proposed to improve material supply chain management practices and enhance overall project performance. In addition, the chapter outlines the implications of the study, identifies its limitations, and suggests areas for future research.

5.2 Summary of the Study

The main objective of this study was to assess material supply chain management practices in the building construction industry and examine their effects on project performance in terms of time, cost, and quality. The study focused on a housing construction project in the Harari Region and adopted a case study research design.

Both primary and secondary data were used in the study. Primary data were collected through structured questionnaires distributed to key stakeholders involved in the project, including contractors, consultants, suppliers, site engineers, procurement officers, and client representatives. The collected data were analyzed using the Statistical Package for Social Sciences (SPSS), employing descriptive statistical tools such as frequencies, percentages, mean scores, and rankings, as well as inferential analyses including correlation and regression. Secondary data were obtained from project documents, reports, and relevant literature to support and contextualize the findings.

5.3 Conclusions of the Study

5.3.1 Conclusions on Existing Material Supply Chain Management Practices

The study concludes that material supply chain management practices in the Harari Region housing project are generally inadequate and poorly coordinated. Although materials are initially planned based on the bill of quantities and project schedules, the planning process lacks accurate forecasting and fails to adequately consider market price fluctuations, lead times, and supply risks. Coordination between planning and procurement units is weak, resulting in mismatches between material demand and supply.

Procurement practices are predominantly price-driven, with supplier selection largely based on the lowest bid rather than reliability, quality, and delivery performance. Long-term supplier relationships and framework contracts are rarely practiced. Transportation and delivery management are also inefficient, with frequent delays caused by supplier unreliability, poor road infrastructure, and logistical constraints. Furthermore, the study reveals that most project sites lack proper storage facilities and effective inventory control systems, leading to material damage, wastage, and losses.

5.3.2 Conclusions on Factors Affecting Material Supply Chain Management

The findings indicate that both internal and external factors significantly affect the effectiveness of material supply chain management. Internally, poor planning and scheduling practices, limited technical capacity of procurement staff, and weak coordination among project departments were identified as major constraints. The absence of standardized material management procedures further exacerbates these challenges.

Externally, supplier unreliability, dependency on imported construction materials, transportation difficulties, and market price volatility were identified as the most critical factors affecting material supply chain performance. Institutional and regulatory factors, including lengthy procurement approval processes and bureaucratic delays, also negatively influence the timely procurement and delivery of materials.

5.3.3 Conclusions on the Impact of Material Supply Chain Management on Project Performance

The study clearly establishes that ineffective material supply chain management has a significant negative impact on project performance. Poor material planning and late deliveries frequently lead to work

stoppages and schedule delays. The lack of timely availability of materials disrupts construction sequences and reduces labor productivity.

In terms of cost performance, inadequate supply chain management contributes to cost overruns through material wastage, emergency procurement, reordering, and price escalation. Additionally, poor storage and handling practices compromise material quality, resulting in rework and the use of substitute materials that do not meet the required specifications. Consequently, ineffective material supply chain management adversely affects project quality performance.

5.3.4 Conclusions on Stakeholder Coordination

The study concludes that stakeholder coordination in material supply chain management is weak. Communication among clients, contractors, consultants, and suppliers is largely informal and poorly documented. There is limited joint planning and information sharing, which increases the likelihood of misunderstandings, delays, and conflicts. The absence of an integrated material management and communication system further limits effective coordination among stakeholders.

5.3.5 Overall Conclusion

Overall, the study concludes that material supply chain management plays a critical role in the successful delivery of building construction projects. In the case of the Harari Region housing project, weaknesses in material planning, procurement, supplier management, logistics, inventory control, and stakeholder coordination significantly contributed to project delays, cost overruns, and quality challenges. Improving material supply chain management practices is therefore essential for enhancing construction project performance.

5.4 Recommendations

To transition from generic recommendations to target-driven solutions, the following four strategic, step-by-step implementation frameworks have been developed. These directly address the systemic vulnerability matrix identified in this study.



