A STRATEGY FOR EFFECTIVE SAFETY MANAGEMENT IN CONSTRUCTION SITES IN NAIROBI COUNTY

ELVIS SHISYA WAMEYO

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A Strategy for Effective Safety Management in Construction Sites in Nairobi County

Elvis Shisya Wameyo

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

Signature: …… Date: ……..

Elvis Shisya Wameyo

This thesis has been submitted for examination with our approval as the University Supervisors:

Signature: …… Date: ……..

Dr. Maina Kiambigi, PhD

JKUAT, Kenya

Signature: …… Date: ……..

Dr. James Okaka, PhD

JKUAT, Kenya

DEDICATION

This thesis is dedicated to my daughters, Lisa and Tasha; my wife, Milly; my parents, James and Rhoda; and everyone engaged in the relentless battle for effective health and safety management in construction sites in Kenya.

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My sui generis tribute is foremost to God Almighty, in whose word I've soared in excellence: "In the writing of many books, there's no end… (Ecclesiastes 12:12)." My most profound appreciation also goes to Dr. Kiambigi and Dr. Okaka, who served as my advisors, mentors, and patrons in this endeavor. Their tremendous wisdom and wealth of experience has been and will always be a significant source of inspiration. Similarly, I'd like to express my gratitude to everyone in the Department of Construction Management, JKUAT. Special thanks to their benevolence and encouragement. In conclusion, I'd like to thank my wife, daughter, and parents, who've supported me unremittingly throughout this journey. May God bless you all!

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ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
BIM	Building Information Modelling
DOSHS	Directorate of Occupational Safety and Health Services
FPC	Finite Population Correction
GDP	Gross Domestic Product
HRO	High-Reliability Organization
IEK	Institution of Engineers of Kenya
ILO	International Labour Organization
IoT	Internet of Things
IRB	Institutional Review Board
JKUAT	Jomo Kenyatta University of Agriculture and Technology
MOHURD	Ministry of Housing and Urban-Rural Development of the People's Republic of China
NCA	National Construction Authority
ODPC	Office of the Data Protection Commissioner
OLR	Ordinal Logistic Regression
OSHA	Occupational Safety and Health Act
PPE	Personal Protective Equipment
SMS	Safety Management Systems.

USSD Unstructured Supplementary Service Data

ABSTRACT

The construction industry in Nairobi County remains one of the most hazardous occupational sectors, with accident rates sustained by weak enforcement, informality, limited training, and fragmented organizational commitment. While global literature has advanced safety management frameworks, gaps persist in contextualizing these approaches to resource-constrained and informal construction environments. In particular, psychosocial, economic, and cultural dimensions remain underexplored, giving rise to this study. The research aimed to develop a strategy for effective safety management in construction sites in Nairobi by pursuing four objectives: (i) establish the current level of safety management, (ii) determine influencing factors, (iii) examine their interrelationships, and (iv) formulate a practical strategy. An explanatory sequential mixed-methods design was employed. The quantitative phase surveyed 100 contractors selected through stratified random sampling from 1,447 registered projects, generating ordinal data analyzed using descriptive statistics, Spearman's rank correlation, and ordinal logistic regression. The qualitative phase, involving interviews and focus groups with regulators, managers, and workers, explained contextual dynamics. Integration of both phases ensured robust strategy formulation. Findings indicated that safety management in Nairobi is generally low to moderate. Larger firms adopt structured systems, but small and informal contractors rely on reactive practices. Key determinants included management commitment, worker training, regulatory enforcement, and PPE utilization, while economic constraints, psychosocial stressors, and weak digital adoption further undermined safety outcomes. The study concludes that Nairobi's safety environment is transitional, requiring both stronger site-level practices and systemic organizational and policy reforms. Practically, the study recommends dual reforms: strengthening practices (training, PPE, hazard monitoring) while embedding systemic strategies (leadership accountability, inspections, digital tools, and policy integration). These reforms can reframe safety from a compliance burden into an investment in productivity and workforce wellbeing. Theoretically, the study extends accident causation, safety climate, and resilience frameworks to fragmented construction sectors. For future research, the study recommends a greater focus on psychosocial well-being and economic structures as integral dimensions of construction safety.

Keywords: Construction, Safety Management, Nairobi, Strategy, Informality.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

The construction industry is widely recognized as a cardinal driver of economic growth and employment creation, both in developed and developing nations. Globally, it contributes approximately 10% to the world's Gross Domestic Product (GDP), underscoring its importance to socioeconomic development. Despite this, the sector remains among the most hazardous industries, with consistently high rates of injuries and fatalities compared to other sectors. The prevalence of accidents within construction has severe consequences, not only for workers but also for the general public, making safety a central concern in industry research and practice.

In Asia, safety concerns in construction have been particularly pronounced. Data from the Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) indicated that between 2011 and 2017, there were 4,766 construction-related fatalities, averaging 1.87 deaths per day. In response, MOHURD strengthened safety legislation, enhanced training programs, introduced accident reporting systems, and incentivized safety compliance through penalties and rewards (Assembly, 2015).

While these interventions yielded measurable progress, persistent challenges including weak enforcement, high workforce turnover, inadequate training, and limited resources continue to undermine safety outcomes as of 2025 (Xu et al., 2025). Recent findings further indicate that rapid technological advancement and the rise of digital construction methods have created new categories of safety risks, particularly associated with automation and robotics (Li et al., 2023; Wang & Chong, 2024). In the United States, the Bureau of Labor Statistics (2024) reported that construction recorded the highest occupational fatalities of any industry in 2023, with 1,075 deaths. Falls, slips, and trips accounted for 39.2% (421), and transportation incidents for 22.3% (240), resulting in a fatal injury rate of 3.5 per 100,000 full-time equivalent workers. Although OSHA continues to intervene through inspections,

training, and enforcement, the sector still faces worker shortages, training deficiencies, and persistently high injury rates. Recent literature further identifies mental health, fatigue, and stress as significant accident factors, underscoring the need to address psychosocial as well as physical hazards (Westgaard & Winkel, 2022; Brown et al., 2023).

Kenya's construction industry faces serious safety concerns. From 2015 to 2023, 9,071 workplace injuries were reported: 6,307 being minor, 1,890 requiring up to three days off, 810 with longer absences, and 64 fatal (Kennedy et al., 2025). Key causes include limited worker knowledge and poor compliance with safety regulations. The Occupational Safety and Health Act (OSHA, 2007), supported by DOSHS and the NCA, provides a framework for enforcement and training, yet challenges remain due to weak awareness, inadequate enforcement, and low stakeholder commitment. Further research shows Nairobi's rapid urbanization and informal practices heighten risks, particularly for young, inexperienced workers lacking proper safety training (Omondi & Ochieng, 2022; Hafeez et al., 2023).

The central issue across these contexts is that while the demand for safer working environments continues to grow, construction contractors often fail to fully integrate safety into their decision-making processes. Safety remains narrowly viewed as a regulatory requirement rather than as an essential organizational value and strategic priority. Although most workplace accidents are preventable, implementation of safety measures is often inconsistent, poorly monitored, or inadequately evaluated. Recent scholarship has argued for a paradigm shift, positioning safety as an enterprise-wide capability that enhances resilience, sustainability, and workforce well-being, rather than as a mere compliance activity (Nnaji et al., 2022; Xu et al., 2024).

This study addresses these gaps by proposing a strategic safety management framework tailored to the Kenyan construction industry. The framework emphasizes proactive approaches that transcend compliance, integrating safety into the core of organizational strategy and decision-making. In doing so, it seeks to reduce accidents, improve regulatory compliance, enhance productivity, and safeguard

vulnerable worker populations. Ultimately, by reframing safety as both a strategic and human-centered endeavor, this study contributes to advancing sustainable construction practices that align with global occupational health and safety goals.

1.2 Statement of the Problem

The construction industry is paradoxically regarded as a remarkable driver of economic growth and one of the most hazardous occupational sectors. While its contribution to GDP and employment is significant, safety on construction sites is often neglected and inadequately managed. In practice, safety issues are frequently raised in project management meetings, but they are routinely overshadowed by discussions centered on budgetary constraints, timelines, and quality standards. This imbalance underscores a critical gap: there is insufficient research that comprehensively examines how contractors can effectively prioritize safety, allocate resources, and navigate challenges specific to construction safety management in Nairobi (Al-Naser et al., 2024).

The Directorate of Occupational Safety and Health Services (DOSHS) annual report substantiated this concern in 2011. Between 2005 and 2009, there were 7,769 reported fatalities across all sectors in Kenya, with construction accounting for 16% of fatal accidents (40 cases per 100,000 workers) and 7% of mild cases. Similarly, a study by the Institution of Engineers of Kenya (IEK) disclosed that out of 6,295 construction workers in Nairobi, 571 sustained injuries of varying severity, including 391 minor cases not requiring time off duty, 119 requiring up to three days' leave, 51 requiring more than four days' leave, and four fatalities (Kemei et al., 2016).

Research by Nyaruai (2019) further revealed that safety management practices in Kenya's construction sector remain weak, with accidents and injuries ranging from 10% to 56% of reported cases. Worker protection was negligible, often ranging between 0% and 33%. Safety training was grossly insufficient, with formal specialized training spanning only 3.2% to 33%, and most skills being acquired informally through apprenticeship. Documentation of safety procedures was limited, while compliance levels with occupational safety laws remained critically low, with only 25% of sites achieving high conformity.

The complexity and diversity of construction projects exacerbate these risks. Each site involves unique hazards and multiple stakeholders, often with poorly defined responsibilities, which increases risk exposure. Furthermore, the industry's focus on immediate deliverables such as project timelines, cost control, and quality assurance, tends to displace safety as a priority. This lack of systematization heightens accident risks and negatively impacts workers' psychological and physical well-being, ultimately inflating both direct and indirect project costs (Nyabioge, 2022). Recent evidence highlights that psychosocial risks such as stress, fatigue, and mental health challenges are becoming major contributors to accidents, further complicating the safety landscape (Westgaard & Winkel, 2022; Brown et al., 2023).

Although regulatory institutions such as DOSHS and the National Construction Authority (NCA) have established frameworks to promote safer working conditions through legislation, training, and awareness campaigns, significant gaps persist. While compliance has improved project efficiency and reduced accident rates in some contexts, contractors continue to struggle with consistent implementation of safety management practices. Intentional violations of safety regulations—often linked to cost-cutting pressures and unrealistic deadlines—remain common. These infringements not only compromise worker safety but also disrupt project delivery, necessitate costly work suspensions, and contribute to resource overruns. Scholars have recently emphasized that Kenya's regulatory enforcement remains fragmented, with weak institutional capacity and limited integration of safety in professional training curricula (Omondi & Ochieng, 2022; Xu et al., 2024).

If such systemic shortcomings are left unaddressed, Kenya's construction industry risks facing sustained increases in workplace accidents, disabilities, serious injuries, and fatalities. This study responds to these challenges by seeking to enhance safety management through the development of a strategic framework that integrates safety awareness across multiple stakeholders, strengthens legislative enforcement, and fosters collective commitment. By reconceptualizing safety as a strategic and organizational priority rather than a regulatory afterthought, the study aims to bridge the persistent gap between safety theory and practice, thereby contributing to the realization of safer, more resilient, and sustainable construction environments.

1.3 Research Aim and Objectives

This study aimed to formulate a strategy for effective safety management in construction sites in Nairobi County. This was achieved through the following specific objectives:

1. To assess the level of safety management in construction sites in Nairobi County.
2. To determine the factors influencing the level of safety management in construction sites in Nairobi County.
3. To examine the relationship between the level and factors affecting the level of safety management in construction sites in Nairobi County.
4. To develop a strategy for effective safety management in construction sites in Nairobi County.

1.4 Research Questions

In order to achieve the stated aim and objectives of this study, the following research questions were formulated to guide the investigation and provide a structured basis for data collection and analysis.

1.4.1 What is the Current Level of Safety Management in Construction Sites in Nairobi County?

1. How does safety management system implementation in large versus small projects influence overall safety maturity in Nairobi County?
2. How do operational safety practices (PPE, hazard monitoring, incident reporting) drive continuous safety improvement in Nairobi construction sites?
3. How do organizational safety strategies (leadership, resources, digital tools) affect alignment between policies and on-site practices in Nairobi?
4. How do psychosocial and technological risks (stress, fatigue, automation) impact safety performance in Nairobi construction sites?
5. How do Accident Causation, Safety Climate, HRO, and Resilience Engineering theories explain Nairobi's transitional safety management maturity?

1.4.2 What Factors Influence the Level of Safety Management in Construction Sites in Nairobi County?

1. How does regulatory enforcement and compliance affect safety management in Nairobi construction sites?
2. How do safety culture and leadership commitment influence safety management effectiveness in Nairobi construction sites?
3. How do worker training and competence impact safety management effectiveness in Nairobi construction sites?
4. How does workforce informality affect adherence to safety standards in Nairobi construction sites?
5. How does adopting digital technologies (BIM, IoT, AI) influence safety management in Nairobi construction sites?
6. How do psychosocial and ergonomic factors (stress, fatigue, poor conditions) affect safety performance in Nairobi construction sites?
7. How does the availability and use of PPE affect safety management in Nairobi construction sites?
8. How do economic pressures influence the implementation and sustainability of safety management in Nairobi construction site?

1.4.3 What is the relationship between the level of safety management and the factors influencing it in construction sites in Nairobi County?

1. What is the relationship between regulatory enforcement and the maturity of safety management in Nairobi construction sites?
2. How does leadership commitment correlate with safety management levels in Nairobi construction sites?
3. To what extent does worker training and competence predict higher safety management maturity?
4. How does workforce informality relate to variations in safety management levels?
5. What is the association between PPE availability/use and safety management outcomes?

6. How do digital technology adoption and psychosocial/ergonomic factors relate to safety management levels?
7. How do economic pressures interact with other factors to shape safety management maturity?
8. Which combination of organizational, regulatory, and workforce factors best predicts safety management outcomes in Nairobi construction sites?

1.4.4 What Strategy Can Be Developed to Enhance Effective Safety Management In Construction Sites in Nairobi County?

1. How can site-level practices and organizational reforms be integrated to improve safety management in Nairobi construction sites?
2. How do worker training, PPE provision, and emergency preparedness enhance safety outcomes in Nairobi construction sites?
3. How can regulatory enforcement, leadership accountability, and subcontracting reforms strengthen safety management in Nairobi construction sites?
4. How do psychosocial, ergonomic, and digital monitoring interventions support adaptive and resilient safety management in Nairobi construction sites?
5. How can Accident Causation, Safety Climate, HRO, and Resilience Engineering frameworks inform a context-specific safety management strategy in Nairobi construction sites?
6. What framework can be proposed for continuous monitoring, evaluation, and improvement of safety practices in Nairobi's construction industry?

1.5 Research Hypothesis

H_0: The level of safety management is not influenced by factors affecting safety management in construction sites in Nairobi County.

H_1: The level of safety management is influenced by factors affecting safety management in construction sites in Nairobi County.

1.6 Theoretical and Operational Definitions of Terms

Key concepts underpinning the hypotheses were defined theoretically and operationally to ensure clarity and precision in their application within this study.

1.6.1 Level of Safety Management

Theoretical definition: Refers to the extent to which safety systems, practices, and procedures are implemented, monitored, and improved in an organization to protect workers and reduce risks (Zhang et al., 2020).

Operational definition: In this study, the level of safety management was measured using a composite score derived from:

1. Existence of formal safety management policies and documented safety plans.
2. Frequency and quality of safety training for staff and workers.
3. Level of management commitment (e.g., visible leadership, provision of resources).
4. Risk identification and hazard assessment practices in place.
5. Enforcement/compliance: degree of compliance with safety regulations; use of PPE; adherence to safety procedures.
6. Monitoring & evaluation: inspections/safety audits; incident/accident reporting; corrective actions taken.
7. Safety culture/safety climate metrics (workers' perceptions of safety priority, communication, and feedback).

1.6.2 Factors Affecting Safety Management

Theoretical definition: These are internal and external determinants that shape how effectively safety policies and practices are carried out. These include management commitment, worker behavior, resource availability, regulatory enforcement, and organizational culture (Muñoz-La Rivera et al., 2021).

Operational definition: In this study, the factors were operationalized as measurable variables:

1. Management commitment: measured by survey items on leadership involvement, communication, and budget allocation.
2. Training and worker attitudes*:* measured by training frequency, knowledge tests, and perception surveys.
3. Resource availability: measured by adequacy of PPE and safety equipment checklists.
4. Regulatory enforcement: measured by frequency of government inspections and penalties.
5. Safety culture: measured through survey items on perceptions of safety priority, peer support, and openness of reporting.

1.6.3 Influence (Relationship)

Theoretical definition: Influence refers to the effect or impact that one variable exerts on another, typically tested through statistical relationships such as correlations, regressions, or causal pathways (Creswell & Creswell, 2018). In this study, it reflected the extent to which independent variables (factors) predicted or explained variations in the dependent variable (level of safety management).

Operational definition

Influence was tested through statistical analysis:

1. Null hypothesis (H_0): No statistically significant relationship exists between factors and the level of safety management ($p \geq 0.05$).
2. Alternative hypothesis (H_1): A statistically significant relationship exists between factors and the level of safety management ($p < 0.05$).
3. Measured by Ordinal Logistic Regression (OLR) to assess predictive strength strength and Spearman Rank Correlation analysis to assess associations.

1.7 Significance of the Study

Treating safety as a strategic priority rather than merely a matter of regulatory compliance is fundamental to how construction firms generate long-term value, sustain competitiveness, and strengthen organizational resilience. A strategic orientation embeds safety considerations within core business decisions, reframing them from reactive cost obligations into proactive drivers of resilience, productivity, and corporate reputation. Viewing safety management through this strategic lens positions it as a critical organizational capability that shapes risk management practices, supports technological innovation, enhances workforce engagement, and contributes to overall performance (Ahmad et al., 2022; Nnaji et al., 2022).

Historically, construction safety management has focused predominantly on compliance and reactive interventions. Although such measures have improved adherence to regulations, they have not fully mitigated persistent hazards. This study advances the discourse by examining safety management both strategically and theoretically, thereby enriching scientific understanding, improving predictive accuracy, and developing frameworks for resilient safety systems (Zhang et al., 2020). Situating safety management within broader organizational behavior and management theories also promotes integrative approaches that recognize human and organizational dynamics, moving beyond narrow technical or procedural solutions (Hallowell et al., 2021).

A further contribution of this study lies in its focus on a critical yet often neglected segment of the construction workforce. Young and inexperienced workers remain disproportionately vulnerable due to limited safety training, inadequate risk perception, and greater exposure to unsafe practices. Despite their substantial presence within the industry, this demographic has been relatively marginalized in both research and practice. Prioritizing their safety is essential not only for reducing accident rates but also for fostering workforce sustainability, strengthening safety culture, and ensuring the sector’s long-term viability (Estudillo et al., 2025; Abaya, 2023).

The analysis underscores the pressing need to advance safety management in construction, a sector that continues to record some of the world's highest rates of injuries and fatalities (Nyabioge, 2022; Ohija et al., 2020). This urgency is driven by multiple imperatives: protecting human life, reducing economic and healthcare costs, adapting to rapid technological transformation, and safeguarding vulnerable workers. Without sustained scholarly and practical engagement, the industry risks ongoing preventable accidents, inefficiencies, and systemic weaknesses that undermine its contribution to sustainable development (Olutende et al., 2021; Chacha, 2020; Xu et al., 2024).

The significance of this study therefore lies in its dual advancement of safety management as both a strategic and theoretical pursuit, while foregrounding overlooked worker populations and the imperative for immediate action. By reconceptualizing safety as an organizational capability rather than a compliance obligation, the study offers critical insights for policymakers, contractors, and construction managers seeking to foster safer, more resilient, and sustainable construction environments.

1.8 Justification of the Study

Globally, construction worker safety remains a major concern, requiring systems that continuously monitor sites and reduce hazards (Zhang et al., 2020). A key challenge is the lack of a clear safety vision, with many contexts managing safety reactively, which increases accidents and injuries. The Occupational Safety and Health Act (OSHA, 2007) reflects this gap by stressing penalties for non-compliance while neglecting the need for a proactive vision. Ahmad et al. (2022) argues that developing such a vision shifts organizations from compliance to sustainable practices. A proactive, visionary strategy is therefore vital to replace fragmented, reactive approaches to safety.

Although contractors often recognize the importance of integrating safety into all decision-making processes, implementation is largely driven by the motivation to fulfill legal obligations (Abaya, 2023). Consequently, safety remains treated as a peripheral value rather than a core organizational priority. Employees, moreover, are

rarely held accountable for serious safety violations, while management fails to adequately encourage reporting of safety concerns or reward initiatives aimed at improvement. This study, therefore, seeks to address a critical gap in literature: the need to understand contractors' safety climate from both managerial and worker perspectives, particularly in relation to what is expected, rewarded, and supported in the workplace.

