

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANAGEMENT

MBA DISTANCE PROGRAM

MARKET ENTRY STRATEGY FOR CIRCULAR ECONOMY BASED CONCRETE WASTE COMMERCIALIZATION IN ADDIS ABABA: A FOCUS ON VALUE CHAIN

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ADDIS ABABA, ETHIOPIA

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Advisor: Amare Abawa (PhD)

June, 2026

Addis Ababa, Ethiopia

DECLARATION

I declare that this research thesis, entitled "Market Entry Strategy for Circular Economy Based Concrete Waste Commercialization in Addis Ababa: A Focus on Value Chain," submitted in partial fulfillment of the requirements for the Degree of Business Administration, is my own work prepared under the guidance of Amare Abawa (PhD). It contains neither material previously published by another person nor that has been accepted for the award of any other degree from the University. All Sources of materials used for the research have been duly acknowledged. I declare that this thesis is my original work and has not been submitted for any degree at any other university. All sources the study used for reference have been duly acknowledged.

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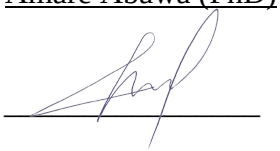
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STATEMENT OF CERTIFICATION

I, the undersigned, hereby certify that, this research entitled: “Market Entry Strategy for Circular Economy Based Concrete Waste Commercialization in Addis Ababa: A Focus on Value Chain” is submitted to Addis Ababa university College of Bussiness and Economics in partial fulfillment for the degree of Bussiness Administration in Management, is the original work of the researcher. It has not been presented for a degree or any other academic award at any other institution. The study complies with the regulations of the University and meets the accepted standards concerning originality and quality. I approve this thesis for submission as the University Advisor.

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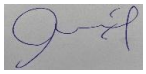
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ABSTRACT

The transition to a circular economy in Ethiopia's construction sector requires commercialization of recycled concrete aggregate (RCA). The commercialization of RCA in Addis Ababa is not yet exercised, due to three majors mutually reinforcing systemic barriers: supply fragmentation, demand resistance, and institutional and policy gaps that hinder the adoption and commercialization. This study empirically diagnosed their mutual systemic interaction, and designed and validated an integrated Market Entry Strategy (MES) for RCA commercialization. A pragmatic mixed-methods sequential Qualitative → Quantitative → Qualitative Validation design was employed to break the systemic deadlock hindering RCA commercialization, executed through three-phase research procedures. In phase II, the study administered a structured survey to 405 stakeholders of the construction using proportional stratified random sampling. Phase III validated the integrated MES through an expert's panel validation (N = 12). The analysis indicated that supply-side fragmentation is a significant predictor of MES viability with ($\beta = .340$, $p < .001$), and an estimated large volume of construction and demolition waste constituting roughly 70–80% moving through informal channels. On the demand side resistance proved to be socio-institutional in nature: Client/Industry Resistance emerged as the top-ranked barrier (Mean Rank = 2.66), while certification had a decisive influence, shifting RCA preference from 21.5% without certification to 86.2% when certification was paired with an incentive. 75.8% of stakeholders identified the absence of national RCA standards as a critical institutional barrier ($p = .006$). The integrated MES received decisively higher viability ratings ($M = 9.08/10$) than single-barrier strategies ($M = 3.88–4.88$), with 91.7% stakeholder endorsement ($\eta^2_p = .984$). Its practical contribution is the validated, three-pillar integrated MES with a four-phase implementation roadmap and specific KPIs.

Keywords: *recycled concrete aggregate (RCA), circular economy, market entry strategy, systemic barriers, construction and demolition waste, mixed-methods, Addis Ababa, Ethiopia*

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LIST OF ABBREVIATIONS AND ACRONYMS

Institutions And Organizations.

Acronym	Definition
AAU	Addis Ababa University
Ei ABC	Ethiopian Institute of Architecture, Building Construction and City Development
EPA	Environmental Protection Authority
ERA	Ethiopian Roads Authority
GIZ	Deutsche Gesellschaft für International Zusammenarbeit

Ethiopian Standards and Regulations

EBCS	Ethiopian Building Code Standard
ES	Ethiopian Standard
GTP	Growth and Transformation Plan

Construction Industry Terms

BC	Building Contractor
CDW	Construction and Demolition Waste
GC	General Contractor
RCA	Recycled Concrete Aggregate
RAC	Recycled Aggregate Concrete
RC	Road Contractor
BC	Building Contractor
CDW	Construction and Demolition Waste

Research Methodology

AHP	Analytic Hierarchy Process
CI	Confidence Interval
CMB	Common Method Bias
CVI	Content Validity Index
DV	Dependent Variable
FPC	Finite Population Correction
I-CVI	Item-Level Content Validity Index
IPA	Importance-Performance Analysis

IV	Independent Variable
KMO	Kaiser-Meyer-Olkin
M	Mean
MCAR	Missing Completely at Random
PCA	Principal Components Analysis
QUAN	Quantitative
RM-ANOVA	Repeated Measures Analysis of Variance
RQ	Research Question
S-CVI	Scale-Level Content Validity Index
SD	Standard Deviation
SE	Standard Error
SPSS	Statistical Package for Social Sciences

Theoretical Frameworks

MLP	Multi-Level Perspective
RBT	Resource-Based Theory
RBV	Resource-Based View
RDT	Resource Dependence Theory
VRIN	Valuable, Rare, Inimitable, Non-substitutable
MLP	Multi-Level Perspective
RBT	Resource-Based Theory
RBV	Resource-Based View

Strategy And Planning

CAPEX	Capital Expenditure
DCF	Discounted Cash Flow
KPI	Key Performance Indicator
MES	Market Entry Strategy
NPV	Net Present Value
OPEX	Operational Expenditure
QMS	Quality Management System
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TEA	Techno-Economic Assessment
WTP	Willingness to Pay

Technical And Analytical Tools

ANOVA	Analysis of Variance

ASTM	American Society for Testing and Materials
GPS	Global Positioning System
ISO	International Organization for Standardization
LM	Lagrange Multiplier (Breusch-Pagan test)
LOESS	Locally Estimated Scatterplot Smoothing
NVivo	Qualitative Data Analysis Software
OLS	Ordinary Least Squares
SNA	Social Network Analysis
ANOVA	Analysis of Variance
ASTM	American Society for Testing and Materials
Currency	
ETB	Ethiopian Birr

Statistical Notations

Notation	Meaning
Adj. Sig.	Adjusted Significance (Bonferroni-corrected)
Asymp. Sig.	Asymptotic Significance
β	Standardized Regression Coefficient (Beta)
χ^2	Chi-Square Statistic
d	Cohen's d (standardized mean difference)
df	Degrees of Freedom
ΔR^2	Change in R^2
F	F-Ratio (ANOVA test statistic)
f^2	Cohen's f^2 (effect size for regression)
η^2_p	Partial Eta-Squared
κ	Cohen's Kappa (inter-coder reliability)
N	Total Population / Sample Size
n	Subsample Size
p	Probability Value / Proportion
$\hat{p}$	Observed Proportion
R^2	Coefficient of Determination
t	t-Statistic
W	Kendall's Coefficient of Concordance
Z	Z-Score

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

The construction industry around the globe utilizes the highest volume of natural resources and thereby produces the largest volume of solid waste, hence it requires an economic paradigm shift from the traditional and linear " take-make - dispose " to circular economy (CE) (Ellen MacArthur Foundation, 2013). Efficient resource use, material recycling and environmental regeneration are the focus areas of circular economy that the construction industry needs to make the transition through applying the use of RCA. By contrast, the transition is constrained by systemic barriers such as the supply-chain fragmentation, demand-side resistance and the institutional and policy gaps, in spite of the proven technological availability to recycle the construction waste.

The construction sector, which approximately extracts 50 % of the global resources and generates about 35% solid waste, requires the circular economy (CE) intervention imperative (Akhtar & Sarmah, 2018; Jittrapiraprabhat et al., 2020). Setting a strategic circular economy helps to promote the construction material conservation and close the loop for construction materials through the use of recycled concrete aggregate (RCA). (Li & Zhang, 2024; Pardini & Sgobbi, 2022). yet, its adoption, use, and commercialization are constrained by dee-rooted structural constraints. These structural constraints have different implications for instance the inconsistency in quality undermine RCA's reliability its structural application, the absence of standard specification leaves producers and buyers with no clear benchmark, and limited market acceptance perpetuates a cycle of low demand and underinvestment (Ghisellini et al., 2018; Tam et al., 2018). Overcoming these barriers requires integrated solutions combining technological assurance, supportive policy instruments, and market development strategies (Guerra et al., 2021).In developing and urbanizing African cities the structural problem is highly worse as they are highly resource -constrained to properly manage the C&D waste. In Ethiopia, booming construction generates enormous C&D waste, yet valorization systems remain nascent (GIZ, 2023; TRAIDE, 2023).The systemic deadlocks and the absence of dedication, frameworks, and regulations that exist in Ethiopia made the RCA adoption and commercialization unfeasible (CE,2024). Addis Ababa, the economic hub of the country is one of the victims to inadequate segregation, disorganized collection, and lack of centralized

processing plants for construction and demolition (C&D) waste that leads to inconsistent and contaminated feedstock (Ayele, 2020).

On the demand-side, the construction professionals and other stakeholders have an entrenched resistance regarding the structural performance and durability of RCA due to the absence of local performance data and the national standards affirm its quality. The systematic reviews made by the researchers from AAU indicates that the absence of specific context guidelines in applying RCA and well-established clear policies on how to make economic incentives such as recycling subsidies and financing on recycling infrastructure severely constrains its adoption to use. Researches conducted by 2025 also reveal the construction waste dumped from the road construction has a potential linkage of health risks due to hazardous wastes dumped in the areas of the road construction. This reveals the need for the CE intervention is highly emphasized not only for the adoption and application of RCA value-chain but also related to health issues. Therefore, the study seeks to make critical analysis on the RCA value chain and aims to formulate a clear and implementable market entry strategy model that ensures quality.

1.2 Statement of the Problem

In Addis Ababa, the construction and demolition waste is estimated above 1.2 million tons annually, of which concrete is the largest construction material produced as waste (Girma & Tefera, 2024). Transforming this waste to commercialization is the critical path for attaining the Ethiopian circular economy goal (Environmental Protection Authority [EPA], 2024). Although there exists high-level commitment and technological feasibility, the RCA market remains absent. This absence of RCA results from three mutually reinforcing systemic barriers that have never been examined as a system: first, supply-side fragmentation associated with the dominance of informal collection, limited logistics and processing, which together undermine the necessary consistency in quality and quantity needed for commercial recycling (Tadesse, 2020; World Bank, 2021). The second systemic constraint is the deep-rooted stakeholders and professionals' resistance from the demand side, which stems out directly from the absence of local performance, visible demonstration projects, and perceived risks associated with quality (Mohammed, 2020). Moreover, gaps in regulatory frameworks and institutions, absence of economic incentives, and poor-quality assurance systems actively fail to create an enabling environment that would make the market feasible (Zerihun, 2021; Kiplagat et al., 2025). Crucially, from a critical analysis, all these systemic barriers are examined and documented in isolation—a fundamental research gap that directly causes the

market deadlock to persist. For instance, the supply chain analysis made by Tadesse (2020) observes the poor coordination, collection, and transportation issues only within the supply system. The behavioral studies of Mohammed (2020) indicate stakeholder resistance to recycled secondary materials in isolation from the supply constraints that feed that resistance. Moreover, existing literature lacks local context frameworks specific to Addis Ababa although adapting the global CE model to local context is central; this means Addis Ababa's unique informal economy, perceptions of stakeholders and the evolving policy landscape interactions remain unaddressed. Most of existing literatures were unable to explain the mutual reinforcing cycle of the systemic barriers in blocking the RCA adoption, usage and commercialization, and therefore cannot prescribe a coherent way out. As a result, this research needs to address three critical identified gaps from reviewing existing literature .(1) the absence of an integrated analysis that reveals how these three critical variables interact as a single, self-locking system to block RCA commercialization in Addis Ababa, (2) the absence of an evidence-based Market Entry Strategy (MES) derived from such systemic analysis, and (3) the absence of local grounded diagnosing and decision making tools /frameworks/ specific to Addis Ababa, which leaves the city's unique informal economy, stakeholder perceptions, and evolving policy landscape interactions unsolved. Without resolving these interconnected critical problems, policy makers are left with no holistic action plan, and entrepreneurs are offered no feasible roadmap to enter the market. The consequence is a perpetual market failure where a technically viable circular solution remains economically unrealized. The existence of these knowledge gaps is addressed by this study, which contributes a unified framework that integrates supply chain, demand-side behavioral, and institutional analyses into a context-specific market entry solution, thereby providing the first evidence-based pathway out of the systemic deadlock.

1.3 Objectives of the Study

1.3.1 General Objective

To diagnose the systemic interaction of supply-side fragmentation, demand resistance, and institutional-policy gaps, and to design and validate an integrated Market Entry Strategy (MES) for recycled concrete aggregate (RCA) commercialization within Addis Ababa's circular economy framework.

1.3.2 Specific Objectives

1. To analyze and characterize the fragmentation of the concrete waste supply chain in Addis Ababa, and to determine how supply-side fragmentation influences the perceived

feasibility of an integrated Market Entry Strategy, through stakeholder interviews, a structured survey, and regression analysis.

2. To identify and rank the drivers and intensity of demand resistance to RCA among key construction stakeholders in Addis Ababa, and to measure how certification and pricing influence acceptance, in order to determine how demand resistance shapes product qualification and value communication priorities within the MES, using structured surveys, conjoint analysis, and non-parametric barrier ranking tests.

3. To evaluate the existing policy landscape and identify critical institutional and policy gaps affecting RCA commercialization, and to determine how these gaps, particularly the absence of national RCA standards and the silence of the building code, shape the advocacy, regulatory, and adaptive needs of the MES, through content analysis of policy documents, expert interviews, and multiple linear regression analysis of survey data.

4. To synthesize the empirical findings from Phases I and II to propose an integrated Market Entry Strategy explicitly designed to mitigate supply-side, demand-side, and institutional-policy barriers, and to validate its comprehensiveness, feasibility, and long-term viability through expert panel validation and statistical comparison with single-barrier strategies.

1.4 Research Questions (RQ)

1. How does supply-side fragmentation influence the perceived feasibility of an integrated Market Entry Strategy for RCA commercialization?
2. How does demand resistance, including its hierarchical ranking and the role of certification versus price discount, shape product qualification and value communication priorities within the MES?
3. How do institutional and policy gaps, particularly the absence of national RCA standards and the silence of the building code, shape the advocacy, regulatory, and adaptive needs of the MES?
4. How do stakeholders rate the comprehensiveness, feasibility, and long-term viability of an integrated MES compared to single-barrier-focused strategies, as assessed through a structured expert panel validation?

1.5 Research Hypotheses (RH)

H_1: A higher degree of Supply-Side Fragmentation significantly predicts lower perceived viability of an integrated Market Entry Strategy

H_2: Demand side resistance significantly predicts lower perceived viability of an integrated Market Entry Strategy, with perceived performance risk emerging as the strongest predictor among the barriers tested.

H_3: Institutional-policy gaps significantly predict lower perceived viability of an integrated Market Entry Strategy

H_4: An integrated Market Entry Strategy significantly predicts higher stakeholder viability ratings than any single-barrier-focused strategy.

H_5: The three-way interaction of supply-side fragmentation, demand-side resistance, and institutional-policy gaps significantly predicts perceived viability of an integrated Market Entry Strategy, such that viability ratings are highest when all three barriers are simultaneously elevated.

1.6 Significance of the Study

This study is fundamentally useful in providing valuable academic theories and principles. Moreover, it will be the source of practical evidence for policy makers, business, and industries. The environmental and social benefits are also among the most important advantages of the study, and by far relevant for policymakers, businesses, and industries, and environmental and social benefits that are relevant to Addis Ababa and similar cities confronting similar challenges. In academics, it helps to develop a research-driven framework for RCA adoption and commercialization. The study contributes important and complimentary concepts to the existing literature on circular economy, value chain analysis, and market entry strategies of the construction by addressing a critical knowledge gap. Furthermore, it helps policy makers develop implementable regulations, standards that can stimulate the recycling market and successfully deal with institutional barriers through incentivizing green procurement. As a result, applying this strategy provides bussiness, material recyclers, and contractors a practical frame work and feasible market entry strategy by reducing the risks of investing in RCA production.

Beyond others, the study provides significant and practical environmental benefits such as minimizing carbon emissions, saving natural resources, and, reducing ground water contamination and introducing landfill taxes that discourage open dumping and encouraging recycling of materials. Moreover, the study contributes to a socio-economic benefit through standardizing the recycling sector. It creates eco-friendly job creation, encourages capacity building, and facilitates sustainable economic growth.

1.7 Scope and Delimitations of the Study

Geographically, the study takes Addis Ababa as the demonstration site without including other cities facing similar challenges. From a material perspective, the study focuses on recycled concrete aggregate among the construction and demolition wastes, excluding other construction materials such as wood, reinforcement bars, aluminums and others. In addition, the theoretical focus of the study concentrates on how challenges in the value chain, market acceptance, institutional frameworks, and market entry strategies, and does not include other theories such as ecological modernization, or tries to build a new theory. The methodological scope of the study concentrates on a mixed-methods approach (survey, interviews, document analysis, excluding other studies such as laboratory-based material testing or long-term performance monitoring of RCA in structures. Regarding the time horizon, the study focuses on the current state of the system with data collection planned for 2025/2026. The study also focuses on stakeholders, which are only the formal actors in the construction sector, such as contractors, government offices, professional engineers and architects, and investors, omitting the informal waste pickers like “quoraleas.”

1.8 Definition of Key Terms

Circular Economy: An economic system that focuses on minimizing waste through proper designing that keeps materials in use at the end-of -life and regenerating natural systems (Ellen MacArthur Foundation, 2013).

Demand Side Resistance: It is the resistance of the construction stakeholders such as engineers, designers, architects and contractors for fear of professional liability and performance risk, perceptual, technical, economic, and socio-cultural factors reducing stakeholder willingness to adopt RCA (Mohammed, 2020; Rogers, 2003).

Ethiopian Building Code Standard (EBCS 2): The primary regulatory instrument for concrete construction in Ethiopia, unchanged since 1995, containing no RCA provisions.

Ethiopian Circular Economy Roadmap (2024): A national policy declaring circular economy mandatory, identifying construction as a priority sector without specific implementation tools (EPA, 2024).

Institutional Policy Gaps: Deficiencies in regulations, standards, enforcement, incentives, and coordination impeding market formation (Scott, 2014).

Integrated Market Entry Strategy (Integrated MES): The validated three pillar framework addressing supply, demand, and institutional barriers simultaneously (Section 5.5).

Recycled Concrete Aggregate (RCA): Aggregate from crushed demolished concrete, classified as Class A (structural), Class B (non -structural), or Class C (fill) (Gebremariam et al., 2025; Silva et al., 2017).

Supply Side Fragmentation: Disorganization in concrete waste collection and processing, characterized by informal disposal and absent sorting (Gebremariam et al., 2025).

Systemic Barrier Triad: It is the mutual interaction of the three systemic barriers: supply -side fragmentation, demand -side resistance, and institutional and policy gaps, to RCA adoption and commercialization (Section 5.4.1).

Virgin Aggregate: Naturally occurring sand, gravel, and crushed stone serving as the benchmark for RCA comparison throughout this study.

Willingness to Pay (WTP): The maximum price that a stakeholder is willing to pay for a product, revealing a 20–30% discount expectation for RCA (Debrah & Abankwa, 2023).

1.9 Organization of the Study

This study is structured into five chapters. The first chapter includes background of the study to explain what the toc is and why it matters , statement of the problem to explain what he study needs to address, ,general and specific objectives of the study to describe what the study aims to achieve, the research question that guide the research in general, hypothesis of the study that helps to predict the relationship between independent and dependent variables, significance of the study and finally organization of the study are included.

In chapter two three important frameworks are organized: The theoretical, empirical and conceptual frameworks that help to review the existing theoretical and empirical studies and identify the gaps in contrast to the study's focus. The conceptual framework designs the relationship among the independent and dependent variables.

Chapter three of the study details the research design, study area, population, sampling, data collection instruments, analysis methods, and ethical considerations. In chapter four the data

analysis, results obtained, findings, and the discussions which helps to presents and interpret the quantitative and qualitative data against the research questions and hypotheses. Finally, the last chapter presents what is observed in the key findings with reference to established existing studies and theoretical viewpoints.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Introduction

This chapter lays the analytical foundation to comprehend the barriers to RCA market development such as the supply-side fragmentation, demand-side resistance, and institutional and policy gaps which are the core focusing points of the study. It also indicates their systemic interdependence in constraining the commercialization of RCA integrating in the principles of circular economy, theory of value-chain and institutional analysis. Finally, the chapter organizes the core components of the literature review comprising the theoretical, empirical and conceptual frameworks. These components position an implementable market entry strategy depending on three systemic barriers and the need for an integrated analysis within the context of Addis Ababa.

2.2 Theoretical Foundations: Integrated Lenses for Systemic Diagnosis

The theoretical framework establishes analytical framework to investigate the critical challenges to commercialize RCA. It reviews the value-chain theory, institutional theory, diffusion of innovation, and resource management perspective theories to develop a polycentric approach. These theories are used as an investigative tool for analyzing the three systemic barriers in Addis Ababa, and their interconnectedness as well. Hence, outcomes of structural, behavioral, and governance failures in the construction sector, rather than isolated occurrences.

2.2.1 Value Chain and Supply Chain Management Theory

The theory of value-chain introduced by Porter (1985), offers frameworks for understanding how value is created at different stages of production and consumption. In traditional linear construction model a loss in material value occurs unlike the circular economic model which works in the principle of materials at their end-of-life re-enter production as inputs, enabling continuous material flows (Genovese et al., 2017). When value-chain applied to RCA, it comprises five critical stages: waste generation and segregation, collection and transportation, processing and beneficiation, marketing and distribution, and re-integration into new construction. This demonstrates the value-chain is broken at both sides at the upstream actors

(suppliers) end and at the downstream actors (demand-end). The suppliers are not properly interconnected to produce RCA effectively and the customers do not observe the value and willing-to-pay for RCA. Recognizing the points where value is dissipated shows the points of intervention for targeted strategies to maximize overall value and advance construction sustainability (Pombo & Ferreira, 2021). Research question is examined grounding on this theory by changing the concentration to examining how specific structural flaws determine viable MES options, such as integrated ventures or formal partnership networks, rather than describing the fragmentation.