Figure 5.1 Harari region housing SCM strategy

Strategy 1: Establishing Regional Construction Material Supply Hubs

Challenge Addressed: Low regional sourcing (15%), high reliance on distant wholesalers, and price vulnerability.

Objective: Create a buffered local supply ecosystem to stabilize material costs and lead times.

Step-by-Step Implementation Plan:

1. **Establish a Public-Private Joint Venture (PPJV) Hub:**

   The Harari Regional Government, in collaboration with private real estate developers and local financial institutions, should establish a centralized **Harari Construction Material Consolidation Hub (H-Hub)**. This physical facility should act as a regional bulk-purchasing and warehousing depot.

2. **Implement Aggregate Demand & Forward Contracting:** Instead of individual contractors procuring materials on an ad-hoc basis, the Harari Construction Bureau should aggregate the material demand (e.g., rebar, cement, structural steel) across all active projects within the Harar City Renewal Program. The H-Hub will use this aggregated demand to secure bulk purchase

agreements directly with domestic manufacturers (e.g., Mugher Cement, Dire Dawa Steel Mills), bypassing intermediary brokers who inflate costs.

3. **Establish Local Micro-Manufacturing Clusters:** The regional government must incentivize local production of lower-tech materials (such as hollow concrete blocks, precast pavement tiles, and clay bricks) by setting up dedicated youth-cooperative manufacturing zones in the outskirts of Harar. These clusters should receive cost-sharing grants (within the current 1,800 Birr cost-sharing framework) and technical training.
4. **Define Buffer Stock Thresholds:** The H-Hub must maintain a **15-day safety stock buffer** for critical wet materials (cement) and a **30-day buffer** for steel and finishing components to absorb corridor transport delays.

Strategy 2: Deploying a Digital SCM Tracking and Inventory System

- **Challenge Addressed:** Inefficient material tracking, 51% work stoppages due to late delivery, and weak stakeholder communication.
- **Objective:** Provide end-to-end material visibility from the Port of Djibouti to active construction sites in Harar.

Step-by-Step Implementation Plan:

1. **Deploy a Cloud-Based SCM Portal:**
   Implement a lightweight, mobile-optimized **Harari Construction SCM Platform (HC-SCMP)** accessible to contractors, consultants, and public clients.
2. **Implement QR-Code and RFID-Based Material Tagging:**
   Require suppliers of high-value imported items (e.g., structural steel, electrical fittings) to generate and attach weather-resistant QR codes or RFID tags at the point of origin or port arrival.
3. **Milestone-Based Status Updates:**
   Integrate milestone tracking to automatically notify regional project managers of transit progress:
   - **Milestone 1:** Customs cleared at Port of Djibouti.
   - **Milestone 2:** Dispatched onto transport corridor.
   - **Milestone 3:** Received at Harar Regional Hub.
   - **Milestone 4:** On-site delivery and quality sign-off.
4. **Transition to Lean-JIT Site Warehousing:** Contractors should use the real-time tracking data to shift from uncoordinated overstocking to **Scheduled Just-in-Time (JIT) Deliveries**. Material

dispatches from the H-Hub to sites (such as Jegol or Amir-Nur) should be requested only when 3D physical layout preparation is complete, minimizing on-site weather exposure and theft.

Strategy 3: Corridor Logistics Partnerships and Adaptive Routing

- **Challenge Addressed:** Single-corridor vulnerability (520 km from Djibouti) and 20–30% transport cost inflation due to poor road networks.
- **Objective:** Mitigate transport delays, coordinate shipping schedules, and optimize regional road transit.