Safety training, as Estudillo et al. (2025) note, is largely shaped by national standards and regulations. In Kenya, although safety and risk prevention laws set minimum training requirements, inadequate and inconsistent training remains the main cause of construction fatalities (Nyabioge, 2022). Ohija et al. (2020) report that about 70% of construction injuries stem from poor safety knowledge, reflected in workers' inability to identify, anticipate, and respond to hazards. This study is distinctive in emphasizing strategies to strengthen workers' capacity to recognize risks, shaping their attitudes toward hazardous situations, and improving safety practices overall.

The role of Personal Protective Equipment (PPE) in safeguarding construction workers against risks such as falling objects, exposure to chemicals, ergonomic hazards, dangerous tools, and electrical shocks cannot be overstated. However, despite its proven importance, barriers such as limited availability, insufficient worker training, weak managerial commitment, regulatory laxity, and negative worker attitudes continue to undermine effective PPE adoption (Olutende et al., 2021). As such, there is a pressing need for strategies that promote PPE acceptance through comprehensive training, increased awareness of its benefits, reinforcement of legal frameworks, and the integration of awareness measures to optimize PPE effectiveness.

Beyond PPE, effective hazard monitoring on construction sites is vital. The Ministry of Labour (2012) cites weak institutional and legal frameworks, along with limited human and financial resources, as major barriers to safety in Kenya. Chacha (2020) adds that poor data management and limited integration of OSH in education contribute to skill gaps and weak safety practices. This study proposes a proactive hazard monitoring framework that prioritizes emergency response planning and

continuous improvement through real-time data. Such an approach supports efficient hazard tracking while strengthening the development and sustainability of safety management systems.

1.9 Scope of the Study

This study examined safety management within construction sites in Nairobi County, Kenya, focusing on developing a strategic framework for effective safety practices. It emphasizes how contractors and other stakeholders prioritize safety, the factors shaping management practices, and ways safety can be integrated into organizational decision-making. Although acknowledging broader national and international implications, the study's scope is limited to Nairobi County, chosen for its rapid urbanization, high concentration of construction projects, and frequent workplace accidents.

Methodologically, it employed a mixed-methods approach, combining quantitative surveys and qualitative interviews with site managers, site supervisors, and workers across a purposive sample of construction sites in Nairobi. Secondary data drawn from regulatory agencies, industry reports, and academic literature was also utilized to complement the primary data. The research was cross-sectional in design, focusing on current safety practices and perceptions rather than on longitudinal changes. Consequently, the findings were context-specific and may not be generalizable to all regions of Kenya or beyond.

Theoretically, the study was grounded in safety culture and risk management frameworks, which provided lenses for understanding how organizational values, managerial attitudes, and systemic factors influence safety outcomes. It proceeded on the assumption that effective safety management was not merely a function of compliance but required strategic integration into decision-making processes at all organizational levels. The theoretical scope did not extend to the development of new theories but rather to the application and contextual adaptation of existing models to the construction sites in Nairobi County.

In terms of temporal limits, the study was bound to the period between 2024 and 2025, reflecting both recent accident trends and contemporary safety management practices in Nairobi. Earlier data was referenced only for historical context, while projections beyond 2025 fell outside the boundaries of this research. The analysis therefore situated itself firmly within the current realities of Nairobi County's construction sector while offering insights for immediate and near-future policy and practice.

1.10 Limitations of the Study

This study was subject to several limitations that influence the scope, depth, and generalizability of its findings. These limitations arose from methodological considerations, challenges in data access, and constraints related to data availability.

1.10.1 Methodological Limitations

A key methodological limitation arose from the complex and diverse nature of Nairobi's construction projects. With multiple stakeholders, distinct risk profiles, and dynamic operations, generalizing findings across all sites was difficult. Sampling also posed challenges, as safety practices differed widely between large contractors, SMEs, and informal builders, making true representation hard to achieve. The study further noted the difficulty of measuring abstract constructs such as safety climate, attitudes toward PPE, and proactive safety culture. These concepts are not easily quantifiable, which may have constrained the accuracy of measurement instruments.

1.10.2 Data Access Limitations

The study was also constrained by challenges in accessing relevant data. Official accident and fatality records from institutions such as the Directorate of Occupational Safety and Health Services (DOSHS), the National Construction Authority (NCA), and private firms were often subject to strict confidentiality policies and bureaucratic procedures. This restricted access limited the comprehensiveness of the dataset used in the analysis. Moreover, some contractors resisted sharing safety performance

information due to concerns about reputational risks, possible regulatory penalties, or project delays.

1.10.3 Data Availability Limitations

Beyond access, the study also faced limitations related to the availability and quality of data. Government statistics on occupational health and safety were sometimes incomplete, outdated, or not reflective of current realities, thereby constraining the accuracy of trend analysis. Reporting systems for construction accidents were often fragmented, with widespread underreporting of minor injuries and inconsistent submission of safety data across firms. This inconsistency weakened the comprehensiveness of the datasets used.

In addition, most official records captured incidents within a specific year and lacked longitudinal detail that would reveal long-term patterns of safety performance across projects or contractors. Finally, the availability of locally relevant research remained limited. Much of the existing literature on construction safety management originated from Asia, Europe, or the United States, while context-specific studies for Kenya were scarce. This narrowed the comparative base for the study and limited opportunities to benchmark findings against a robust body of Kenyan research.

1.11 Assumptions of the Study

This study was guided by several underlying assumptions that informed its theoretical foundation, methodological approach, and practical orientation. These assumptions were necessary to frame the scope of inquiry, provide clarity in interpretation, and establish boundaries within which the findings could be understood. They were categorized into theoretical and methodological assumptions as outlined below.

1.11.1 Theoretical Assumptions

The study proceeded on the assumption that safety management in the construction industry was directly linked to accident reduction, worker well-being, and overall project efficiency (Lingard & Rowlinson, 2020). It was further presumed that

integrating safety into decision-making processes at all levels of management (not solely at the site level) had the potential to significantly reduce risks (Zou & Sunindijo, 2015).

This research viewed construction safety challenges as systemic, stemming not only from individual negligence but also from structural issues such as inadequate training, weak regulatory enforcement, and resource limitations (Choudhry & Fang, 2021). It also assumed that greater compliance with safety regulations led to safer worksites (Mohamed, 2019). Furthermore, the study held that a strategic, structured approach to safety management (rather than ad hoc or reactive measures) was essential for achieving sustainable improvements in safety outcomes (Hallowell et al., 2021).

1.11.2 Methodological Assumptions

From a methodological perspective, the study assumed that reported accident and fatality statistics represented accurate and reliable indicators of the safety situation in the construction sector (International Labour Organization [ILO], 2022). It was also assumed that studies conducted in diverse contexts, including China, the United States, and Kenya, were sufficiently comparable, allowing lessons from one context to inform another (Zhang et al., 2020; Wachira, 2018).

In addition, the research presumed that contractors' decision-making processes regarding safety could be examined and generalized despite variations in project size, type, and stakeholder composition (Aksorn & Hadikusumo, 2008). It further assumed that past research findings, such as those of Nyaruai (2019) and Kemei et al. (2016), remained relevant and reflective of current conditions in Nairobi's construction sector. Finally, the study was based on the assumption that stakeholders; contractors, regulators, and workers, were likely to respond to policy changes, training initiatives, and awareness programs in reasonably predictable ways (Fang et al., 2020).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This review evaluates operational safety practices, PPE use, hazard inspections, and toolbox talks, alongside systemic strategies such as leadership commitment, policy integration, and resource allocation. Drawing on Accident Causation Models, Safety Climate Theory, High-Reliability Organization (HRO) Theory, and Resilience Engineering, it explores how daily practices interact with organizational strategies to shape safety outcomes. Incorporating local and global evidence, emerging risks, and contextual realities, the review identifies gaps between practical measures and long-term strategies in Nairobi's fragmented construction sector. It begins by examining the theoretical foundations linking site-level practices with organizational strategies.

2.2 The Theoretical Grounding of the Study

A sound theoretical foundation is vital for framing effective construction safety strategies, as theories shape how challenges are understood, practices interpreted, and strategies developed. This study, focusing on Nairobi County, drew on Accident Causation, Safety Climate, High-Reliability Organization (HRO), and Resilience Engineering theories. These frameworks clarified the distinction between safety practices (daily operational behaviors) and safety strategies; systematic approaches embedding safety into organizational culture and project management.

2.2.1 Accident Causation Theories

Accident causation models, including Heinrich's Domino Theory and Reason's Swiss Cheese Model, posit that accidents are not random but stem from identifiable chains of failure within systems (Fang et al., 2020). Within Nairobi's construction context, unsafe acts such as improper use of Personal Protective Equipment (PPE) or inadequate scaffolding are often the proximate causes of accidents. However, underlying systemic issues such as poor planning, lack of training, or weak enforcement of regulations serve as latent conditions that make accidents more likely

(Zhang et al., 2020). From this perspective, safety practices (e.g., adherence to PPE protocols) act as immediate controls, while safety strategies (e.g., structured safety training frameworks, systematic hazard identification processes) address the underlying causes.

2.2.2 Safety Climate Theory

Safety Climate Theory emphasizes workers' shared perceptions of the importance placed on safety within an organization (Zhang, Lingard, & Nevin, 2020). In construction sites, this climate shapes whether employees comply with safety practices voluntarily or resist them. A positive safety climate encourages reporting of hazards, compliance with procedures, and proactive engagement with safety initiatives (Brown, Chen, & Patel, 2023). Safety practices such as toolbox talks, routine inspections, and feedback loops are influenced by safety climate. Safety strategies, on the other hand, involve leadership commitment, integration of safety goals into project planning, and transparent communication channels. In Nairobi's construction sector, where informal practices and resource limitations often undermine safety, strengthening safety climate is a critical strategy to sustain effective practices.

2.2.3 High-Reliability Organization (HRO) Theory

HRO theory argues that organizations operating in high-risk environments can achieve exceptional safety performance by cultivating mindfulness, preoccupation with failure, and redundancy in safety systems (Westgaard & Winkel, 2022). Construction sites in Nairobi, characterized by complexity and multiple subcontractors, resemble high-reliability settings. Here, safety practices (e.g., double-checking scaffolds, cross-verification of electrical systems) reflect operational mindfulness, while safety strategies (e.g., embedding safety checkpoints in project schedules, assigning independent safety officers) institutionalize these practices at the organizational level. This theory underscores the necessity of not only having safety practices but also building organizational systems that consistently reinforce them.

2.2.4 Resilience Engineering

Resilience Engineering provides a complementary theoretical lens by focusing on an organization's ability to anticipate, adapt, and recover from unexpected disruptions (Hafeez, Khan, & Zhao, 2023). Construction projects in Nairobi often face dynamic challenges, including fluctuating labor availability, regulatory inconsistencies, and resource shortages. Safety practices here may involve adaptive measures such as improvising safe scaffolding procedures under material constraints. Safety strategies, however, focus on embedding resilience in organizational processes; for instance, through scenario planning and simulation-based safety training. Resilience Engineering highlights the interplay between micro-level practices and macro-level strategies in sustaining safety performance in uncertain environments.

2.2.5 Distinguishing Safety Practices and Safety Strategies

It was important to distinguish clearly between safety practices and safety strategies. Practices refer to the specific, routine activities and behaviors performed on construction sites to prevent accidents and manage hazards, for example, wearing PPE, conducting safety drills, or carrying out hazard inspections (Olutende, Musau, & Okoth, 2021). Strategies, in contrast, represent the long-term, systemic approaches organizations use to embed safety into their culture and operations, such as policy formulation, safety leadership, integration of safety into design and planning, or digitalization of monitoring systems (Wang & Chong, 2024). While practices operationalize safety on the ground, strategies provide the framework within which practices are sustained and improved.

In this study, safety practices and strategies were treated as interdependent. Strategies guided the design, prioritization, and sustainability of practices, while practices provided feedback on the effectiveness of strategies. This dynamic interplay was particularly critical in Nairobi's construction sector, where fragmented project environments and resource challenges necessitated a balance between practical site-level interventions and robust organizational frameworks.

2.3 The Level of Safety Management in Construction Sites in Nairobi County

Understanding the level of safety management in construction sites within Nairobi County was critical because it revealed not only the strengths and weaknesses of existing interventions but also the gaps between site-level practices and organizational strategies. While practices refer to day-to-day measures applied at the site, strategies denote broader frameworks, leadership commitments, and systemic approaches that guide sustainable safety improvement.

The current state of safety management in Nairobi reflects both progress and persistent shortcomings. Although larger contractors and formal projects demonstrate structured systems, much of the sector, especially small-scale and informal construction, remains characterized by reactive, compliance-driven approaches. This section analyzed the level of safety management in Nairobi County, distinguishing between practices and strategies, highlighting emerging risks, interpreting findings through established theories, and drawing implications for improvement.

2.3.1 Current State: Overall Maturity and Sector Snapshot

The construction industry in Nairobi County occupies a central role in Kenya's economic growth, but it also records some of the highest workplace accidents in the country. Recent studies consistently highlight that the safety management maturity level in Nairobi is low to moderate; characterized by the coexistence of formalized safety practices in large-scale projects and weak or absent safety protocols in smaller or informal works (Omondi & Ochieng, 2022; Chacha, 2020).

Projects funded by government agencies, international donors, or multinational developers tend to adopt structured safety management systems (SMSs) with written safety policies, dedicated safety officers, and compliance audits (Nnaji, Gambatese, & Karakhan, 2022). In contrast, informal and small-scale construction firms (which account for a substantial portion of Nairobi's building activities) often lack formal SMSs and rely on ad hoc safety practices driven by immediate project needs (Olutende, Musau, & Okoth, 2021).

This dual reality indicates that while Kenya has advanced regulatory frameworks under the Occupational Safety and Health Act (2007) and the National Construction Authority guidelines, translation into practice is inconsistent. The level of safety management is therefore fragmented: some sites meet international standards, while others operate with minimal controls. Such fragmentation undermines sector-wide progress and sustains persistently high accident rates (ILO, 2022; Wang & Chong, 2024).

2.3.2 Safety Practices in Sites (Operational Measures)

At the operational level, most Nairobi construction sites implement basic practices, though these are inconsistently enforced. These practices include the use of personal protective equipment (PPE), daily toolbox talks, fire extinguishers, scaffolding inspections, and periodic site audits. However, PPE compliance remains a chronic challenge. Olutende et al. (2021) found that only about 60% of construction workers consistently used helmets and safety boots, with compliance for gloves, harnesses, and masks being significantly lower. Barriers included cost, lack of replacement, discomfort and weak supervisory follow-up.

Hazard monitoring and incident reporting also demonstrate limitations. Chacha (2020) observed that many Nairobi sites relied on manual recordkeeping, which was prone to underreporting and delays. Workers often feared retaliation for reporting accidents or near misses, while employers prioritized reputation and deadlines over transparency. This undermined learning from past incidents and hampered proactive risk management. Overall, practices exist but are reactive; implemented to satisfy regulatory inspections or client audits rather than embedded in organizational culture. Without sustained monitoring and follow-through, these measures reduce risks only temporarily but fail to drive continuous safety improvement (Fang, Wu, & Dong, 2020).

2.3.3 Safety Strategies (Organizational and Systemic Approaches)

Whereas practices are site-level interventions, strategies represent organizational commitments and systemic approaches to safety management. Strategic integration

includes leadership involvement, allocation of resources, integration of safety into project planning, and establishing a clear safety vision.

In Nairobi County, research indicates that such strategic approaches are uneven. Larger contractors often adopt formalized strategies, such as integrated OSH management systems, safety budget allocations, appointment of safety officers, and contractual enforcement of safety standards (Nnaji et al., 2022). However, many medium and small firms view safety as a cost center rather than a value-adding component of project delivery (Ahmad, Ali, & Khan, 2022).

Despite digital transformation offering strategic opportunities such as Building Information Modelling (BIM)-based hazard simulation, drone monitoring, and digital reporting systems (Li, Ding, & Luo, 2023; Xu, Li, & Wang, 2024), the uptake of such technologies remains limited to larger projects, with small and informal firms unable to afford or operate these tools. Consequently, Nairobi's construction sector is characterized by a weak alignment between strategy and practice: where strategies exist, they are often not translated into consistent daily practices, and where practices exist, they are not reinforced by long-term strategic commitment.

2.3.4 Emerging Risks and Psychosocial Dimensions

Recent scholarship emphasizes that safety management is not only about physical hazards but also about emerging risks such as psychosocial stressors, mental health, and new technologies. In Nairobi, construction workers frequently face long working hours, poor housing, and limited social protection, which contributes to fatigue and stress (Brown, Chen, & Patel, 2023). Psychosocial risks remain largely unrecognized in current safety frameworks, increasing vulnerability to human error and accidents.

Moreover, the growing adoption of automation and robotics in Kenyan construction introduced new risks, including insufficient worker training, machine-related accidents, and resistance to technological change (Li et al., 2023). Without strategic preparation, these technological transitions may exacerbate safety gaps rather than mitigate them. As Westgaard and Winkel (2022) argue, psychosocial and

technological risks must be integrated into comprehensive safety strategies, moving beyond the narrow focus on PPE and physical hazards.

2.3.5 Theoretical Interpretation: How Theories Explain the Observed Level

The theoretical grounding of this study provides lenses for interpreting Nairobi's current safety management status:

Accident Causation Models: Latent conditions such as inadequate training, poor planning, and weak supervision align with unsafe worker behaviors to cause accidents, explaining the persistence of high incident rates (Zhang et al., 2020).

Safety Climate Theory: Workers' perceptions of management's true commitment to safety strongly influence their behavior. In Nairobi, inconsistent leadership and poor enforcement foster a weak safety climate, undermining compliance (Fang et al., 2020).

High-Reliability Organization (HRO) Theory: Large projects with dedicated safety officers and proactive monitoring exhibit traits of reliability (preoccupation with failure, redundancy). Most SMEs, however, lack these features, which increases risk exposure (Hallowell, Hinze, & Behm, 2021).

Resilience Engineering: The sector lacks robust capacities for anticipation, adaptation, and learning, which are necessary to manage emerging psychosocial and technological risks (Xu et al., 2024).

These frameworks collectively illustrate why safety management in Nairobi remains at a transitional stage; strategic intent and practices are present but not systematically aligned to produce resilience.

2.3.6 Comparative View: Safety Practices VS. Safety Strategies

Table 2.1: Comparison of Site-Level and Systemic Safety Approaches in Nairobi County

Aspect	Safety Practices (Site-Level)	Safety Strategies (Organizational/Systemic)	Status in Nairobi County
Definition	Day-to-day operational measures that directly reduce risks (e.g., PPE, toolbox talks).	Long-term, systemic approaches involving leadership, policy, planning, and resource allocation.	Practices are present but reactive; strategies are partial and concentrated in large firms.
Examples	PPE usage, scaffolding checks, toolbox meetings, ad-hoc hazard monitoring.	Safety vision, SMS implementation, leadership accountability, and digital transformation.	Practices common but inconsistent; strategies fragmented.
Theoretical Link	Accident Causation Models, Safety Climate Theory.	HRO Theory, Resilience Engineering.	Weak climate and resilience limit effectiveness.
Challenges	Inconsistent enforcement, underreporting, and cultural resistance.	Limited leadership buy-in, resource constraints, lack of integration.	Both levels are underdeveloped but mutually dependent.
Implication	Reduce immediate risk but lack sustainability.	Drive systemic resilience, but it is ineffective without practices.	Need for integration of strategies and practices.

Note. PPE = Personal Protective Equipment; SMS = Safety Management Systems.

Source: Author

Table 2.1 provides a comparative view of site-level safety practices and organizational or systemic safety strategies, highlighting how both dimensions interact to shape construction safety outcomes in Nairobi County. The table is anchored in the theoretical understanding that safety management operates simultaneously at two interdependent levels: the operational level, where hazards are directly controlled through daily practices, and the strategic or systemic level, where long-term frameworks, leadership commitment, and institutional mechanisms determine the sustainability of those practices. This duality reflects the conceptual distinction between safety climate and safety culture discussed in the literature, where operational measures reflect immediate behaviors, while systemic strategies reflect deeper organizational values and structures (Brown, Chen, & Patel, 2023; Ahmad, Ali, & Khan, 2022).

As shown in the table, site-level safety practices such as the use of PPE, scaffolding checks, toolbox meetings, and hazard monitoring, represent the visible and immediate controls that mitigate risk at the worker level. These practices correspond with the Accident Causation Models and Safety Climate Theory, which emphasize that accidents often stem from unsafe acts or conditions that can be mitigated through training, supervision, and compliance with safety procedures (Zhang et al., 2020; Olutende, Musau, & Okoth, 2021). However, the literature and field findings consistently show that such practices in Nairobi are reactive and inconsistent, often implemented after incidents occur or only under regulatory pressure. This limited implementation stems from cultural resistance, weak enforcement, and insufficient resources, as observed in studies of PPE noncompliance and irregular safety inspections (Olutende et al., 2021).