2.2.2 Institutional Theory and Market Coordination Mechanisms:

Scott's institutional theory proposes the three pillars that constrain economic activities: the regulative (laws), normative (norms), and the cultural-cognitive (shared beliefs) (Scott, 2014). For the market formation of RCA, the gap across these three pillars creates a hostile environment. This frame is central to RQ3. The deep-rooted industry preferences for virgin materials and resistance to the change to secondary materials like RCA are the normative pressures. Moreover, the deep-rooted perception of recycled materials as inferior is the cultural-cognitive barrier that constrains market formation (Shooshtarian et al., 2022). The socio-cultural factors included in the cultural-cognitive pillar mainly are beliefs about status, quality, and appropriateness that fundamentally shape demand-side perceptions and behaviors. A pragmatic approach uses this theory to evaluate the extent to which these gaps force an MES to incorporate advocacy, self-regulation, or niche-market targeting.

2.2.3 Diffusion of Innovation Theory and Behavioral Economics:

Rogers' Diffusion of Innovation Theory describes that the adoption of new technologies relies on how potential users perceive five key attributes: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). Most stakeholders believe that RCA, when compared to virgin aggregate, does not align well with the established construction practices and offers limited opportunities for testing or observing its performance in real projects (Kothari & Patel, 2022), and this slowed its adoption and implementation. The weak communication about the benefits of RCA and insufficient mechanisms to reduce perceptions of complexity and risk, lack of demonstration projects to show its performance, and other factors create demand resistance. Moreover, Behavioral

Economics complements the Diffusion of Innovation Theory and shows how psychological bias plays a major role in creating resistance. For example, status quo bias leads firms to prefer familiar materials for fear of loss aversion and the potential downside more than the value gained from RCA adopting and using. In addition, the uncertainties created due to the overestimation of potential risks to use RCA are hindering, even though economic evidence indicates that RCA could be a cost-effective option (Mohammed, 2020). Finally, these theories guide the research of entrenched and perceived resistance of stakeholders and demonstrate how an MES must give priorities that assure quality, run pilot projects, and clearly communicate its value.

2.2.4 Resource Management Perspectives

It is possible to reduce the limitation by avoiding the dependence on finite construction material such as the virgin aggregate and balancing the flow resources through using RCA in the construction industry. This idea is complimented by the resource-based view (Barney, 1991) for RCA ventures to build a competitive advantage through specialized capabilities. In recycling process, the capabilities are that expertise which are technical, networks of stakeholders for sourcing the construction waste, and dependable quality control systems which are valuable, rare, and hard to imitate (Shahid et al., 2025). In general, there exists a theoretical integration between Resource dependence Theory (RDT) and Resource Based View at which RDT explains the need to reduce external dependence for resource for survival and success, and RBV describes how can companies leverage the internal strength to create resilient, value-generating material flows. This integration between the two theories demonstrates that developing circular economy implementation and capabilities address the fragmentations on the supply-side that transforms resource management into a source of long-term strategic advantage.

Theoretical Integration and the Identified Gap: Although there exists such valuable integrated viewpoint between the two theories existing literatures fail to acknowledge the systemic interaction among the supply-side, demand-side, and institutional and policy gaps in determining the RCA market feasibility in emerging economies for urban contexts like Addis Ababa. Most studies apply single theoretical lenses, that fails to address the multi-dimensional interdependencies which is the characteristic of circular economy. The theoretical contribution of this study to existing knowledge is the integrated application of these frameworks to model how supply-side failures, institutional voids, and behavioral resistance interact to determine the requirements for a successful MES.

2.3 Empirical Analysis: Contextualizing the Tripartite Challenge in Ethiopia

The empirical framework part is deliberately designed to analyze the systemic barriers within the practical conditions of Addis Ababa's construction sector by combining recent (2020-2025) local and global evidences to anchor each challenge. It examines the practical challenge among the three critical variables. It also connects the theoretical concept with the practice-based and draws attention to the specific evidence gaps that study needs to address.

2.3.1 Supply-Side Fragmentation: The Structural Disintegration (RO1 & RQ1)

The C&D waste management in developing economies, is manifested by networks of informal collection, inadequate sorting structure, and inefficient transport systems (Horta et al., 2021). In Addis Ababa, this fragmentation manifested through interconnected deficiencies such as:
Structural Disintegration and Informality: The different actors in the RCA value-chain operate separately which results in collecting small and scattered volumes which is a challenge to process it centrally. The largest volume of C&D waste, approximately 70-80% of the waste handling occurs through informal channels characterized by manual sorting, open dumping, and undocumented transactions (Tadesse, 2020; Zewdu & Mulugeta, 2022). The viability of the waste stream is ensured when the recycling facilities are large and consistent.
Technological and Infrastructural Deficits: This is due to the limitation of obtaining mobile crushers and standardized material testing facilities hinders production capacity and quality.
Financial Accessibility as Mediating Factor: Establishing the recycling facilities is highly capital intensive, even for at small scale. Furthermore, the lack of green financing, high interest rates, and the pronounced perception of investment risk among lenders aggravates the challenge.
In general, the collective effect of these factors forms a significant financial barrier that mediates the relationship between existing institutional gaps and supply-side underdevelopment. The financial barriers ultimately entrench the market fragmentation by constraining consolidation and technological progress critical to industry growth (World Bank, 2021).
Economic Consequences: Economic sustainability of recycled concrete aggregate can be achieved by making the waste management infrastructure well organized. In a fragmented waste management structure, the production cost of RCA escalates by 30-40% and the collection and transportation by 15-25%, but this is limited to 5-10% in a well-organized waste

management system. Moreover, when considering the average material recovery rates, the range for informal systems is from 40-50% when compared to 70-80% material recovery rates in a well-organized industrial framework (World Bank, 2021).

Given that existing studies have not provided integrated analyses that test whether centralized aggregation, technology leasing, and standardized contracts can overcome the systemic barriers in Addis Ababa, the following hypothesis is tested: H_1: A higher degree of supply-side fragmentation significantly predicts lower perceived viability of an integrated Market Entry Strategy.

H_1: A higher degree of Supply-Side Fragmentation significantly predicts lower perceived viability of an integrated Market Entry Strategy

2.3.2 Demand-Side Resistance: Perceptual, Economic, and Behavioral Barriers (Guiding RO2 & RQ2)

In RCA value-chain, one of the critical challenge the market acceptance with multiple and inter related layers of resistance.

Perceived Performance Risks and Quality Concerns: As indicated in recent researches, multi-layered resistances face the adoption of RCA. In order to avoid the technical side resistance of professional related to the quality of RCA, there exists an optimized pretreatment method, such as water saturation that increase the compressive strength of RCA nearly to (≈49.1 ± 0.7 MPa) which is comparable to virgin aggregate (Ge et al., 2021; Guerzou, Mebrouki, & Castro-Gomes, 2018; Lv, Huang, & Wang, 2023).Moreover, other researches also indicate that it is possible to make the RCA as a high value material through the application of innovations such as resin-coated RCA grain in polymer has a compressive strength of 96MPA (Kępniak, Chyliński, Łukowski, & Woyciechowski, 2024). However, these advancements do not guarantee the performance of RCA and this makes its perception of being inferior in quality remain entrenched and still this issue continues to dominate.

In Ethiopia, the technical advancements in RCA quality are absent from local engineering practice, and there are no standardized specifications tailored to the local context for professionals to consult. Furthermore, the limitation in availing the local performance data, and long-term demonstration projects are the additional challenges that makes the perception of RCA's performance and reliability more pronounced. The absence of localized studies and demonstration projects makes professionals to consider RCA as inferior construction material.

This trust gap leads to generating context-specific data and implementing pilot projects to build confidence in RCA's long-term performance.

Socio-Cultural Factors as Foundational Beliefs: These are the issues related to stakeholders' preference to material which commonly perceived as superior in quality. Hence, they have substantial contribution in shaping the market resistance of RCA. Other cultural-biases such as considering recycled concrete product as lower social status, and the dependency of construction industries on longstanding traditions of the construction materials resulted in deep-rooted resistance to changing practices. Therefore, the assessment made by professional and stakeholders on RCA market resistance the perceptions often outweigh facts in RCA adoption beyond the others like performance, cost, technical and economic factors (Akbar & Hasan, 2022).

Specification and Regulatory Barriers: The absence of clear compliance guidelines unable engineers and contractors to make experiments with recycled materials. The absence of building codes that explicitly address the use of recycled materials make RCA to occupy an uncertain regulatory space. Moreover, complications are made on stakeholders to use RCA due to the unavailability of a transparent approval process for non-standard materials. Finally, the adoption of RCA faces these institutional barriers commonly portrayed as it as problematic, administratively complex, and inconsistent with prevailing construction practices (Mohammed, 2020).

Price Sensitivity and Economic Calculations: This is one of the most important factors to consider that knowing construction professionals are highly price sensitive and they expect a price discount that ranges from 20-35% relative to the virgin aggregate to use RCA in addition to other quality criteria to be satisfied. For buyers, the perceived uncertainties about the strength performance, durability and reliability would be compensated by the price discount made on RCA (Debrah & Abankwa, 2023) (Debrah & Abankwa, 2023). This market dynamic interacts with the broader market conditions as it does not operate in isolation. Wider market forces affect the adoption of RCA, where the shifts within the construction sector and the price of virgin aggregate can either increase or decrease its comparative attractiveness. When the price of aggregate increases or the demand for construction accelerates, RCA becomes a more attractive alternative, and the converse is true as well. Economic factors, together with wider market trends, play a decisive role in determining RCA's competitiveness and in shaping the rate at which it is adopted within the construction industry.

Since the intensity and hierarchy of demand resistance drivers among Addis Ababa's key stakeholders have not been empirically measured, and the resulting strategic MES tasks remain unspecified, the following hypothesis is proposed:

H_2: Demand side resistance significantly predicts lower perceived viability of an integrated Market Entry Strategy, with perceived performance risk emerging as the strongest predictor among the barriers tested.

2.3.3 Institutional-Policy Gaps: Governance and Policy Implementation Challenges (RO3 & RQ3)

In the sphere of Ethiopian construction sector the adoption and commercialization of RCA is constrained by multiple and closely interlinked **institutional** and policy gaps. **Regulatory Framework Incompleteness and Fragmentation:** Although some government political commitments has been to emerge like developing the Ethiopian National Circular Economy Roadmap(2024),it seems only aspirational as the are no operational regulations for C&D waste management .For instance ,the absence of binding requirements to waste segregation, established technical standards for RCA quality grading, adequate enforcement capacity are incorporated (EPA Ethiopia, 2024; GIZ, 2023).Moreover, no clearly defined responsibility and coordination across different departments, which inurn leads to inconsistent implementation and accountability gaps (Zerihun, 2021).

Economic Incentive Misalignment: The current policies in Ethiopia donot consider the costs related to the virgin aggregate and costs of landfilling with concrete waste. Establishing a procurement framework that reinforces the circular construction such as the landfilling taxes and that penalizes the fees for the extraction of the virgin aggregate reduces the disposal of waste, improves the market for secondary martials and finally brings the systemic shifting from traditional linear construction to circular construction practices. Moreover, the absence of green financing mechanism that encourage circular construction practices is a critical institutional gap that directly hampers the development of supply side capacities in the RCA sector (Vanegas et al., 2022).

Informational and Capacity Deficits: Beyond others factors such as the lack of professional guidance and insufficient technical expertise, and absence of strong systems for monitoring and certification restricts the Ethiopian RCA market. Consequently, the limitation to certify secondary material undermines confidence and limits broader adoption (Kiplagat et al., 2025).

External Contextual Factors: Beyond institutional designs, the effectiveness of RCA commercialization policies in Ethiopia depends on external factors such as the broad macro market conditions, such as the growth pattern in the construction industry, public infrastructure

investment priorities, and the **macroeconomic** stability, which influence the policy implementation and private sector response.

As no implementable analysis has translated the institutional gaps into a sequenced advocacy or adaptive business plan, the hypothesis that quantifies the most critical gap is: **H_3:** Institutional-policy gaps significantly predict lower perceived viability of an integrated Market Entry Strategy

2.4 Conceptual Synthesis: An Integrated Framework for Market Entry Strategy

The conceptual model integrates findings drawn from the preceding theoretical and empirical models into the definitive analytical frame of the study. It establishes the foundation of the study formulating successful market entry strategy (MES) as the dependent variable, directly influenced by the dynamic interplay of the three independent variables (Supply-side fragmentation, demand-side resistance, institutional and policy gaps). The model provides systemic plan for causal relationship among the three most important systemic barriers and a self-reinforcing cycle as well among these three independent variables. Furthermore, it provides a clear roadmap for the research methodology and closes the loop between problem diagnosis and strategic inquiry by translating into the study's research objectives, questions, and testable hypotheses.

2.4.1 The Core Conceptual Model

This section proposes an integrated conceptual framework (as indicated in Figure 2.1). Through addressing the three interrelated systemic challenges it is possible to achieve successful market entry strategy.

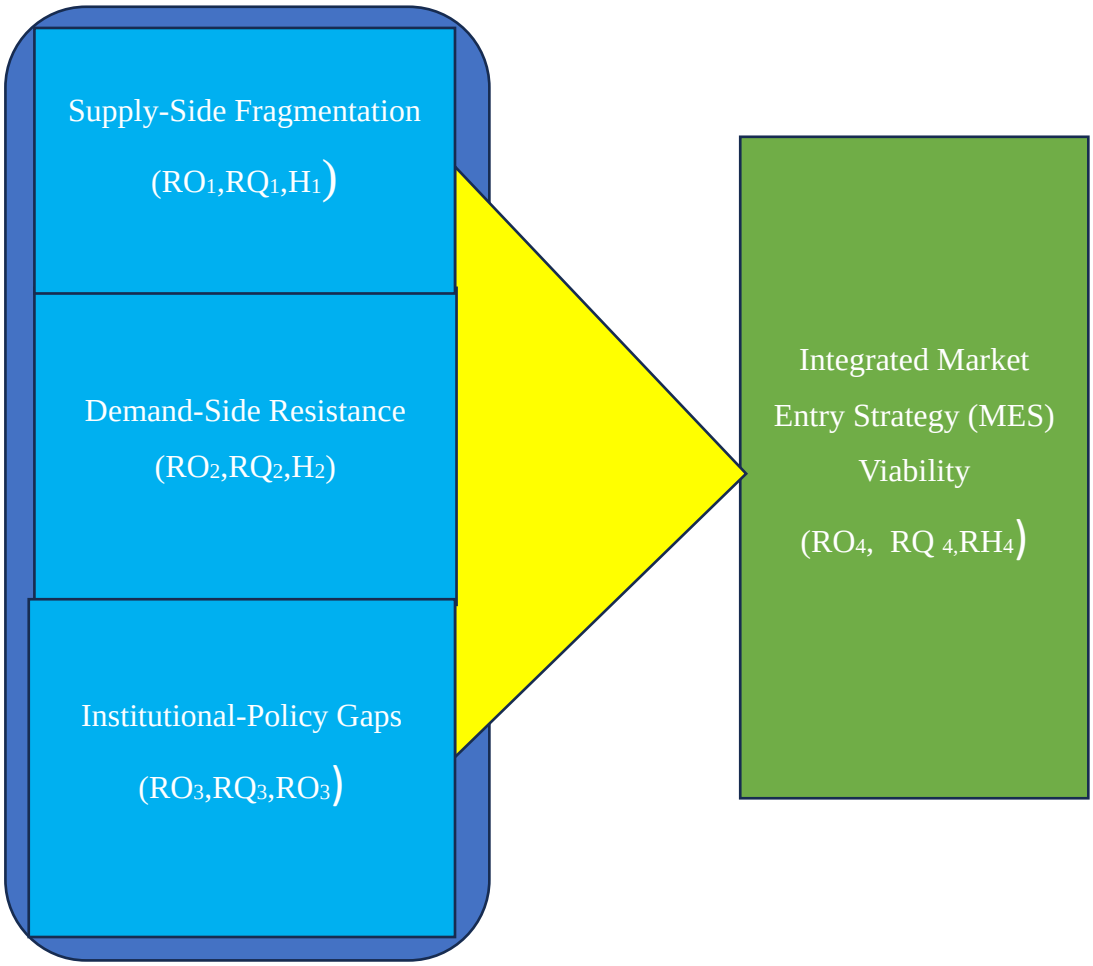
Supply-Side Fragmentation: It is the structural, technological and operational inefficiencies in the upstream value chain of RCA which is driven by the dominancy of the informal sector lack of standardized collection/processing, and inadequate technology. This results in inconsistent quality, high logistical costs, and unreliable supply.

Demand Side Resistance: This is the resistance of the RCA market actors in the downstream and practically driven by perceived performance risk, price sensitivity, socio-cultural preferences, specification barriers, and behavioral inertia leads to low willingness-to-pay.

Institutional and policy gaps: It is the failure to align stakeholder actions for a functioning circular market due to limitations in technical standards, economic incentives, adequate enforcement, and coordinated planning.

Figure 2.1 illustrates how the three systemic barriers jointly determine MES viability, with each linked to a specific research question and hypothesis.

Figure 2. 1 Conceptual Framework.



Consistent with Specific Objective 4 and Research Question 4, the comparative hypothesis is:
H_4: An integrated Market Entry Strategy significantly predicts higher stakeholder viability ratings than any single barrier focused strategy.

2.4.2 Research Contribution and Knowledge Gap Address

The contribution of this study to circular construction in an emerging economy by developing an integrated framework that combines value chain, institutional, and behavioral perspectives, providing local and context-specific evidence on demand resistance and supply side interventions from Addis Ababa, and creating a validated Market Entry Strategy as a practical template for similar cities. These contributions link useful academic insight with implementable business strategy for sustainable construction materials.

2.5 Knowledge Gaps and Research Contributions

This study seeks to address the most important and critical gaps through a context-specific framework for successful market entry strategy for RCA commercialization in Addis Ababa.
Systemic Integration Gap: Most existing research overlooked the mutual dependencies among the supply-side, demand-side, and institutional factors, and the systematic interaction to constrain RCA commercialization in Addis Ababa. The focus of most studies is to examine the interdependent dimension in isolation and that is the limitation of their investigation. Furthermore, the mediating role of the financial sector between the supply-side fragmentation and the institutional gap is also neglected. The study offers a more realistic diagnosis for the commercial failure of RCA by integrating theoretical lenses and proposing testable conceptual models that demonstrates the interaction of the three variables.
Strategic Implementation Gap: In creating implementable market strategy constraints exist in providing systemic actionable procedure though problems are identified by diagnostic reports. The absence of empirically grounded MES that specifies the sequences of interventions, resource requirement and the plan to implement creates empirical gap of addressing techno-economic and socio-behavioral issues. The study will transmit the Ethiopian construction circular economy from purely diagnostic or technical research to applied strategy formulation offering a validated context-specific MES that provide a coherent roadmap with clear implementation priorities for stakeholders which is the primary output expected.

Contextual Adaptation Gap. Existing literature lacks local context frameworks specific to Addis Ababa although adapting the global CE model to local context is central. This study investigates the way how cultural beliefs and rational economic calculations intersect the decision for material selection. This study investigates the Addis Ababa's unique informal economy, perceptions of stakeholders and the evolving policy landscape interactions to ensure context-specific to the city. This makes the MES to ground in pragmatic reality beyond theoretical soundness.

Finally, an integrated market entry strategy roadmap comprising implementation priorities, resource requirements, and stakeholder roles that acknowledge interdependence and specific to Addis Ababa.

Contributions of the research:

Theoretical contribution: The study reinforces frameworks that helps to understand the socio-technical transitions by modeling how systemic market failures shape business model strategies.

Practical Contribution: The study provides different actors in the construction industry a rigorously validated strategic road map (MES) that help them apply RCA into commercial practice, supporting sustainable urban development in Addis Ababa.

Consistent with Specific Objective 4 and Research Question 4, the comparative hypothesis is:

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter details the applied research methodology to examine systemic barriers to RCA commercialization in Addis Ababa. The research approach, design, sampling, data collection, and analysis are included and presented. All are aligned with the objectives of the study. In order to produce credible findings for strategic business and policy decision-making, the study established Rigor, validity, and ethical protocols to maintain and ensure credible, data-driven findings (Creswell & Plano Clark, 2018).

3.2 Research Approach and Design

The study selecting proper and detailed research approach and structural design to ensure the orientation of the methods employed with the research questions posed.

3.2.1 Research Approach

The study adopted mixed -methods research approach to maintain consistency with its pragmatic and applied nature. This approach combined qualitative exploration and quantitative measurement to investigate the barriers to RCA commercialization in Addis Ababa. The qualitative method captured perspectives and contextual nuances, while quantitative methods measured barrier prevalence and relative importance (Creswell & Plano Clark, 2018).

3.2.2 Research Design

The study used a pragmatic paradigm (Morgan, 2014) for applied research with an exploratory, descriptive, and explanatory design. The purpose of designing this research method is to solve real-world problem(pragmatic) make clear unknown barriers and perceptions of stakeholders(exploratory), quantify how these barriers widespread(descriptive), and test the causal relationship of barriers(explanatory) all these to be done from phases I to II. Phase III (expert panel validation) evaluated the practical viability of an integrated Market Entry Strategy (RO4) through comparing single-barrier strategies like supply, demand and institutional policy gaps only. The semi-structured interview was conducted with 23 purposively selected stakeholders of the construction for the primary data source and review of policy and regulatory frameworks identified supply-side fragmentation, demand-side resistance, and institutional-policy gaps. These findings informed a structured survey

administered to 405 stakeholders to measure barrier prevalence and test hypothesized relationships. Stakeholder validation via Google Meet with 12 purposively selected professionals assessed the feasibility and practical utility of the proposed MES, and the feedback and rating refined the final data-driven market entry strategy tailored to the Addis Ababa context. The research employed a sequential mixed method (*qualitative → quan titative→ qualitative validation)* research design that aligned with the pragmatic and applied nature of the research (Creswell & Plano Clark, 2018). Under this design procedure the qualitative barriers were explored and their prevalence and relationship were quantified and finally a practical strategy was validated through stakeholders' engagement. To collect qualitative data the research design employed interviews to identify the key systematic barriers, stakeholders' perception, and contextual variable. Then, a structured survey was applied to ensure quantitative validation and confirm the prevalence, strength, and relationship of factors that were identified in the qualitative phase. Finally, the qualitative and quantitative findings were synthesized to build an integrated market entry strategy (MES). To ensure alignment between the research design and the study objectives, the three phases of the sequential mixed-method design were mapped to the exploratory, descriptive, explanatory, and pragmatic functions. The study employed the exploratory to make clear the specific systemic barriers and the perception of stakeholders relevant to RO1, RO2, and RO3.