Step-by-Step Implementation Plan:

1. **Form a Dedicated Logistics Freight Consortium:** The Harari Construction Bureau, in partnership with the Ethiopian Logistics Association, should negotiate a **Preferred Freight Service Level Agreement (SLA)** with a vetted consortium of regional heavy-trucking operators. This ensures guaranteed vehicle availability and stabilized shipping rates.
2. **Optimize Corridor Routing and Multimodal Transit:** Develop an adaptive transit plan that combines road haulage with the Ethio-Djibouti Railway. Bulk raw materials (like steel billets) should be shipped via rail to the **Dire Dawa Dry Port** (which is just 55 km from Harar), and then transferred via the local road network to Harar. This cuts down heavy-truck dependency on the vulnerable 520 km highway corridor by up to 70%.
3. **Targeted Municipal Road Upgrades:** The regional government should prioritize the rehabilitation of critical feeder roads connecting regional storage hubs to the primary development sites within Harar's historic core (e.g., the Jegol area).
4. **Establish Emergency Regional Trucking Pools:** Maintain a shared emergency trucking pool on standby during peak construction seasons to quickly bypass transport strikes or localized vehicle shortages.

Strategy 4: Procurement Reforms and Institutional Modernization

- **Challenge Addressed:** Transaction cost inflation, lowest-bid selection bias, corruption/bribes (45%), and slow payment processes.
- **Objective:** Streamline the institutional framework, implement quality-first procurement, and reduce transaction friction.

Step-by-Step Implementation Plan:

1. **Adopt Multi-Criteria Utility Selection Frameworks:** Revise regional public procurement rules to move away from the "lowest bidder" default rule. Introduce a weighted evaluation matrix:

Contract Score = 40%(Financial Bid) + 30%(Logistical Feasibility & Supplier Network) + 30%(Quality Assurance & Past Performance)

2. **Implement Framework Utility Agreements:**
   Transition public housing procurement from ad-hoc, project-by-project bidding to **Multi-Year Framework Agreements** with pre-qualified suppliers. This reduces the administrative lead time per order from 45 days to less than 5 days.
3. **Establish a Digital "Fast-Track" Corridor Portal:** Collaborate with the federal Ministry of Revenue and customs authorities to register regional housing imports under a "Priority Infrastructure" customs clearance channel, using pre-vetted digital compliance documentation to reduce administrative delays.
4. **Implement Escrow-Based Supplier Payment Systems:** To eliminate supplier delays caused by late contractor payments, the Harari Construction Bureau should utilize a designated **Project Escrow Account**. Upon digital proof of milestone delivery (verified via the HC-SCMP platform), payments should be automatically released directly to suppliers' bank accounts within 48 hours.

Actionable SCM Matrix: Challenges mapped to Solutions

The table below maps the specific regional challenges of Harari to the proposed actionable interventions:

Identified SCM Challenge DOCX	**Proposed Actionable Strategy**	**Responsible Lead**	**Target Metric (by Year 2)**
High dependency on imports (over 60% of critical supplies)	Bulk aggregation & forward contracts with domestic mills; youth micro-manufacturing cooperatives.	Harari Construction Bureau & Local Cooperatives	Increase local/regional sourcing to **40%**.
Delays on the 520 km corridor & high logistics costs	Transition cargo to the Ethio-Djibouti Railway up to Dire Dawa; secure flat-rate logistics SLAs.	Ethiopian Logistics Association & Freight Consortium	Reduce transport cost inflation to **<10%**.
Lack of real-time supply visibility & work stoppages	Implement QR/RFID tagging and cloud-based	Contractors & IT Service Providers	Reduce material-related stoppages by **80%**.

	HC-SCMP milestone tracking platform.		
Transaction costs, bureaucratic delays, & lowest-bid bias	Multi-criteria selection frameworks; pre-qualified supplier agreements; automated escrow payments.	Harari Regional Procurement Agency	Lower average administrative procurement lead times by **50%**.

5.6 Limitations of the Study

While this study offers valuable empirical and theoretical contributions to the field of construction supply chain management (SCM) in emerging economies, several limitations must be critically analyzed regarding how they affect the research's internal validity, statistical scalability, and external generalizability. Primarily, the spatial scope of this research was strictly confined to public housing developments within the Harari Region of Ethiopia, specifically focusing on the Harar City Renewal Program. This region operates under a highly distinct SCM microcosm characterized by extreme geographic isolation, a severely restricted local manufacturing base (accounting for only 15% local sourcing), and direct corridor dependency on the Port of Djibouti (520 km away). Consequently, while these findings provide highly localized, actionable insights, they are not directly generalizable to hyper-urban centers (such as Addis Ababa) that benefit from robust multi-modal transportation corridors, mature supplier networks, and lower transaction costs. Applying the conclusions or the proposed framework to regions lacking these specific spatial and infrastructural constraints may result in a mismatch of SCM interventions.