In contrast, organizational and systemic safety strategies such as leadership accountability, Safety Management Systems (SMS), regulatory enforcement mechanisms, and digital integration, address the structural and cultural drivers of safety performance. These strategies align with High-Reliability Organization (HRO) Theory and Resilience Engineering, which emphasize foresight, redundancy, and continuous learning as essential features of safe organizations (Hallowell, Hinze, & Behm, 2021; Hafeez, Khan, & Zhao, 2023). However, the table indicates that in

Nairobi County, such strategies are fragmented and unevenly applied, primarily concentrated among large, formal contractors, while small and medium-sized firms often lack structured systems, leadership oversight, or long-term safety planning. This pattern mirrors global findings that SMEs tend to adopt reactive, compliance-based approaches rather than integrated, preventive ones (Nnaji, Gambatese, & Karakhan, 2022).

The comparative analysis in table 2.1 further demonstrates that both safety practices and strategies in Nairobi remain underdeveloped yet mutually dependent. Site-level practices reduce immediate risks but cannot deliver sustained safety improvement without systemic reinforcement through policy, leadership, and organizational learning. Conversely, systemic strategies such as digital monitoring or safety culture programs, are ineffective without strong site-level compliance and worker engagement. This dual dependency supports the argument advanced in this study that effective safety management must integrate daily operational measures with organizational and systemic reforms. Such integration fosters resilience, ensures continuity of safety practices, and promotes a culture of shared responsibility across all levels of the construction process.

Ultimately, the table underscores the central rationale of this study: that Nairobi's construction sector must transition from fragmented, reactive safety efforts toward a holistic, proactive, and systemically integrated safety management model. This study contributes to filling the literature gap by developing a context-specific strategy that operationalizes this integration; bridging site-level practices with organizational systems, guided by the theoretical lenses of Safety Climate, Accident Causation, HRO, and Resilience Engineering theories.

2.4 Factors Influencing the Level of Safety Management in Construction Sites in Nairobi County.

The level of safety management in Nairobi's construction sector is influenced by regulatory enforcement, organizational safety culture, worker training, informality, technology adoption, psychosocial conditions, PPE availability, and economic

pressures. These factors are interconnected, and gaps in one area often weaken overall safety performance. These factors were:

2.4.1 Regulatory Enforcement and Compliance

The extent to which construction firms in Nairobi comply with occupational safety and health (OSH) regulations directly shapes safety outcomes. Weak enforcement, bureaucratic delays, and limited inspection capacity often result in partial compliance, particularly among small and informal contractors. Studies indicate that despite the Occupational Safety and Health Act in Kenya, enforcement remained inconsistent, undermining worker protection (Omondi & Ochieng, 2022). Effective regulatory oversight was therefore a critical determinant of safety management levels.

2.4.2 Organizational Safety Culture and Leadership Commitment

Safety culture within construction firms determines how safety is prioritized relative to cost and timelines. Leadership that actively integrates safety into project planning fosters higher compliance and accountability. Evidence shows that strong leadership commitment is linked to reduced accident rates and improved worker behavior (Ahmad et al., 2022). In Nairobi, where profit margins and deadlines often override safety, weak safety cultures undermine effective safety management.

2.4.3 Worker Training and Competence

Training equips workers with knowledge of hazards and appropriate protective measures. Young and inexperienced workers in Nairobi's construction sector are particularly vulnerable due to limited exposure to structured safety training (Hafeez et al., 2023). Limited investment in continuous training among contractors reduces safety awareness and increases accident risks.

2.4.4 Informality and Nature of the Construction Workforce

A significant portion of Nairobi's construction workforce is employed informally, often without formal contracts or access to safety equipment. Informality contributes

to weak accountability and poor adherence to safety standards (Chacha, 2020). Workers in informal setups are also less likely to report accidents due to fear of job loss, further masking the true safety situation.

2.4.5 Technological Adoption in Safety Management

The integration of digital technologies such as Building Information Modeling (BIM), Internet of Things (IoT), and Artificial Intelligence (AI) enhances proactive safety monitoring. However, adoption in Nairobi remains limited due to high costs and inadequate technical capacity (Li et al., 2023). Consequently, construction safety management is still largely manual and reactive, limiting its effectiveness.

2.4.6 Psychosocial and Ergonomic Factors

The mental and physical well-being of workers also influences safety performance. Long working hours, poor ergonomics, and psychosocial stress increase the likelihood of unsafe behaviors and accidents (Westgaard & Winkel, 2022). In Nairobi, where workers often operate in congested and poorly resourced sites, these factors exacerbate safety challenges.

2.4.7 Availability and Utilization of Personal Protective Equipment (PPE)

Access to and proper utilization of PPE is a core element of safety management. In Nairobi, barriers such as cost, lack of enforcement, and worker negligence reduce effective PPE use (Olutende et al., 2021). This limitation weakens the overall level of safety management, especially in smaller projects.

2.4.8 Global and Local Economic Pressures

Construction firms in Nairobi faced financial constraints that limit investment in safety infrastructure. Economic pressures often push contractors to prioritize cost-cutting and project speed over safety provisions (Nnaji et al., 2022). This compromises the sustainability of safety strategies in the sector.

2.5 Review of Related Studies

The review of related studies presented in this section examines global and local evidence on safety management in construction, with a particular focus on the distinction between safety practices and safety strategies. Safety practices refer to the day-to-day operational measures employed at construction sites, while safety strategies represent long-term, systemic approaches designed to embed safety into organizational culture and management frameworks (Wang & Chong, 2024).

2.5.1 Safety Practices in Construction

Studies have consistently highlighted that safety practices such as the use of PPE, hazard inspections, toolbox talks, and emergency drills form the operational backbone of construction safety (Olutende, Musau, & Okoth, 2021). In Nairobi, research indicates that although these practices are present, their implementation is inconsistent. For example, PPE usage remained partial, with less than two-thirds of workers reporting consistent compliance, often due to affordability, discomfort, and inadequate enforcement (Olutende et al., 2021).

Globally, similar challenges persist. In China, Zhang et al. (2020) noted that despite regulations, workers often neglected PPE and hazard reporting due to weak supervision. In Australia, Brown, Chen, and Patel (2023) found hazard monitoring effective only when reinforced by a strong safety climate that encouraged reporting without fear of retaliation. These studies highlight that while practices reduce risks, their effectiveness depends on organizational and cultural contexts.

2.5.2 Safety Strategies in Construction

Unlike practices, safety strategies involve systemic, long-term approaches such as leadership commitment, resource allocation, integration of safety into project planning, and adoption of digital technologies (Li, Ding, & Luo, 2023). In Nairobi, large-scale and government-funded projects were found to adopt Structured Safety Management Systems (SMSs), with formal policies, dedicated safety officers, and contractual enforcement of safety standards (Nnaji, Gambatese, & Karakhan, 2022).

However, small and informal firms; which account for a significant share of construction activity, often lack formal strategies, viewing safety as a cost rather than an investment (Ahmad, Ali, & Khan, 2022).

International studies show that strong strategic approaches build long-term safety resilience. Xu, Li, and Wang (2024) found that digital tools like BIM and IoT improved hazard anticipation and reporting in China, while Hallowell, Hinze, and Behm (2021) showed that applying HRO principles such as preoccupation with failure and redundancy, reduced accidents sustainably. Overall, practices mitigate immediate hazards, but strategies provide the frameworks to institutionalize safety. Nairobi's construction sector still faces a major gap in aligning these two dimensions.

2.5.3 Emerging Risks and Broader Dimensions of Safety

Recent studies emphasize that safety management must extend beyond physical hazards to include psychosocial, ergonomic, and technological risks. Brown et al. (2023) highlight the rising importance of worker well-being, noting that long hours, fatigue, and mental stress increase accident risks. In Nairobi, construction workers often face poor working conditions, limited social protection, and unstable employment, which exacerbate psychosocial risks (Omondi & Ochieng, 2022).

Technological risks are also becoming increasingly relevant. Li et al. (2023) cautioned that while automation and robotics enhanced efficiency, insufficient worker training and resistance to change introduced new hazards. These findings suggest that resilience in safety management requires adaptive strategies capable of addressing both traditional and emerging risks.

2.5.4 Theoretical Insights from Related Studies

The reviewed studies align with the theoretical frameworks underpinning this study. Accident Causation Theories explain how unsafe acts, such as not wearing PPE, interact with latent organizational failures like inadequate training to cause accidents (Zhang et al., 2020). Safety Climate Theory emphasizes that workers' perceptions of

leadership commitment strongly shape compliance (Brown et al., 2023). HRO Theory accounts for higher reliability in large, structured projects compared to small, informal setups (Hallowell et al., 2021). Resilience Engineering underscores the need for adaptive capacities to address uncertainties like labor shortages and regulatory inconsistencies (Hafeez, Khan, & Zhao, 2023).

Collectively, these insights demonstrate that Nairobi's construction sector is at a transitional stage: practices are present but reactive, and strategies are fragmented and concentrated in larger firms, justifying the current study's focus on developing a strategy for effective safety management that aligns site-level practices with organizational frameworks

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2.5.5 Summary Matrix of Reviewed Studies

Table 2.2: Summary of Key Studies on Construction Safety Management and Identified Gaps

Author(s), Year	Focus of Study	Context	Key Findings	Gap Identified
Olutende, Musau, & Okoth (2021)	PPE usage and compliance	Nairobi, Kenya	Inconsistent PPE usage; cost and enforcement barriers	Lack of systemic strategies to support practices
Zhang et al. (2020)	Accident causation and unsafe acts	China	Unsafe behaviors linked to systemic weaknesses	Need for integration of causation models into strategy
Brown, Chen, & Patel (2023)	Safety climate and worker compliance	Australia	Positive climate improves hazard reporting and compliance	Weak climate in Nairobi contexts
Nnaji, Gambatese, & Karakhan (2022)	Safety management systems	Global/large projects	Structured SMS improve outcomes	Limited adoption in SMEs
Ahmad, Ali, & Khan (2022)	Leadership and safety culture	Pakistan	Leadership commitment reduces accidents	Leadership gaps in Nairobi
Li, Ding, & Luo (2023)	Digital tools in safety management	China	BIM/IoT enhance monitoring	Limited technological uptake in Nairobi
Hafeez, Khan, & Zhao (2023)	Resilience in construction safety	Asia	Adaptive strategies improve recovery	Weak resilience capacities in Nairobi
Xu, Li, & Wang (2024)	Digital transformation of safety	China	BIM and AI improve hazard anticipation	Low uptake in Nairobi's informal sector
Hallowell, Hinze, & Behm (2021)	HRO principles in construction	U.S.	Reliability principles reduce accidents	SMEs in Nairobi lack HRO features

Note: BIM= Building Information Modelling, SMEs = Small and Medium Enterprises, U.S = United States

Source: Author

The matrix presented in Table 2.2 consolidates empirical and theoretical contributions from global and local studies on construction safety management, situating this research within existing knowledge while identifying critical gaps addressed by the present study. Collectively, the reviewed studies underscore that effective safety management is multidimensional, encompassing behavioral, managerial, systemic, and technological components. However, the synthesis also reveals a persistent divide between developed and developing contexts, where systemic integration, leadership commitment, and digital innovation remain unevenly applied.

Locally, the work of Olutende, Musau, and Okoth (2021) highlights that while personal protective equipment (PPE) compliance is recognized as essential, actual usage in Nairobi construction sites remains inconsistent due to enforcement weaknesses and cost constraints. This aligns with findings from Ahmad, Ali, and Khan (2022) in Pakistan, where leadership commitment emerged as a crucial determinant of safety culture. Both studies reveal that without strong managerial accountability and systemic support, safety practices remain reactive rather than preventive. Similarly, Brown, Chen, and Patel (2023) emphasize that a strong safety climate encourages reporting and compliance; however, this condition is largely absent in Nairobi, where fragmented supervision and informal practices erode trust and accountability.

In the broader international literature, Zhang et al. (2020) and Hallowell, Hinze, and Behm (2021) demonstrate that unsafe acts and accident causation are rooted in systemic deficiencies rather than individual negligence. Their insights reinforce the need for Nairobi's construction sector to adopt holistic frameworks such as Accident Causation Models and High-Reliability Organization (HRO) principles, which emphasize redundancy, vigilance, and continuous learning. Furthermore, Nnaji, Gambatese, and Karakhan (2022) show that structured Safety Management Systems (SMS) significantly enhance safety outcomes in large, formalized projects, yet similar systems are largely absent among small and medium-sized enterprises (SMEs) in Nairobi; an observation echoed throughout this study's findings.

Technological and resilience dimensions are also prominent in recent literature. Studies by Li, Ding, and Luo (2023) and Xu, Li, and Wang (2024) demonstrate the transformative role of digital tools; particularly Building Information Modelling (BIM), Internet of Things (IoT), and artificial intelligence, in monitoring hazards and anticipating risks. Nevertheless, Nairobi's construction sector remains characterized by low digital uptake, limited resources, and informality, constraining technological adaptation. Complementarily, Hafeez, Khan, and Zhao (2023) reveal that resilience and adaptive capacity are essential for recovery and prevention in dynamic construction environments. In Nairobi, however, the lack of learning mechanisms and proactive risk anticipation limits the sector's resilience and ability to respond effectively to emerging safety challenges.

The reviewed literature converges on the premise that safety management transcends individual compliance, representing instead a function of systemic integration, leadership commitment, and continuous organizational learning. Existing research reveals persistent fragmentation within Nairobi's construction sector, where safety initiatives are frequently implemented in isolation, inadequately funded, and weakly enforced. This study addresses these deficiencies by proposing a proactive, context-specific safety management framework that aligns daily operational practices with broader organizational and systemic structures. It adapts and extends established global theories such as Safety Climate, Accident Causation, High Reliability Organization (HRO), and Resilience Engineering, to Nairobi's resource-constrained environment, thereby bridging the gap between abstract theoretical constructs and local industry realities. In doing so, the research not only addresses a critical gap in the literature but also enriches both theoretical and practical understanding of how safety management systems can be effectively strengthened within developing construction contexts.

2.6 Research Gap

A review of recent literature revealed that while significant progress had been made in understanding and advancing construction safety management globally, critical

gaps remained when contextualized to Nairobi County. Fang, Wu, & Dong (2020) emphasized behavioral-based safety management and its role in shaping worker conduct. While this work identified unsafe behaviors as immediate contributors to accidents, it did not sufficiently examine how broader systemic issues - such as informality and weak regulation in Nairobi - sustained these unsafe practices.

Zhang, Lingard, & Nevin (2020) explored the connection between safety climate and performance, establishing that perceptions of management commitment strongly affected compliance. However, most findings were drawn from formalized and structured construction environments, leaving limited insights into informal or resource-constrained contexts like Nairobi's small and medium contractors.

Olutende, Musau, and Okoth (2021) provided one of the few Nairobi-specific studies, highlighting inconsistent PPE use and weak enforcement. Yet, the study's focus was largely descriptive and didn't extend to how safety strategies (e.g., systemic integration) could sustainably improve practices at the site level. Hallowell, Hinze, and Behm (2021) advanced high-reliability principles, showing how organizations can embed resilience in safety management. While useful, such principles assumed relatively strong organizational structures. This left a gap in adapting HRO concepts to fragmented and informal project setups in Nairobi, where many contractors operated without dedicated safety units.

Ahmad, Ali, and Khan (2022) demonstrated the role of leadership commitment in fostering safety culture. However, their work focused on broader developing economies without narrowing down to Nairobi's unique interplay of informality, rapid urban growth, and regulatory limitations, leaving contextual gaps unaddressed. Nnaji, Gambatese, and Karakhan (2022) examined global best practices in Safety Management Systems (SMSs). While this contributed strategic insights, their findings highlighted limited application in low-resource settings. Nairobi's construction sector, where SMS adoption is inconsistent, requires more context-specific frameworks that balance cost, culture, and enforcement.

Omondi and Ochieng (2022) analyzed regulatory enforcement challenges in Nairobi and confirmed weak compliance as a barrier. Yet, their study largely framed this in terms of regulation, without sufficiently connecting enforcement gaps to organizational culture, training, and systemic strategy adoption. Hafeez, Khan, and Zhao (2023) emphasized Resilience Engineering and adaptive safety management. While they provide models for anticipating and mitigating risks, the study was conducted outside of East Africa, and it remains unclear how resilience frameworks can be localized for Nairobi's unpredictable, informal construction environments.

Brown, Chen, and Patel (2023) highlighted psychosocial risks and their effects on compliance and accident rates. While this represents a critical expansion of safety discourse, psychosocial risks remain underexplored in Nairobi's context, where long working hours, low wages, and informality exacerbate stress-related vulnerabilities. Li, Ding, and Luo (2023) explored digital tools (BIM, IoT) in proactive safety monitoring. However, adoption of such technologies in Nairobi remained minimal, particularly in small and informal firms. Thus, while global studies emphasized technological solutions, their practical transferability to Nairobi's construction sector remained under-researched.

Wang and Chong (2024) reviewed strategic safety integration across projects and stressed the importance of aligning safety with policy and organizational objectives. Despite this, the Nairobi context - where many firms treated safety as a cost rather than an investment - required localized strategies that account for resource and cultural constraints. Xu, Li, and Wang (2024) identified AI applications in safety management, but similar to Li et al. (2023), such studies reflected highly digitized construction sectors. Their relevance to Nairobi, where technological uptake was still emerging, remained limited without contextual adaptation.

While global scholarship has advanced theoretical and strategic frameworks for construction safety, Nairobi's construction sector has not been adequately studied in terms of the interplay between safety practices and strategies, the role of informality and weak enforcement, and the integration of emerging risks (psychosocial,

technological, economic). This study therefore, addresses these gaps by investigating the level, practices, and strategies of safety management in Nairobi County, situating them within both local realities and global theoretical perspectives.

2.7 The Conceptual Framework

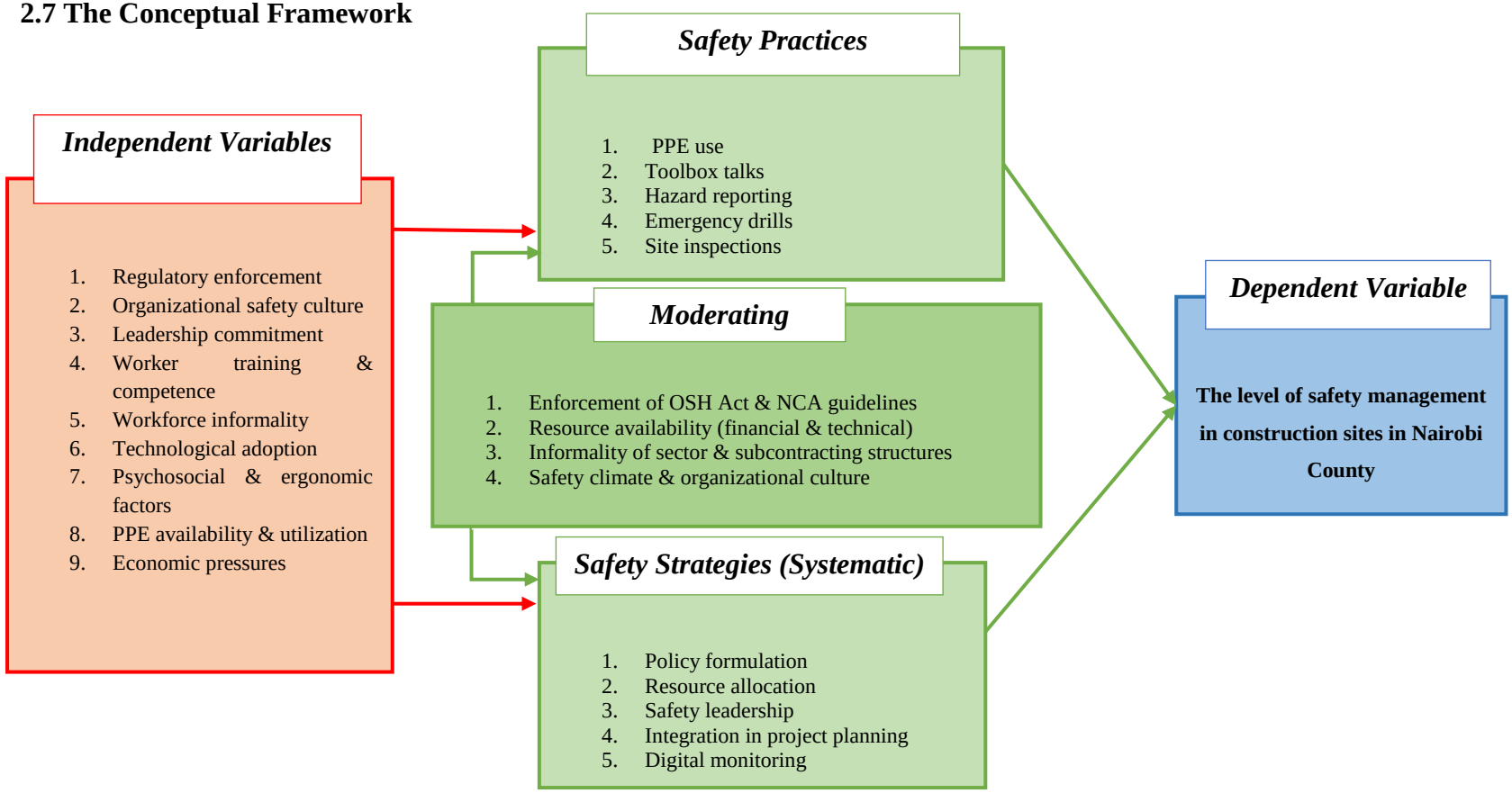

***Figure 2.1*: Conceptual Framework for Effective Safety Management in Construction Sites in Nairobi County.**

Source: Author

This study was anchored on the understanding that the level of safety management in construction sites within Nairobi County depends on the dynamic interplay between safety practices, safety strategies, and a set of influencing contextual factors. The framework (Figure 2.1) organizes these relationships into independent variables, dependent variables, and moderating/mediating conditions that shape outcomes.