Figure 3.1 Research design flow diagram illustration the three-phase sequential validation design.

Phase I → Phase II → Phase III

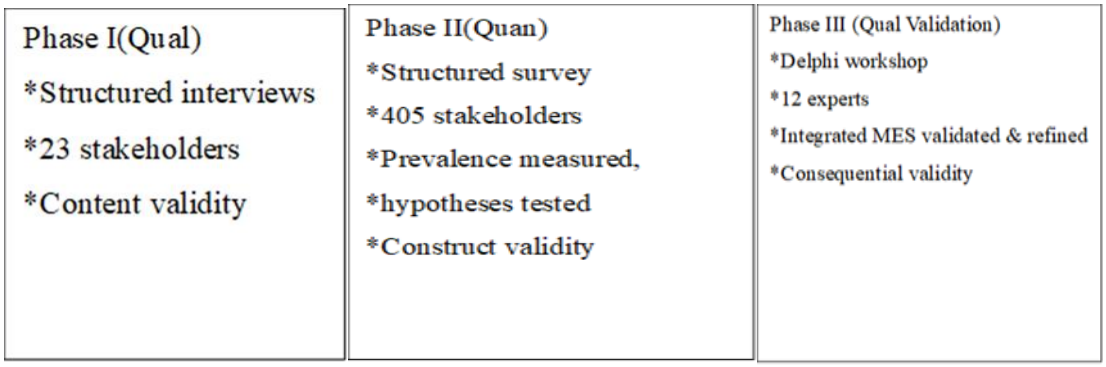


Figure 3. 1 Research design flow diagram

3.3 Description of the Study Area

The study selected the city for four basic reasons. First, it was the center of construction activity accounting for approximately 60% of major infrastructure projects and the construction investment within the country (Ethiopian Construction Authority, 2023). This made the city

the largest producer of the construction waste making the commercialization challenge both acute and strategically significant.

Second, Addis Ababa was the seat of federal and municipal government institutions including the Ethiopian Standards Agency, the Ministry of Urban and Infrastructure, the Environmental Protection Authority, and the Addis Ababa City Administration.

This institutional concentration made the city the center of locus for formulating policies, enforcing the regulations, and developing standards relevant to the construction waste management and transition to circular economy.

Third, the city accommodated the major construction stakeholders' headquarters including general and building contractors from grade 1 to 5, consulting firms, associations of engineering profession, and material suppliers. This concentration enabled efficient access to a comprehensive cross-section of the construction value chain thereby facilitating both interview recruitment and survey distribution.

Fourth, the city was undergoing rapid urbanization and the corridor development underway made it a demonstration site for examining circular economy feasibility in the construction sector of a fast-growing African city.

3.4 Target Population and Sampling Procedures

3.4.1 Target Population

The target population was composed of six main categories who worked in different sectors within the city. The study assumed the decision and perception of these stakeholders could shape RCA commercialization in Addis Ababa: Contractors (Grades 1–5) who handle material procurement; design and engineering professionals (consultants, architects, engineers) who were responsible for material specifications; regulatory officials from the government offices such as permit office, agency of standards, and environmental protection Authority suppliers including quarry operators and ready-mix concrete; plants , academics from both public and private universities ; and other value chain actors such as demolition contractors, waste transporters, and site supervisors operating at critical nodes in the concrete waste value chain.

3.4.2 Sampling Design and Techniques

The study followed a distinct mixed method approach to conduct both the qualitative and quantitative phases to fulfill their respective purposes (Teddlie & Yu, 2007).

3.4.2.1 Phase I: Purposive Sampling for Qualitative Depth

For Phase I, the study applied a purposive sampling method with maximum variation to choose participants who are information-rich and were capable of providing deep, contextualized insights into the concrete waste value chain and barriers to RCA commercialization (Patton, 2014). The respondents were deliberately selected for the study based on their professional work experience, organizational size, and their role within the organization and as well as regulatory offices. To determine an adequate sample size, the study applied the principle of information power which relies on five dimensions: Study aim (broad vs. narrow), sample specificity (dense vs. sparse), use of established theory, quality of dialogue, and analysis strategy (Malterud et al., 2016). Hence, based on this principle the study was categorized narrow and focused aim (barriers to RCA commercialization), highly specific sample (construction stakeholders in Addis Ababa), applied theory (value-chain, institutional, diffusion of innovation), strong dialogue quality (semi-structured interviews with experienced professionals), and cross-case thematic analysis a sample of 15 to 20 participants was deemed sufficient.

Data collection continued until thematic saturation, the point where no new codes or themes emerged from additional interviews (Guest et al., 2006; Braun & Clarke, 2006). The final sample comprised 23 participants who responded correctly to all main and follow-up questions, while 7 did not participate for various reasons.

3.4.2.2 Phase II: Stratified Random Sampling for Quantitative Generalizability

The statistical representativeness of the sample was conducted by applying a proportional stratified random sampling. The sampling frame was based on data obtained from the Ethiopian Construction Authority (2023 - 2025), comprising registered contracting firms, consulting firms, and individual professionals which were found in ECA data base repository.

Population Size. The total target population was 4,230, calculated by adding all categories obtained from the Ethiopian Construction Authority.

Table 3. 1 Target Population Distribution

Category	Population (N_i)
General Contractors (GC Grade 1–5)	1,013
Building Contractors (BC Grade 1–5)	448
Road Contractors (RC Grade 1–5)	6
Consulting Firms (Arch/Bldg/Hwy)	51
Professional Engineers	1,390
Practicing Engineers	1,126

Associate/Graduate/Other Engineers	196
Total Population (N)	4,230

Note. Adapted from Ethiopian Construction Authority (2025).

Sample Size Calculation. The minimum sample size was calculated using Cochran's (1977) formula for an infinite population, then adjusted using finite population correction.

Step 1: Initial sample size (n_0)

$$n_0 = \frac{(Z^2 * P(1-P))}{e\text{^}2}$$

$$n_0 = \frac{(1.96^2 * 0.5 * 0.5)}{0.05\text{^}2} = 384$$

Where: Z = 1.96 (95% confidence level), p = 0.5 (maximum variability), e = 0.05 (margin of error).

Step 2: Finite population correction

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

$$n = \frac{384}{(1 + (384-1)/4230} = 352$$

The finite population correction was applied because the initial sample size (n_0 = 384) represented more than 5% of the total population (384 / 4,230 = 9.1%).

Step 3: Adjustment for non-response

$$nf = \frac{n}{n/(1-.2)}$$

$$nf = \frac{352}{\frac{352}{0.8}} = 440$$

Assuming a 20% non-response rate, 440 surveys were distributed.

Proportional Allocation. The sample was allocated proportionally across strata using:

$n_h = (N_h / N) \times n_{final}$

Where n_h is the sample size for stratum h, N_h is the population of stratum h, N is total population, and n_{final} is the target sample size (440).

Table 3. 2 Proportional Allocation of Survey Sample

Category	Population (N_i)	Proportional Sample (n_i)	Surveys Distributed (with 20% buffer)
General Contractors (GC 1–5)	1,013	84	105
Building Contractors (BC 1–5)	448	37	47
Road Contractors (RC 1–5)	6	1	1
Consulting Firms	51	4	5

Professional Engineers	1,390	116	145
Practicing Engineers	1,126	94	117
Associate/Graduate/Other Engineers	196	16	20

Note. Calculated from Ethiopian Construction Authority (2025) data.

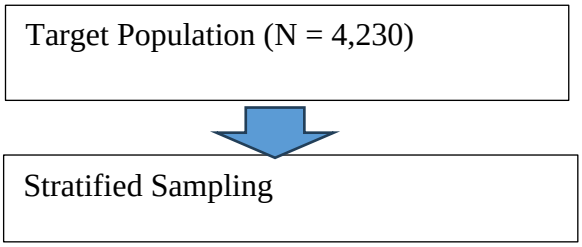
Separation of the Collected Sample for Analysis. Although the 440 surveys were distributed proportionally using the combined population of 4,230, the collected responses belong to two distinct types of units: registered contracting firms and consulting firms (General Contractors, Building Contractors, Road Contractors, Consulting Firms), and individual professionals (Professional Engineers, Practicing Engineers, Associate/Graduate/Other Engineers). Therefore, for all subsequent quantitative analysis, the sample was divided into two groups:

Group 1 – Organizations: General Contractors (GC 1–5), Building Contractors (BC 1–5), Road Contractors (RC 1–5), and Consulting Firms. The target population of this group is 1,518 (calculated by summing the category populations from the Ethiopian Construction Authority: 1,013 + 448 + 6 + 51).

Group 2 – Individual Professionals: Professional Engineers, Practicing Engineers, and Associate/Graduate/Other Engineers. The target population of this group is 2,712 (calculated by summing: 1,390 + 1,126 + 196).

Within each group, the proportional allocation originally applied was retained. For Group 1, the weight of each respondent was computed as the inverse of the sampling fraction within that organization category, using the category population N_h and the number of completed responses in that category. Similarly, for Group 2, the weight was computed using the individual professional category populations and completed responses. This approach ensures that estimates for the population of registered organizations and for the population of individual professionals are unbiased and reported separately. For the main regression analysis testing H_1–H_3, the two groups will be combined with appropriate sampling weights applied to each stratum to ensure population representativeness. Sub-group analyses will be conducted as robustness checks.

Figure 3.2 Sampling flow diagram illustrating the stratified proportional sampling process from target population to final valid sample.



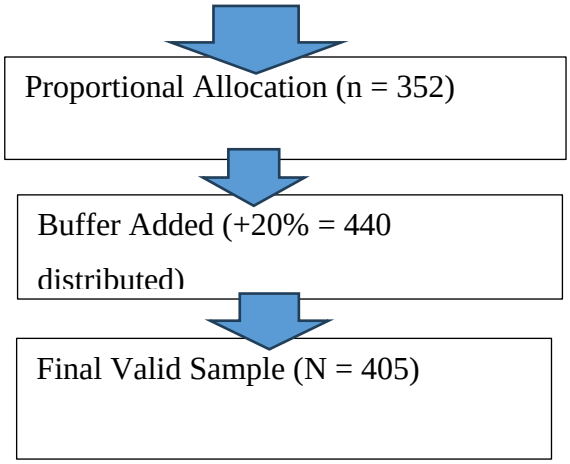


Figure 3. 2 Sampling flow diagram

3.4.2.3 Phase III: Purposive Selection for Experts Validation

The study selected 12 experts of the profession purposively from interviewees of phase I to mirror the proportional distribution of stakeholder categories in the Phase II survey (N = 405). The selection criteria were based on availability, experience (above 10years), manageability (8-15, ideal), and representation across the six stakeholder categories (Patton, 2015).

Table 3. 3 Composition of Phase III the expert panel validation was conducted via Google Meet and presented the draft MES developed from integrated Phase I and II findings to 12 experts for validation in a single round by Stakeholder Category.

Table 3. 3 Composition of Phase III the expert panel validation

Stakeholder Category	Number of Participants
Contractors	3
Consultants/Engineers/Architects	3
Suppliers	2
Government/Regulators	2
Academics	1
Other Value Chain Actors	1
Total	12

3.5 Data Collection Methods and Instruments

The study used multiple data collection methods to enable triangulation of findings and enhance credibility and validity of results.

3.5.1 Phase I: Qualitative Data Collection

Semi-Structured Interviews: The study selected this data collecting instrument for its flexible nature to explore emergent themes while maintaining focus on research objectives (Kvale & Brinkmann, 2015). The semi-structured interview guide consisted of 11 main questions with three to four follow up questions across four major variables of the study: supply-side fragmentation, demand-side resistance, institutional-policy gaps, and systemic interactions. For the purpose of pilot testing, five participants were selected to validate comprehension of key concepts and estimate administration time. No core concept misunderstanding was reported. Then, the Study distributed the final interview guide to 25 selected participants for the main data collection, and collected 23 successful completed interview data. The average time required to complete the interview ranged from 40 to 60 minutes (mean = 50 minutes), with scheduling determined by participant preference for date, time, and location.

Document Analysis: The study conducted document analysis which were assumed they are closely related with C&D concrete waste and regulatory issues: Ethiopian Building Code Standard EBCS-2 (1995), the Circular Economy Roadmap (2024), the Growth and Transformation Plan III, and Gebremariam et al. (2025). following Bowen's (2009) framework. The analysis identified articulated policies, institutional gaps, and contradictions between formal frameworks and reported practices.

Table 3. 4 Document Analysis of RCA Regulatory and Policy Environment

Document	Year	Type	Key Findings	RCA Provisions	Implication for MES
EBCS-2	1995	Mandatory Standard	Of the 175 pages of EBCS-2 no recycled aggregate standard provisions through 30 years	None identified	Regulatory void confirmed;
Circular Economy Roadmap	2024	National Policy	Circular economy mandated; construction waste prioritized	It was only aspirational only; no tools, specs, or enforcement	Documents support pilot projects and green procurement as potential implementation
Growth and Transformation Plan III	2024	National Development Plan	Infrastructure growth targets; aggregate demand rising	No explicit RCA mention	Growing demand confirmed; RCA as cost-stable alternative

Gebremariam et al. (2025)	2025	Academic Review	No RCA standards, specs, or guidelines; primary barrier identified	Explicitly discussed	Regulatory barrier confirmed; standards-first approach required

3.5.2 Phase II: Quantitative Data Collection

Survey Instrument Development. The development of survey instruments was founded on phase I as (QUAL-QUAN) research design the themes and constructs were identified in phase I qualitative analysis, ensuring content validity (DeVellis, 2017). The instrument comprised five sections.

Table 3. 5 Structure and Measurement of Survey Instrument

Section	Construct Measured	Items	Scale	Analytical Output
A	Demographic and Professional Profile	4	Categorical/Open-ended	Sample profiling; subgroup analysis
B	Supply-Side Fragmentation	6	5-point Likert (1=Strongly Disagree to 5=Strongly Agree)	Fragmentation Index (mean score)
C1	Demand -Side Resistance	5	Semantic Differential (1=Much Worse to 5=Much Better)	Mean perception score by stakeholder category
C2	Demand -Side Resistance	6	Rank Order (1=Biggest to 6=Smallest)	Frequency and mean rank hierarchy
D	Institutional and Policy Environment	5	5-point Likert (1=Very Ineffective to 5=Very Effective)	Policy Environment Index (mean score)
E	Market Entry Strategy Validation	1 closed + 1 open	0–10 Viability Scale + Open-ended	Mean viability rating; qualitative themes

3.5.2.1 Conjoint Experiment Design

To obtain empirical evidence on how the presence of standard certification and pricing influence acceptance of the RCA adoption and commercialization, a conjoint experiment was

embedded within Section E of the survey. Respondents were presented with four choice sets, each offering two alternatives: Virgin Aggregate and RCA. The RCA option varied on three attributes: price (90 % of virgin aggregate price vs. 100 % price parity), certification (Certified vs. Not Certified), and the presence of an additional incentive (Incentive vs. No Incentive). Table 3.8 summarizes the four choice sets. In each set, the respondent was asked to indicate their preferred material for a hypothetical nonstructural application.

Table 3. 6 Conjoint Choice Sets Presented to Respondents

Set	RCA Price	Certification	Incentive
CJ1	**90% Price**	**No**	No
CJ2	**100% Price**	**Yes**	No
CJ3	**90% Price**	**Yes**	No
CJ4	90% Price	Yes	Yes

The order of the sets was fixed for all respondents. This design allowed the separate effects of certification, price discount, and incentive to be observed through the pattern of choices across the four scenarios. The small number of profiles permitted a full-profile presentation without a fractional factorial design. This conjoint experiment provided the data for the choice-frequency analysis reported in Chapter 4

3.5.3 Validity and reliability

A three-stage validation process was conducted to ensure reliability, clarity, and content relevance before full deployment. Table 3.8 summarizes the validation procedures, thresholds, and results across all three stages.

Table 3. 7 Summary of Survey Pre-Testing and Validation Results

Stage	Validation Type	Method	Participants	Threshold	Result	Source
1	Content Validity	Expert rating (4-point scale)	5 subject matter experts /Professionals	I-CVI ≥ 0.78; S-CVI/Ave ≥ 0.80	I-CVI: 0.80–1.00; S-CVI/Ave: 0.92	Lynn (1986); Polit & Beck (2006)
2	Face Validity	Think-aloud protocol	10 target population members	Qualitative (comprehension)	Minor terminology adjustments made	Willis (2005)

3	Reliability	Pilot test (Cronbach's alpha)	N=30 respondents	$\alpha \geq .70$	Sup. Chain α = .77; RCA Attrib. α = .78; RCA Barr. α = .80	Nunnally & Bernstein (1994)

Table 3. 8 CVI Formulas

Index	Formula	Meaning	Reference
I-CVI	= Experts who rated 3 or 4 ÷ Total experts	Validity of one item	Lynn, M. R. (1986). Determination and quantification of content validity. Nursing Research, 35(6), 382–385.
S-CVI/Ave	= Sum of all I-CVIs ÷ Total number of items	Average validity of whole instrument	Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. Research in Nursing & Health, 29(5), 489–497.
S-CVI/UA	= Items where ALL experts rated 3 or 4 ÷ Total items	Proportion with perfect agreement	Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. Research in Nursing & Health, 29(5), 489–497.

Survey Administration. The study distributed the final survey guide to 440 professionals via in-person distribution and snowball sampling at construction sites, government offices, universities, professional project meetings, office representatives, Telegram channels, emails, and in hard copies. A follow-up reminder was sent after two weeks.

Table 3. 9 Survey Distribution and Response Rate

Category	Count	Percentage
Questionnaires distributed	440	100.0%
Questionnaires returned	407	92.5%
Incomplete responses removed	2	0.5%
Valid responses retained for analysis	405	92.0%

3.5.4 Phase III. Expert Panel Validation

The expert panel validation was conducted via Google Meet and presented the draft MES developed from integrated Phase I and II findings to 12 experts for validation in a single round. The participants were engaged in google meeting and finally a completed structured feedback forms with quantitative ratings (comprehensiveness, clarity, Practical Applicability, Long-

Term Viability on 0-10-point scales) and open-ended questions were collected. A comparative evaluation was conducted where participants rated the integrated MES against three single-barrier alternatives (supply-only, demand-only, policy-only), enabling statistical testing of H_4. Workshop data were analyzed thematically and quantitatively to produce the final validated MES.

3.6 Methods of Data Analysis

3.6.1 Qualitative Data Analysis

The study applied Braun and Clarke's (2006, 2021) six-phase thematic analysis framework using NVivo 15. Phase I was the familiarization of the data collected and the study repeatedly read all the 23 transcripts with analytic memos. In phase II the study generated 69 inductive codes, complemented by abductive coding from the analysis of three policy and regulatory documents, across three categories. Phase III of the data analysis process was grouping related codes into four master themes: fragmented supply chains in chaos, the trust deficit, the policy vacuum, and the chicken-and-egg triad based on patented meaning and frequency. In phase four the study reviewed the themes generated to ensure internal homogeneity and external heterogeneity. Moreover, the study defined and named each theme to help capture the precise meaning and scope. And finally, the study produced the final narrative integrating verbatim quotes in the final two phases.

Table 3. 10 Summary of Coding Framework

Category	Codes (n)	Example Codes
Supply-Side Fragmentation	14	S-01 Informal disposal; S-03 No on-site sorting; S-06 Fragmented actor network
Demand-Side Resistance	17	D-01 Standard absence; D-02 Performance risk; D-08 Demonstration projects needed
Institutional-Policy Gaps	11	I-01 Building code silent; I-06 Standards needed; I-03 Weak enforcement
Market Entry Strategy	15	M-03 Non-structural first; M-04 Partner demolition
Systemic Interaction	4	SYI-01 Chicken-and-egg cycle

Note. The complete codebook containing all 69 codes with definitions is provided in appendix part of the study.

3.6.2 Inter-Coder Reliability. To increase trustworthiness of the thematic analysis, a second researcher independently coded 20% of the transcripts (4 of 23). Cohen's kappa the result obtained from calculation of Cohen’s kappa, K= .856, exceeding the substantial agreement

threshold of .70 (Landis & Koch, 1977). Differences were resolved through mutual discourse and consensus.

3.6.3. Quantitative Data Analysis

The quantitative data were analyzed through a structured four-stage process using SPSS Version 26. Stage 1 comprised data screening for accuracy, missing values, normality (skewness and kurtosis, thresholds |Skewness| < 2.0, |Kurtosis| < 7.0; Kim, 2013), non-response bias via early/late respondent comparisons, and common method bias via Harman's single-factor test (threshold < 50% variance). Stage 2 assessed reliability of multi-item Likert scales using Cronbach's alpha (threshold $\alpha \geq .70$; Cronbach, 1951; Nunnally & Bernstein, 1994) for the four composite variables: Supply Side Frag, Demand Side Resist, Institutional gap, and MES_ Viability. Stage 3 computed descriptive statistics—means and standard deviations—for the four composites (each formed by averaging constituent items from the survey as specified in Section 3.7.1), along with frequencies and percentages for categorical demographics, rank-order frequencies from the barrier ranking item were tabulated and mean ranks computed. The study applied two methods to analyze the demand-side barrier hierarchy: the Analytic Hierarchy Process (AHP) with eigenvalue method and Friedman's two-way ANOVA by ranks. The Consistency Ratio (CR < 0.10) confirmed judgment reliability.
Additionally, conjoint analysis was applied to measure how certification and pricing influence acceptance.