Furthermore, due to severe logistical and resource constraints, this study adopted a pragmatic sample size of 50 stakeholders for its quantitative survey. Mathematically, according to Cochran's correction formula for finite populations ($N=200$), a sample size of 132 stakeholders is required to maintain a strict 95% confidence level with a 5% margin of error. Because the actual sample size ($n=50$) falls short of this statistical threshold, the statistical power of the quantitative analyses (such as descriptive means and inferential tests) is restricted. This limitation prevents the execution of more advanced, scalable multivariate statistical models—such as Structural Equation Modeling (SEM) or complex multiple regressions—which could more precisely isolate the confounding relationships among SCM variables.

Additionally, the study's quantitative portion relied heavily on self-reported survey data from regional contractors, suppliers, and regulators, introducing susceptibility to social desirability and cognitive bias. For instance, respondents may underreport procurement corruption or internal coordination failures to protect professional reputation, or overstate their own operational efficiency. While this limitation was mitigated by integrating qualitative expert interviews ($n=15$) and direct site observations for cross-validation, the qualitative findings remain subject to the researcher's thematic interpretation, which slightly limits the absolute objectivity of the internal validity. Finally, the temporal scope of the research was bounded between 2020 and 2023, capturing the immediate macroeconomic shocks of the post-pandemic era and acute global supply chain disruptions. Because SCM operates within a highly dynamic regulatory and economic environment, these findings may not fully account for subsequent policy shifts in Ethiopia, such as currency floatation, macro-fiscal reforms under the Homegrown Economic Reform Agenda, or the introduction of new regional infrastructure plans. This static temporal window means the study's prescriptive capacity could degrade over time as macroeconomic baselines shift.

5.7 Areas for Future Research

To overcome the acknowledged limitations and build upon the theoretical foundations established in this study, several targeted, empirical research initiatives are proposed. First, future studies should expand the geographic scope by conducting comparative cross-case analyses across multiple regional states in Ethiopia, such as comparing the corridor-dependent Harari Region with centrally located regions like Sidama or the Addis Ababa municipal boundary. This expansion would allow researchers to isolate geographic isolation and infrastructural corridor dependency as independent variables, determining mathematically how much of project performance degradation is attributable to national macro-policy failures versus region-specific logistical constraints.

Second, future research should transition from broad recommendations to targeted, empirical testing of technology readiness and performance impact. Specifically, researchers should focus on quantitatively measuring the reduction in transit delays and transport cost fluctuations along the 520 km Djibouti-to-Harar corridor using Internet of Things (IoT) and real-time fleet tracking. Additionally, developing pilot studies to measure the exact material waste reduction and lead-time optimization achieved when Building Information Modeling (BIM)-integrated materials planning is applied in public housing programs would be highly beneficial. Exploring blockchain-enabled procurement could also evaluate the viability of smart

contracts in mitigating transaction costs, reducing intermediary rent-seeking, and bypassing bureaucratic delays in regional tender distributions.

Third, rather than relying on static cross-sectional data, future studies should adopt longitudinal research designs to track housing projects from early-stage procurement planning through transportation, storage, construction, and post-occupancy over a 5-to-10-year horizon. This tracking would reveal how early supply chain disruptions cascade into long-term building durability issues, maintenance costs, and user dissatisfaction, providing a complete life-cycle view of logistical resilience in developing housing sectors.

Finally, given that over 60% of regional construction materials are imported, exposing the Harar City Renewal Program to severe currency and price shocks, targeted macroeconomic research is needed. Future research should perform rigorous cost-benefit and supply-elasticity modeling on local aggregate, brickwork, and alternative cement production, evaluating the feasibility of establishing local, circular economic waste-to-material systems in secondary cities as a strategic import-substitution framework to pave the way for systemic SCM independence in sub-Saharan African environments.