The independent variables encompass regulatory enforcement, organizational safety culture, leadership commitment, worker training, workforce informality, technological adoption, psychosocial and ergonomic conditions, availability and utilization of personal protective equipment (PPE), and economic pressures. These factors represent the structural, organizational, and environmental conditions that either enable or constrain effective safety management.

Within this context, safety practices and safety strategies function as the primary drivers of safety performance. Practices refer to site-level, operational measures such as PPE use, toolbox talks, hazard reporting, emergency drills, and site inspections. They are immediate and tangible risk-control actions applied directly by workers and supervisors. Strategies, in contrast, are systemic and organizational in scope, including safety policy formulation, leadership accountability, allocation of resources, integration of safety into project planning, and adoption of digital monitoring technologies. Strategies provide the framework that sustains practices over time.

The dependent variable, the level of safety management in Nairobi's construction sites, reflects the overall maturity and effectiveness of safety interventions in reducing accidents and fostering safe working environments. It is an outcome that emerges when practices are consistently enforced and supported by well-designed strategies. The framework also incorporates moderating and mediating variables that condition the strength of these relationships. Key among them are the enforcement of the Occupational Safety and Health Act (2007) and National Construction Authority guidelines, the financial and technical resource base of firms, the degree of informality in sectoral structures, and the prevailing safety climate. These factors

determine whether practices and strategies translate into tangible safety improvements or remain fragmented and reactive.

By distinguishing between practices and strategies, yet showing their interdependence, the framework emphasizes that neither dimension is sufficient on its own. Practices provide the frontline defense against accidents, while strategies create the enabling environment for sustainability and continuous improvement. Together, they determine the trajectory of safety management maturity within Nairobi County's construction sector.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methodology adopted to investigate a strategy for effective safety management in construction sites within Nairobi County. It details the research design, population and sampling, data collection methods, instruments, and data analysis procedures, while also addressing validity, reliability, and ethical considerations. The chosen approach was guided by the study objectives and the need to generate both statistical evidence and contextual insights to develop a practical and evidence-based safety management strategy.

3.2 Research Design

This study was grounded in the pragmatic research philosophy, which prioritizes practical problem-solving and methodological pluralism to address complex, real-world issues (Creswell & Plano Clark, 2018). Pragmatism provided the flexibility to combine quantitative and qualitative methods, allowing the study to measure the level of safety management while exploring the contextual mechanisms influencing it. Accordingly, an explanatory sequential mixed-methods design was adopted, beginning with a quantitative phase that established the level of safety management, identified influencing factors, and examined their relationships using descriptive statistics, Spearman's rank correlation, and ordinal logistic regression (Agresti, 2010; Schober & Schwarte, 2018).

The subsequent qualitative phase used semi-structured interviews and focus group discussions to explain the quantitative results and provide contextual insights. Thematic analysis, following Braun and Clarke's (2021) framework, enabled the integration of qualitative patterns with statistical findings. This sequential, data-driven process produced a comprehensive and empirically grounded strategy for improving construction safety management in Nairobi County. The research design

was operationalized through a systematic methodological framework linking objectives, variables, and analysis techniques.

The study population included construction stakeholders, contractors, site managers, supervisors, workers, and regulators, representing both formal and informal sectors. A stratified random sampling approach ensured representation across contractor categories, while purposive selection in the qualitative phase captured diverse perspectives and contrasting safety performance levels. A target of approximately 100 sites was determined using Cochran's formula with finite population correction to balance statistical precision and feasibility (Taherdoost, 2016).

Quantitative data were collected using structured questionnaires based on OSHA 2007 standards and validated safety constructs, while qualitative data were gathered through interviews and FGDs guided by open-ended protocols. Instrument validity and reliability were ensured through expert review, pilot testing, and statistical verification using Cronbach's alpha (Heale & Twycross, 2021; Müller & Hörner, 2022). The integration of survey findings, secondary records, and stakeholder narratives strengthened construct validity, enabling triangulation across data sources.

This mixed-methods design was the most appropriate for the study because it aligned with both the pragmatic paradigm and the applied nature of the research problem. Construction safety is a multidimensional phenomenon requiring not only quantitative measurement of practices and factors but also qualitative understanding of perceptions, motivations, and institutional barriers. The design's explanatory sequential structure offered the necessary rigor to generate statistically valid patterns and the interpretive depth to explain them.

Ethical integrity was upheld through informed consent, voluntary participation, and compliance with Kenya's Data Protection Act (ODPC, 2021). While the focus on Nairobi County limits external generalizability and the cross-sectional nature restricts causal inference, these limitations were mitigated through stratified sampling, mixed data triangulation, and the inclusion of varied construction settings.

Overall, this research design ensured philosophical coherence, methodological rigor, and ethical transparency, producing findings that were both theoretically significant and practically actionable for enhancing safety management in construction projects.

3.3 Measurement of Variables

Table 3.1: Logical Framework for Measurement of Variables, Data Collection, and Analysis in the Study.

Research Objective	Variables	Type (Quant/Qual)	Indicators / Measures	Data Source / Collection Method	Analysis Technique
1.To assess the level of safety management in construction sites in Nairobi County.	Dependent variable: Level of safety management	Quantitative	- Frequency of safety training- Use of PPE- Compliance with OSHA 2007 regulations- Accident/incident frequency	Survey questionnaire Secondary data (DOSHS, NCA reports), Interviews & FGDs	Descriptive statistics (mean, frequencies, percentages, kurtosis)
2. To determine the factors influencing the level of safety management in construction sites in Nairobi County.	Independent variables: Management commitment, Safety knowledge, Training frequency, Resource availability, Regulatory enforcement	Quantitative	- Managerial prioritization of safety- Budget allocation to safety- Frequency/quality of training- PPE availability- Presence of safety officers	Structured survey (Likert scales), Interviews and Focus Group Discussions (FGDs).	Descriptive statistics (mean, frequencies, percentages, kurtosis)
3. To examine the relationship between the level and factors affecting the level for safety management in construction sites in Nairobi County.	Dependent: Safety management level Independent: Factors listed above	Quantitative	Strength and direction of association between safety level and predictors	Results obtained from analysis of the level and factors influencing the level of safety management.	Spearman's rank correlation; Regression analysis
4. To develop a strategy for effective safety management in construction sites in Nairobi County.	Integration of quantitative and qualitative findings	Mixed (Qual & Quant)	- Thematic patterns from interviews & FGDs (e.g., barriers, perceptions)- Triangulation of statistical results and narratives	Semi-structured interviews, FGDs, survey findings.	Thematic analysis (qualitative); Convergence with quantitative results

Source: Author

The logical framework presented in table 3.1 demonstrates how the study objectives were operationalized through variables, data collection, and analysis techniques. Each research objective was systematically linked to measurable variables, ensuring alignment between the study's purpose and its methodological execution.

For the first objective, to establish the level of safety management in construction sites in Nairobi County, the dependent variable was defined as the level of safety management, measured quantitatively through indicators such as frequency of safety training, PPE use, compliance with OSHA 2007 regulations, and accident frequency. Data were collected through surveys, official reports, interviews, and focus group discussions, and analyzed using descriptive statistics. This approach allowed the study to establish a baseline understanding of prevailing safety practices.

The second objective, to determine the factors influencing the level of safety management, was addressed through independent variables such as management commitment, safety knowledge, training frequency, resource availability, and regulatory enforcement. These were operationalized into measurable indicators, including budget allocation, presence of safety officers, and training quality. Structured surveys using Likert scales, complemented by interviews and FGDs, provided data that were again analyzed descriptively. This ensured a systematic identification of the drivers and barriers to effective safety management.

The third objective, to examine the relationship between the level and factors affecting safety management, was pursued by testing associations between the dependent and independent variables. Using results from the first two objectives, statistical techniques such as Spearman's rank correlation and regression analysis were applied to establish both the strength and direction of relationships. This provided empirical evidence of how the identified factors influenced safety performance.

Finally, the fourth objective, to develop a strategy for effective safety management, drew upon both quantitative and qualitative strands of evidence. The integration of survey findings with thematic insights from interviews and FGDs enabled triangulation, ensuring that the strategy was grounded in both statistical results and

lived experiences. Thematic analysis and convergence of data enhanced the robustness of the proposed framework.

Overall, the logical framework ensured internal consistency between objectives, variables, and methods. It not only provided a structured roadmap for data collection and analysis but also guaranteed that findings were empirically grounded, theoretically informed, and practically relevant to addressing construction safety challenges in Nairobi County.

3.4 Sources of Data

In line with the explanatory sequential mixed-methods design, this study utilized both primary and secondary data sources to capture a comprehensive understanding of safety management practices in construction sites in Nairobi. The use of multiple data sources strengthened validity through triangulation and enhanced the robustness of strategy development (Niu & Leicht, 2024; Wasti et al., 2022).

3.4.1 Primary Data

Primary data was collected directly from stakeholders engaged in the construction sector to provide first-hand insights into safety management practices, influencing factors, and lived experiences. The sources include:

1. Site managers: They provided information on organizational commitment to safety, resource allocation, and compliance with regulatory requirements.
2. Site supervisors and workers: Their responses reflected day-to-day safety practices, training participation, and use of Personal Protective Equipment.
3. Safety officers: They shared expertise on safety policies, implementation challenges, and incident management procedures.
4. Regulatory officials (DOSHS and NCA representatives): They contributed perspectives on compliance levels, enforcement mechanisms, and systemic challenges.

Quantitative primary data was collected through structured survey questionnaires, while qualitative data was obtained via semi-structured interviews and focus group discussions (Nielsen et al., 2022).

3.4.2 Secondary Data

Secondary data was obtained from relevant institutional and documentary sources to complement primary data and provide contextual evidence. These include:

1. Directorate of Occupational Safety and Health Services (DOSHS): accident and compliance records, inspection reports, and official statistics.
2. National Construction Authority (NCA): data on registered contractors, safety audits, and compliance enforcement initiatives.
3. Published reports and academic studies: contemporary literature on construction safety management in Kenya and comparable contexts.
4. Policy and legal frameworks: documents such as the Occupational Safety and Health Act, 2007, and subsequent amendments that set regulatory expectations.

The triangulation of primary and secondary data ensured the findings were both empirically grounded and contextually validated, thereby supporting the development of a realistic and actionable safety management strategy (Draucker et al., 2020; Wasti et al., 2022).

3.5 Data Collection Methods

In keeping with the explanatory sequential mixed-methods design, data collection in this study was executed in two distinct but complementary phases: an initial quantitative phase followed by a qualitative phase. Each phase employed different instruments tailored to capture both measurable indicators of safety management and the contextual experiences of construction stakeholders.

3.5.1 Quantitative Phase

The quantitative phase employed a structured survey questionnaire administered to site managers, supervisors, and construction workers. The questionnaire consisted of closed-ended items primarily measured on a five-point Likert scale, assessing dimensions such as safety training frequency, knowledge of safety procedures, use of personal protective equipment (PPE), compliance with OSHA 2007 requirements, management commitment, and adequacy of resources.

The use of a survey instrument is justified because it enabled the systematic collection of standardized data across a large sample, allowing for statistical analysis of safety management levels and factors influencing them (Rahimian et al., 2021). Structured questionnaires were also efficient for identifying trends and relationships among variables, which was essential in testing the study's hypotheses (Akintoye & Maina, 2022).

3.5.2 Qualitative Phase

The qualitative phase utilized semi-structured interviews and focus group discussions (FGDs) to complement the quantitative findings. Semi-structured interviews were conducted with contractors' representatives, safety officers, and regulatory officials (DOSHS and NCA). This method allowed flexibility in probing emerging themes while ensuring consistency across participants through guiding questions (Nielsen et al., 2022).

Focus Group Discussions (FDGs) were held with groups of site workers to capture collective perceptions, shared experiences, and attitudes toward safety management practices, particularly training and PPE usage. FGDs encouraged interaction among participants, often generating richer data than individual interviews (Osei-Kyei et al., 2021). The qualitative instruments were justified because they provided contextual depth, allowing exploration of underlying organizational and cultural factors influencing safety practices. They also enhanced the explanatory power of the study by clarifying quantitative results and identifying practical barriers and enablers of safety management (Creswell & Plano Clark, 2021).

3.5.3 Secondary Data Review

Besides primary data collection, document analysis was conducted using secondary data obtained from DOSHS and NCA. Records included accident reports, inspection outcomes, compliance statistics, and regulatory documents. Secondary data provided an independent benchmark for validating primary data findings and situating them within broader industry and policy contexts (Draucker et al., 2020).

3.6 Tests of Sound Measurement

Ensuring the validity and reliability of data collection instruments was critical in guaranteeing that the study findings were both credible and generalizable. For this study, the structured questionnaire, semi-structured interviews, and focus group discussion guides were subjected to rigorous tests of sound measurement, as outlined below.

3.6.1 Validity

a) Content Validity

Content validity referred to the extent to which the instruments adequately covered the construct under investigation. The survey questionnaire items were developed based on a review of relevant literature, international safety standards (e.g., OSHA 2007), and validated instruments from prior construction safety studies. To further strengthen content validity, the draft instruments were reviewed by a panel of experts comprising occupational safety officers, academics, and regulators (NCA and DOSHS). Their feedback ensured that the items were representative, comprehensive, and contextually appropriate (Taherdoost, 2020).

b) Construct Validity

Construct validity evaluated whether the instrument measured the theoretical concepts it intended to assess. Factor analysis was applied to test whether items measuring safety knowledge, PPE usage, training, and management commitment clustered as expected under their respective constructs. This approach is commonly

recommended in safety research to establish the dimensional structure of survey items (Yiu & Chan, 2021).

c) Face Validity

Face validity was checked by piloting the questionnaire with a small group of construction workers and supervisors not included in the final sample. This process helped ensure that questions were easily understood, culturally appropriate, and interpreted consistently by respondents (Alase, 2022).

3.6.2 Reliability

Reliability concerns the consistency and stability of measurements across time and respondents. Several procedures were used to ensure reliability:

a) Internal Consistency Reliability

Cronbach's alpha coefficients were calculated for each construct (e.g., training, PPE, management commitment). A coefficient value of 0.70 or higher was considered acceptable for indicating reliable scales (Müller & Hörner, 2022).

b) Test–Retest Reliability:

The survey was piloted twice, with a two-week interval, to check the stability of responses over time. The high correlation between the two administrations indicated reliability (Heale & Twycross, 2021).

c) Inter-Coder Reliability

For qualitative data, transcripts of interviews and FGDs were independently coded by at least two researchers. Cohen's Kappa statistic was applied to assess coding consistency, ensuring reliability in thematic analysis (Campbell et al., 2021).

3.6.3 Triangulation

Besides validity and reliability checks, triangulation was employed by comparing findings across multiple data sources (survey responses, interviews, FGDs, and secondary records). This approach enhanced the credibility of results by reducing potential bias from a single instrument (Shorten & Smith, 2017).

3.7 The Population, Sample and Sampling Technique

The target population included all actors engaged in construction activities in Nairobi County, as well as institutions mandated with safety regulation and enforcement. This comprehensive composition ensured that the study captured both top-down (management and regulatory) and bottom-up (workers and supervisors) perspectives on construction safety. However, while the target population spanned all stakeholders across the construction sector in Nairobi, the accessible population was limited to active construction sites registered with the National Construction Authority (NCA) within Nairobi County at the time of data collection. This ensured feasibility while maintaining representativeness. In addition, regulatory officials from the Directorate of Occupational Safety and Health Services (DOSHS) and the NCA stationed in Nairobi formed part of the accessible population.

3.7.1 Calculation of Sample Size

The study frame contained 1,447 active building works construction sites registered within Nairobi County, among a total of 1,539 from NCA's database (NCA, November 24). The aim was to produce a feasible sample not exceeding 100 units while retaining sufficient precision to support descriptive estimates and subgroup comparisons. Cochran's formula (for proportions) with a relaxed precision level (margin of error = 0.10 or 10%) was used to achieve a practical sample size within the 100-unit limit. The Finite Population Correction (FPC) was then applied. This approach was appropriate since the population was finite and logistic constraints required a modest sample size (Taherdoost, 2020; Etikan & Bala, 2023).

1. **Cochran's formula (initial estimate)**

Cochran's formula for an initial sample size for estimating proportions in a large population is:

$$n_0 = \frac{z^2 p(1-p)}{e^2}$$

Where:

- z= z-score for desired confidence level (1.96 for 95% confidence).
- p = estimated proportion (0.5 used, when unknown to maximize sample size).
- e = desired margin of error.

Using a 95% confidence level and choosing e=0.10 (10% margin of error) to remain within operational constraints:

$$n_0 = \frac{1.96^2 x\ 0.5(1-0.5)}{0.10^2} = 96$$

2. **Finite Population Correction (FPC)**

Because the population is finite (N = 1,447), the finite population correction was applied:

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

Substituting n_0 = 96 and N = 1,447:

$$n = \frac{96}{1 + \frac{96 - 1}{1447}} = 90.08 \approx 90$$

Thus, Cochran + FPC yields an estimated sample size of ≈90 sites when using e = 10%.

To allow modest room for subgroup analyses, to simplify proportional allocation, and to provide a buffer for nonresponse or inaccessible sites, the study rounded the FPC value upward to 100 as the final target sample. Increasing from 90 to 100 gave additional analytical flexibility while keeping the sample within the maximum of 100 (Heale & Twycross, 2021; Müller & Hörner, 2022).

3.7.2 Sampling Technique

To improve representativeness and ensure adequate coverage of important subgroups (i.e. contractor's category), a stratified random sampling approach was used. The full sampling frame of the 1,447 registered sites from the National Construction Authority (NCA) database was obtained and appended basic strata variables (i.e. contractor category). Proportional allocation was then computed to the target sample (100) using:

$$n_h = \frac{N_h}{N} \times n$$

Where N_h was the number of sites in stratum h, N was the total population (1,447) and n was the total sample (100).

3.8 Data Processing and Analysis

Data processing and analysis followed the logic of the explanatory sequential mixed-methods design, where quantitative data was analyzed first, followed by qualitative data, and then both strands are integrated for interpretation (Creswell & Creswell, 2023; Wasti et al., 2022). This process ensured that statistical trends were supported

and explained by contextual narratives, thus enhancing the robustness of conclusions and the validity of the developed safety management strategy.

3.8.1 Quantitative Data Processing and Analysis

Quantitative data from structured survey questionnaires was coded, entered, and cleaned before analysis. The Statistical Package for the Social Sciences (SPSS v25) and Microsoft Excel were used for processing. Data cleaning involved checking for missing values, outliers, and inconsistent responses to enhance accuracy and reliability (Niu & Leicht, 2024). Descriptive statistics were computed to establish the current level of safety management practices across construction sites. Inferential statistics was then applied to test hypotheses and relationships between variables. Correlation analysis assessed the strength and direction of associations between factors while regression analysis (multiple linear regression) determined the predictive power of these factors on overall safety management levels. The choice of these statistical tools aligns with the study objectives, which focused on identifying influential factors and quantifying their relationships with safety outcomes (Chen et al., 2021).

a) Analysis of the correlation between variables

Given that the study relied primarily on ordinal data collected through Likert-scale items, Spearman's Rank Correlation Coefficient (ρ) was the most appropriate statistical technique to examine the strength and direction of relationships among variables. The coefficient was determined as using the formula:

$$r_s = 1 - \left[\frac{6\Sigma\, d_i^2}{n(n^2-1)}\right]$$

Where:

- d_i = difference between ranks of i th pair of the two variables.
- n = number of pairs of observations.
- r_s = Spearman's coefficient of correlation.

Unlike Pearson's correlation, which assumes linearity and normally distributed interval data, Spearman's correlation is a non-parametric test that is specifically designed to handle ordinal data and non-linear but monotonic relationships (Schober & Schwarte, 2021). The choice of Spearman's correlation is further justified by the study objectives, which aimed to determine the relationships between safety management factors such as management commitment, training, and compliance with safety regulations. These variables were typically measured on ranked or ordinal scales rather than precise continuous metrics, making Spearman's ρ the most statistically valid approach (Noether, 2022).

Additionally, Spearman's correlation is robust against outliers and skewed distributions, both of which were common in construction safety data where some responses were biased by workers' perceptions (Gauthier, 2023). This robustness enhanced the reliability of the findings, ensuring that the observed relationships truly reflected patterns within the data rather than distortions caused by non-normality.