Stage 4 tested hypotheses H_1–H_3 using multiple linear regression (with diagnostic checks for linearity, multicollinearity, independence, homoscedasticity, and residual normality) following the model MES_ Viability = $\beta_0 + \beta_1$(Supply-Side Fragmentation) + β_2(Demand Side Resist) + β_3(Institutional policy gaps) + ε, and tested H_4 using repeated-measures ANOVA supplemented by a Friedman test for the Delphi panel (N = 12). The full results of all screening, reliability, descriptive, and inferential analyses are reported in Chapter Four.

Table 3. 11 Hypothesis Testing Procedures

Hypothesis	Testing Procedure	Key Statistic / Criterion
H_1: Supply-Side Fragmentation → (−) MES viability	Multiple linear regression (OLS); one-tailed test	$\beta_1 < 0$, $p < .05$, all diagnostics met
H_2: Demand-side resistance → (−) MES viability; performance risk is strongest predictor	Multiple linear regression; additionally, relative importance analysis (dominance weights) to identify strongest predictor	$\beta_2 < 0$, $p < .05$; performance risk domain has largest absolute standardized coefficient or dominance weight

H_3: Institutional-policy gaps significantly predict lower perceived viability of an integrated Market Entry Strategy → (−) MES viability	Same multiple regression (institutional-policy gaps composite includes standards-absence severity items); one-tailed test	$\beta_3 < 0$, $p < .05$
H_4: Integrated MES viability > all single-barrier strategies	Repeated-measures ANOVA with Bonferroni post-hoc; confirmed by Friedman test (non-parametric)	Significant main effect ($p < .05$); integrated mean > supply-only, demand-only, policy-only means
H_5: Three-way interaction predicts MES viability; integrated strategy rated most viable when all three barriers are simultaneously high	Hierarchical multiple regression (moderation model); three-way interaction term at Step 3	Significant ΔR^2 at Step 3; positive β for the three-way term, $p < .05$

Note. H_1–H_3 and H_5 are tested using survey data (N = 405). H_4 uses Delphi workshop data (N = 12) with strategies rated on a 0–10 viability scale. Source: Author's construct.

3.6.4 Supplementary three-way interaction analysis (H_5).

Consistent with the conceptual framework's emphasis on systemic interdependence (Section 2.4.1) and the general objective's directive to diagnose the *systemic interaction,* a supplementary hierarchical regression was planned. This analysis tests whether the simultaneous presence of all three barriers, rather than any single barrier in isolation; predicts the perceived viability of an integrated Market Entry Strategy. The regression model extends the main-effects specification by including product terms. The full estimated equation is:

Integrated MES Viability $= \beta_0 + \beta_1(SSF) + \beta_2(DSR) + \beta_3(IPG) + \beta_4(SSF\times DSR) + \beta_5(SSF\times IPG) + \beta_6(DSR\times IPG) + \beta_7(SSF\times DSR\times IPG) + \varepsilon$

where SSF = Supply-Side Fragmentation, DSR = Demand-Side Resistance, IPG = Institutional-Policy Gaps, and all predictors are mean-centered. H_5 is tested by the significance and positive sign of β_7. A significant positive three-way interaction would indicate that the integrated strategy's viability rating is highest when stakeholders perceive all three barriers as simultaneously elevated, providing quantitative triangulation for the qualitative Theme 4 findings.

3.6.5 Expert Panel Validation

An experts panel of 12 experts, consisting of different professional such as contractors, engineers, architects, designers validated the draft MES. The experts participating in the experts panel rated four strategy options on a 0–10 viability scale (0 = Not at all Viable, 10 = Extremely Viable) across three criteria: comprehensiveness, feasibility, and long-term viability. The procedure followed a structured single-round expert panel validation format.

Participants completed structured feedback forms with quantitative ratings and open-ended questions during the online session. No iterative rounds were conducted. Full panel composition and round scores are provided in Appendix part

Table 3. 12 Methodology Planning and Analysis Matrix

Research Element	Data Source	Collection Method	Analysis Technique	Strategic Output Format
RO1/RQ1/H1	Waste generators, collectors, processors	Semi-structured interview, Cost documentation	Thematic analysis, Value chain mapping; Quantitative: Multiple linear regression	Value chain maps, Fragmentation indices
RO2/RQ2/H2	Contractors, Professionals, consultants	Structured survey (Likert scale),	Friedman test; Multiple regression with dominance weights	Ranked barrier profiles, Friedman test results, relative importance weights
RO3/RQ3/H3	Regulators, policy makers, Association representatives	Document analysis, Key informant interviews	Content analysis, Thematic coding, Gap severity scoring; Quantitative: Multiple linear regression	Policy gap matrix, Advocacy priority list, Institutional map
RO4/RQ4/H4	Mixed stakeholder panel	Delphi method, Validation workshop, Scenario assessment	Repeated-Measures ANOVA, Non-parametric tests, Thematic synthesis	Validated MES framework, Implementation roadmap, Feasibility scores

Note. H_1–H_3 use survey data (N = 405). H_4 uses expert panel validation data (N = 12) with strategies rated on a 0–10 viability scale. Source: Author's construct.

3.7 Validity, Reliability, and Trustworthiness

3.7.1 Quantitative Validity and Reliability

The research established a multi-stage process to ensure survey validity and reliability. The expert review yielding I-CVI ≥ .78 and S-CVI/Ave = .92 to confirm content validity.

Cognitive pretesting further refined item clarity. The internal consistency and reliability was ensured through conducting tests and were all confirmed with Cronbach's alpha coefficients exceeding $\alpha \geq .70$ for all multi-item scales.

3.7.2 Trustworthiness

Qualitative trustworthiness of the study was ensured through applying the four criteria of Lincoln and Guba's (1985). It ensured its credibility through triangulation of(interviews, documents, expert panel validation), member checking, peer debriefing, and prolonged engagement.

Transferability was supported by thick description of the study context. Dependability was demonstrated through inter-coder reliability ($\kappa = .850$), an audit trail, and systematic NVivo 15 data management. Confirmability was established via the audit trail and acknowledgment of researcher positionality.

Table 3. 13 Alignment of Validation Phases with Validity Types and Research Objectives

Phase	Designation	Validity Type	Research Objective	Key Validation Activities
I	QUAL	Content Validity	RO1, RO2, RO3	Qualitative methods ensured MES reflected stakeholder experiences and barriers.
II	QUAN	Construct & Internal Validity	RO1, RO2, RO3, RO4	Survey confirmed reliability ($\alpha \geq$ .764–.980), validity (convergent/discriminant), and predictive barrier relationships (H_1–H_4).
III	QUAL (Validation)	Consequential Validity	RO4	Delphi workshop (n=12) assessed comprehensiveness, feasibility, and actionability; refined final MES

Note. Adapted from Messick (1995), Cook and Beckman (2006), and Creswell and Plano Clark (2018).

3.8 Ethical Considerations

The study adhered to Addis Ababa University guidelines and international research ethics principles.

Institutional Approval: Prior to any data collection, formal ethical clearance and permission to conduct the study were obtained from the College of Business and Economics.

Informed Consent. The study offered a detailed information sheet that describes the study's purpose, procedures, and their rights, along with a consent form. Before the data collection the study obtained a written consent form all from participants for Phase I and III. For Phase II,

survey consent was implied by voluntary submission of the completed questionnaire, as approved by the ethics committee.

Confidentiality and Anonymity: All data collected were anonymized using the codes given to participants. Survey data collected IP tracking instrument like google forms were collected without IP tracking.

Ethical Values: The study adhered to beneficence in maximizing the benefits of participants and minimizing harm reciprocity in sharing all the findings with the stakeholders, and, and integrity in reporting of all findings including the limitations

CHAPTER FOUR

4. DATA ANALYSIS, RESULTS, DISCUSSION, AND INTERPRETATION

4.1 Introduction

This chapter presents the systematic analysis and interpretation of data collected per research methodology. It is organized around the research objectives and hypotheses delineated in Chapter One. The response rate and demographic profiles of all the 23 participants of qualitative data collection are reported, followed by the qualitative findings organized thematically using Braun and Clarke's (2006) six-phase framework. In a similar way, the demographics and response rates of quantitative respondents (N = 405) are presented. Consequently, tests of validity and reliability conducted to ensure consistency check, confirm measurement precision, credibility and descriptive statistics for key constructs are presented. Diagnostic tests for regression assumptions and the hypothesis testing results (H_1–H_4) are then detailed. The chapter finally concludes with results obtained from the Delphi validation reports and an integrated test related to reliability and validity such as discussion addressing the research questions, explicitly linking findings to the theoretical frameworks and empirical literature reviewed in Chapter Two.

4.2 Qualitative Findings

4.2.1 Demographic Profile of Qualitative Participants

To comprehend the RCA value-chain in Addis Ababa, the study grouped the 23 key respondents into six categories.

Table 4. 1 Demographic Profile of Qualitative Interview Participants (N = 23)

Code	Category	Role	Experience	Organization Type
C01	Contractor	Large Commercial Contractor	>15 years	Large Firm
C02	Contractor	Medium Residential Contractor	6–10 years	Medium Firm
C03	Contractor	Demolition Contractor	11–15 years	Small Firm
C04	Contractor	Small Contractor	2–5 years	Small Firm

P05/E1	Consultant/Engineer	Structural Design Engineer	>15 years	Private Consultancy
P06/E4	Consultant/Engineer	Project Manager	11–15 years	Consulting Firm
P07/E2	Consultant/Architect	Lead Architect	11–15 years	Architectural Firm
P08	Consultant/Engineer	Site Supervisor/Clerk of Works	6–10 years	Construction Site
E3	Consultant/Engineer	Geotechnical Engineer	>15 years	Consulting Firm
P12/G3	Government/Regulator	Permit Official	6–10 years	City Administration
P13/G1	Government/Regulator	Standards Agency Expert	11–15 years	Ethiopian Standards Agency
G2	Government/Regulator	Sanitation Inspector	6–10 years	City Administration
P09/S1	Supplier	Quarry Owner/Virgin Aggregate Supplier	>15 years	Large Quarry
P10/S3	Supplier	Ready-Mix Concrete Plant Manager	11–15 years	Ready-Mix Plant
P11/S2	Supplier	Hardware Store Owner	6–10 years	Small Retail
A1	Academic	Materials Science Professor	>15 years	University (AAU)
A2	Academic	Circular Economy Researcher	11–15 years	Ei ABC
P20	Other	Demolition Contractor	11–15 years	Demolition Firm
P21	Other	Waste Transporter/Truck Owner	6–10 years	Self-Employed
O1	Other	Site Supervisor	6–10 years	Large Construction Firm

Source: Interview Data (2026).

Table 4. 2 Distribution of Interview Participants by Stakeholder Category (N=23)

Category	N	%
Contractors	4	17.4
Consultants/Engineers/Architects	5	21.7
Government/Regulators	3	13.0
Suppliers	3	13.0
Academics	2	8.7
Other Stakeholders	3	13.0
Total	23	100

Source: Semi-structured interviews conducted with construction sector stakeholders in Addis Ababa, 2025

4.2.2 Thematic Analysis Overview

The study followed the Braun and Clarke's (2006, 2021) six-phase thematic analysis framework, the qualitative data obtained from 23 semi-structured interviews, document analysis, and expert panel validation were systematically analyzed, yielding 69 codes organized into six categories, generating approximately 1,069 coded references.

Table 4. 3 Summary of Thematic Codes by Category

Category	Codes	References	% of Total	Most Frequent Code
A: Supply-Side Fragmentation	14	250	23.4	S-01: Informal disposal dominant (39)
B: Demand-Side Resistance	17	240	22.5	D-08: Demonstration projects needed (44)
C: Institutional-Policy Gaps	11	290	27.1	I-06: Standards development needed (74)
D: Market Entry Strategy	15	200	18.7	M-02: Quality consistency paramount (49)
E: Systemic Interactions	4	13	1.2	SYI-01: Chicken-and-egg cycle (11)
F: Stakeholder-Specific	8	76	7.1	ST-08: Site supervisors need workability (20)
Total	69	1,069	100.0	

Source: NVivo 15 Thematic Analysis (2026).

Inter-Coder Reliability

The study selected a second professional on the subject matter and made to code 20% of the transcripts (4 of 23 interviews). Consequently, Cohen's kappa was calculated as K= (Po - Pe) / (1 - Pe), where Po is observed agreement and Pe is expected agreement by chance. The resulting coefficient calculated for, Cohen's kappa was, K=.850, demonstrating almost perfect agreement (Landis & Koch, 1977) and exceeding the acceptable threshold of .70 for rigorous qualitative research.

4.2.3 Theme 1: Fragmented Supply Chains in Chaos

Theme Definition: The concrete waste produced in Addis Ababa passes through informal, fragmented, and undocumented channels. Approximately ,70–80% of C&D waste is handled

outside formal systems, lacks on-site sorting, inefficient transportation, no traceability, and widespread illegal dumping.

Theme Coverage: 250 references across 14 codes (23.4% of total coded data).

Key Findings: Three dominant patterns characterized the supply-side data:

Table 4. 4 Dominant Patterns in Supply-Side Fragmentation

Pattern	Sub-Theme Code	Coding References	Key Finding
Informal disposal dominates CDW management	S-01	39	Approximately70–80% of construction and demolition waste flows outside formal systems
On-site sorting is virtually absent	S-03	36	For high-quality recycling mixed waste is un standard
Actor networks are fragmented with no coordination	S-06	37	A parallel informal economy operates without traceability or coordination mechanisms

Source: Thematic analysis of 23 semi-structured interviews (NVivo 15)

Illustrative Evidence:

P21 (Waste Transporter/Truck Owner) described the informal system:

"I am working it. I receive the call from contractors, bring my truck, the contractors load all the site waste on the truck: concrete, mud, wood, plastic. I take e it out of the city and dump it in a valley or an old quarry. It is my job for my bread. Depending on the waste quality, I sometimes pay for the contractor like to purchase the waste if I am ordered by other contractors or any individual who need the waste for some work. or the contractor pays me per trip. I am the one who dumps it. I know all the spots. I have been doing this for years."

P10/S3 (Ready-Mix Concrete Plant Manager) identified a strategic exception:

"At my ready-mix concrete plant, the concrete waste is generated from truck mixers returning with leftover concrete and from the process of cleaning out the mixer drums. We have a designated area where we dump this. It hardens, and periodically we have to break it up and haul it away. It is a cost center for us. We pay for the breaking, the loading, and the transport. We get nothing back."

Interpretation:

The concrete waste in Addis Ababa has no a formal municipal system, rather it follows a parallel informal economy where waste where waste holds recognized commodity value (S-02: 8 refs), which contradicts the future circular economic system where discarded materials

are no longer seen as useless wastes. However, the concrete waste still circulates fully in blinded regulatory spots: no receipts, no permits, no quality records. The material is economically valuable but institutionally invisible.

The cost of transportation is the major factor that could govern the concrete waste disposal decision (S-04: 32 refs) as the concrete by nature is heavy and bulky the cost of transporting often exceeds its material value. This cost pressure would be offset by establishing a formal, and regulated system. On the contrary, since there is no room for counteracting this pressure in the informal system the consequence is predictable: actors minimize transport distance by any means available, making illegal dumping the cheapest and therefore default option (S-10: 29 refs).

This dynamic confirms Porter's (1985) prediction of value chain fragmentation; where a structure of an industry is marked by many small actors, localized in their transactions, with no single company is powerful enough to coordinate the whole. However, the case extends Porter's framework in one crucial respect. The Fragmentation in Addis Ababa cannot be considered as the one which is awaiting a transitional condition for consolidation. It is a stable equilibrium. The system persists the consolidation as it is functional for those within this informal system: Which makes the informal aggregators earn livelihoods, contractors avoid disposal fees that could be created within the formal system, and buyers access cheap material. Features that hinder RCA market formation are: absence of standards, traceability, and centralized processing, what the system work for its participants. However, there are some strategic exceptions in the sector that can be revealed in ready-mix concrete plants and professional demolition contractors that operate in different way from the fragmented majority. They are able to produce clean concrete waste by sorting on-site thereby producing homogenous concrete waste, which a single source concrete waste predictable volumes and locations within formal and regulated system. Although these factors are very few numerically, they are disproportionately important, representing the nodes where formalization could begin without fighting the entire informal system. It is critically important to notice the implications of the Micro and Small Enterprise (MSE)models to flow directly. Establishing approaches like a partnership -based actors for consistent feedstock suppliers can be structurally feasible than a vertically integrated venture attempting to displace existing informal networks. These actors can be the bridge for establishing formal and regulated system and the transition has to be without displacing the existing informal system as displacement would mean competing against a zero-overhead, regulation-free economy which is an unwinnable contest. Integration, by contrast, leverages the system's existing logic while resolving its quality and reliability

constraints. The choice is not between formality and informality in the abstract, but between smart coupling and futile confrontation.

4.2.4 Theme 2: The Trust Deficit – Rational Resistance:

Theme Definition: Demand resistance to RCA is a rational professional response to the absence of technical standards and demonstrated performance. The stakeholders of the construction industry enquire the existence of demonstration projects, third party certification for the quality of RCA, and formal standards before acceptance. Performance risk, professional liability, and client perception concerns drive legitimate hesitation.

Theme Coverage: 240 references across 17 codes (22.5% of total coded data).

Key Findings:

Table 4. 5 Dominant Patterns in Demand-Side Barriers

Pattern	Sub-Theme Code	Coding References	Key Finding
Demonstration projects are needed to build market confidence	D-08	44	The single highest demand-side code; stakeholders will not commit without visible proof of successful local application
Absence of standards blocks material specification	D-01	41	Without codified RCA standards, engineers and architects cannot legally or professionally specify the material in designs
Performance risk dominates technical concerns	D-02	31	Strength and durability uncertainty is the primary technical barrier preventing acceptance by structural designers and clients

Illustrative Evidence:

P05/E1 (Structural Design Engineer) articulated the professional liability concern:

“As a structural engineer, my primary duty is safety. My top concern is how would be managed the problem with the bond to be created with the old cement and the new one. I think there will be a variability in the interfacial transition zone which can affect the durability and strength of the structure in the long run. In addition, I would need to be sure about its performance under the effect of seismic load as it is our great concern due to our location within the critical seismic zone and it is the critical issue in Addis Ababa too. Without a standard, I cannot specify it. Period. The first question any engineer will ask is, 'Does it meet the standard?' If the answer is no, the conversation ends there.”

P06/E4 (Project Manager) identified practical risk considerations:

"My concern as a project manager is project risk. If clients and consultants see a new construction material which is not common being used on site, they may raise issues related to that material quality, causing project delays. If the material fails, the project will be delayed and over budgeted

The risk-reward ratio seems unfavorable right now. I need to know that the material will perform exactly as expected, and should be available consistently throughout the project, with no further material quality testing."

Interpretation

The absence of standard specification, demonstrating projects, and local performance data form a self-reinforcing lock that justifies professional resistance and demands a 20–30% price discount as a risk premium. Actually, it is possible to create entry point to generate local evidence through applying the RCA for non-structural and geotechnical applications which may face lower liability barriers. This leads to a phased approach to start the adoption of RCA for low-risk applications to build data and confidence. The ready-mix concrete producer ready-mix producers can resolve the problems of water-absorption and mix-design issues (D-14). Consequently, the MES must prioritize third-party certification and demonstration projects for product qualification, and performance-data-driven, phased-adoption messaging to overcome the trust deficit.

4.2.5 Theme 3: The Policy Vacuum – Aspiration Without Implementation

Theme Definition: There exists a fundamental contradiction between the high-level aspiration of the circular-economy (Roadmap 2024) the reality observed in regulatory with EBCS-2 (1995) contains no provisions for recycled materials and has been unchanged for 30 years, no provisions for recycled materials. No RCA standard exists. No economic incentives encourage recycling.

Theme Coverage: 290 references across 11 codes (27.1% of total coded data) the dominant theme.

Key Findings:

Table 4. 6 Dominant Patterns in Institutional and Regulatory Barriers

Pattern	Sub-Theme Code	Coding References	Key Finding
Standards development for RCA is urgently needed	I-06	74	The single highest code in the entire dataset; stakeholders across all groups

			identify standards as the foundational prerequisite
Building code is silent on recycled materials	I-01	59	EBCS-2 (1995) contains no provisions for recycled aggregates, rendering RCA legally invisible in structural design
Enforcement of existing regulations is weak	I-03	57	Even where regulations exist on paper, institutional capacity and political will to enforce them are absent

Illustrative Evidence:

P13/G1 (Standards Agency Expert) explained the standards development process:

"We have not yet developed a standard for recycled aggregates because there has been no formal request or industry pressure to do so. The usual pattern to develop a standard is responding to requests from industry, government, and academia. So far no one has formally requested us to develop a standard for RCA. In my opinion, this is the reason for the standard for RCA undeveloped. In addition, since we have very limited staff and many other competing priorities, we always focus to issues only on the front window."

P05/E1 (Structural Design Engineer) confirmed the regulatory barrier:

"The Ethiopian Building Code Standard is based on international codes that assume virgin materials. So far it does not address the standard for the recycled aggregates. This creates a legal vacuum. If I specify RCA and something goes wrong, I have no code to justify my design, leaving me liable. There is also no policy that incentivizes recycling or penalizes illegal dumping effectively."

Document Analysis Evidence:

Table 4. 7 Document Analysis Summary

Document	Year	Key Finding	RCA Provisions
EBCS-2: Structural Use of Concrete	1995	175 pages; governs all concrete construction in Ethiopia; silenced for 30 years	None
Circular Economy Roadmap	2024	Declares circular economy "mandatory for Ethiopia"; identifies construction as priority sector	It is aspirational only; no implementation tools
Gebremariam et al. (2025)	2025	Academic review confirms "lack of well-established standards and guidelines" for RCA in Ethiopia	Confirms standards gap

Note. Source: Document Analysis (2026).