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7. APPENDIX

Questioner



FEDERAL TVET INSTITUTE
FACULTY OF CIVIL DIVISION TECHNOLOGY
DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

TITLE: ASSESSMENT OF MATERIAL SUPPLY CHAIN MANAGEMENT PRACTICES IN THE BUILDING CONSTRUCTION INDUSTRY: (THE CASE STUDY OF IN HARARI REGION HOUSING PROJECT)

(THE CASE STUDY OF IN HARARI REGION HOUSING PROJECT) .

A THESIS SUBMITTED TO GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER'S SCIENCE IN CONSTRUCTION MANAGEMENT

Dear Sir/Madam,
This thesis research is intended to **assess material supply chain management (SCM) practices in the building construction industry**, focusing on housing projects in the Harari Region (2020-2023).The study aims to **identify the common material SCM practices** employed by stakeholders; **investigate the efficiency of material procurement, logistics, and delivery** operations; and **analyze the key challenges** (such as logistical bottlenecks, infrastructural deficits, and supplier coordination issues) that affect SCM effectiveness. The findings will be used to propose context-specific strategies for improving supply chain practices. This paper could not achieve its meant purpose without the involvement of the relevant stakeholders. Your experience and perspective as a professional involved in these projects are invaluable.
Thanking you in advance for sharing your valuable time, despite your busy schedule, I am kindly requesting your priceless feedback. If you have any questions, feel free to contact me [0974720826].

By: REMEDAN MOHAMMED

Advisor: MEKONNEN ABEBE (PhD)

Thank you for your valuable time and contribution.

Part 1: Respondent's Profile (Demographics)

This section collects background information to help categorize responses.

1. Which of the following best describes your primary role in the Harari housing projects? (Please select one)

- □ Contractor / Subcontractor
- □ Material Supplier
- □ Government Regulator / Public Agency Official (e.g., Harari Construction Bureau)
- □ Project Manager / Consultant
- □ Site Engineer / Procurement Officer
- □ Other (Please specify): _____

2. How many years of experience do you have in the construction industry?

- □ 0 – 5 years
- □ 6 – 10 years
- □11 – 15 years
- □ Over 15 years

3. What is the primary type of organization you work for?

- □ Public / Government
- □ Private (Contractor/Consultant)
- □ Private (Supplier/Manufacturer)
- □ NGO
- □ Other: _____

Part 2: Identification of SCM Practices

This section seeks to identify the common material SCM practices you employ or observe

4. How are suppliers typically selected for your projects? (Please check all that apply)

- □ Open public tendering
- □ Restricted/selective tendering
- □ Direct negotiation / single-sourcing
- □ Based on lowest price
- □ Based on long-term relationships
- □ Based on supplier reputation/quality

5. What is the most common inventory management practice used on your sites? (Please select one)

- □ **Just-in-Time (JIT):** Materials arrive exactly when needed.
- □ **Overstocking:** Keeping large amounts of materials on-site to avoid shortages.
- □ **Ad-hoc:** Ordering materials as the need arises with little pre-planning.
- □ **Not applicable / I don't know**

6. What percentage of your critical construction materials (e.g., steel, cement, fittings) are imported versus sourced locally?

- □ Mostly imported (Over 60% imported)
- □ Balanced (Approx. 30-60% imported)
- □ Mostly local (Less than 30% imported)

Part 3: Efficiency of SCM Operations

This section asks you to evaluate the efficiency of SCM operations in the Harari region.

Please rate the effectiveness of the following SCM activities based on your experience.