On the whole, several recent methodological studies in occupational health recommend Spearman's correlation for ordinal and non-normally distributed data, highlighting its suitability for exploratory and applied research (Vogt & Johnson, 2020; Sarstedt et al., 2020). Therefore, employing Spearman's Rank Correlation in this study ensured methodological rigor and aligned with best practices in analyzing ordinal survey data.

b) Multiple regression analysis

Multiple non-linear regression; in this study specified as an Ordinal Logistic Regression (OLR) model, was employed to analyze the influence of multiple predictors on the level of safety management in construction sites within Nairobi County. Unlike simple regression models, which test the effect of a single predictor, OLR allowed for the simultaneous assessment of multiple independent variables and their non-linear associations with an ordinal dependent variable (Tabachnick & Fidell, 2019). This choice was particularly suitable since the dependent variable, "Level of safety management", was measured on an ordinal scale derived from Likert-type responses.

The general form of the ordinal logistic regression model applied is:

$$ln\left(\frac{P(Y \leq j)}{P(Y > j)}\right) = \alpha j - (\beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k)$$

Where:

- Y = the ordinal dependent variable (Level of Safety Management),
- P = probability (a value between 0 and 1)
- j = threshold for category j of Y,
- αj = intercept (cut-point) for the j^{th} category,
- X_1, $X_{2....}X_k$ = independent factors (e.g., regulatory enforcement, leadership commitment, economic pressures, training, reporting systems, etc.),
- $\beta_0 + \beta_2 + \beta_3$, β_k = regression coefficients representing the change in the log odds of being at or below a given level of safety management for a unit change in the predictor variable.

This model specification captures the cumulative probability of being in a given category or below, thereby respecting the ordered nature of the dependent variable (Agresti, 2010). Construction site safety management is inherently multidimensional, shaped by regulatory, organizational, economic, and cultural influences that often interact in non-linear ways (Lingard & Rowlinson, 2005). The OLR framework provided flexibility to model these dynamics and offered a more valid analytical lens compared to linear models, which assume equal intervals between response categories. Thus, applying ordinal logistic regression in this study not only enabled the estimation of the strength and direction of influence of each predictor but also ensured methodological congruence with the measurement scale of the data, thereby enhancing both validity and interpretability of the results.

3.8.2 Qualitative Data Processing and Analysis

Qualitative data from semi-structured interviews and focus group discussions was transcribed verbatim and reviewed for accuracy. Transcripts were entered into NVivo

software for systematic analysis. Thematic analysis, following Braun and Clarke's (2021) six-step approach, was applied to identify recurring themes and subthemes. This process included familiarization with the data, generating initial codes, searching for themes, reviewing and refining themes, defining and naming them, and producing the report. Coding was both deductive (based on study objectives and survey findings) and inductive (emerging from participants' narratives). Inter-coder reliability checks were conducted by involving multiple researchers in the coding process to minimize bias (Campbell et al., 2021).

3.8.3 Integration of Quantitative and Qualitative Findings

Integration occurred at the interpretation and discussion stage. Quantitative results established "what" relationships existed between factors and safety management, while qualitative findings explained "why" and "how" these relationships manifested in practice. Convergence and divergence between the two strands were highlighted to ensure a holistic understanding. This integration strengthened the study by providing nuanced explanations that statistical results alone would not have capture (Draucker et al., 2020; Wasti et al., 2022).

3.8.4 Secondary Data Analysis

Secondary data from the Directorate of Occupational Safety and Health Services (DOSHS) and the National Construction Authority (NCA) was analyzed using document review techniques. Trends in accident statistics, compliance rates, and safety audits were compared with primary data findings to triangulate results and validate conclusions (Zhou et al., 2022).

3.9 Ethics of Research

Ethical compliance was prioritized in this study to ensure that the rights, dignity, and well-being of all participants was safeguarded throughout the research process. The study adhered to established ethical guidelines for social science and occupational health research, following principles of informed consent, confidentiality, voluntary participation, and integrity (Resnik, 2020).

First, it adhered to both international ethical guidelines and Kenya's Data Protection Act (2019), which mandates lawful, fair, and transparent processing of personal data for explicit and legitimate purposes (Office of the Data Protection Commissioner [ODPC], 2021). To comply, personal identifiers such as names, phone numbers, and site-specific details were excluded from research data, while pseudonymization and coding techniques were employed to reduce re-identification risks. These measures not only safeguarded participants' privacy but also ensured full legal compliance with Kenya's data governance framework (Kimutai & Wanyama, 2023).

Ethical clearance was first sought from the relevant Institutional Review Board (IRB) before data collection. Permission was also obtained from regulatory bodies such as the National Construction Authority (NCA) and the Directorate of Occupational Safety and Health Services (DOSHS) to access construction sites and secondary data. Informed consent was then obtained from all participants. Respondents were provided with a clear explanation of the study's purpose, procedures, and potential risks and benefits. Participation was strictly voluntary, and individuals retained the right to withdraw at any stage without penalty (Fleming & Zegwaard, 2020).

Confidentiality and anonymity were equally maintained. Survey responses and interview transcripts were coded, and no identifying information was reported. Digital data were stored securely in password-protected files, while physical documents were locked in secure cabinets. Only the research team had access to raw data. Such safeguards were essential for sensitive workplace-related research where disclosure could potentially affect employment relationships (Biros, 2021).

The study also avoided any form of harm - physical, psychological, or professional. Participants were assured that findings would be presented in aggregate form to prevent attribution to specific companies. Research integrity was likewise maintained through accurate reporting, transparency in methodology, and proper acknowledgment of all sources. The use of triangulation in data collection further ensured fairness and minimized researcher bias (Saunders et al., 2023). By observing these ethical principles, the study ensured compliance with international best practices while also respecting the local regulatory environment for occupational safety research in Kenya.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter integrates survey data, statistical modeling, and qualitative insights from interviews, focus groups, and questionnaires to examine safety management in Nairobi's construction sector. Based on an 88% response rate, mainly from small and mid-sized contractors, the findings are organized around the study objectives, focusing on safety practices, enforcement, leadership, training, informality, and regulation. The results highlight gaps between policy and practice and show how systemic, cultural, and organizational factors shape safety outcomes.

4.2 Response Rate

Out of 100 targeted respondents including site managers, site supervisors, workers, safety officers representing contractors, and regulatory officials from DOSHS and NCA, 88 responded positively, giving a response rate of 88%. Most responses came from smaller or mid-sized contractors (categories NCA 6-8), with few from large contractors (NCA 1-5). This response rate can be viewed excellent, in studies involving practitioners in the construction sector, where time limits and workload often reduce willingness or ability to respond. Comparable studies in Kenya report response rates in the 70-90% range for contractor; for instance, a study on cost management practices in road construction reported a 91.2% response rate (Mutiso, 2023), while research on corporate strategy implementation in the construction industry recorded an 89.2% rate (Oketch, 2024). Based on this, response rates above 70% are generally considered excellent, with lower rates requiring bias analysis (Nguyen et al., 2020).

Categorization of contractors by NCA (category 1 having unlimited project value and category 8 up to KES 10,000,000) influenced the level of safety management. Larger contractors (NCA 1-5) typically have greater financial, human, and technical resources, enabling more structured safety systems, formal training, better

supervision, consistent PPE provision, and systematic hazard inspection. Smaller contractors (NCA 6-8), dominating in the responses, often have fewer resources, less formal organization, and treated safety practices as secondary to cost and schedule pressures. Hence, a sample skewed more toward smaller contractors meant the findings were relevant for understanding safety gaps in the bulk of the sector

4.3 Results from Interviews

Table 4.1 summarizes the interview findings on the current level of safety management across construction sites in Nairobi County, integrating insights on existing practices, enforcement consistency, leadership commitment, and barriers to implementation. As indicated in the table, while basic safety measures exist, inconsistencies in enforcement, weak leadership commitment, and structural barriers continue to limit the achievement of comprehensive safety management across sites as discussed below:

1 Current safety practices

Officials from both DOSHS and NCA acknowledged that safety practices such as PPE use, toolbox talks, and hazard inspections exist, but implementation is inconsistent.

"Most large contractors (NCA 1-5) provide PPE and conduct toolbox talks, but in smaller sites (NCA 6-8), these practices are often irregular or absent altogether" (NCA Official).

"Inspections reveal that hazard identification is rarely systematic; it is treated more as a reaction to accidents rather than a proactive measure" (DOSHS Official).

The responses highlighted a dual reality in Nairobi's construction sector: formalized practices exist, but their application is inconsistent. Large firms demonstrate better compliance with PPE and toolbox talks, whereas smaller or informal contractors lack structured systems. This confirms earlier studies (Olutende et al., 2021; Fang et al., 2020), but the interviews added nuance by showing that hazard inspections were largely reactive, revealing a gap between written protocols and lived practice.

2 Enforcement Consistency

Participants noted that enforcement of safety practices was uneven across projects.

"Compliance is generally higher when contractors expect inspections, but it drops significantly when oversight is minimal" (DOSHS Official).

"Some supervisors strictly enforce PPE use, while others prioritize project speed over safety" (NCA Official).

The findings confirmed that compliance fluctuated depending on the presence of inspections or supervisory pressure. This reinforces literature noting weak and inconsistent enforcement (Chacha, 2020). The interview feedback deepened this by showing that compliance often reflected external oversight rather than internalized safety values, underscoring fragile accountability systems.

Table 4.1: Summary of Interview Findings on the Level of Safety Management in Nairobi Construction Sites.

Subject Area	Quantitative Findings	Qualitative Findings	Analysis
Current Safety Practices	PPE, toolbox talks, and hazard inspections present in many sites but inconsistently applied; stronger in NCA 1–5 contractors, weaker in NCA 6–8.	Large firms provide PPE and talks; small/informal sites lack structured practices. Hazard inspections reactive rather than proactive.	Confirms literature: practices exist but unevenly implemented. Adds nuance by showing inspections are reactive, highlighting the gap between written protocols and actual practice.
Enforcement Consistency	Compliance higher when inspections are expected; drops significantly with minimal oversight.	Supervisors vary: some enforce PPE strictly; others prioritize speed over safety.	Reinforces literature on weak/inconsistent enforcement. Shows compliance depends more on external oversight than internal safety culture, reflecting fragile accountability systems.
Leadership and Organizational Commitment	Firms treating safety as a core value show stronger compliance; those viewing it as a cost record frequent violation.	Leadership commitment directly influences worker behavior and organizational safety culture.	Supports Safety Climate Theory: leadership shapes compliance. Confirms many Nairobi firms see safety as a financial burden, limiting cultural change.
Barriers to Implementation	Resource constraints and informality limit consistent safety practice.	PPE and training seen as expensive; informal sector operates without structured safety systems.	Matches literature on economic/structural barriers. Expands by highlighting institutional neglect in informal sector—barriers are not only financial but systemic.
Suggested Improvements	Stronger enforcement, more frequent inspections, and mandatory safety training proposed.	Calls for penalties to outweigh cost of compliance; mandatory training before site access emphasized.	Aligns with literature on systemic strategies (training, enforcement, penalties). Highlights shift from reactive to preventive approaches, suggesting embedding safety into induction/training.

Source: Author

3 Leadership and Organizational Commitment

Officials emphasized that leadership commitment was a critical determinant of safety culture.

"Where management views safety as a core value, compliance is stronger; where it is treated as a cost, violations are frequent" (NCA Official).

"Contractors who embed safety in their organizational policies set a tone that influences worker behavior" (DOSHS Official).

The interviews strongly supported the argument that management commitment set the tone for safety culture. Where safety was integrated into organizational priorities, compliance improved significantly. This aligns with Safety Climate Theory (Brown et al., 2023) but also suggests that many firms in Nairobi still perceive safety as a financial burden, limiting long-term cultural change.

4 Barriers to Implementation

Key barriers highlighted included resource constraints, weak regulation, and economic pressures.

"Many contractors argue that PPE and training are expensive, so they cut corners" (DOSHS Official).

"The informal sector, which forms a large part of Nairobi's construction, often operates without structured safety systems" (NCA Official).

Resource constraints, economic pressure, and informality emerged as dominant barriers. While literature has previously highlighted these issues (Ahmad et al., 2022; Omondi & Ochieng, 2022), the interviews expanded the discussion by pointing to the systematic neglect in the informal sector.

1 Suggested Improvements

Participants suggested stronger regulatory enforcement, more frequent inspections, and mandatory training programs.

"Safety training should be mandatory for all workers before accessing sites, not just for supervisors" (NCA Official).

"We need to strengthen penalties so that safety violations cost more than compliance" (DOSHS Official).

The proposed solutions; mandatory training, stronger penalties, and more frequent Inspections, mirror systemic strategies advocated in recent scholarship (Wang & Chong, 2024). Importantly, participants emphasized preventive rather than reactive approaches, signaling a shift towards embedding safety in worker induction and training, which may help bridge the gap between policy and practice.

Table 4.2 summarizes interview findings on the key factors influencing the level of safety management in construction sites across Nairobi County, integrating managerial, regulatory, and behavioral perspectives. As shown in the table, weaknesses in leadership commitment, enforcement, and training, combined with systemic and cultural barriers, collectively undermine consistent safety performance on construction sites as discussed below:

2 Management Commitment

Officials reiterated that safety outcomes depend heavily on management priorities.

"Some contractors only comply when accidents occur; proactive commitment is rare" (DOSHS Official).

Consistent with Nielsen et al. (2022), the findings showed that safety was often reactive, gaining attention only after incidents occurred. This underscores that without proactive leadership, compliance will remain weak, and safety will continue to be treated as an afterthought.

3 PPE Challenges

Respondents confirmed issues with cost, comfort, and enforcement of PPE use.

"Workers resist wearing PPE because they feel it slows them down, and supervisors often don't push back" (NCA Official).

The interviews reinforced existing literature on PPE barriers (Olutende et al., 2021), but also highlighted a cultural resistance among workers who see PPE as a hindrance. This interplay between cost, comfort, and cultural resistance shows that interventions must address both material and behavioral dimensions.

4 Training availability

Training was highlighted as essential yet insufficiently provided.

"Only larger firms (NCA 1-5) consistently invest in training, while many small (NCA 6-8) contractors do none at all" (DOSHS Official).

Training gaps persisted among smaller contractors. The findings confirm Zhou et al. (2022) but also added that training inequality between large and small firms widened safety disparities across Nairobi's sites, suggesting the need for standardized training requirements across all contractor categories.

5 Worker attitudes and safety culture

Officials observed that cultural perceptions undermine compliance.

"Many workers see safety rules as obstacles to productivity, not as protections for their lives" (NCA Official).

The feedback that workers perceived safety as an obstacle to productivity echoes Niu and Leicht (2024). This showed that safety culture was not yet deeply embedded and required cultural transformation possibly through sustained communication campaigns and worker engagement strategies.

6 Regulatory oversight

Regulators admitted that inspections were limited due to capacity constraints.

"We don't have enough inspectors to monitor all 1,447 sites in Nairobi" (DOSHS Official).

Capacity constraints at DOSHS revealed systemic weaknesses in enforcement. The quote about monitoring "1,447 sites" illustrated scale as a structural barrier, confirming Amponsah-Tawaih and Adu (2021). It also highlighted that regulatory agencies were under-resourced, limiting their deterrent power.

7 Communication

Both agencies emphasized that communication gaps existed between management, supervisors, and workers.

"Instructions are often top-down, with little feedback from workers on actual risks" (NCA Official).

The finding that communication was top-down, with little worker input, aligns with Wasti et al. (2022). It also indicated that participatory approaches could strengthen compliance as workers would feel more engaged in identifying risks.

8 Resource allocation

Limited budgets and staffing were cited as barriers.

"Contractors prioritize project delivery over investing in safety equipment or extra staff" (DOSHS Official).

Consistent with Brown et al. (2020), resource allocation directly shaped safety investment decisions. This confirmed that financial and staffing limitations hindered comprehensive safety systems and perpetuated a project-over-safety mentality.

Table 4.2: Interview Findings on the Factors Influencing the Level of Safety Management in Construction Sites in Nairobi County

Subject Area	Quant. Findings	Qualitative Findings	Analysis
Management Commitment	No numeric data reported	Safety is often reactive; contractors act only after accidents	Leadership commitment is weak, causing safety to be treated as an afterthought, confirming gaps in proactive culture.
PPE Challenges	No numeric data reported	PPE issues linked to cost, comfort, and worker resistance; supervisors often fail to enforce use	Barriers are both material and behavioral, requiring interventions that address cost and worker attitudes simultaneously.
Training Availability	Larger firms (NCA 1–5) provide training; smaller ones (NCA 6–8) mostly do not	Training is limited and unevenly distributed	Training inequality across contractor categories widens safety disparities; standardized requirements are needed.
Worker Attitudes & Safety Culture	No numeric data reported	Workers see safety rules as obstacles to productivity	Safety culture is shallow; requires mindset change via campaigns, engagement, and consistent leadership reinforcement.
Regulatory Oversight	1,447 construction sites in Nairobi vs limited inspector capacity	Agencies lack manpower to monitor all sites	Enforcement is structurally weak due to resource constraints, reducing deterrent power of inspections.
Communication	No numeric data reported	Instructions flow top-down with little worker input	Communication gaps hinder risk identification; participatory communication could strengthen compliance.
Resource Allocation	No numeric data reported	Budgets prioritize project delivery over safety	Staffing limitations undermine safety investment, perpetuating a cost-over-safety culture.
Worker Motivation	No numeric data reported	Compliance rarely rewarded; penalties weak	Lack of incentives leaves workers unmotivated to comply with safety rules.
Subcontracting & Workforce Composition	No numeric data reported	Subcontracting fragments responsibility and weakens oversight	Multiple contracting layers dilute accountability, worsening safety enforcement and policy application.
Barriers to Higher Standards	No numeric data reported	Corruption, cost-cutting, and informality block progress	Systemic governance issues hinder safety, showing site-level fixes alone are insufficient.

Source: Author

9 Worker motivation

Officials noted that compliance was rarely incentivized.

"There are no real rewards for following safety rules, but penalties for noncompliance are also weak" (NCA Official).

The absence of incentives or effective penalties illustrated a weak motivational environment. This matches Zhang et al. (2020), but the interviews emphasized that neither positive reinforcement nor deterrence was effectively applied, leaving workers unmotivated to comply.

10 Subcontracting and workforce composition

Multi-layer subcontracting complicated safety enforcement.

"The main contractor may have policies, but subcontractors often ignore them, and oversight is fragmented" (DOSHS Official).

The interviews confirmed that subcontracting fragmented responsibility and weakened oversight (Zhou et al., 2022). What emerged here is the structural challenge of accountability, where main contractors may set policies, but sub-contractors dilute implementation, worsening safety risks.

11 Barriers to higher standards

Finally, officials identified systemic barriers.

"Corruption, cost-cutting, and informal employment are the biggest obstacles to raising safety standards" (NCA Official).

The identification of corruption, cost-cutting, and informality as barriers broadened the literature gap. Previous studies have emphasized enforcement and resource challenges, but the interviews revealed governance and accountability weaknesses as

systemic obstacles, showing that site-level interventions alone were insufficient without broader institutional reforms

4.4 Focus Group Discussion Results

Table 4.3 presents a synthesis of the focus group discussion findings triangulated with quantitative results, outlining the key subject areas influencing the overall level of safety management in construction sites within Nairobi County. The table integrates workers' perceptions and site-level observations to illustrate the interplay between organizational structures, regulatory compliance, and daily safety practices across different project types. As shown in the table, variations in safety perception, leadership commitment, enforcement strength, and reporting culture reveal a fragmented safety landscape as explained below:

1. General perception of safety

60% of workers perceived improvement in safety over time but stressed a strong site-to-site contrast: large/formal projects showed better safety, small/informal sites remained lax. 40% observed that safety was often enforced reactively (e.g., when inspectors visit).

"Honestly, safety has improved compared to a few years back, but it still depends on which site you're working at. Big projects have rules and officers, but smaller ones are quite relaxed." (Skilled worker)

This mirrored the literature's finding that Nairobi's safety management maturity was low-to-moderate and fragmented, with structured SMSs on large projects and ad-hoc practices on small ones (Nnaji et al., 2022; Omondi & Ochieng, 2022). The responses provided empirical texture to the gap that existing studies were often descriptive and focused on formal sites; in this study, the workers' voice confirmed fragmentation and reactive enforcement.

2. Safety Practices (PPE, Toolbox Talks)

55% of workers noted PPE availability (high for basics, low for specialized gear), and that toolbox talks occurred but were often perfunctory.

"We're given helmets and boots, but sometimes gloves or harnesses are missing. On smaller sites, you have to buy your own PPE if you want to be safe." (Skilled Worker)

This directly reflected Olutende et al. (2021) and other studies noting inconsistent PPE use and the practical barriers (cost, discomfort, replacement). From an Accident Causation perspective, the presence of practices without reliable enforcement represented controls that were incomplete or unreliable. Safety Climate Theory suggests that if talks are perfunctory, the underlying climate is weak and practices will not be internalized (Brown et al., 2023).

3. Compliance and Enforcement

Only 65% of large sites enforced compliance while 35% of small sites weakly enforced safety procedures. These findings revealed that compliance was uneven; discomfort, heat, and productivity pressure reduced PPE use.