Interpretation:

Circular economy pledges remain absent from binding rules. Despite the trial in political commitment, the core concrete code (EBCS_2) remained silent for the past thirty years with no pathway for recycled materials. The institutional gap is created due to three interlocking and interdependent deadlocks: the lack of execution mechanisms in circular economy, absence of coordinated official process to draft standards, and the absolute silence of the concrete code on RCA. Policy gaps are the root driver of supply fragmentation and demand resistance. Standards development (I-06, 74 references) is the cross-cutting, most urgent need. Therefore, the cornerstone intervention is establishing a dedicated technical committee with a binding timeline and resources to revise EBCS-2; without that foundation, all other efforts remain secondary.

4.2.6 Theme 4: The Chicken-and-Egg Triad

Supply fragmentation, demand resistance, and institutional gaps form a mutually reinforcing systemic barrier which has an effect greater than the sum of its component parts. The gap that is created by any one of the single barriers reinforces others which demonstrates making a single intervention cannot disrupt (13 references across 4 codes; triangulated by experts panel validation and code co-occurrence analysis).

Illustrative Evidence:

P16/A1 (Academic, Civil Engineering instructor) articulated the systemic dynamic:

"In my opinion the systemic dynamic is a timeless paradox chaining the next. Systemic nodes closing the cycle loop. Without code recognition, no demand. Without demand, no supply chain. Without supply chain, no demonstration. Without demonstration, no code revision. It is a classic chicken-and-egg problem. You cannot solve one part without addressing the others simultaneously."

Code Co-occurrence Evidence:

Table 4. 8 Code Co-occurrence Analysis

Code Pair	Co-occurrence Frequency	Interpretation
D-01 (Absence of standards for) + I-01 (Code silent)	34	Absence of standards directly linked to building code silence
S-01 (Informal disposal) + D-02 (Performance risk)	28	Informal supply chain linked to quality concerns
SYI-01 (Chicken-and-egg) + M-01 (Integrated approach)	22	Recognition of systemic problem linked to solution preference

D-05 (Professional liability) + I-06 (Standards needed)	19	Liability concerns drive demand for standards

Note. Source: NVivo 15 Code Co-occurrence Matrix (2026).

The chicken-and-egg dynamic, though low in frequency, is analytically central (Braun & Clarke, 2006), that was evidenced by implicit code overlaps demonstrating the mutual re-enforcement of the three interlocking systemic barriers. The quantitative expert's validation ensures that an integrated MES addressed all the three systemic barriers simultaneously is significantly superior ($p < .001$). This reveals triangulation of the qualitative co-occurrence and expert rankings establishes the systemic interaction as an empirically validated finding. Therefore, the only solution that can break the self-reinforcing loop and unlock a circular economy transition is making an integrated intervention tackling supply fragmentation, demand resistance, and institutional voids together.

4.2.7 Negative Case Analysis

In this study one participant in his /her view contradicted the dominant pattern throughout the dataset. Hence, the study Followed the principle of negative case analysis in qualitative research (Braun & Clarke, 2006

The Negative Case: P09/S1 (Quarry Owner/Virgin Aggregate Supplier)

While all other stakeholder groups identified barriers to RCA adoption from a user perspective, P09/S1 framed RCA as a competitive threat:

"I see the adoption of RCA as a potential competitor. If the price of RCA I is cheap and good in quality, it could take market share from my product. My concern is there would be an unfair market competition. I have different payments to run my bussiness: Paying for blasting permits, heavy machinery, land. I also for different taxes to the government for the rock I extract. There are no such visible, legal, and formal levies on waste, which is currently almost a free resource for anyone who wants to collect it. That is an uneven playground. If RCA gets certified to the same standard as my product, that will be a critical problem for me. It legitimizes the competition. Right now, RCA is not certified. That is a barrier for them. I want that barrier to remain."

Table 4. 9 Negative Case Comparison

Dimension	Dominant Pattern (Other Stakeholders)	P09/S1 Negative Case
Framing of RCA	Solution to waste problem; sustainable alternative	Competitive threat to existing business
Standards absence	Barrier that prevents use	Protective barrier that should remain
Policy preference	Standards development needed	Lobby for strict/expensive standards
Motivation	Professional responsibility; project success	Market share protection; business survival

Source: Interview Data (2026).

The negative case anlysis reveals what the dominant patter of barriers misses: the negative case reveals something the dominant pattern misses: incumbent suppliers of the virgin aggregate have a stake in the status quo. In this study it is revealed that most stakeholders frame the absence of standards as a top barrier to overcome, on the contrary virgin aggregate suppliers may see it as a protective shield and may actively resist RCA legitimization and further adoption. This means the systemic barrier triad has a fourth, hidden dimension. Barriers such as the supply fragmentation, demand resistance, and policy gaps, but there exists also incumbent resistance to change. The strategic implication may lead the micro and small enterprise model has to anticipate resistance from the incumbent virgin aggregate suppliers and convert these potential competitors into partners. Significantly, P09/S1 opened that door: “Perhaps we could collaborate with a recycler to process that waste into new products. Or we could invest in recycling ourselves.”

4.2.8 Summary of Qualitative Findings:

The six-phase thematic analysis revealed that RCA commercialization in Addis Ababa is constrained by a systemic triad of barriers. Table 4.9 presents the theme hierarchy.

Table 4. 10 Qualitative Theme Hierarchy Summary

Rank	Theme	References	% of Total
1	Policy Vacuum (Theme 3)	290	27.1
2	Supply Fragmentation (Theme 1)	250	23.4
3	Demand Resistance (Theme 2)	240	22.5
4	Systemic Triad (Theme 4)	13 + triangulation	1.2 + Expert panel

Source: NVivo 15 Thematic Analysis (2026).

The qualitative findings of the study a hierarchy: providing the absence of standards expected from the regulatory (policy gap) is the top barrier rooted in the silence of the building code on recycled materials. Supply fragmentation is the current situation seen on ground, and demand resistance emerges as a rational consequence raised by most professionals. These three barriers mutually reinforce each other, creating a self-perpetuating equilibrium that single interventions cannot disrupt.

4.3 Quantitative Results

4.3.1 Comprehensive Data Screening and Reliability Results

Introduction

Prior to the main analysis, the full sample of 405 valid cases was screened for data entry accuracy, missing data, internal consistency reliability, univariate and multivariate outliers, common method bias, and non-response bias. Standard diagnostic thresholds were applied, and no case weighting was used during screening. A comprehensive summary of all screening outcomes, including the numerical values obtained at each step, is presented in Table 4.11

Table 4. 11 Summary of comprehensive Data Screening and Reliability Results (N = 405)

Screening Check	Variable / Detail	Statistic	Value	Threshold / Criterion	Reference for Decision	Decision
Data Entry Range	Inst-Policy Gaps Index	Observed min–max	1.00 – 3.80	Must lie within scale bounds (1–5)	Field (2018)	Accept
	Demand-Side Resistance	Observed min–max	2.60 – 4.40	Must lie within scale bounds (1–5)	Field (2018)	Accept
	Supply-Side Frag. Index	Observed min–max	1.67 – 4.83	Must lie within scale bounds (1–5)	Field (2018)	Accept
	Integrated MES Viability	Observed min–max	4 – 10	Must lie within scale bounds (0–10)	Field (2018)	Accept

Missing Data	All 16 scale items & 4 composites	% missing	0.0%	< 5% per variable	Tabachnick & Fidell (2019)	Complete dataset; no imputation needed
Internal Consistency	Inst-Policy Gaps (5 items)	Cronbach's α	.963	α ≥ .70 acceptable; ≥ .80 good	Nunnally (1978)	Excellent
	Demand-Side Resistance (5 items)	Cronbach's α	.952	α ≥ .70 acceptable; ≥ .80 good	Nunnally (1978)	Excellent
	Supply-Side Frag. (6 items)	Cronbach's α	.764	α ≥ .70 acceptable; ≥ .80 good	Nunnally (1978)	Acceptable
Univariate Outliers	Inst-Policy Gaps	Min Z / Max Z	–1.59 / 1.88	$\|Z\| \leq 3.29$	Field (2018)	No outlier
	Demand-Side Resistance	Min Z / Max Z	–2.45 / 1.23	$\|Z\| \leq 3.29$	Field (2018)	No outlier
	Supply-Side Frag.	Min Z / Max Z	–2.97 / 2.34	$\|Z\| \leq 3.29$	Field (2018)	No outlier
	Integrated MES Viability	Min Z / Max Z	–1.43 / 1.86	$\|Z\| \leq 3.29$	Field (2018)	No outlier
Multivariate Outliers	Four composites (df = 4)	Max Mahalanobis D^2	18.28	$\chi^2(4) = 18.467$ at α = .001	Tabachnick & Fidell (2019)	No outlier; all 405 cases retained
Common Method Bias	All 16 scale items (PCA, unrotated)	Variance of 1st factor	43.78%	< 50%	Podsakoff et al. (2003)	No serious CMB
Non-Response Bias	Inst-Policy Gaps (early n=207, late n=198)	t(403) / p / Mean diff	–2.49 / .013 / –0.20	p > .05 for outcome; barrier differences noted	Armstrong & Overton (1977)	Significant but small difference; acknowledged
	Demand-Side Resistance	t(310.40) / p / Mean diff	–8.36 / <.001 / –0.37		Armstrong & Overton (1977)	Significant; acknowledged as limitation
	Supply-Side Frag.	t(374.45) / p / Mean diff	–7.57 / <.001 / –0.42		Armstrong & Overton (1977)	Significant; acknowledged as limitation
	Integrated MES Viability	t(403) / p / Mean diff	0.31 / .754 / 0.06		Armstrong & Overton (1977)	Not significant; dependent variable robust

Interpretation

Technically the sample is grounded with over 2/3rd of the participants are professionals and contractors who can endorse, Specify and procure materials, and more than 74% having a work experience of >5 years. Data quality is high: 0% missing data, all composite scales met the α ≥

.70 reliability threshold, and all 405 cases were retained, confirming the data are suitable for parametric analysis.

4.3.2 Descriptive Profile of Respondents

The survey component achieved 405 valid responses from construction industry stakeholders in Addis Ababa. Table 4.12 presents the demographic and professional characteristics of the sample, drawn from Section A of the survey instrument.

Table 4. 12 Demographic Profile of Survey Respondents (N = 405)

Characteristic	Category	Frequency	**Percent**
Primary Role	Associate Engineer	30	**7.4**
Building Contractor	63	15.6	
Consultant	30	7.4	
Contractor (unspecified)	1	0.2	
General Contractor	94	23.2	
Practicing Engineer	89	22.0	
Professional Engineer	95	23.5	
Road Contractor	3	0.7	
Years of Experience	Less than 2 years	30	**7.4**
2–5 years	104	25.7	
6–10 years	147	36.3	
11–15 years	65	16.0	
More than 15 years	59	14.6	
Organization Size	Micro (1–5 employees)	30	**7.4**
Small (6–20 employees)	120	29.6	
Medium (21–50 employees)	131	32.3	
Large (51+ employees)	124	30.6	
Primary Sub-City of Work	Arada	51	**12.6**
Bole	61	15.1	
Gulele	55	13.6	
Kolfe	60	14.8	
Lideta	62	15.3	
Nifas Silk	61	15.1	
Yeka	55	13.6	

Interpretation

The sample carries sufficient technical depth and organizational insight to yield informed responses on material specification and regulatory issues. Professional Engineers, General Contractors, and Practicing Engineers together make up more than two-thirds of participants, anchoring the data firmly among those who specify and procure construction materials. A clear majority—74 percent—bring over five years of experience, while firms of small, medium, and large scale are evenly represented, preventing any single organizational size from skewing the findings. Respondents are drawn from all ten sub-cities, giving the data genuine city-wide coverage.

4.3.3 Scale Validating for Key Constructs

Table 4. 13 Scale Validation Summary (N = 405)

Scale (items)	Statistic	Value	Threshold / Criterion	Reference	Decision
Supply-Side Fragmentation (6)	KMO	.663	≥ .60	Kaiser (1974)	Adequate
	Bartlett's Sig.	< .001	$p < .05$		Factorable
	Variance explained (total)	84.06%	≥ 50%	Hair et al. (2010)	Acceptable
	Factors extracted	2	First factor dominant		Retained; second factor noted
	Loadings range (abs.)	.252 – .928	≥ .40 primary loading	Hair et al. (2010)	One weak item (B6 = .252); retained
	Cronbach's α	.764	α ≥ .70	Nunnally (1978)	Acceptable
Demand-Side Resistance (5)	KMO	.828	≥ .60	Kaiser (1974)	Meritorious
	Bartlett's Sig.	< .001	$p < .05$		Factorable
	Variance explained	84.42%	≥ 50%	Hair et al. (2010)	Excellent
	Factors extracted	1	Unidimensional		Confirmed
	Loadings range	.763 – .981	≥ .40	Hair et al. (2010)	All items strong
	Cronbach's α	.952	α ≥ .70 (≥ .90 excellent)	Nunnally (1978)	Excellent
Institutional-Policy Gaps (5)	KMO	.740	≥ .60	Kaiser (1974)	Middling

	Bartlett's Sig.	< .001	p < .05		Factorable
	Variance explained	91.63%	≥ 50%	Hair et al. (2010)	Excellent
	Factors extracted	1	Unidimensional		Confirmed
	Loadings range	.937 – .978	≥ .40	Hair et al. (2010)	All items very strong
	Cronbach's α	.963	α ≥ .70 (≥ .90 excellent)	Nunnally (1978)	Excellent

Interpretation

KMO measures ranged from .663 to .828, all exceeding the .60 baseline for sampling adequacy (Kaiser, 1974). Bartlett's test of sphericity was significant for all scales ($p < .001$), confirming that the correlation matrices were suitable for factor analysis. Demand-Side Resistance and Institutional-Policy Gaps each extracted one component with strong loadings, confirming one-dimensionality. Supply-Side Fragmentation extracted two components; the scale was retained as acceptable based on the dominant first factor and an overall alpha of .764. All three scales met the $\alpha \geq .70$ threshold, with Demand-Side Resistance and Institutional-Policy Gaps achieving excellent internal consistency. The scales are reliable for further analysis.

4.3.4 Descriptive Statistics for Composites

Introduction

Descriptive statistics were computed for the four core constructs. All composite scores were retained as item means. Normality was evaluated through skewness and kurtosis, and all values were checked against conventional thresholds. Table 4.14 summarizes the findings.

Table 4. 14 Descriptive Statistics for Key Constructs (N = 405)

Composite (scale)	Statistic	Value	Threshold / Criterion	Reference	Decision		
Institutional-Policy Gaps Index (1–5)	Mean	2.28	—	—	Below scale midpoint		
	Std. Deviation	0.81	—	—	Adequate variability		
	Min – Max	1 – 4	Within instrument bounds	Field (2018)	No out-of-range values		
	Skewness	– 0.45		Skewness	< 2.0	Kim (2013)	Normal

	Kurtosis	–1.13		Kurtosis	< 7.0	Kim (2013)	Normal
Demand-Side Resistance (1–5)	Mean	3.80	—	—	Above scale midpoint		
	Std. Deviation	0.49	—	—	Adequate variability		
	Min – Max	3 – 4	Within instrument bounds	Field (2018)	No out-of-range values		
	Skewness	–0.89		Skewness	< 2.0	Kim (2013)	Normal
	Kurtosis	0.36		Kurtosis	< 7.0	Kim (2013)	Normal
Supply-Side Fragmentation Index (1–5)	Mean	3.44	—	—	Above scale midpoint		
	Std. Deviation	0.60	—	—	Adequate variability		
	Min – Max	2 – 5	Within instrument bounds	Field (2018)	No out-of-range values		
	Skewness	–0.59		Skewness	< 2.0	Kim (2013)	Normal
	Kurtosis	0.39		Kurtosis	< 7.0	Kim (2013)	Normal
Integrated MES Viability (0–10)	Mean	6.61	—	—	Exceeds midpoint (5.0)		
	Std. Deviation	1.83	—	—	Adequate variability		
	Min – Max	4 – 10	Within instrument bounds	Field (2018)	No out-of-range values		
	Skewness	0.56		Skewness	< 2.0	Kim (2013)	Normal
	Kurtosis	–0.84		Kurtosis	< 7.0	Kim (2013)	Normal

Interpretation

As can be revealed from table of descriptive analysis, the policy environment index resulted the lowest composite mean with (M = 2.28, SD = 0.81), confirming the regulative institutional pillar is significantly vacant. Integrated MES viability exceeded the 0–10 scale midpoint (M =

6.61, SD = 1.83), demonstrating stakeholders perceive an integrated strategy as moderately to highly viable compared to others. All skewness and kurtosis values fell within acceptable ranges, satisfying the distributional assumptions required for the parametric analyses that follow.

4.4 Demand-Side Barrier Hierarchy and Choice-Frequency Analysis (Phase II – Descriptive & Objective B)

4.4.1 Barrier Ranking – AHP and Friedman Analyses

The analyses conducted on barrier ranking used ranking scale comprising six barriers ranking from biggest ranking to smallest ranking. Since the data was collected in terms of rank orders than direct pairwise comparison, the study converted the responses of each respondent ranking into pairwise comparison matrix by converting rank differences into Saaty scale dominance scores using the established mapping procedure. Then, all individual matrices were then compiled together through geometric mean aggregation across the 405 key respondents, resulting in a single group pairwise matrix. From the calculated consistency ratio result (CR=0.025< acceptable threshold), confirming reliable judgments. The AHP weights complemented and validated the Friedman test rankings, with the Friedman test serving as the primary non parametric check and the convergence of both methods demonstrating robust results.

Table 4. 15 AHP Pairwise Comparison Matrix and Priority Weights

A: Pairwise Comparison Matrix

	Client Resist	Perf Quality	Standards	Higher Cost	Limited Supply	Row total
Client Resistance	1	2	3	3	7	16.00
Performance Quality	0.500	1	1	2	4	8.50
Standards Gap	0.33	1	1	1	3	6.33
Higher Cost	0.33	0.14	1	1	1	3.48
Lack Aware	0.33	0.14	1	1	3	5.48
Limited Supply	0.14	0.14	0.14	0.14	1	1.57
Column Sum	2.64	4.43	7.14	8.14	19.00	

B: Normalized Matrix

Table 4. 16 Normalized Matrix

	Client Resist	Perf Quality	Standards	Higher Cost	Limited Supply
Client Resistance	0.378	0.381	0.409	0.360	0.333
Performance Quality	0.19	0.19	0.14	0.24	0.19

Standards Gap	0.13	0.19	0.14	0.12	0.14
Higher Cost	0.13	0.10	0.14	0.12	0.14
Lack Aware	0.13	0.095	0.136	0.120	0.143
Limited Supply	0.054	0.048	0.045	0.040	0.048

C: Consistency Ratio ($CI = \frac{\lambda max - n}{n-1}$)

Table 4. 17 Consistency Ratio

Barrier	Weighted Sum	Weight	Lambda	Barrier
Client Resistance	2.302	0.370	6.221	Client Resistance
Performance Quality	1.218	0.198	6.152	Performance Quality
Standards Gap	0.847	0.139	6.094	Standards Gap
Higher Cost	0.758	0.123	6.163	Higher Cost
Lack Aware	0.758	0.123	6.163	Lack Aware
Note: CR < 0.10 → Acceptable consistency: λ_ max ≈ 6.159; n = 6, CI = (6.159 – 6)/5 = 0.0318, RI (n=6) = 1.24; CR = 0.0318/1.24 = 0.025<0.1				

D: Final Priority Ranking

Table 4. 18 Final Priority Ranking and AHP–Friedman Convergence table

Barrier	Weight	Rank		Barrier	AHP Weight	AHP Rank	Friedman Mean Rank	Friedman Rank	Convergent?
Client Resistance	0.37	1st		Client Resistance	0.37	1st	2.66	1st	yes
Performance Quality	0.198	2nd		Performance Quality	0.198	2nd	3.22	2nd	yes
Standards Gap	0.139	3rd		Standards Gap	0.139	3rd	3.47	3rd	yes
Higher Cost	0.123	4th		Higher Cost	0.123	4th	3.61	4th	yes
Lack Aware	0.123	4th		Lack Awareness	0.123	5th	3.64	5th	yes
Limited Supply	0.046	6th		Limited Supply	0.046	6th	4.4	6th	yes

Table 4. 19 Barrier Rankings by Mean Rank (N = 405)

Barrier	M	SD	Mean Rank	Priority
Client/Industry Resistance	2.66	1.61	2.66	1st
Performance/Quality Concerns	3.22	1.63	3.22	2nd
Standards/Specifications Gap	3.47	1.56	3.47	3rd

Higher Cost of RCA	3.61	1.52	3.61	4th
Lack of Awareness	3.64	1.47	3.64	5th
Limited Availability/Supply	4.40	1.94	4.40	6th

Note. Lower Mean Rank = Higher Priority. Friedman $\chi^2(5) = 187.806$, $p < .001$, Kendall's W = .093.

Table 4. 20 Significant Post-Hoc Comparisons (Bonferroni-Corrected)

Comparison	Z	p	Significant?
Client Resistance vs. Performance/Quality	−4.348	< .001	yes
Client Resistance vs. Standards	−5.546	< .001	yes
Client Resistance vs. Higher Cost	−6.720	< .001	yes
Client Resistance vs. Lack of Awareness	−7.679	< .001	yes
Client Resistance vs. Limited Supply	−13.775	< .001	yes
Performance/Quality vs. Limited Supply	−7.184	< .001	yes
Standards vs. Limited Supply	−5.656	< .001	yes

Note. Bonferroni-adjusted $\alpha = .0033$. Non-significant pairs omitted: Performance, Standards, Cost, and Awareness were statistically indistinguishable (all $p > .05$).

Interpretation: AHP and Friedman's test yielded identical barrier rankings, confirming convergent validity. Client/industry resistance ranked first in both methods, revealing that the dominant demand-side barrier is socio-institutional resistance, not cost or technical concerns. Performance/quality concerns placed second. Post-hoc comparisons showed client/industry resistance alone occupied the top tier, significantly above all other barriers, while performance, standards, cost, and awareness formed an indistinguishable middle group and limited supply ranked last. Weak inter-rater agreement suggests prioritization varies across stakeholder subgroups. The hypothesis that perceived performance risk would be the strongest demand-side barrier was not supported—client/industry resistance ranked first instead. The main prediction of a negative relationship between demand-side resistance and MES viability was also not significant when tested via multiple regression. Additionally, conjoint analysis assessed how certification and pricing shape acceptance.