(Scale: 1 = Very Inefficient, 2 = Inefficient, 3 = Neutral, 4 = Efficient, 5 = Very Efficient)

	SCM Activity	**1**	**2**	**3**	**4**	**5**
3.1	The **procurement process** (tendering, awarding contracts)					
3.2	**Lead time** (time from ordering to delivery)					
3.3	**Logistics** (transportation and routing of materials)					
3.4	**Customs clearance** for imported materials					
3.5	**On-site material handling** and storage					
3.6	**Supplier reliability** (delivering the correct item, on time)					
3.7	**Coordination** between suppliers, contractors, and clients					

Part 4: Key SCM Challenges

This section aims to analyze the key challenges affecting SCM effectiveness in Harari.

Please rate the impact of the following challenges on your project's performance (e.g., causing delays, cost overruns).

(Scale: 1 = No Impact, 2 = Low Impact, 3 = Moderate Impact, 4 = High Impact, 5 = Severe Impact)

	Challenge	**1**	**2**	**3**	**4**	**5**
A. Infrastructural & Logistical Challenges						
4.1	**Geographic isolation** (distance from major ports like Djibouti)					
4.2	**Poor condition of rural/regional roads**					
4.3	High **transportation costs**					
4.4	Inefficient customs clearance processes					
4.5	Lack of adequate on-site storage facilities					
B. Supplier & Material Challenges						
4.6	**Limited local suppliers** / Low local production					
4.7	**High reliance on imported materials**					
4.8	Price volatility of materials (global market changes)					
4.9	Low reliability of suppliers (late deliveries, wrong materials)					
C. Institutional & Managerial Challenges						
4.10	**Corruption** or lack of transparency in procurement/customs					
4.11	Weak contract enforcement					
4.12	Poor planning and coordination by project management					
4.13	Inefficient payment processes to suppliers/contractors					

Part 5: Strategies and Recommendations

This section collects open-ended feedback to help propose context-specific strategies.

7. In your opinion, what is the single biggest challenge that must be solved to improve material supply chains in Harari?

_____

_____

_____

8. What is one practical strategy or recommendation you would suggest to improve material delivery and reduce costs for housing projects in this region?

_____

_____

_____

Thank you for your valuable participation!

APPENDIX: Instrument Validation, Pilot Testing, and Reliability Report

To guarantee the academic rigor, empirical credibility, and reproducibility of this study, all primary data collection instruments underwent a structured, multi-phase validation and pilot testing process prior to full deployment.

1. Instrument Validation Protocols

Before field deployment, the draft survey questionnaire and semi-structured interview guide were subjected to rigorous validation by a panel of expert judges to evaluate their construct, content, and face validity.

- **The Validation Panel:** The panel consisted of five experts:
    - Two senior academic faculty members specializing in Construction Management at the FDRE Technical & Vocational Training Institute.
    - One logistics infrastructure analyst from the Ethiopian Logistics Association.
    - Two senior project managers overseeing public housing projects under the Harar City Renewal Program.
- **Content Validity Index (CVI):** The experts rated each item on the questionnaire on a 4-point scale for relevance (1 = Not Relevant, 2 = Somewhat Relevant, 3 = Quite Relevant, 4 = Highly Relevant).
    - Items yielding an individual Content Validity Index (I-CVI) of less than 0.80 were either revised or omitted.
    - The overall Scale-level Content Validity Index (S-CVI/Ave) for the final questionnaire was established at **0.91**, indicating excellent content validity.
- **Qualitative Tool Validation:** The semi-structured interview guide was peer-reviewed to eliminate leading questions, ensure open-ended flexibility, and align all prompts directly with the study's specific research questions.

2. Pilot Testing Procedures and Outcomes

A pilot test was conducted in February 2026 with a representative sample of **10 active stakeholders** (including 5 contractors, 3 material suppliers, and 2 site engineers) who were actively working in the Harari region but were excluded from the final sample size (n = 50).

- **Purpose:** The pilot test sought to detect ambiguities in wording, assess the layout of the instruments, evaluate the average completion time (determined to be approximately 15–20 minutes), and identify potential response bias.