"Some workers don't like wearing PPE because it's uncomfortable, especially when it's hot. Supervisors warn you, but everyone goes back to normal." (Skilled Worker)

This aligned with Omondi & Ochieng (2022) on enforcement limitations and the sector's informality (Chacha, 2020). HRO theory indicated that enforcement and redundancy were elements of reliability: where enforcement mechanisms and supervisory weight were present, compliance increased (Hallowell et al., 2021). Conversely, weak regulatory/ supervisory systems created latent failures per Reason/Heinrich.

4. Leadership and Supervision

50% of workers said safety-focused managers improved compliance, while 50% said supervisors prioritized speed over safety. Workers equally noted that when managers prioritized safety, compliance improved; however, most supervisors prioritize speed and deadlines over safety.

"Where the manager cares about safety, you can feel it. They make sure you follow the rules and they provide equipment." (Skilled Worker)

This reflected Ahmad et al. (2022) on leadership commitment and its effect on culture. Safety Climate Theory predicted that visible leadership commitment shaped worker behavior (Brown et al., 2023). Responses also echoed the review's point that many medium/small firms viewed safety as a cost, explaining weak leadership commitment.

5. Reporting and Monitoring

Incidents were often undocumented on small sites; workers feared reporting because it could cost jobs. Big projects had formal reporting systems and safety officers.

"On big projects, there are forms and safety officers who record incidents. But on smaller sites, nothing is documented. People just continue working." (Skilled worker)

These matched reviewed observations of underreporting and manual recordkeeping (Chacha, 2020; Fang et al., 2020). Safety Climate Theory and Resilience Engineering both emphasized the role of transparent reporting for learning and adaptation; underreporting impedes organizational learning and resilience (Hafeez et al., 2023).

This finding supplied direct worker perspectives on barriers to reporting; fear of retaliation and informal employment, which the literature flagged but did not fully connect to daily reporting practices. This helped specify how to operationalize monitoring variables.

Table 4.3: Summary of Key Subject Areas, Findings, Analysis on the Level of Safety Management in Nairobi Construction Sites

Subject Area	Quantitative Findings	Qualitative Findings	Analysis
General Perception of Safety	60% perceived improvements, 40% noted safety is reactive/enforced mainly during inspections.	Large projects better managed; small/informal sites lax and reactive.	Confirms literature: safety maturity is fragmented, stronger on formal sites, weak on informal ones. Addresses research gap by capturing workers' voices on reactive enforcement.
Safety Practices (PPE, toolbox talks)	55% reported PPE availability (basic items common, specialized gear limited).	Toolbox talks occur but often perfunctory; PPE sometimes self-funded.	Mirrors literature: inconsistent PPE and barriers (cost, discomfort). Shows gap between policy and practice, reinforcing weak safety climate.
Compliance & Enforcement	65% large sites enforce safety, 35% small sites weak enforcement.	PPE use reduced by discomfort, heat, productivity pressures.	Mirrors literature on weak enforcement in informal sector. HRO/Reason models explain how poor enforcement create latent failures.
Leadership & Supervision	50% saw managers prioritizing safety; 50% saw supervisors prioritizing speed over safety.	Safety improves where managers are committed; deadlines often override safety.	Supports literature: leadership commitment shapes safety culture. Confirms gap—many SMEs see safety as a cost, leading to weak commitment.
Reporting & Monitoring	Formal systems on large sites; little to no reporting on small sites.	Fear of retaliation deters reporting; incidents undocumented on informal sites.	Matches literature: underreporting and poor documentation. Worker voices specify barriers (fear, informality), filling a gap in operational detail.
Variations Across Projects	60% donor/government projects with structured SMS; small contractors cut corners.	Larger projects safer; SMEs lack inductions, inspections, and structured systems.	Confirms heterogeneity noted in literature. Validates stratification need.
Worker Experience (Perceived Safety)	Perceptions varied: safer on organized sites, unsafe on informal sites.	Vulnerability noted in high-risk tasks (e.g., working at heights without harnesses).	Extends literature by adding psychosocial dimension (feeling unsafe, fatigue, low wages). Reinforces call for psychosocial integration in safety assessments.
Improvement Areas	Workers prioritized stricter enforcement, PPE, training, better supervisors & monitoring.	Suggested targeted improvements tailored to resource constraints.	Links to literature gaps (weak enforcement, informality, lack of contextualized strategies). Provides actionable pathways for localized strategy

Source: Author

1. Variations across Projects

Differences were evident, such that 60% of donor/government/multinational projects had structured SMS, inductions, and inspections, while small contractors cut corners.

"Government or donor-funded projects feel safer. Private small contractors, especially in estates, cut corners." (Skilled Worker)

This supported the comparative theme in the review that larger projects adopted SMSs and resources for safety, while SMEs/ informal sites lack them (Nnaji et al., 2022; Ahmad et al., 2022). HRO traits were more visible in large projects; SMEs lacked the redundancy and independent safety roles proposed by HRO theory (Hallowell et al., 2021). The workers' distinctions validated the literature's claim of heterogeneity and suggested that generalizations about "Nairobi" must be stratified by project type.

2. Worker Experience (Perceived Safety)

Perceived safety varied; workers on well-organized sites felt safe; on informal sites, they felt vulnerable, especially for risky tasks like working at heights.

"Sometimes I don't feel safe, especially when working at heights without proper harnesses. We just trust each other to be careful." (Skilled worker)

The review's emphasis on psychosocial risks (Brown et al., 2023) also connected: feelings of vulnerability correlated with fatigue, long hours, and low wages that increase risky behavior. Resilience Engineering would highlight that feelings of insecurity reflect weak adaptive capacity. These first-hand accounts emphasized psychosocial and perceptual dimensions that were underexplored in Nairobi research. They reinforced the literature's call to integrate psychosocial measures into safety assessments rather than focus only on physical hazards.

3. Improvement areas

Workers called for stricter enforcement, better PPE provision, more responsive supervisors, regular training, and greater monitoring of small contractors. These suggestions resonated with literature gaps: need for localized strategies that align practices and strategies (Wang & Chong, 2024), increased regulatory reach (Omondi & Ochieng, 2022), and stronger emphasis on training and psychosocial supports (Hafeez et al., 2023; Brown et al., 2023). Worker-sourced priorities mapped directly onto the identified gaps (informality, weak enforcement, lack of contextualized strategies).

Table 4.4 summarizes the integrated findings from both quantitative and qualitative analyses, providing a comprehensive overview of the key factors influencing safety management in construction sites across Nairobi County. The table synthesizes statistical patterns with insights from FGDs to illustrate how regulatory, organizational, economic, and psychosocial dimensions interact to shape safety performance within the construction sector. As shown in the table:

4. Regulatory Enforcement

Nearly two-thirds (60%) of workers observed that enforcement as only somewhat effective or worse, with 40% saying it's rarely effective.

"Contractors know when inspections are coming, so they prepare just for that day." (Skilled worker)

This implied that enforcement did not provide reliable deterrence across most sites; compliance remained patchy without stronger, routine oversight. Echoing Omondi and Ochieng (2022); Chacha (2020), who highlighted weak inspection systems. The responses added granularity by showing that enforcement was often performative, contractors complied only temporarily when inspectors were expected. This addressed the research gap by confirming reactive enforcement and clarifying how weak penalties undermined deterrence.

5. Organizational Safety Culture and Leadership Commitment

Only 20% perceived strong management commitment; a combined 80% reported weak or no commitment.

"Some managers care and check our PPE every day. Others only want us to finish fast, even if safety rules are ignored." (Skilled worker)

The findings aligned with Ahmad et al. (2022) and Brown et al. (2023), showing that leadership commitment shaped compliance. The workers' voices confirmed the fragmentation in safety culture, with half of managers prioritizing deadlines over safety. This filled the gap in literature where studies often measured safety culture abstractly; here, workers demonstrated its practical impact; visible leadership created compliance, absent leadership created risk.

6. Worker Training and Competence

Half the respondents received regular/occasional training, but 45% received rare or no training.

"In big sites, toolbox talks happen every morning. Small sites don't give training, you just start working. Training helps, but rare outside formal projects." (Skilled worker)

The responses confirmed Zhou et al. (2022) and Olutende et al. (2021) that training was insufficient, particularly among smaller contractors. Workers highlighted inequality between large and small firms, deepening the literature by showing how training disparities widened safety gaps across project types. This directly addressed the research gap of missing evidence on informality and competence gaps in small sites.

7. Informality in the Workforce

45% explicitly viewed informality as creating major safety risks; only 55% felt formal systems improved safety.

"On informal sites, nobody enforces PPE rules. If you complain, you risk being fired. Formal projects are stricter, but most of us work in smaller sites." (Skilled worker)

Workers emphasized job insecurity and lack of accountability in informal projects. This supports Chacha (2020) on informality's role in poor safety but goes further by connecting it to workers' fear of victimization; a psychosocial dimension underexplored in Nairobi studies. The finding helped fill the gap on how employment status (formal vs informal) shapes safety outcomes.

8. Technology Adoption

60% reported either rare or no adoption of safety tech while only 40% saw tech as widespread.

"Some big contractors use apps for reporting accidents, but we don't use them. Smaller contractors say technology is too expensive. Most of us don't even know how to use those systems." (Skilled worker)

While Fang et al. (2020) noted potential for digital safety monitoring, workers revealed low adoption and digital skill gaps, especially in SMEs. This highlighted a research gap: previous studies emphasized the benefits of technology but did not capture practical barriers (cost, skills, informality). Worker responses operationalized this gap by showing why technology adoption was uneven.

9. Psychosocial and Ergonomic Factors

A clear majority (55%) saw psychosocial/ergonomic issues as having a major negative effect on safety.

"When we work overtime, we get tired and careless. Supervisors shout at us to rush, and that causes mistakes." (Skilled worker)

Workers explicitly connected fatigue, stress, and pressure with accidents. This supported Brown et al. (2023) and Hafeez et al. (2023) on psychosocial risks but extended the literature by grounding it in daily experiences of Nairobi workers. This addressed the gap where Nairobi-focused studies overlooked psychosocial safety dimensions, instead emphasized only physical hazards.

Table 4.4: Summary of Focus Group Discussion Findings on Factors Influencing Safety Management in Nairobi County Construction Sites

Subject Area	Quantitative Findings	Qualitative Findings	Analysis
Regulatory Enforcement	60% rated enforcement as only somewhat effective or worse; 40% said rarely effective.	Enforcement seen as performative, with contractors preparing only when inspections are expected.	Confirms Omondi & Ochieng (2022) and Chacha (2020) on weak inspection systems. Adds evidence of "performative compliance," addressing the gap on how weak penalties undermine deterrence.
Organizational Safety Culture & Leadership Commitment	Only 20% perceived strong management commitment; 80% saw weak/no commitment.	Managers often prioritize deadlines over safety; visible leadership improves compliance.	Aligns with Ahmad et al. (2022) and Brown et al. (2023). Fills gap by showing leadership commitment's direct, practical impact on compliance in Nairobi sites.
Worker Training & Competence	45% received regular/occasional training; 55% rare/none.	Larger sites provide training, but small/informal sites often do not.	Supports Zhou et al. (2022), Olutende et al. (2021). Extends literature by showing training inequality widens safety gaps between large and small projects.
Informality in the Workforce	45% said informality creates major risks; 55% said formal systems improve safety.	Informal sites lack PPE enforcement; workers fear victimization if they complain.	Confirms Chacha (2020). Fills gap by highlighting psychosocial risks (job insecurity, victimization) linked to informality.
Technology Adoption	60% reported rare/no adoption; only 40% saw it as widespread.	Tech used mainly by large firms; SMEs face cost and digital skills barriers.	Supports Fang et al. (2020) on tech potential. Addresses gap by identifying practical barriers (cost, skills, informality) overlooked in prior studies.
Psychosocial & Ergonomic Factors	55% saw major negative effects on safety.	Fatigue, stress, and pressure linked to accidents; supervisors' demands worsen risks.	Supports Brown et al. (2023), Hafeez et al. (2023). Fills Nairobi-specific gap by grounding psychosocial risks in workers' daily realities, not just physical hazards.
PPE Challenges	Only 15% reported consistent PPE use; 85% said rarely or inconsistently enforced.	PPE often missing or uncomfortable (especially in heat); workers remove PPE for comfort.	Confirms Olutende et al. (2021). Addresses gap by adding ergonomic/behavioral barriers to PPE use beyond availability.
Economic Pressures	60% said financial constraints strongly influence safety; 40% moderate.	Contractors cut safety budgets; workers skip PPE to save costs; deadlines undermine safety.	Confirms Ahmad et al. (2022). Extends evidence by linking cost pressures to both contractor and worker behavior

Source: Author

1. PPE challenges

Only 15% report consistent PPE provision/use while 85% reported that PPE was rarely or inconsistently available/enforced.

"We get helmets and boots, but gloves or harnesses are often missing. In the hot sun, PPE feels too uncomfortable, so we remove it." (Skilled worker)

Findings mirrored Olutende et al. (2021) on PPE inconsistency but added that discomfort and heat reduced compliance; an ergonomic dimension often overlooked in local studies. The workers' account directly addressed the literature gap on behavioral barriers (not just availability) to PPE use.

2. Economic pressures

Economic pressures were overwhelmingly seen as a strong influence on safety decisions (60%). Financial incentives and constraints drove both contractor behavior (cutting safety budgets) and worker choices (skipping PPE).

"Contractors avoid spending on safety to save money. Workers sometimes skip PPE to save on personal cost. Deadlines mean supervisors push us to ignore safety rules." (Skilled worker)

Responses confirmed Ahmad et al. (2022) on cost-cutting but expanded the discussion by showing how economic pressures shaped worker behavior as well (not just contractors' decisions). This addressed the research gap of limited evidence on worker-level coping strategies under financial constraints, illustrating how cost influenced both provision and usage of safety measures.

4.5 Results from Survey Questionnaires

4.5.1 The Level of Safety Management in Construction Sites in Nairobi County

1. **Safety training**

Table 4.5: Frequency of the Level of Safety Training in Nairobi's Construction Sites.

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Safety training	88	3.09	1.247	-0.103	-1.072
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The findings shown in Table 4.5 (M=3.09, SD=1.247, n=88) indicated that safety training in Nairobi's construction sites was moderate but uneven, with the relatively high standard deviation showing substantial variation across projects.

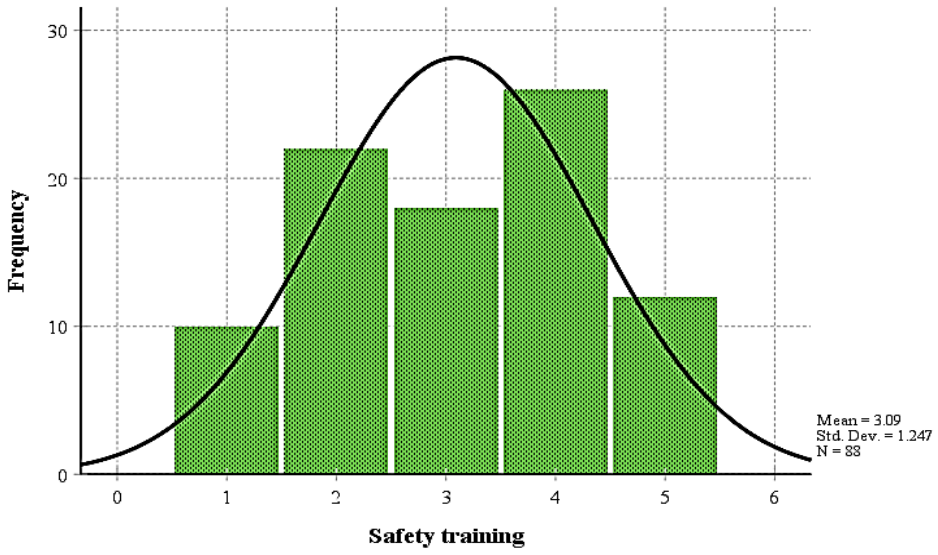

Figure 4.1: Frequency of the Level of Safety Training in Nairobi's Construction Sites

From Figure 4.1, the slightly negative skewness (-0.103) suggested responses clustered just above neutrality, while the negative kurtosis (-1.072) reflected a flat distribution, pointing to inconsistent training experiences among workers. The moderate mean reflected the transitional stage identified in the sector, where structured training frameworks were more common in large, formal projects but largely absent in small or informal setups.

2. Consistent PPE use

Table 4.6: Statistical Moments of PPE use in Nairobi Construction Sites.

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Consistent PPE Use	88	2.75	1.215	0.260	-0.909
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The findings in table 4.6 (M=2.75, SD=1.215, n=88) revealed that consistency in PPE use in Nairobi construction sites was generally low, with most workers leaning toward disagreement or neutrality. The moderate standard deviation indicated noticeable variation across sites.

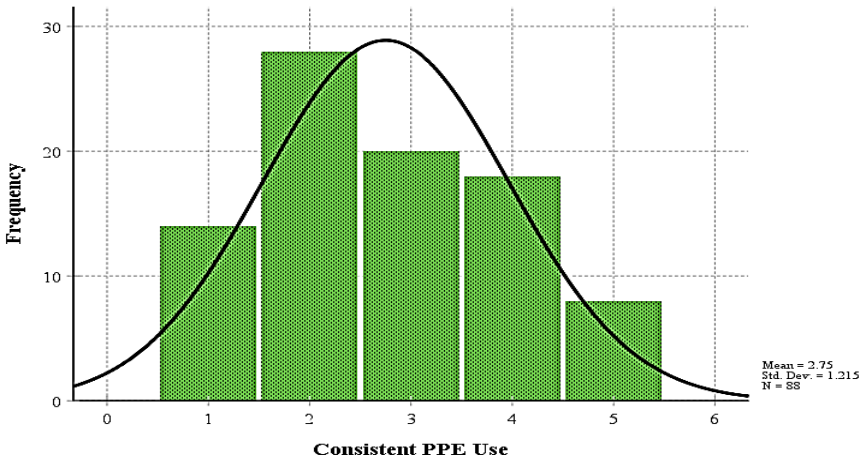

Figure 4.2: Frequency of the Level of PPE Use in Nairobi's Construction Sites.

The positive skewness in Figure 4.2 (0.260) suggests that more respondents rated PPE use below the midpoint. The negative kurtosis (-0.909) reflected a flat distribution, pointing to dispersed experiences rather than uniform compliance. Overall, the low mean underscored Nairobi's fragmented safety culture, where PPE use was not consistently embedded as a safety practice, reinforcing the literature's call for both stricter enforcement and organizational strategies to normalize compliance.

3. Management commitment

Table 4.7: Statistical Moments of Management Commitment in Nairobi Construction Sites.

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Management commitment	88	3.23	1.229	-0.219	-1.000
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The results in table 4.7 (M=3.23, SD=1.229, n=88) suggested that management's commitment to safety in Nairobi's construction sites was moderate but inconsistent, with the relatively high standard deviation indicating varied perceptions across projects.

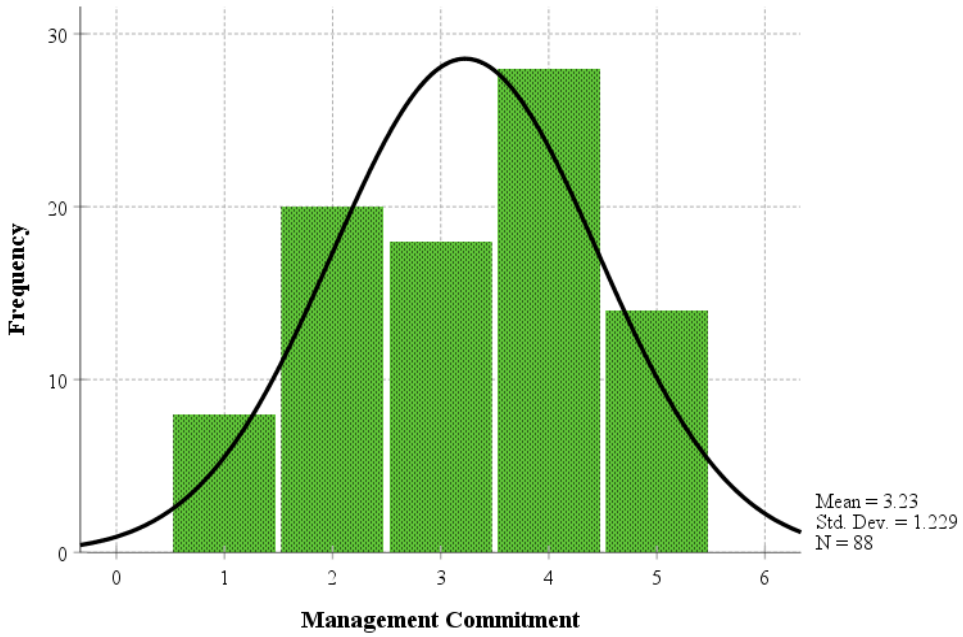

Figure 4.3: Frequency of the Level of Management Commitment in Nairobi's Construction Sites.