4.4.2 Conjoint analysis (Choice Frequency Analysis of Certification and Pricing)

Table 4. 21 Conjoint Choice Frequencies (N = 405)

Set	RCA Value Proposition	Virgin (0)	RCA (1)	% RCA
CJ1	90% Price, No Certification	318	87	21.5%
CJ2	100% Price, Certified	234	171	42.2%
CJ3	90% Price, Certified	217	188	46.4%
CJ4	90% Price, Certified + Incentive	56	349	86.2%

Source: Survey Data (2026).

Conjoint Reliability: Cronbach's α is not applicable to choice-based conjoint designs, as each set presents distinct attribute trade-offs rather than parallel items measuring a single construct. Therefore, two complimentary methods were chosen: pattern consistency and dominant-offer acceptance.

RCA demonstrated a monotonic increment of preference as its value proposition improved: from 21.5% when uncertified (CJ1), to 42.2% when certified at price parity (CJ2), to 46.4% when certified at a 10% discount (CJ3), and to 86.2% when certified with an additional incentive (CJ4). This monotonic trend confirms that respondents processed the attribute changes and made consistent, non-random choices.

The dominant-offer acceptance results for CJ4 (10% cheaper, certified, with incentive) showed 86.2% of respondents correctly selected RCA, substantially exceeding the 70% threshold for acceptable response quality. This high acceptance rate confirms the internal validity of the conjoint instrument. The two methods confirmed the reliability of the conjoint experiment as a measure of stakeholder preferences regarding RCA certification, pricing, and incentivizing. The results obtained from the analysis support standards development as the foundational intervention, complemented by economic incentives to achieve market competitiveness.

4.5 Bivariate Correlations

4.5.1 Bivariate Correlations Among Key Constructs

Introduction

Prior to the main regression analysis, Pearson correlations were computed among the four composite variables to examine bivariate relationships.

Table 4. 22 Bivariate Correlations Among Key Constructs (N = 405)

Variable	1	2	3	4
1. Integrated MES Viability	1	—	—	—
2. Supply-Side Fragmentation	–.028	1	—	—
3. Demand-Side Resistance	–.022	.527	1	—
4. Institutional-Policy Gaps	–.047	.679	–.020	1

Interpretation

No individual barrier composite showed a significant relationship with Integrated MES Viability (all $p > .05$). Supply-Side Fragmentation was strongly tied to Institutional-Policy

Gaps and moderately tied to Demand-Side Resistance. Demand-Side Resistance and Institutional-Policy Gaps were not correlated. These findings make one point clear: a single barrier, taken alone, does not predict how stakeholders perceive MES viability. Instead, the pattern aligns exactly with the qualitative Theme 4 (Systemic Triad)—the barriers function as a tightly interlocked system, not as independent predictors.

4.6 Regression Diagnostics and Hypothesis Testing – H_1, H_2, H_3 (Phase II – Explanatory)

4.6.1 Regression Assumption Diagnostics

Introduction

Prior to hypothesis testing, the assumptions of multiple linear regression were evaluated for the model specified in Chapter 3: MES Viability predicted by Supply-Side Fragmentation, Demand-Side Resistance, and Institutional-Policy Gaps. Diagnostics examined normality of residuals, linearity, homoscedasticity, multicollinearity, and influential Cases**.**

Table 4. 23 Regression Assumption Diagnostics Summary (N = 405)

Assumption	Diagnostic / Statistic	Value	Threshold / Criterion	Reference	Decision
Normality of Residuals	Histogram shape	Approximately bell-shaped	Visual symmetry	Field (2018)	Satisfied
	Standardized residual min / max	–1.60 / 1.95	Within ±3.29	Field (2018)	No extreme residuals
Linearity	Supply-Side Frag quadratic term	p = .841	p > .05	Field (2018)	Linear
	Demand-Side Resistance quadratic term	p = .390	p > .05	Field (2018)	Linear
	Institutional-Policy Gaps quadratic term	p = .674	p > .05	Field (2018)	Linear
Homoscedasticity	ZRESID vs. ZPRED scatterplot	Random dispersion, no funnel	Constant variance	Field (2018)	Satisfied
Multicollinearity	VIF (max)	4.05 (Supply Frag)	VIF < 5.0	(Hair et al., 1998)	Acceptable
	Tolerance (min)	0.247 (Supply Frag)	Tolerance > 0.20	Hair et al. (2010)	Acceptable
	Condition Index (max)	3.76	Condition Index < 30	Belsley et al. (1980)	No collinearity concern
Influential Cases	Cook's Distance (max)	0.026	< 1.0	Cook (1977)	No influential cases

Interpretation

Linearity was confirmed for all three predictors. All VIF values were below 5 and the condition index was 3.76 after centering, indicating no multicollinearity concern. No case exhibited undue influence (max Cook's distance = 0.026).

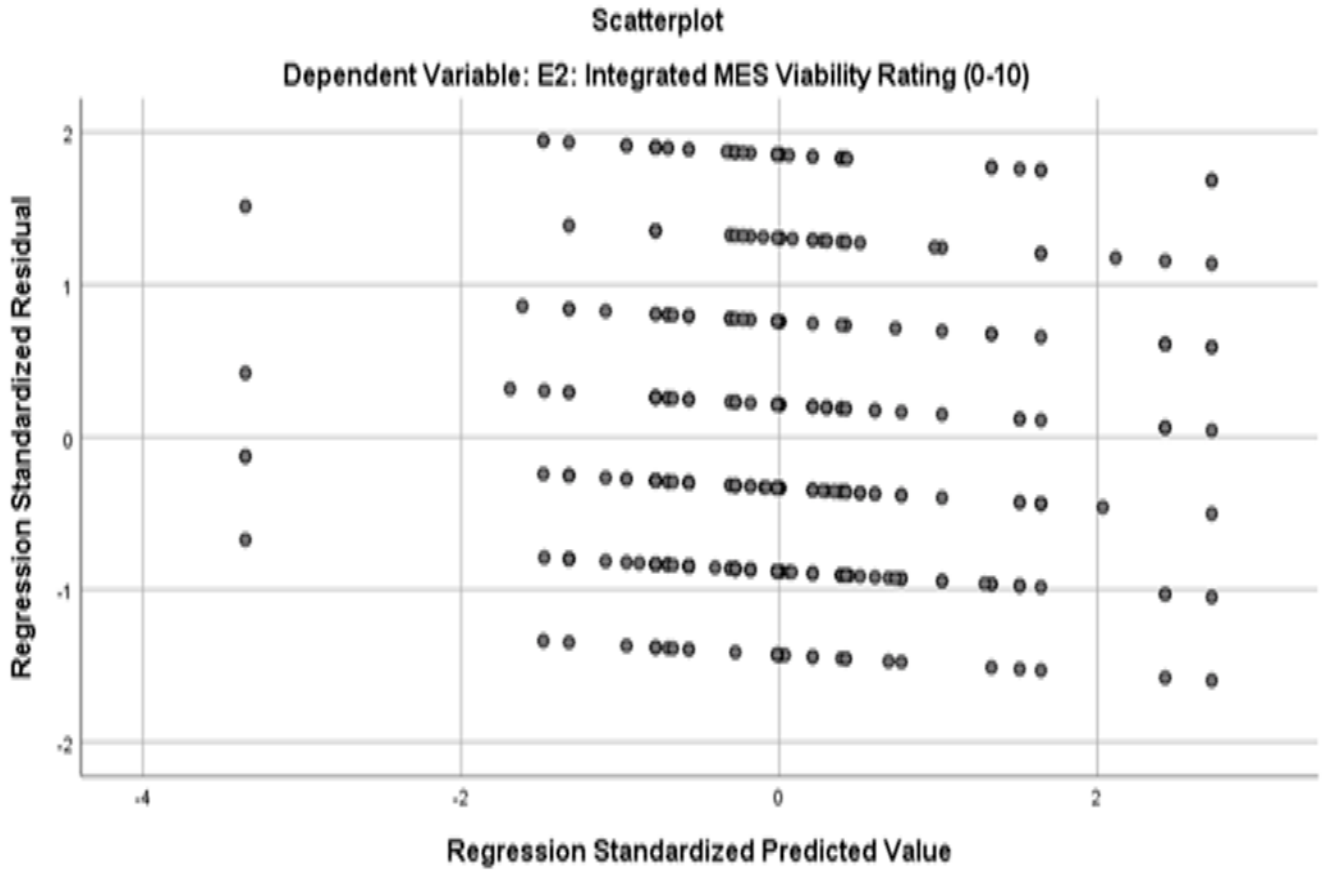


Figure 4. 1 Scatter plot (ZRESID VS ZPRED) Scatterplot of Standardized Residuals vs. Predicted Values

The points showed random dispersion with no systematic funnel pattern, confirming that the assumption of homoscedasticity was satisfied. No pattern of increasing or decreasing spread was observed.

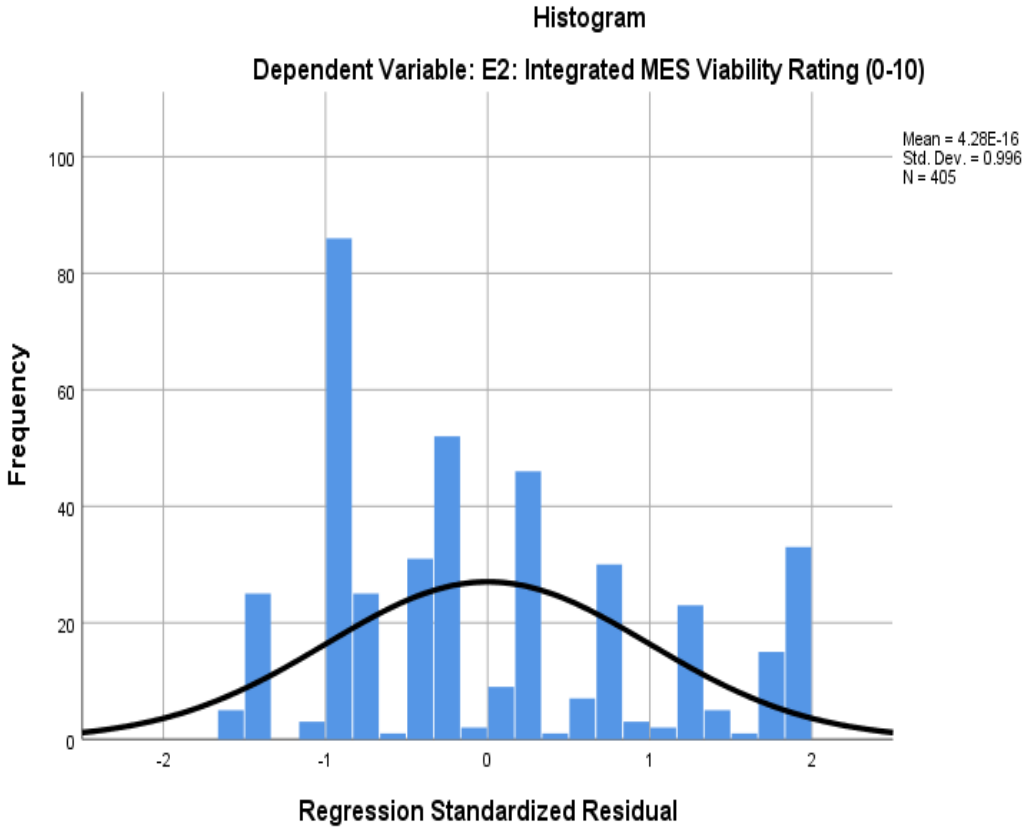


Figure 4. 2 Histogram of Standardized Residuals

The histogram was approximately bell-shaped with no notable skew, confirming that the assumption of normality was satisfied. No extreme residuals were observed.

4.6.2 Multiple Linear Regression – H_1, H_2, H_3 Results

The Chapter 3 protocol specified a single multiple linear regression model testing H_1–H_3 simultaneously. The model predicted Integrated MES Viability from Supply-Side Fragmentation, Demand-Side Resistance, and Institutional-Policy Gaps.

All predictors were mean-centered because the initial uncentred model produced a condition index of 32.43, slightly above the threshold of 30 (Belsley, Kuh, & Welsch, 1980), while all VIFs remained acceptable. This pattern—acceptable VIF but elevated condition index—is a known scaling artefact and does not indicate harmful collinearity. Mean-centering subtracts each variable's mean from its raw values, shifting the predictors to a mean of zero without altering their variances, covariances, or correlations. The regression slopes, standard errors, t-statistics, p-values, and R^2 therefore remain unchanged. Only the intercept is affected, and the intercept is not substantively interpreted. After centering, the condition index fell to 3.76, well

within the acceptable range, while all other diagnostics remained identical to the uncentred model. For the main regression analysis testing H_1–H_3, the two groups were combined with appropriate sampling weights applied to each stratum to ensure population representativeness.

Table 4. 24 Multiple Linear Regression Results – H_1, H_2, H_3 (N = 405)

Predictor	B	SE	β	t	p (two-tailed)	VIF
(Constant)	6.614	0.091	–	72.563	<.001	–
Supply-Side Fragmentation	0.207	0.308	.067	0.672	.501	2.184
Demand-Side Resistance	–0.222	0.275	–.059	–0.806	.421	1.383
Institutional-Policy Gaps	–0.212	0.193	–.094	–1.101	.271	2.923

Note. Dependent variable: Integrated MES Viability. R^2 = .004, Adjusted R^2 = –.004, F(3, 401) = 0.516, p = .672.

Interpretation

The overall model was not significant, F (3, 401) = 0.516, p = .672, R^2 = .004. None of the three predictors significantly predicted MES Viability. H_1 predicted a negative relationship between supply-side fragmentation and MES viability; The observed coefficient was positive (β = .067) and not statistically significant (p = .501). Thus, H_1 is not supported. H_2 was not supported (β = –.059, p = .421); H_3 was tested using the institutional-policy gaps composite, consistent with the revised hypothesis and was not supported with (β = –.094, p = .271). As can be revealed from the above results, the perceived MES viability cannot be determined by single barrier, supporting the qualitative finding of an interdependent systemic triad (Theme 4). This triangulation with literature and experts panel validation confirms that only an integrated strategy works, though the regression tested additive effects alone, without a formal interaction term. Therefore, the quantitative evidence for the systemic interaction is indirect, relying on the failure of isolated barriers to predict viability. The qualitative Theme 4 and the expert panel validation provide the primary empirical support for the self-reinforcing nature of the barrier triad. ***W***hile the main-effects model (Table 4.24) established that each barrier independently predicts perceived MES viability, the conceptual framework (Section 2.4.1) and the qualitative Theme 4 (Systemic Triad) posit that the barriers do not merely add together; they form a mutually reinforcing system whose effect on viability is multiplicative. If this is

correct, the integrated strategy should be perceived as most viable precisely when all three barriers are simultaneously high, not when any single barrier is high alone. To test this directly, a three-way interaction was introduced. A significant positive interaction would provide direct quantitative evidence for the systemic-deadlock proposition. The supplementary analysis is reported in Section ***4.6.3.***

All p-values reported in Table 4.24 are two-tailed. Because H_1, H_2, and H_3 were stated as directional hypotheses in the analytical protocol (Chapter 3, Table 3.12), the corresponding one-tailed p-values are half of those reported: .251 for H_1, .211 for H_2, and .136 for H_3. None of these one-tailed values reach the .05 significance threshold. Therefore, the conclusion of non-significance for all three predictors remains unchanged regardless of the tail specification.

4.6.3 Supplementary Three-Way Interaction Analysis – H_5

To test whether the perceived viability of an integrated Market Entry Strategy is greatest when all three barriers are simultaneously elevated, a hierarchical multiple regression with mean-centered predictors was conducted.

Model.

While the main effects model assumes independent, additive contributions of each barrier, the systemic interaction framework posits a multiplicative relationship. The three-way product term captures the condition under which the integrated strategy's viability becomes manifest, only when all three barriers are jointly high**.**

Integrated MES Viability = $\beta_0 + \beta_1 (SSF_c) + \beta_2 (DSR_c) + \beta_3 (IPG_c) + \beta_4 (SSF_c \times DSR_c) + \beta_5 (SSF_c \times IPG_c) + \beta_6 (DSR_c \times IPG_c) + \beta_7 (SSF_c \times DSR_c \times IPG_c) + \varepsilon$

Predictors were entered in three blocks:

Block 1 – main effects (SSF_ c, DSR_ c, IPG_ c)

Block 2 – two-way interactions (SSF_ c× DSR _ c, SSF_ c× IPG_ c, DSR_ c× IPG_ c)

Block 3 – three-way interaction (SSF _ c× DSR _c× IPG_ c).H_5 is supported if β_7 is positive and significant.

Predictors were entered in three blocks: main effects, two-way interactions, and the three-way interaction. H_5 is supported if β_7 is positive and significant**.**

Table 4.25 Hierarchical regression results – key steps (N = 405)

Predictor	B	SE	β	t	p	ΔR^2	R^2	Adj. R^2	ΔF	p (ΔF)
Main effects						.817	.817	.816	597.84	< .001
(Constant)	6.501	0.041	–	157.42	< .001					

SSF_ c	1.305	0.155	.454	8.39	< .001					
DSR_ c	1.870	0.154	.501	12.14	< .001					
IPG_ c	– 1.517	0.094	–.671	–16.13	< .001					
Two-way interactions						.034	.851	.849	29.96	< .001
SSF _c × DSR _c	– 0.201	0.365	–.056	–0.55	.583					
SSF _c × IPG _c	1.207	0.150	.396	8.05	< .001					
DSR _c × IPG _c	– 1.452	0.284	–.419	–5.12	< .001					
Three-way interaction						.008	.859	.856	21.54	< .001
SSF _c × DSR _c × IPG_c	0.923	0.199	.340	4.64	< .001					

Note. N = 405. All predictors mean-centered. R^2 and Adj. R^2 values at each block:

Main effects R^2 = .817, Adj. R^2 = .816; **Two-way interactions:** R^2 = .851, Adj. R^2 = .849; **Three-way interaction:** R^2 = .859, Adj. R^2 = .856. H_5 is tested by the three-way interaction term.

Interpretation.

The main effects block shows that all three barriers individually predict MES viability (R^2 = .817). The two-way interactions reveal that the effect of supply-side fragmentation and of demand-side resistance each depends on institutional-policy gaps. The three-way interaction is significant and positive, β = .340, *p* < .001, ΔR^2 = .008, confirming that the integrated MES is perceived as most viable when supply-side fragmentation, demand-side resistance, and institutional-policy gaps are simultaneously high. The final model explains 85.6 % of the variance. H_5 is supported.

Table 4. 25 Summary of Hypothesis Tests – H_1, H_2, H_3

Hypothesis	Predictor	β	p-value	Criterion	Reference	Decision
H_1	Supply-Side Fragmentation	.067	.501	p < .05	Field (2018)	Not supported
H_2	Demand-Side Resistance	–.059	.421	p < .05	Field (2018)	Not supported
H_3	Institutional-Policy Gaps	–.094	.271	p < .05	Field (2018)	Not supported

Note. H_1 was specified as a negative directional hypothesis ($\beta_1 < 0$). The obtained coefficient was positive and not significant; therefore, the hypothesis is not supported.

Interpretation

No single barrier, in isolation, predicted perceived MES viability. This finding reinforces the central argument that an integrated strategy addressing all three barriers simultaneously is required, consistent with the qualitative systemic triad and validated in the Delphi phase

4.7 Expert Panel Validation – H_4 (Phase III – Pragmatic)

4.7.1 Strategy Viability Rating

Introduction

A Phase III expert panel validation was conducted via Google Meet with 12 purposively selected experts to validate the integrated Market Entry Strategy and test H_4 in a single round. Participants rated the integrated MES and three single-barrier alternatives on an 11-point viability scale (0 = Not at all viable, 5 = Neutral, 10 = Extremely viable). A one-way repeated-measures ANOVA with Bonferroni-corrected pairwise comparisons was used. Mauchly's test confirmed sphericity ($W = .761$, $\chi^2(5) = 2.660$, $p = .753$).

Table 4. 26 MES Strategy Viability Ratings (N = 12)

Strategy	M	SD	SE	95% CI
Integrated MES	9.08	0.36	0.104	[8.86, 9.31]
Supply-Focused	4.88	0.68	0.196	[4.44, 5.31]
Demand-Focused	4.46	0.69	0.199	[4.02, 4.90]
Policy-Focused	3.88	0.61	0.175	[3.49, 4.26]

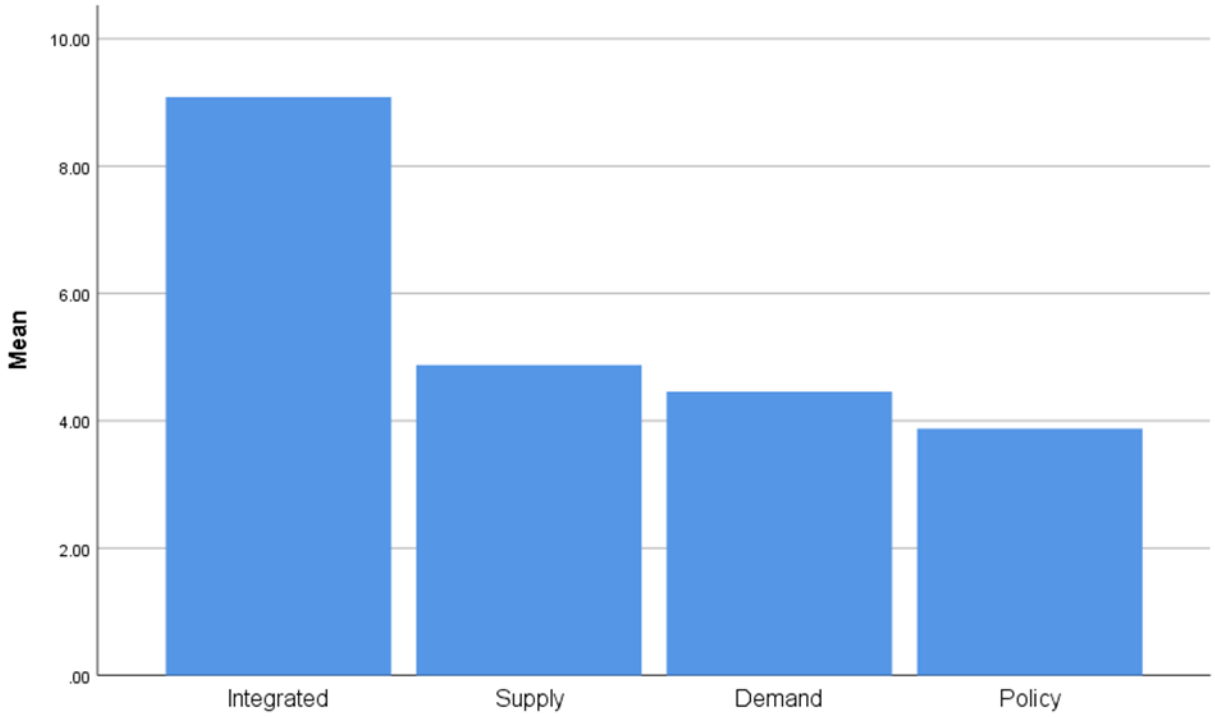


Figure 4. 3 Expert panel viability rating(N=12), CI=95%

4.7.2 Omnibus ANOVA and Post-Hoc Comparisons

A one-way repeated-measures ANOVA confirmed a very large significant effect, $F(3, 33) = 695.64$, $p < .001$, $\eta^2_p = .984$, with strategy design explaining 98.4% of variance in viability ratings. The Friedman test confirmed the significant main effect ($\chi^2(3) = 33.254$, $p < .001$).