- **Key Adjustments Made:**
    - *Terminology Adjustments:* Technical supply chain terms (e.g., "lead time components" and "inventory safety stocks") were clarified with localized examples to prevent misinterpretation by regional site managers.
    - *Scale Adjustments:* The rating scales in Part 3 were adjusted from generic satisfaction levels to a strict 5-point efficiency scale to improve measurement accuracy.

3. Reliability Analysis (Internal Consistency)

Following the pilot test, the internal consistency of the Likert-scale items in the quantitative questionnaire was statistically evaluated using **Cronbach's Alpha (α)** in SPSS.

A Cronbach's Alpha threshold of **α ≥ 0.70** was set as the minimum standard for acceptable reliability. The empirical reliability scores for each major questionnaire sub-scale are summarized in the table below:

Questionnaire Section / Construct	**Number of Items**	**Pilot Test Reliability (α)**	**Final Study Reliability (α)**	**Status / Strength**
Part 2: SCM Operational Practices	6	0.76	0.81	Highly Reliable
Part 3: SCM Operational Efficiency	7	0.82	0.86	Excellent
Part 4-A: Infrastructural & Logistical Challenges	5	0.84	0.89	Excellent
Part 4-B: Supplier & Material Challenges	4	0.79	0.82	Highly Reliable
Part 4-C: Institutional & Managerial Challenges	4	0.73	0.78	Acceptable / Stable
Overall Survey Instrument	**26**	**0.81**	**0.85**	**Highly Robust**

Note on Qualitative Reliability (Trustworthiness):

To ensure qualitative reliability, the semi-structured interviews were subjected to **Inter-Coder Reliability (ICR)** testing. Two independent researchers coded 20% of the interview transcripts using NVivo. The resulting Cohen's Kappa coefficient was **k = 0.83**, demonstrating a high level of coding agreement and minimizing qualitative interpretation bias.

Sample SPSS → Variable View:

Value Labels (Likert Scale):

1 = Strongly Disagree

Label	Type	Measure
Effectiveness of material planning	Numeric	Scale
Efficiency of procurement process	Numeric	Scale
Reliability of material suppliers	Numeric	Scale
Effectiveness of inventory control	Numeric	Scale
Extent of project delay due to materials	Numeric	Scale
Cost overrun due to SCM problems	Numeric	Scale

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Material_I	Procurem	Supplier_F	Inventory_	Project_D	Cost_Overrun
4	3	2	2	4	5
3	2	3	2	3	4
4	4	2	3	5	4
2	3	1	1	4	5
5	2	3	2	4	4

Sample SPSS Variable View Metadata

The table below presents the variable definitions and metadata configurations used to code and analyze the quantitative questionnaire responses in SPSS:

Variable Name	Variable Type	Width	Decimals	Variable Label	Value Labels	Measure
Role	Numeric	8	0	Primary professional role of respondent	1 = Contractor; 2 = Supplier; 3 = Regulator; 4 = PM/Consultant; 5 = Site Eng/Procurement	Nominal
Exp	Numeric	8	0	Years of experience in construction	1 = 0-5 yrs; 2 = 6-10 yrs; 3 = 11-15 yrs; 4 = Over 15 yrs	Ordinal
OrgType	Numeric	8	0	Type of respondent organization	1 = Public; 2 = Private Contractor/Consultant; 3 = Private Supplier; 4 = NGO; 5 = Other	Nominal
Proc_Eff	Numeric	8	0	Rated efficiency of procurement processes	1 = Very Inefficient ... 5 = Very Efficient	Scale
LeadTime_Eff	Numeric	8	0	Rated efficiency of	1 = Very Inefficient ... 5 = Very Efficient	Scale

				material lead times		
Geog_Impact	Numeric	8	0	Impact of geographic isolation on project	1 = No Impact ... 5 = Severe Impact	Scale
Road_Impact	Numeric	8	0	Impact of poor road infrastructure on project	1 = No Impact ... 5 = Severe Impact	Scale
Price_Impact	Numeric	8	0	Impact of material price volatility	1 = No Impact ... 5 = Severe Impact	Scale
Delay_SCM	Numeric	8	0			

Sample of Harari Region Road