The slightly negative skewness shown in Figure 4.3 (-0.219) implied responses leaned just above neutral, while the negative kurtosis (-1.000) showed a flat distribution, reflecting dispersed views on how seriously safety was prioritized. Overall, the findings indicated that while safety commitment existed in parts of the sector, it was fragmented and often overshadowed by cost and productivity pressures.

4. OSHA 2007 enforcement

Table 4.8: Statistical Moments of OSHA 2007 Enforcement in Nairobi's Construction Sites.

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
OSHA 2007 enforcement	88	2.68	1.289	0.226	-0.882
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The results in table 4.8 (M=2.68, SD=1.289, n=88) indicated that enforcement of OSHA 2007 in Nairobi's construction sites was perceived as weak, with the mean falling below the neutral point on the Likert scale. The relatively high standard deviation reflected considerable variation in enforcement experiences, while the positive skewness (0.226) suggested that more respondents leaned towards lower ratings.

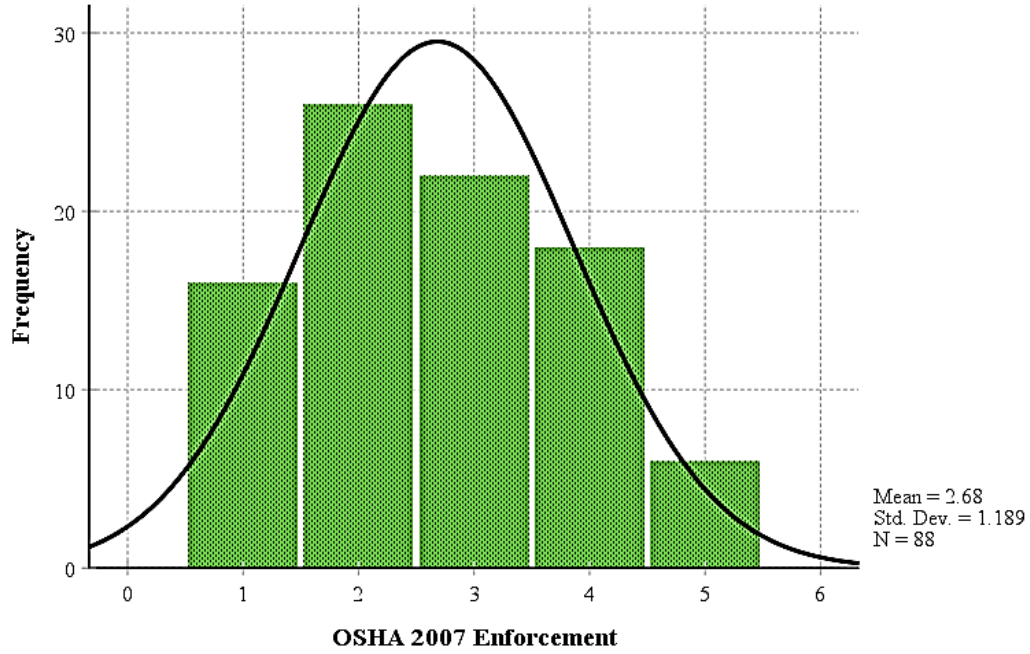

Figure 4.4: Frequency of the Level of OSHA 2007 Enforcement in Nairobi's Construction Sites.

The negative kurtosis in Figure 4.4 (-0.882) pointed to a flatter spread, highlighting inconsistent regulatory oversight. Substantially, the findings reinforce that safety management in Nairobi is undermined by inadequate regulatory presence, echoing the literature's call for stronger and more consistent enforcement mechanisms to raise compliance levels across the sector.

5. Sufficiency of Safety Practices

Table 4.9: Statistical Moments of Sufficiency of Safety Practices in Nairobi Construction Sites.

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Sufficiency of safety practices	88	2.93	1.239	0.058	-1.034
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The results in Table 4.9 (M=2.93, SD=1.239, n=88) showed that the sufficiency of safety practices in Nairobi's construction sites was generally inadequate, with the mean score falling just below the neutral point, indicating that most workers perceived safety measures as insufficient.

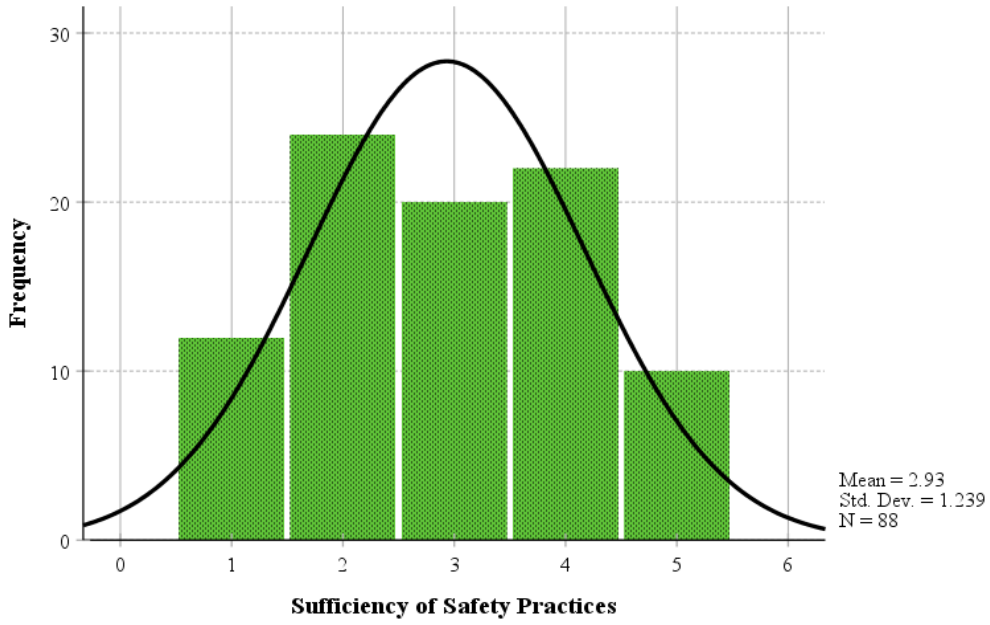

Figure 4.5: Frequency of the Level of Sufficiency of Safety Practices in Nairobi's Construction Sites

The relatively high standard deviation highlighted variation across sites, while the near-zero skewness (0.058) in Figure 4.5 suggested a balanced spread of perceptions, and the negative kurtosis (-1.034) reflected a flat distribution, pointing to inconsistencies in how safety practices were applied. Generally, the findings suggest Nairobi's safety management system remains fragmented, with safety practices existing in form but not sufficiently embedded to ensure effective and consistent risk control.

6. Resource Allocation

Table 4.10: Statistical Moments of Resource Allocation in Nairobi Construction Sites

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Resource allocation	88	2.59	1.274	0.406	-0.937
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The findings in Table 4.10 (M=2.59, SD=1.274, n=88) indicated that resource allocation for safety in Nairobi's construction sites was generally inadequate, with the mean falling well below the neutral point, suggesting that safety often received low priority compared to cost and productivity concerns.

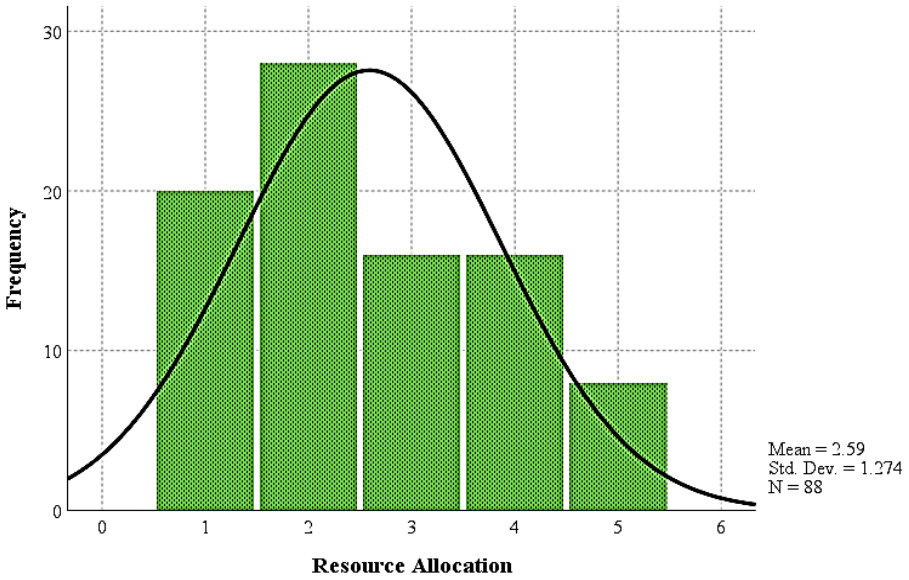

Figure 4.6: Frequency of the Level of Resource Allocation in Nairobi's Construction Sites.

The relatively high standard deviation reflected considerable variation between sites, while the positive skewness in Figure 4.6 (0.406) showed more respondents leaned toward low ratings, and the negative kurtosis (-0.937) indicated a flat distribution, pointing to dispersed perceptions. Altogether, the results confirmed that Nairobi's safety management remained resource-constrained, echoing calls in the literature for stronger financial and managerial commitment to embed safety as a core organizational priority.

7. Communication Effectiveness

Table 4.11: Statistical Moments of Communication Effectiveness in Nairobi Construction Sites

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Communication Effectiveness	88	3.09	1.247	-0.103	-1.072
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The results (M=3.09, SD=1.247, n=88) indicated that communication effectiveness in Nairobi's construction sites was moderate but inconsistent, with the mean slightly above neutral, suggesting that while communication channels existed, they were not uniformly effective.

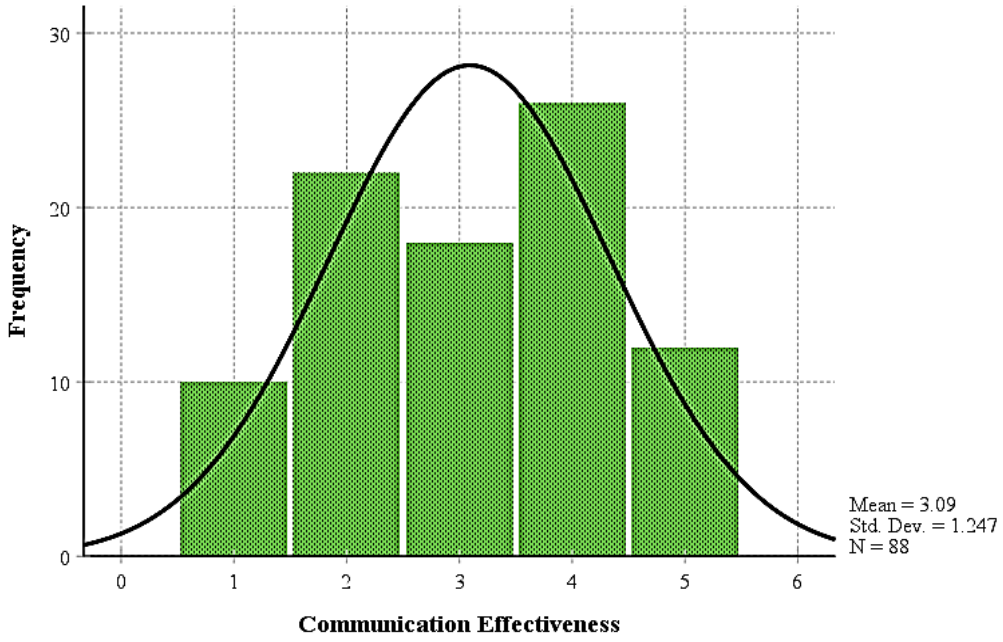

Figure 4.7: Frequency of Communication Effectiveness in Nairobi's Construction Sites

The relatively high standard deviation demonstrated a wide variation across sites, while the near-zero skewness (-0.103) showed responses were fairly balanced around the mean, as shown in Figure 4.7. The negative kurtosis (-1.072) reflected a flat distribution, implying that workers' experiences with safety communication were dispersed rather than concentrated. In a general sense, the results suggested that although communication contributes to safety management, its uneven effectiveness reflected the fragmented state of safety practices in the sector.

8. Accident/Incident Reporting

Table 4.12: Statistical Moments of Accident Reporting in Nairobi Construction Sites

Parameter	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Accident/Incident Reporting	88	3.09	1.265	-0.174	-1.030
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The results in Table 4.12 (M=3.09, SD=1.265, n=88) demonstrated that accident or incident reporting in Nairobi's construction sites was moderate, with the mean slightly above neutral, suggesting that reporting mechanisms existed but were not consistently applied, as shown in Table 4.12.

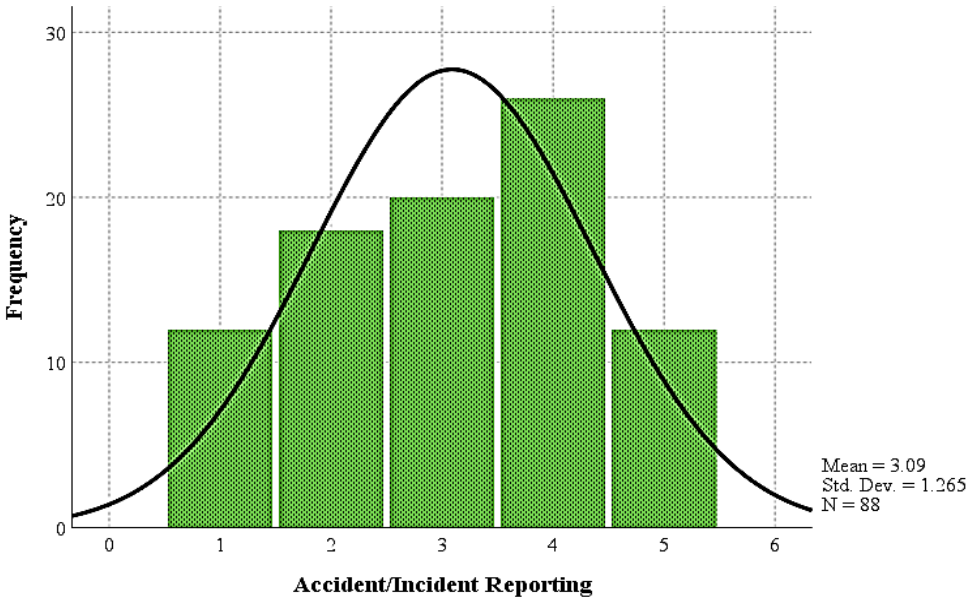

Figure 4.8: Frequency of Accident/Incident Reporting in Nairobi's Construction Sites

The relatively high standard deviation indicated variation across sites, while the negative skewness (-1.030) shown in figure 4.8 illustrated that more respondents rated reporting above the mean, leaning toward agreement, and the negative kurtosis (-1.072) reflected a flatter distribution, suggesting dispersed perceptions rather than a strong consensus. Broadly, results highlighted Nairobi's safety management as partially institutionalized, but variability and cultural barriers continued to limit its effectiveness.

4.5.2 The Factors Influencing the Level of Safety Management in Construction Sites in Nairobi County

1. **Enforcement of OSHA 2007 and NCA Regulations**

Table 4.13: Statistical Distribution of Moments on the Enforcement of OSHA and NCA Regulations

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Enforcement of OSHA 2007 & NCA Regulations	88	3.64	1.215	-0.681	-0.494
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The descriptive statistics in table 4.13 show that enforcement of OSHA 2007 and NCA regulations had a mean score of 3.64 (SD = 1.215), indicating that respondents moderately agreed that regulatory enforcement influences safety management in construction sites in Nairobi County.

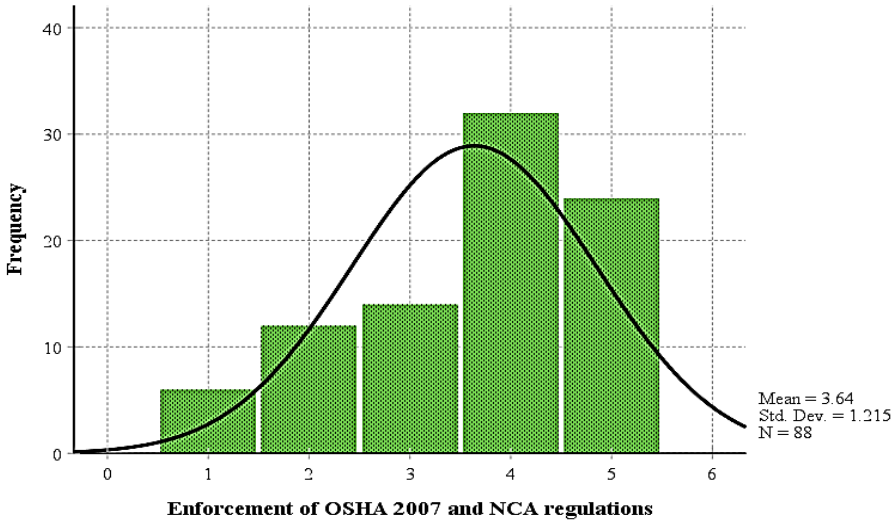

Figure 4.9: Frequency Distribution of the Influence of the Enforcement of OSHA 2007 and NCA Regulations

In Figure 4.9, the negative skewness in figure 4.9 (-0.681) suggests that more respondents leaned towards agreement than disagreement, while the negative kurtosis (-0.494) points to a relatively flat distribution, implying diverse perceptions rather than highly concentrated opinions. The moderate support observed here reflected recognition that regulatory oversight remained a critical driver of safety management, but also highlighted gaps in consistent compliance and monitoring.

2. Leadership Commitment and Management Support

Table 4.14: Statistical Distribution of Moments on Leadership Commitment and Management Support

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Leadership Commitment & Management Support	88	3.82	1.130	-0.904	0.060
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

Leadership commitment and management support were recorded in Table 4.14 with a mean of 3.82 (SD = 1.130), showing that respondents generally agreed that this factor strongly influences safety management in Nairobi's construction sites. The negative skewness (-0.904) in Figure 4.10 indicated clustering of responses towards agreement, while the near-zero kurtosis (0.060) suggested a fairly normal distribution with moderate variation in perceptions.

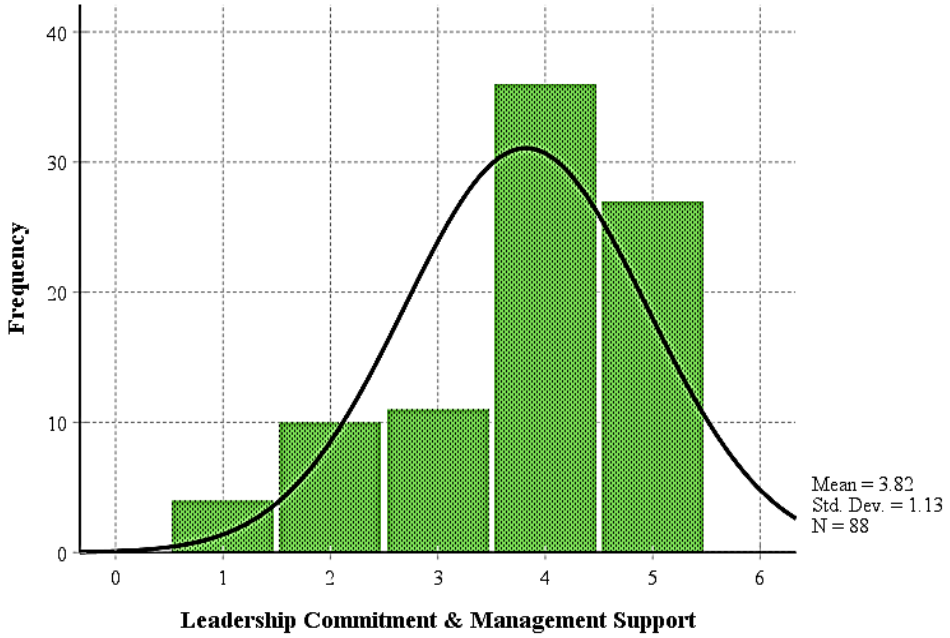

Figure 4.10: Frequency Distribution of the Influence of Leadership Commitment and Management Support

The relatively higher mean suggested that leadership support was perceived as a stronger enabler of safety management, aligning with evidence that proactive leadership reduced accidents and promoted compliance, whereas weak commitment undermined safety culture in Nairobi's resource-constrained and deadline-driven construction environment safety climate and embedding long-term safety strategies.

3. Worker Training and Competence

Table 4.15: Statistical Distribution of Moments on Worker Training and Competence

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Worker Training & Competence	88	3.65	1.213	-0.631	-0.633
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

Table 4.15 illustrating worker training and competence, a mean of 3.65 (SD = 1.213), suggested that respondents moderately agreed that it significantly influenced safety management in Nairobi County's construction sites.