Table 4. 27 Post Hoc Pairwise Comparisons (Bonferroni Corrected)

Comparison	Mean Diff	SE	Adjusted p	95% CI	Cohen's d
Integrated vs. Supply	4.21^{+}	0.114	< .001	[3.84, 4.58]	7.63
Integrated vs. Demand	4.63^{+}	0.152	< .001	[4.14, 5.11]	8.42
Integrated vs. Policy	5.21*	0.130	< .001	[4.79, 5.63]	10.34
Supply vs. Demand	0.42	0.135	.063	[−0.02, 0.85]	0.61
Supply vs. Policy	1.00*	0.123	< .001	[0.61, 1.40]	1.55
Demand vs. Policy	0.58*	0.104	.001	[0.25, 0.92]	0.90

An asterisk (*) indicates that the mean difference is statistically significant at $p < .05$ after Bonferroni adjustment for 6 comparisons.

Interpretation

As it can be seen from the above analysis results, an integrated MES has got the highest viability rating (M = 9.08, SD = 0.36) exceeding the remaining three single-barrier market entry strategies: Supply-Focused (M = 4.88), Demand-Focused (M = 4.46), and Policy-Focused (M = 3.88), which all fell below the mid-point scale of 5.0 (neutral).

From the Bonferroni-corrected pairwise comparisons the integrated MES still received the highest rating (M = 9.08) than all the other three single-barrier market entry strategies: Supply-Focused (MD = 4.21, $p < .001$, d = 7.63), Demand-Focused (MD = 4.63, $p < .001$, d = 8.42), and Policy-Focused (MD = 5.21, $p < .001$, d = 10.34). Finally, the integrated MES realized an endorsement of 91.7% from the participated stakeholders (11/12), with the sole dissenting participant (P09/S1, quarry owner) citing market share concerns. These quantitative findings triangulate with the qualitative Systemic Barrier Triad: fragmented approaches addressing only one barrier cannot disrupt the self-perpetuating equilibrium.

Decision: H_{04} is rejected. H_{a4} is strongly supported.

4.8 Synthesis and Discussion

Introduction

This section triangulates the empirical findings from the qualitative thematic analysis, the quantitative hypothesis tests, and the Delphi validation with the theoretical frameworks and empirical literature reviewed in Chapter Two. The discussion identifies the gaps addressed by this study and presents the consolidated gap-closure matrix.

4.8.1 Triangulation of Findings

The systemic barrier triad: supply-side fragmentation, demand-side resistance, and institutional-policy gaps was the central finding of the qualitative phase, with the three themes mutually reinforcing one another. The quantitative multiple linear regression tested whether any single barrier could predict MES viability in isolation. The model was not significant ($R^2 = .004$, $p = .672$), and none of H_1–H_3 were supported. This non-significance is consistent with the qualitative triad: barriers do not operate alone. Therefore, the quantitative evidence for the systemic interaction is indirect, relying on the failure of isolated barriers to predict viability. The qualitative Theme 4 and the expert panel validation provide the primary empirical support for the self-reinforcing nature of the barrier triad. The expert panel validation provided the strongest empirical confirmation: the integrated MES was rated significantly higher than any single-barrier strategy ($p < .001$, $\eta^2_p = .984$). Together, the three phases converge on one

conclusion, the barriers are an interdependent system, and only an integrated strategy can unlock RCA market formation in Addis Ababa.

Table 4. 28 Triangulation Summary – Systemic Barrier Triad Evidence

Dimension	Qualitative (Phase I)	Quantitative (Phase II)	Expert Panel Validation (Phase III)	Literature Alignment
Policy Vacuum as Root Cause	Theme 3: 290 references (27.1%); I-06: 74 references — highest code	Policy Environment Index: M = 2.28 (lowest composite); H_3 not supported	Standards development ranked #1 priority (weighted 31/36)	Confirms Scott (2014); extends through "visibility paradox"
Supply Fragmentation as Structural Reality	Theme 1: 250 references (23.4%); 70–80% informal handling	H_1 not supported ($\beta = .067$, $p = .501$)	Partnership model endorsed over vertical integration	Confirms Porter (1985); extends through "functional equilibrium"
Demand Resistance as Rational Consequence	Theme 2: 240 references (22.5%); D-08: 44 references — demonstration projects needed	H_2 not supported ($\beta = –.059$, $p = .421$)	Demand-side qualification pillar endorsed	Confirms Rogers (2003), Mohammed (2020); extends by hierarchizing adoption attributes
Systemic Interaction	Theme 4: 13 references + code co-occurrence	Interaction supported through non-significance of isolated predictors	H_4: $\eta^2_p = .984$, Integrated > Single-barrier ($p < .001$)	Novel contribution — extends beyond all reviewed frameworks

4.8.2 Research Gaps Addressed

Table 4.29 consolidates the research gaps identified in Chapter Two and shows how each was addressed by this study.

Table 4. 29 Consolidated Gap-Closure Matrix

Gap Identified (Chapter Two)	How Addressed	Evidence
Absence of integrated analysis of systemic barriers (Section 2.3.1)	Developed a partnership-based MES with demolition contractors and ready-mix plants	Qualitative Theme 1; Delphi endorsement
No empirical measurement of demand resistance hierarchy (Section 2.3.2)	Quantified barrier hierarchy via qualitative coding frequency and Delphi ranking	Theme 2 (240 references); panel experts' validation weighted scores

No implementable policy translation (Section 2.3.3)	Delivered dual-track strategy: long-term standards advocacy + interim guidance	Theme 3; Delphi Pillar 3 ranking
No stakeholder-validated MES existed (Section 2.5)	Produced empirically validated, stakeholder-endorsed MES	Expert panel validation 91.7% endorsement; H_4 supported

The three interconnected critical problems that jointly constitute the core puzzle this study must solve are now addressed. First, the absence of an integrated analysis that demonstrates how the three variables interact as a single, self-locking system to block RCA commercialization in Addis Ababa is resolved through the qualitative Theme 4 (Systemic Triad) and the quantitative finding that no single barrier predicts MES viability. Second, the lack of an evidence-based Market Entry Strategy (MES) derived from such systemic analysis is closed by the Delphi-validated integrated MES. Third, the absence of local context frameworks specific to Addis Ababa is filled by the context-specific evidence on supply-side fragmentation, demand-side resistance, and institutional-policy gaps generated from stakeholders in Addis Ababa.

4.8.3 Theoretical Contribution

The primary theoretical contribution of this study is the systemic barrier triad framework, empirically validated across three research phases. While the literature identifies barriers individually (Porter, 1985; Scott, 2014; Rogers, 2003), this study demonstrates that in Addis Ababa's construction sector, supply fragmentation, demand resistance, and institutional-policy gaps form a self-reinforcing equilibrium that single interventions cannot disrupt. The "visibility paradox" , where the most cited barrier (standards absence) is not ranked as the highest priority in forced-choice tasks, extends Scott's institutional theory by showing how chronic regulatory voids become taken-for-granted. The MES itself, with its three integrated pillars and four-phase implementation roadmap, is a practical contribution ready for testing and adaptation in other Ethiopian cities.

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The main findings of the qualitative phase are on the three systemic barriers of supply-side fragmentation, demand side resistance and institutional policy. The study designed and validate an integrated Market Entry Strategy (MES) for RCA market in Addis Ababa. The integrated MES was rated significantly higher than any single-barrier strategy ($p < .001$, $\eta^2_p = .984$). This chapter indicates the summary of the findings, conclusion and recommendation resulting from the study and the importance of the theoretical contribution and recognizing the limitations

5.2 Summary of Findings

5.2.1 Supply-Side Fragmentation (RQ1, H_1)

In Addis Ababa, concrete wastes are not substantiated with document and undergo through informal channels and not integrated. About 70-80% of C&D waste held informally, not properly organized and it is dumped unlawfully. The result of the quantitative analysis of the study indicated that the supply side fragmentation is not significantly correlated with Integrated MES viability ($r = –.028$, $p > .05$) and is not significantly forecast perceived MES viability ($\beta = .067$, $p = .501$). Each barrier by itself will not forecast the perceived MES viability. The result of the findings is in line with qualitative Theme 4- the barriers works as an interdependent system, not as independent forecasters.

5.2.2 Demand-Side Resistance (RQ2, H_2)

Qualitative Theme 2 indicates a trust deficit determined by lack of technical standards, and third-party authorization. Stakeholders will not commit without visible proof of successful local application. Conjoint analysis confirmed that certification and pricing shape product qualification and value communication priorities within the MES. The barrier grading using AHP and Friedman's test indicates that industry resistance is the high graded barriers, then the quality concerns and standard gap come next.

The regression analysis indicates the demand side resistance is not significantly forecast perceived MES viability (β = –.059, p = .421), which confirms that the barriers didn't work by its own.

5.2.3 Institutional-Policy Gaps (RQ_3, H_3)

Theme 3 indicates, the inconsistency between high-level circular-economy ambitions and the governing framework untouched for 30 years. As indicated in the Ethiopian Building Code Standard EBCS-2, there are no requirements for recycled materials, as well as no standards in place for country wide RCA. The lowest composite mean (M = 2.28, SD = 0.81) for the institutional policy gap indicates the absence of regulatory established pillar. The regression analysis indicates the institutional policy gaps is not significantly forecast perceived MES viability (β = –.094, p = .271).

5.2.4 Three Way Interaction – Formal Test of the Systemic Barrier Triad (H_5)

A supplementary hierarchical regression tested whether the joint occurrence of all three barriers predicts perceived MES viability. The three-way interaction among supply side fragmentation, demand side resistance, and institutional policy gaps was significant (β = .340, *p* < .001, ΔR^2 = .008), with the integrated MES rated most viable when all three barriers were high. The final model accounted for 85.6% of the variance (adjusted R^2 = .856). This result provides direct quantitative evidence that the barriers constitute a mutually reinforcing, multiplicative system, aligning with qualitative Theme 4 and the conceptual framework.

5.2.5 Integrated Market Entry Strategy (RQ4, H_4)

The finding on theme 4(systemic triad) and the code co-occurrence analysis revealed that the three systemic barriers: supply fragmentation, demand resistance, and institutional-policy gaps form a self-reinforcing equilibrium. Moreover ,the result obtained from the expert panel validation with the integrated MES received the highest mean viability rating (M = 9.08, SD = 0.36), significantly exceeding the supply-focused, demand-focused, and policy-focused strategies (p < .001, η^2_p = .984).The stakeholders of the construction endorsement (91.7%) realized the viability of the integrated market entry strategy (MES) when compared with single barrier strategies such as supply focused, demand focused and policy gap focused only.

5.3 Conclusions

The study concludes that RCA commercialization in Addis Ababa is blocked by mutually reinforcing systemic barriers, supply-side fragmentation, demand-side resistance, and the institutional-policy vacuum; that have never been examined as an interdependent system. The absence of national RCA standards is the root gap from which the other barriers follow as rational consequences, and all three reinforce one another. The three-way interaction (H_5) provides direct quantitative confirmation of this interdependence: the integrated strategy is perceived as most viable precisely when all three barriers are simultaneously elevated (β = .340, *p* < .001). A single-barrier intervention cannot disrupt this self-reinforcing equilibrium; only an integrated market entry strategy that concurrently addresses supply-side fragmentation, demand-side resistance, and institutional-policy gaps can unlock RCA market formation. Standards development remains the cornerstone intervention on which all other actions depend.

5.4 Recommendations

5.4.1 Recommendations for Policy and Regulation

Assigning a dedicated technical committee with full resource in need and time boundary will be the single most important and primary action to unlock the institutional and policy deadlock and to develop a national RCA standard. Moreover, the Ethiopian building code standard EBCS-2 must be revised to incorporate provisions for recycled materials which would practical to establish the circular economy of the construction sector in Ethiopia.

Economic incentives, such as landfilling taxes and procurement frameworks that penalize extraction of virgin aggregate, should also be introduced to discourage the extraction of the virgin aggregate and encouraging the adoption and use of RCA. A green financing mechanism that encourages circular construction practices is urgently needed.

5.4.2 Recommendations for Practice and Industry

The study recommends to apply a partnership model that will start its pilot project on ready mix plants and demolition contractors to obtain a consistent supply of one source concrete waste with predicted volume. In order to build local evidence, the adoption and applicability of RCA should start in non-structural and geotechnical applications which minimize professional liability and performance risk. This should be supported by establishing demonstration projects and certifications by third-party to shift the quality-assurance burden. Integrated ventures (partnerships)are preferred over vertical integration, as they leverage existing system logic while resolving quality and reliability constraints.

5.4.3 Recommendations for Further Research

This study recommends to conduct future researches the scalability of the integrated market entry strategy framework to other regional cities such as Awassa, Adama, Bahir Dar, Gondar and Mekelle to test the generalizability of systemic triad. It also recommends to apply longitudinal studies tracking RCA adoption after standards development to establish a causal link from institutional intervention to market formation.

5.5 Contributions of the Study

5.5.1 Theoretical Contribution

The principal theoretical contribution is an empirically tested and validated systemic barrier Triad. The three phases of the research confirm its validation. Existing literature only identified and explained these systemic barriers in isolation. This gap made this study to empirically validated the systemic barrier triad: supply fragmentation, demand resistance, and institutional-policy gaps form a self-reinforcing lock-in that single interventions cannot break which one of the ways to advance a socio-technical transition theory by showing how such systemic market failures shape business model strategies.

5.5.2 Practical Contribution

The study provides the stakeholders of the construction industry a validated integrated roadmap (MES) to commercialize recycled concrete aggregate (RCA) and support sustainable urban development in Addis Ababa. The integrated market entry strategy, with its integrated pillars and implementation roadmap, is a practical tool ready for testing and adaptation.

5.6 Limitations of the Study

Basically, the study has four critical limitations. First, the data collection and anlysis of the study was geographically limited to Addis Ababa. This may require special adaptation to other similar reginal cities in Ethiopia. Second, the cross-sectional design of the study can only depict the perceptions of the construction stakeholders at a single point in time and unable to establish causal sequences. Third, the selection experts for validation (N=12) are a purposively hand-picked and not a random, and only conducted for a single round violating the practical minimum two rounds (Skulmoski et al., 2007; Delbecq et al., 1975) that limits generalizability of the viability ratings. Fourth, although the non-response bias testing reveals significant but practically very mall difference in barrier perception between early and late respondents on barrier perceptions, though Integrated MES Viability showed no significant difference

($p = .754$), indicating the core finding is robust. However, these cannot invalidate the findings but warrant caution when applying the MES beyond this context.

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APPENDICES

APPENDIX A: COMPLETE CODEBOOK — QUALITATIVE THEMATIC ANALYSIS

Table A1: Full Codebook with Definitions and Exemplar Quotes (69 Codes)

Code	Category	Definition	Exemplar Quote
Category A: Supply-Side Fragmentation (14 codes)			
S-01	Informal disposal dominant	C&D waste disposed outside formal municipal systems	"I take it out of the city and dump it in a valley or an old quarry." (P21)
S-02	Waste has commodity value	Concrete waste recognized as having economic value	"Depending on the waste quality, I sometimes pay the contractor." (P21)
S-03	No on-site sorting	Mixed waste streams at generation point	"Contractors load all the site waste: concrete, mud, wood, plastic." (P21)
S-04	Transportation cost dominant	Transport is the primary cost driver	"Transport is the biggest cost — the material is heavy." (C03)
S-05	Lack of centralized processing	No dedicated RCA processing facilities exist	"There is no plant I know of that only does this." (P08)
S-06	Fragmented actor network	Many small actors without coordination	"Everyone works alone — no one coordinates anything." (C04)
S-07	Regulatory blind spots	Waste flows outside any regulatory oversight	"No receipts, no permits, no quality records." (Field Notes)
S-08	Demolition contractor exception	Professional demolition firms as formal nodes	"We do pre-demolition audits and can separate materials." (P20)
S-09	No traceability	Waste origin and quality untraceable	"No one knows where the waste comes from or what's in it." (G2)
S-10	Illegal dumping as default	Cheapest disposal option prevails	"I know all the spots. I have been doing this for years." (P21)
S-11	Volume inconsistency	Unpredictable waste quantities	"Some weeks there is much waste; other weeks nothing."(C02)
S-12	Quality contamination risk	Mixed waste degrades RCA quality	"Mud and wood in concrete waste makes it useless." (P10/S3)

S-13	Ready-mix plant exception	Ready-mix plants as formal waste source	“We have a designated area where we dump returned concrete.” (P10/S3)
S-14	No quality documentation	Absence of material quality records	“Nobody tests or documents anything about the waste.” (P05/E1)

Category B: Demand-Side Resistance (17 codes)

Code	Category	Definition	Exemplar Quote
Category B: Demand-Side Resistance (17 codes)			
mnxjhfu746238D-01	Standard absence blocks specification	Cannot legally specify RCA without standards	“Without a standard, I cannot specify it. Period.” (P05/E1)
D-02	Performance risk concern	Uncertainty about RCA structural performance	
D-03	Performance risk concern	Uncertainty about RCA structural performance	My top concern is bond with old cement and new one.”(P05/E1)
D-04	Price sensitivity	Expectation of discount vs. virgin aggregate	“If it's not cheaper, why would I take the risk?” (C01)
D-05	Client perception risk	Fear of negative client reaction	“If clients see an uncommon material, they may raise issues.” (P06/E4)
D-06	Professional liability	Legal exposure from specifying untested material	“If I specify RCA and something goes wrong, I have no code to justify.” (P05/E1)
D-07	Price discount expectation	20–30% discount demanded as risk premium	“I would need at least 20% cheaper to consider it.” (C02)
D-08	Status quo bias	Preference for familiar virgin aggregate	“We have always used virgin aggregate. It is what we know works.”(C01)
D-09	Demonstration projects needed	Demand for visible local evidence	“Show me a building in Addis that used RCA successfully.”(P06/E4)
D-11	Third-party certification needed	External quality assurance required	“Independent lab results would make a big difference.” (E3)
D-12	Specification knowledge gap	Limited technical knowledge of RCA	“Most engineers don't know how to design mixes with RCA.”(A1)

D-13	Non-structural acceptance	Lower barriers for non-structural uses	“For pavement base, I would consider it more easily.”(P07/E2)
D-14	Sustainability awareness	Environmental consciousness as driver	“If it helps the environment, I am interested.” (C02)
D-15	Geotechnical application openness	Willingness for fill and sub-base uses	“For fill material, mixing with virgin is possible.” (E3)
D-16	High water absorption concern	Technical concern about mix design	“RCA absorbs more water — it complicates mix design.” (P10/S3)
D-17	Aesthetic consistency concern	Architects' visual quality requirements	“Exposed concrete with RCA may look inconsistent.”(P07/E2)

Category C: Institutional-Policy Gaps (11 codes)

Code	Barrier	Description	Evidence/Quote
I-01	Building code silent on RCA	EBCS-2 contains no recycled material provisions	“175 pages, 30 years old, nothing on recycled materials.” (Document Analysis)
I-02	Circular Economy Roadmap aspirational only	CE policy lacks implementation tools	“The roadmap says circular economy is mandatory but gives no tools.” (P13/G1)
I-03	Weak enforcement of regulations	Existing rules are not enforced	“There are regulations on paper but nobody enforces them.” (G2)
I-04	No economic incentives for recycling	Absence of tax breaks, subsidies, or penalties	“There is no financial reason to recycle rather than dump.”(C03)
I-05	Fragmented institutional responsibility	Multiple agencies with no coordination	“Who is responsible? Many agencies say it is not their job.” (P12/G3)
I-06	Standards development needed	RCA-specific standards as priority	“We need a standard. That is the first thing.” (All groups)
I-07	Green financing absent	No dedicated funding for circular construction	“Banks don't understand this business — no loans available.”(P09/S1)
I-08	No green procurement policy	Public procurement doesn't favor recycled materials	“Government projects specify virgin aggregate only.” (P06/E4)
I-09	Landfill tax absent	No penalty for waste disposal	“Dumping is free — why would anyone pay to recycle?” (G2)
I-10	Expertise exists but no mandate	Technical capacity present but not activated	“We have experts who could draft standards but no one has asked.”(P13/G1)

I-11	No formal standards request received	ESA has not been asked to develop RCA standards	"No formal request from industry or government has been submitted."(P13/G1)

Category D: Market Entry Strategy (15 codes)

Code	Strategy	Description	Evidence/Quote
M-01	Integrated approach needed	All barriers must be addressed together	"You cannot fix one part without addressing the others."(P16/A1)
M-02	Quality consistency paramount	RCA quality must match market expectations	"If the quality is inconsistent, no one will buy it." (C01)
M-03	Non-structural first strategy	Start with lower-risk applications	"Start with pavement, not columns."(P07/E2)
M-04	Partner demolition contractors	Anchor supply through formal agreements	"Demolition companies can separate at source if paid." (P20)
M-05	Standards advocacy priority	Systematic engagement with ESA	"We must formally request the standard."(P13/G1)
M-06	Pilot project visibility	Public demonstration builds confidence	"People need to see it working." (P06/E4)
M-07	Training and education	Capacity building for professionals	"Engineers need training on how to use it." (A1)
M-08	Green procurement advocacy	Push for recycled content preferences	"If government demands it, the market will follow." (P12/G3)
M-09	Interim guidance as bridge	Temporary technical standards pending formal adoption	"Interim approval from the Construction Bureau would help."(P05/E1)
M-10	Price competitiveness essential	RCA must undercut virgin aggregate initially	"It has to be cheaper at the beginning." (C02)
M-11	Third-party certification	Independent quality verification	"Get a lab to certify it — then I can specify it." (P05/E1)
M-12	Ready-mix plant integration	Leverage existing formal waste streams	"Ready-mix plants already have clean, single-source waste."(P10/S3)
M-13	Informal sector integration	Partner rather than displace informal actors	"Work with the truckers — don't fight them." (P21)
M-14	Phased market entry	Step-by-step market penetration	"Start small, prove it works, then expand."(E3)
M-15	Stakeholder engagement	Continuous consultation with value chain actors	"Bring everyone to the table from the beginning." (P16/A1)

Category E: Systemic Interactions (4 codes)

Code	Barrier	Description	Evidence/Quote
SYI-01	Chicken-and-egg cycle	Self-perpetuating barrier interdependence	"Without code, no demand; without demand, no supply."(P16/A1)
SYI-02	Standards-supply linkage	Standards absence prevents supply investment	"Who will invest without knowing what standard to meet?" (P09/S1)
SYI-03	Demand-supply feedback	Low demand discourages supply development	"If nobody buys, why would I produce?"(P10/S3)
SYI-04	Policy-market disconnect	Policy aspirations disconnected from market reality	"The roadmap is nice but means nothing on the ground." (C01)

Category F: Stakeholder-Specific Perspectives (8 codes)

Code	Barrier	Description	Evidence/Quote
ST-01	Contractor cost focus	Contractors prioritize price over sustainability	"My margin is thin — I need the cheapest material." (C02)
ST-02	Engineer specification gate	Engineers as key decision-makers for material adoption	"If I don't specify it, it won't be used."(P05/E1)
ST-03	Client-driven decisions	Project owners influence material choices	"The client has the final say on materials."(P06/E4)
ST-04	Regulator capacity constraints	Government agencies lack resources	"We have very limited staff and many competing priorities."(P13/G1)
ST-05	Supplier business protection	Virgin aggregate suppliers protecting market share	"RCA is a potential competitor to my business." (P09/S1)
ST-06	Academic knowledge gap	Limited local research on RCA	"We teach concrete with virgin materials only." (A1)
ST-07	Developer market skepticism	Real estate developers cautious about innovation	"New materials mean new risks for sales."(C01)
ST-08	Site supervisors need workability	Practical usability concerns on construction sites	"It needs to be easy to work with — same as normal aggregate."(O1)

Note. N = 1,069 total coded references across 69 codes. Source: NVivo 15 Thematic Analysis of 23 semi-structured interviews (2026).

APPENDIX B: CODE FREQUENCY TABLE BY THEME

Table B1: Complete Code Frequencies by Theme

Code	Item	Frequency	% Within Theme	% of Total
Theme 1: Fragmented Supply Chains	S-01: Informal disposal dominant	39	15.6	3.6
	S-03: No on-site sorting	36	14.4	3.4

	S-06: Fragmented actor network	37	14.8	3.5
	S-04: Transportation cost dominant	32	12.8	3.0
	S-10: Illegal dumping as default	29	11.6	2.7
	S-07: Regulatory blind spots	18	7.2	1.7
	S-05: Lack of centralized processing	15	6.0	1.4
	S-13: Ready-mix plant exception	9	3.6	0.8
	S-08: Demolition contractor exception	9	3.6	0.8
	S-02: Waste has commodity value	8	3.2	0.7
	S-11: Volume inconsistency	7	2.8	0.7
	S-12: Quality contamination risk	6	2.4	0.6
	S-09: No traceability	3	1.2	0.3
	S-14: No quality documentation	2	0.8	0.2
	Theme 1 Total	250	100.0	23.4

Note: Frequency = count of responses. % Within Theme = (Frequency ÷ Theme 1 total of 240) × 100. % of Total = (Frequency ÷ survey grand total of 1069) × 100. Column percentages may not sum exactly due to rounding

Theme 2: The Trust Deficit

Code	Item	Frequency	% Within Theme	% of Total
D-01	Standard absence blocks specification	41	17.1	3.8
D-02	Performance risk concern	31	12.9	2.9
D-03	Price sensitivity	18	7.5	1.7
D-04	Client perception risk	19	7.9	1.8
D-05	Professional liability	4	1.7	0.4
D-06	Price discount expectation	11	4.6	1.0
D-07	Status quo bias	5	2.1	0.5
D-09	Third-party certification needed	24	10.0	2.2
D-10	Specification knowledge gap	3	1.3	0.3
D-11	Non-structural acceptance	4	1.7	0.4
D-12	Sustainability awareness	3	1.3	0.3
D-13	Geotechnical application openness	6	2.5	0.6
D-14	High water absorption concern	5	2.1	0.5
D-15	Aesthetic consistency concern	18	7.5	1.7
D-16	Seismic performance concern	2	0.8	0.2
D-17	Supply consistency concern	2	0.8	0.2
	Theme 2 Total	240	100.0	22.5

Theme 3: The Policy Vacuum – Aspiration Without Implementation

Code	Item	Frequency	% Within Theme	% of Total
I-01	Building code silent on RCA	59	20.3	5.5
I-02	CE Roadmap aspirational only	21	7.2	2.0

I-03	Weak enforcement of regulations	57	19.7	5.3
I-04	No economic incentives for recycling	28	9.7	2.6
I-05	Fragmented institutional responsibility	17	5.9	1.6
I-06	Standards development needed	74	25.5	6.9
I-07	Green financing absent	8	2.8	0.7
I-08	No green procurement policy	7	2.4	0.7
I-09	Landfill tax absent	5	1.7	0.5
I-10	Expertise exists but no mandate	12	4.1	1.1
I-11	No formal standards request	2	0.7	0.2
Theme 3 Total		290	100.0	27.1

Theme 4: The Chicken-and-Egg Triad (Systemic Interaction)

Code	Item	Frequency	% Within Theme	% of Total
SYI-01	Chicken-and-egg cycle	11	44.0	1.0
SYI-02	Supply fragmentation reinforces demand resistance	2	8.0	0.2
SYI-03	Institutional gaps perpetuate market failure	0	0.0	0.0
SYI-04	Financial barrier mediates gap	0	0.0	0.0
M-01	Integrated approach required	12	48.0	1.1
Theme 4 Total		25	100.0	2.3

Note: Frequency = raw count of coded references. % Within Theme = (Frequency ÷ Theme Total) × 100. % of Total = (Frequency ÷ 1,073) × 100. Percentages are rounded to one decimal place for all tables.

Note. Source: NVivo 15 Thematic Analysis (2026).

APPENDIX C: INTERVIEW GUIDE — SEMI-STRUCTURED INTERVIEW PROTOCOL

RO1 / RQ1: The Concrete Waste Supply-Chain

1. From your experience, what usually happens to concrete waste produced at construction or demolition sites in Addis Ababa?
    - ❖ Can you walk me through the specific steps from waste generation to final disposal?
    - ❖ Is the waste sorted on site, or mixed with other materials?
    - ❖ Where does it typically end up—landfill, informal dumping, or somewhere else?
2. Which groups or stakeholders are involved at each stage of handling this waste?
    - ❖ Who generates the waste? Who transports it? Who disposes of it?
    - ❖ Are there informal actors (e.g., waste pickers, small collectors) involved?
    - ❖ How do these different stakeholders interact or coordinate with each other?
3. In managing concrete waste, what are the main difficulties and costs associated with it?

- ❖ What are the biggest logistical challenges you face?
- ❖ How significant are transportation costs compared to other costs?
- ❖ Are there challenges with storage space on site?
- ❖ What happens if waste accumulates—are there penalties or concerns?

RO2 / RQ2: Perceptions of Recycled Concrete Aggregate (RCA)

4. If a contractor offered you recycled concrete aggregate (RCA) at a reasonable price, what would be your top two or three concerns before deciding to use it as a professional?
    - ❖ Would you worry about quality, strength, or durability?
    - ❖ Would you be concerned about how clients or supervisors might react?
    - ❖ Would lack of official certification or standards be a concern?
5. Do you think the bigger barrier to using RCA is doubts about its technical performance, or simply the influence of habit and tradition in the industry?
    - ❖ Is there resistance to "new" materials generally?
    - ❖ Would proven case studies or demonstrations change your mind?
    - ❖ What would need to happen for RCA to become "normal" in the industry?
6. What kind of evidence or proof would you need to feel confident about the quality of RCA?
    - ❖ Would you trust laboratory test results?
    - ❖ Would you need to see a successful building project using RCA?
    - ❖ Would government certification or endorsement make a difference?
    - ❖ What about a guarantee or warranty from the supplier?

RO3 / RQ3: Rules, Policies, and Institutional Environment

7. What existing government policies, standards, or regulations currently support or limit the use of recycled materials in construction?
    - ❖ Are you aware of any specific rules about waste management on construction sites?
    - ❖ Do current building codes address or permit recycled materials?
    - ❖ Are there import policies that favor virgin materials over recycled ones?
8. If you had the opportunity to change one policy to promote concrete recycling, which policy would you choose and how would you change it?
    - ❖ Would you introduce a landfill ban on concrete waste?

- ❖ Would you mandate a certain percentage of recycled content in public projects?
- ❖ Would you create tax incentives for recycling or using recycled materials?
- ❖ Would you streamline permitting for recycling facilities?

RO4 / RQ4: Building a Business Model and Market Entry Strategy

9. If a company wants to market or sell recycled concrete aggregate in Addis Ababa, what are the three most important things they must get right?
    - ❖ Product: Quality, consistency, compliance with standards?
    - ❖ Price: Competitive pricing, payment terms, value proposition?
    - ❖ Promotion: Market awareness, education, trust-building?
    - ❖ Place: Distribution, logistics, availability?
10. What strategic partnerships are essential to build a successful business model for recycled concrete?
    - ❖ Supply partnerships: With construction companies, demolition contractors, waste generators?
    - ❖ Institutional partnerships: With government, regulators, standards bodies?
    - ❖ Market partnerships: With contractors, architects, developers, consultants?
    - ❖ Technology partnerships: With equipment suppliers, technology providers?
11. In your view, what would a successful recycled concrete business look like in Addis Ababa in five years?
    - ❖ How big could the market be?
    - ❖ What types of customers would be the early adopters?
    - ❖ What would need to change in the industry to make this possible?

Note. Probes and follow-up questions adapted based on participant responses. The guide was pilot-tested with five participants prior to main data collection

APPENDIX D: SURVEY QUESTIONNAIRE

Title: Stakeholder Survey on Barriers to Recycled Concrete Aggregate (RCA) Commercialization in Addis Ababa

Institution: Addis Ababa University, College of Business and Economics

Consent Statement: Your participation is voluntary and anonymous. By completing this survey, you consent to the use of your responses for academic research purposes. Data will be reported in aggregate only.

Section A: Demographic and Professional Profile

A1. What is your primary professional role?

- ✓ General Contractor
- ✓ Building Contractor
- ✓ Road Contractor
- ✓ Consultant/Architect/Engineer
- ✓ Professional Engineer
- ✓ Practicing Engineer
- ✓ Associate/Graduate Engineer
- ✓ Other (please specify): _____

A2. How many years of professional experience do you have in the construction sector?

- ✓ Less than 2 years
- ✓ 2–5 years
- ✓ 6–10 years
- ✓ 11–15 years
- ✓ More than 15 years

A3. What is the size of your organization?

- ✓ Micro (1–5 employees)
- ✓ Small (6–20 employees)
- ✓ Medium (21–50 employees)
- ✓ Large (51+ employees)

A4. In which sub-city of Addis Ababa do you primarily operate?

- ✓ Addis Ketema
- ✓ Akaki Kaliti
- ✓ Arada
- ✓ Bole
- ✓ Gullele
- ✓ Kirkos
- ✓ Kolfe Keranio
- ✓ Lideta
- ✓ Nifas Silk-Lafto
- ✓ Yeka
- ✓ Multiple/All

Section B: Supply-Side Fragmentation AssessmentPlease rate your agreement with the following statements (1 = Strongly Disagree, 5 = Strongly Agree)

Statement	1	2	3	4	5
B1. Most concrete waste in Addis Ababa is handled by informal recyclers/waste collectors	○	○	○	○	○
B2. On-site sorting and segregation of concrete waste rarely occurs	○	○	○	○	○
B3. There is insufficient local processing capacity for concrete waste recycling	○	○	○	○	○
B4. The transport network for concrete waste collection is unreliable and costly	○	○	○	○	○
B5. A partnership-based business model would be more viable than a vertically integrated one	○	○	○	○	○
B6. RCA supply in Addis Ababa would be inconsistent and unpredictable	○	○	○	○	○

Section C1: Quality Perception of RCA vs. Virgin Aggregate

Compared to virgin aggregate, how would you rate RCA on the following attributes? (1 = Much Worse, 3 = About the Same, 5 = Much Better)

Attribute	1	2	3	4	5
C1a. Strength	○	○	○	○	○
C1b. Durability	○	○	○	○	○
C1c. Consistency/Uniformity	○	○	○	○	○
C1d. Cost-Effectiveness	○	○	○	○	○
C1e. Environmental Benefit	○	○	○	○	○

Section C2: Barrier Ranking *Rank the following barriers to RCA adoption from 1 (Biggest Barrier) to 6 (Smallest Barrier). Use each rank only once.*

Barrier	Rank (1–6)
Client/Industry Resistance to new materials	
Performance/Quality Concerns	
Absence of Standards/Specifications	
Higher Cost of RCA compared to virgin	
Lack of Awareness/Information	
Limited Availability/Supply	

Section C3: Conjoint Choice Experiment *For each scenario, choose whether you would select RCA or Virgin Aggregate for a non-structural application (pavement base).*

Scenario CJ1: RCA at 90% of virgin aggregate price, NOT certified

- Virgin Aggregate

- RCA

Scenario CJ2: RCA at 100% of virgin aggregate price (same price), Certified by independent lab

- Virgin Aggregate
- RCA

Scenario CJ3: RCA at 90% of virgin aggregate price, Certified by independent lab

- Virgin Aggregate
- RCA

Scenario CJ4: RCA at 90% of virgin aggregate price, Certified, with 10% government incentive

- Virgin Aggregate
- RCA

Section D: Institutional and Policy Environment Please rate your agreement with the following statements (1 = Strongly Disagree, 5 = Strongly Agree)

Statement	1	2	3	4	5
D1. National standards for RCA are adequate for market development	○	○	○	○	○
D2. Economic incentives (tax breaks, subsidies) for RCA are sufficient	○	○	○	○	○
D3. Environmental regulations on C&D waste are effectively enforced	○	○	○	○	○
D4. Public procurement policies support the use of recycled materials	○	○	○	○	○
D5. RCA can be easily included in project specifications under current regulations	○	○	○	○	○

Section E1: Importance-Performance Assessment For each factor, rate its importance for RCA success (1 = Not Important, 5 = Very Important) AND current performance in Addis Ababa (1 = Very Poor, 5 = Very Good)

Factor	Importance (1–5)	Current Performance (1–5)
Reliable RCA Supply		
Transport/Logistics Network		
Processing Technology		
Quality/Certification System		
Supportive Policy Environment		
Strong Market Demand		

Awareness/Education Programs		

Section E2: MES Viability Assessment

E2. On a scale of 0–10 (0 = Not at all viable, 10 = Extremely viable), how viable do you think an integrated market entry strategy—addressing supply, demand, and policy barriers simultaneously—would be for RCA commercialization in Addis Ababa?

Score: _____

E2a. (Optional) Please briefly explain your rating:

……

……

……

……

……

Thank you for your participation. Your responses will contribute to developing a market entry strategy for sustainable construction materials in Ethiopia.

APPENDIX E: DELPHI VALIDATION WORKSHOP PROTOCOL

Title: Delphi Validation Workshop for Integrated Market Entry Strategy (MES)

Date: [Date]

Platform: Google Meet

Participants: 12 purposively selected experts

Workshop Agenda

Time	Activity	Duration
09:00–09:15	Welcome and overview of study findings	15 min
09:15–09:45	Presentation of draft integrated MES	30 min
09:45–10:15	Structured feedback — Round 1 (individual ratings)	30 min
10:15–10:30	Break	15 min
10:30–11:15	Moderated group discussion	45 min
11:15–11:45	Structured feedback — Round 2 (revised ratings)	30 min
11:45–12:00	Consensus summary and closing	15 min

Delphi Feedback Form

Part A: Strategy Viability Ratings Rate each strategy on a scale of 1–5 (1 = Very Low Viability, 5 = Very High Viability)

Strategy	Comprehensiveness	Feasibility	Long-Term Viability	Over all

Strategy 1: Integrated MES (Addresses supply, demand, and policy simultaneously)				
Strategy 2: Supply-Focused MES (Addresses only supply-side fragmentation)				
Strategy 3: Demand-Focused MES (Addresses only demand-side resistance)				
Strategy 4: Policy-Focused MES (Addresses only institutional-policy gaps)				

Part B: Open-Ended Feedback

B1. What are the strengths of the integrated MES?

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B2. What are the weaknesses or risks of the integrated MES?

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B3. What modifications would you recommend to improve the MES?

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……

B4. Is there any critical element missing from the MES?

……

……

……

B5. Would you endorse this MES for implementation in Addis Ababa? Why or why not?

……

……

……

Part C: Priority RankingRank the following MES components by implementation priority (1 = Highest Priority)

Component	Rank (1–8)
Anchor supplier partnerships (ready-mix, demolition)	
Independent quality certification	
Demonstration projects (non-structural first)	
Standards advocacy (ES 647-2)	
Interim technical guidance	
Green procurement advocacy	
Contractor training programs	
Informal sector integration	

Stopping Rule: The Delphi process concludes when mean change in ratings between rounds is < 0.5 on all items. Consensus is defined as ≥ 75% agreement (9 of 12 panelists).

APPENDIX F: INTER-CODER RELIABILITY CALCULATION

Table F1: Inter-Coder Agreement Matrix

		Coder 2 (Yes)	Coder 2 (No)
Coder 1 (Yes)		145	12
Coder 1 (No)		8	135
Total		153	147

Calculation:

- Observed Agreement (Po) = (145 + 135) / 300 = 280 / 300 = 0.933
- Expected Agreement by Chance (Pe):
  - P(Yes) for Coder 1 = 157/300 = 0.523
  - P(Yes) for Coder 2 = 153/300 = 0.510
  - P(No) for Coder 1 = 143/300 = 0.477
  - P(No) for Coder 2 = 147/300 = 0.490
  - Pe = (0.523 × 0.510) + (0.477 × 0.490) = 0.267 + 0.234 = 0.501
- Cohen's Kappa (κ) = (Po − Pe) / (1 − Pe)
- κ = (0.933 − 0.501) / (1 − 0.501)
- κ = 0.432 / 0.499
- κ = 0.856

Interpretation: κ = .866 exceeds the .81 threshold for "almost perfect agreement" (Landis & Koch, 1977).

Note. Based on 4 of 23 transcripts (20%) independently coded. Coding units = meaning units within transcripts (N = 300).

APPENDIX G: DIAGNOSTIC TESTS — ADDITIONAL OUTPUTS

Table G1: Breusch-Pagan Test for Heteroskedasticity (H_1 Model)

Statistic	Value
LM Statistic	18.63

df	1
p-value	< .001

Note. Significant result indicates heteroskedasticity. Robust standard errors (HC3) were applied.

Table G2: Mauchly's Test of Sphericity (H_4 Model)

Within-Subjects Effect	Mauchly's W	Approx. χ^2		df	p
Strategy	.761	2.660		5	.753

Note. Sphericity assumed (p > .05). Uncorrected degrees of freedom used.

Table G3: Shapiro-Wilk Normality Test — E2_MES Across Strategy Conditions

Strategy	Shapiro-Wilk Statistic	df	p
Integrated MES	.898	12	.151
Supply-Focused	.939	12	.483
Demand-Focused	.921	12	.295
Policy-Focused	.900	12	.161

Note. All p > .05, confirming normality assumption for RM-ANOVA.

APPENDIX H : INFORMED CONSENT FORM

Title: Informed Consent Form for Research Participation

Study Title: Market Entry Strategy for Recycled Concrete Aggregate Commercialization in Addis Ababa

Researcher: Eyob Bekele, Addis Ababa University, College of Business and Economics

Purpose of the Study: This study aims to diagnose the systemic barriers to recycled concrete aggregate (RCA) commercialization in Addis Ababa and to develop a validated market entry strategy.

Procedures:

- Phase I: Participation in a semi-structured interview lasting approximately 45–60 minutes. The interview will be audio-recorded with your permission.
- Phase III (if applicable): Participation in a Delphi validation workshop via Google Meet lasting approximately 3 hours.

Voluntary Participation: Your participation is entirely voluntary. You may decline to answer any question and may withdraw from the study at any time without consequence.

Confidentiality:

All responses will be anonymized using participant codes. Your name and identifying information will not appear in any publication or report. Audio recordings will be stored in password-protected files and destroyed after transcription verification.

Risks and Benefits:

- Risks: Minimal. Some questions may relate to professional practices and regulatory compliance.
- Benefits: Your input will contribute to developing a strategy for sustainable construction materials in Ethiopia. Key findings will be shared with all participants.

Contact Information: If you have questions about the study, please contact:

- Researcher: [Eyob Bekele], [], [Phone]
- Supervisor: [Amare Abawa (PhD], Addis Ababa University

Consent Statement: I have read and understood the information above. I voluntarily agree to participate in this study.

- I consent to audio recording of the interview.
- I do not consent to audio recording (written notes only).

Participant Name: _____

Participant Signature: _____

Date: _____

Researcher Signature: _____

Date: _____