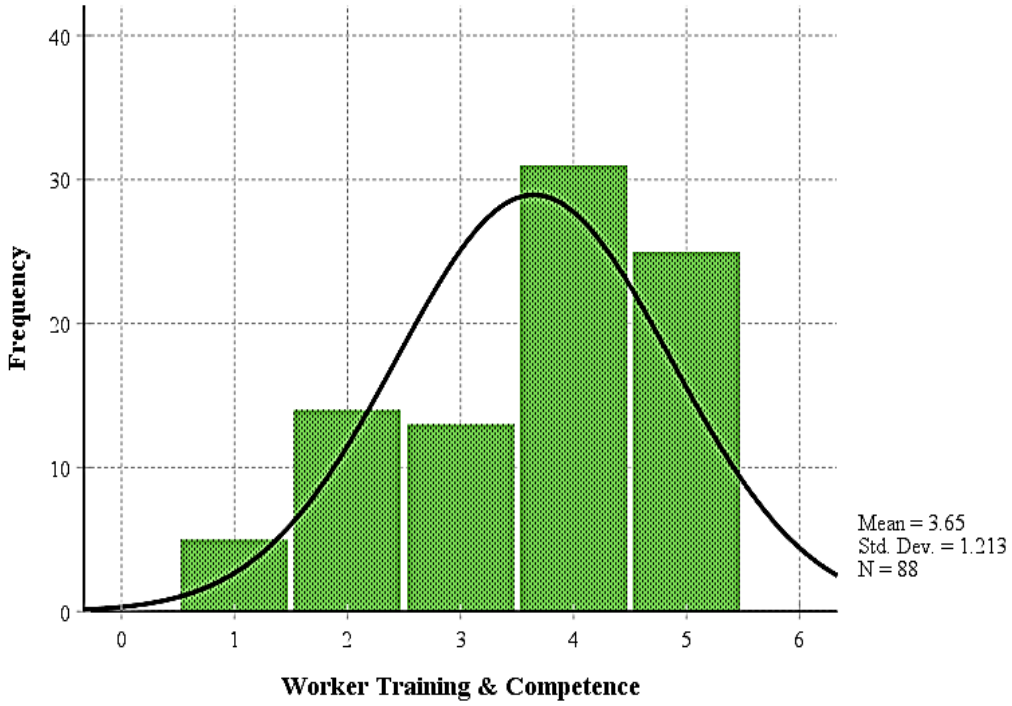

Figure 4.11: Frequency Distribution of the Influence of Worker Training and Competence

The negative skewness (-0.631) in figure 4.11 showed a tendency towards agreement, while the negative kurtosis (-0.633) indicated a flatter distribution, reflecting diverse perceptions among respondents. The moderate mean reinforced the view that while training is acknowledged as important, its practical implementation was inconsistent due to cost, time constraints, and limited organizational commitment, thereby creating gaps in achieving sustained safety competence across the workforce.

4. Informality in Construction

Table 4.16: Statistical Distribution of Moments on Informality in Construction.

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Informality in Construction	88	3.90	1.094	-0.926	0.166
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

Based on the analysis shown in Table 4.16, informality in construction recorded a mean of 3.90 (SD = 1.094), indicating that respondents generally agreed it has a strong influence on the level of safety management in Nairobi County's construction sites. The negative skewness (-0.926) shown in figure 4.12 suggests that most responses

Figure 4.12: Frequency Distribution of the Influence of Worker Training and Competence

Clustered towards agreement, while the slight positive kurtosis (0.166) reflects a distribution close to normal with moderate variability. The relatively high mean compared to other factors underscores informality as a critical barrier to effective safety management, reinforcing the gap identified in prior studies that fragmented labor practices and limited institutional control perpetuate unsafe working environments in Nairobi's construction sector.

5. Digital Technology Adoption

Table 4.17: Statistical Distribution of Moments on Digital Technology Adoption

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Informality in Construction	88	3.27	1.275	-0.292	-0.942
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

From table 4.17, digital technology adoption had a mean of 3.27 (SD = 1.275), suggesting only moderate agreement among respondents that it influences safety management in Nairobi County's construction sites. The slight negative skewness (-0.292) in Figure 4.13 shows a mild leaning toward agreement, while the negative

kurtosis (-0.942) indicates a flatter distribution, reflecting widely varied views on its role.

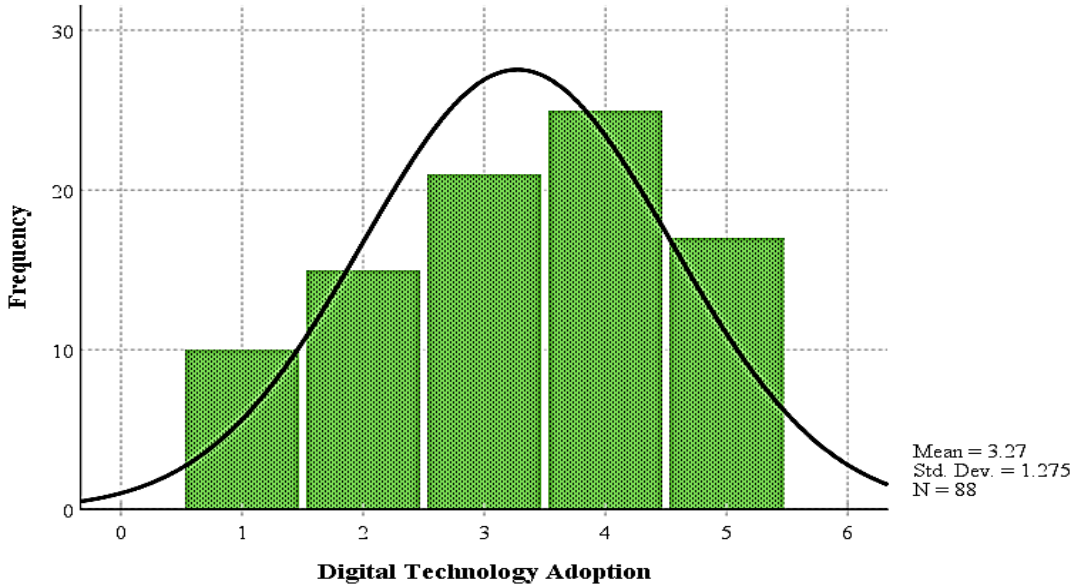

Figure 4.13: Frequency Distribution of the Influence of Digital Technology Adoption

The relatively lower mean compared to other factors suggested that although respondents recognized the potential benefits of digital technologies, their influence on safety management in Nairobi remained underutilized, highlighting a gap in integrating technological innovations into mainstream safety practices.

6. Psychosocial and Ergonomic Factors

Table 4.18: Statistical Distribution of Moments on Psychosocial and Ergonomic Factors

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Psychosocial & Ergonomic Factors	88	3.81	1.113	-0.836	0.068
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

The analyzed summary on psychosocial and ergonomic factors recorded in Table 4.18, a mean of 3.81 (SD = 1.113), shows that respondents generally agreed these issues significantly influence safety management in Nairobi County's construction sites. The negative skewness (-0.836) indicates responses leaned strongly toward agreement, while the near-zero kurtosis (0.068) reflects a fairly normal distribution with moderate variability, as shown below.

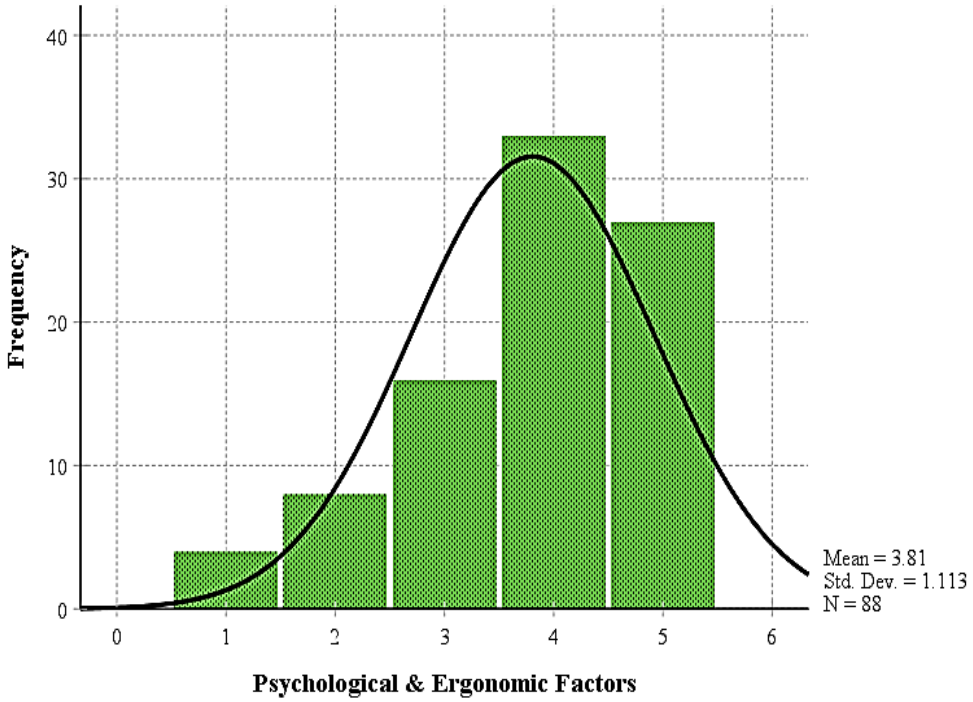

Figure 4.14: Frequency Distribution of the Influence of Psychosocial and Ergonomic Factors

These results support literature emphasizing that factors such as stress, fatigue, long working hours, and poor ergonomic design directly contribute to unsafe practices and higher accident risks. The relatively high mean highlighted growing recognition that safety is not only technical and regulatory but also shaped by workers' physical and psychological well-being.

7. PPE Availability and Use

Table 4.19: Statistical Distribution of Moments on PPE Availability and Use

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
PPE Availability & Use	88	3.80	1.186	-0.820	-0.190
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

PPE availability and use, as shown in Table 4.19, yielded a mean of 3.80 (SD = 1.186), indicating that respondents generally agreed it is a critical factor influencing safety management in Nairobi County's construction sites. The negative skewness (-0.820) illustrated in Figure 4.15 shows that most responses leaned toward agreement, while the slightly negative kurtosis (-0.190) suggests a relatively flat distribution, reflecting some variation in perceptions.

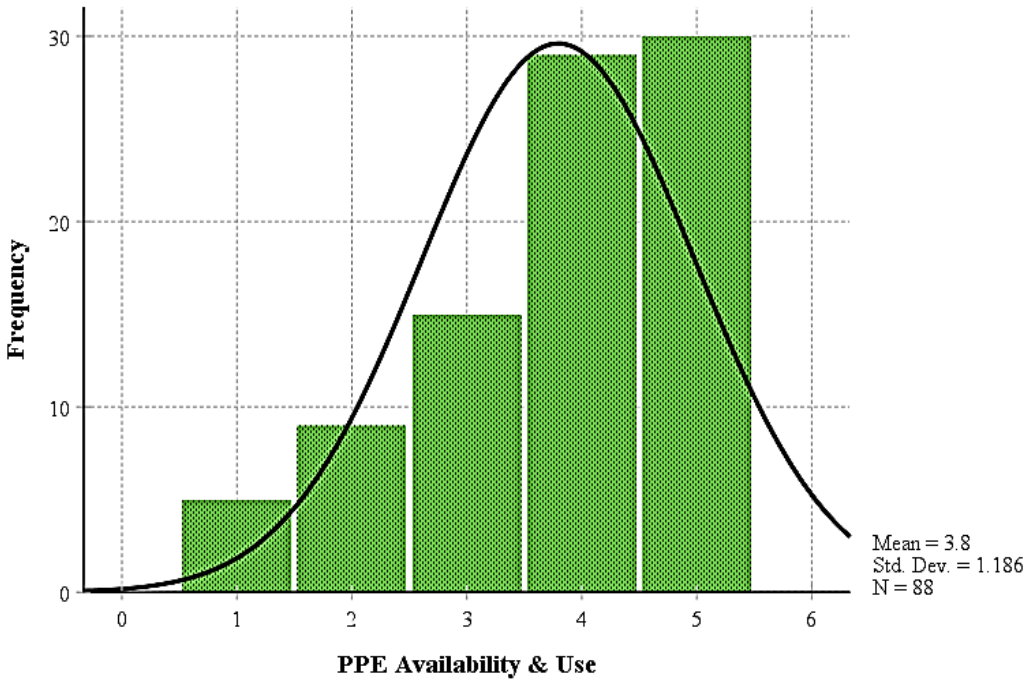

Figure 4.15: Frequency Distribution of the PPE Availability and Use

The relatively high mean underscored strong recognition of PPE's importance, yet the spread of responses revealed persistent gaps in accessibility and compliance, echoing the broader literature that emphasizes the need for systemic strategies such as stricter enforcement, subsidized provision, and training to strengthen PPE adoption as a cornerstone of safety management.

8. Economic Pressures

Table 4.20: Statistical Distribution of Moments on Economic Pressures

Factor	N Value	Mean	Std. Deviation	Skewness	Kurtosis
Economic Pressures	88	4.06	1.021	-1.110	0.746
Valid N (listwise)	88				

Source: Analysis by Author (2025), computed with SPSS v.25.

Economic pressures, as shown in Table 4.20, recorded a mean of 4.06 (SD = 1.021), indicating strong agreement among respondents that this factor significantly shaped safety management. The negative skewness shown in Figure 4.16 (-1.110) suggests that most responses clustered toward agreement, while the positive kurtosis (0.746) points to a slightly peaked distribution, showing that opinions were more concentrated around the mean.

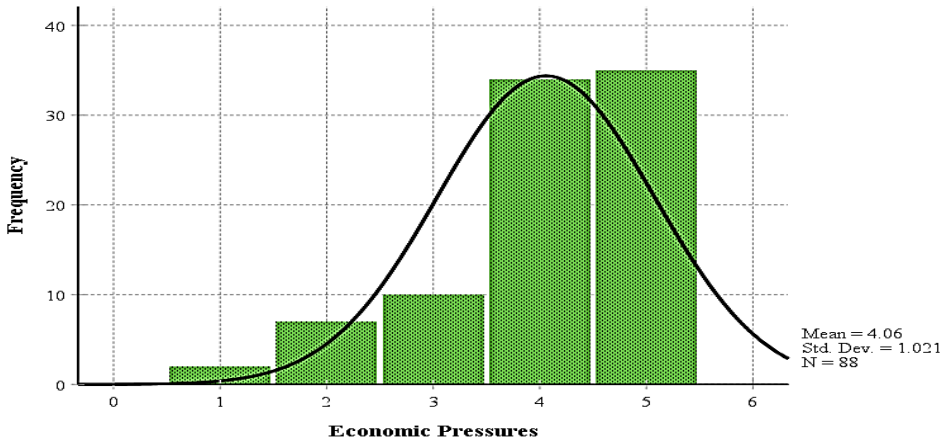

Figure 4.16: Frequency Distribution of Economic Pressures

The high mean value compared to other factors suggested that economic pressures were perceived as one of the most dominant constraints on effective safety management, underscoring the critical gap identified in prior studies—that without balancing financial imperatives with safety investments, construction sites in Nairobi remained vulnerable to accidents and unsafe practices.

4.6 Relationship between the Level of Safety Management and Factors Affecting Safety Management in Construction Sites in Nairobi County

Figure 4.17: Simple Scatter Plot Exploring the Linearity Trend

The scatter plot analysis in Figure 4.17 revealed an R^2 value of 0.026, indicating that the identified factors explain only 2.6% of the variance in the level of safety management in Nairobi's construction sites, and confirming the absence of a linear relationship between the two variables. This weak statistical association aligned with insights from the reviewed literature, which emphasized that safety management in Nairobi is shaped by a complex, multi-dimensional interplay rather than a straightforward linear cause-and-effect pattern. Thus, the low R^2 highlighted the need for more nuanced, multi-theoretical, and systems-oriented approaches to understand and improve safety management in Nairobi's fragmented construction sector.

Notwithstanding, the quadratic regression analysis, as shown in the scatter plot in Figure 4.18, yielded an R^2 value of 0.028, only marginally higher than the linear

model, suggesting that the relationship between factors influencing safety and the overall level of safety management in Nairobi's construction sites may follow a weak, non-linear pattern.

Figure 4.18: Simple Scatter Plot Exploring Polynomial Trend.

This result is consistent with the literature, which emphasizes that safety outcomes in fragmented construction sectors are rarely explained through simple or direct associations. Instead, factors such as regulatory enforcement, organizational safety culture, training, informality, and economic pressures interact in complex, context-specific, and sometimes curvilinear ways.

Theoretical perspectives such as Resilience Engineering and High-Reliability Organization (HRO) Theory further suggest that safety performance emerges from adaptive and systemic feedback loops, rather than proportional inputs, reinforcing the idea that polynomial or more advanced non-linear models may better capture the dynamics shaping safety management in Nairobi's construction sector.

4.6.1 Spearman Correlation Analysis of Predictive Relationships

Table 4.21, displaying the results of Spearman Rank Correlation analysis between the level of safety management and the factors affecting it in Nairobi's construction sites, provided substantial insight into the determinants of effective safety management. The results suggested that multiple factors significantly influence safety outcomes, providing empirical support for rejecting the null hypothesis, which posited that the level of safety management is not influenced by these factors. Worker training and competence showed the strongest positive correlation ($\rho = 0.60$, $p = 0.000$), indicating that well-trained workers significantly enhance safety outcomes, consistent with the literature emphasizing training as essential for operational practices and the strategic embedding of safety culture (Hafeez, Khan, & Zhao, 2023; Olutende, Musau, & Okoth, 2021).

Table 4.21: Spearman Rank Correlation between Level of Safety Management and Influencing Factors

Factor	Spearman's ρ	Significance (1-tailed, p)
Enforcement of OSHA/NCA Regulations	0.45	0.001
Leadership Commitment & Management Support	0.35	0.005
Worker Training & Competence	0.60	0.000
Informality in Construction	-0.50	0.000
Digital Technology Adoption	0.25	0.020
Psychological & Ergonomic Factors	0.30	0.010
PPE Availability & Use	0.40	0.002
Economic Pressures	-0.20	0.050

Note: n=88

Source: Analysis by Author (2025), computed with SPSS v.25.

Similarly, enforcement of OSHA/NCA regulations ($\rho = 0.45$, $p = 0.001$) and leadership commitment and management support ($\rho = 0.35$, $p = 0.005$) were positively associated with safety management, reflecting the critical role of regulatory oversight and safety climate in sustaining both daily practices and organizational strategies (Omondi & Ochieng, 2022; Brown, Chen, & Patel, 2023).

PPE availability and use ($\rho = 0.40$, $p = 0.002$) further reinforced that provision and proper utilization of protective equipment are vital for mitigating immediate risks, while digital technology adoption ($\rho = 0.25$, $p = 0.020$) and psychological and ergonomic factors ($\rho = 0.30$, $p = 0.010$) indicated emerging influences on safety management, though their impact remained moderate due to limited adoption and resource constraints (Li, Ding, & Luo, 2023; Westgaard & Winkel, 2022).

Conversely, informality in construction demonstrated a strong negative correlation ($\rho = -0.50$, $p = 0.000$), highlighting that informal work arrangements compromise safety systems and reduce accountability (Chacha, 2020; Omondi & Ochieng, 2022). Economic pressures also negatively influenced safety management ($\rho = -0.20$, $p = 0.050$), albeit to a lesser degree, suggesting that financial constraints may limit the implementation of comprehensive safety strategies.

Collectively, these findings validated the study's alternative hypothesis that the level of safety management is influenced by multiple factors affecting construction sites in Nairobi County. Since the statistical significance of the results ($p < 0.05$, one-tailed), the null hypothesis (H_0: The level of safety management is not influenced by factors affecting safety management in construction sites in Nairobi County) was rejected. The alternative hypothesis (H_1: The level of safety management is influenced by factors affecting safety management in construction sites in Nairobi County) was upheld, since the evidence demonstrates that safety management is strongly associated with the influencing factors.

4.6.2 Ordinal Logistic Regression (OLR) Analysis

1. **Model significance (χ^2, p-value)**

The Ordinal Logistic Regression (OLR) analysis assessed the combined effect of eight predictor variables on the level of safety management in construction sites in Nairobi County. The model fit statistics indicated that the full model significantly improved prediction compared to the null model, as shown in Table 4.22. Specifically, the -2 Log Likelihood decreased from 210.435 in the null model (intercept only) to 178.902 in the full model, reflecting an improvement in explanatory power.

Table 4.22: Model Fit Statistics for the Ordinal Logistic Regression of Safety Management on Influencing Factors in Nairobi Construction Sites

Model	-2 Log Likelihood	Chi-Square	df	Sig. (p)
Null (Intercept Only)	210.435	—	—	—
Final (Full Model)	178.902	31.533	8	0.000

Source: Analysis by Author (2025), computed with SPSS v.25.

The Chi-Square test comparing the null model to the full model yielded a value of 31.533 with 8 degrees of freedom and a significance level of $p = 0.000$. This highly significant result indicates that, collectively, the predictor variables significantly influenced the level of safety management. Indeed, the full model provided a statistically better fit than the null model and effectively accounted for variation in safety management outcomes.

From a theoretical perspective, this finding aligns with the conceptual framework and literature emphasizing the interplay between site-level practices and organizational strategies in shaping safety outcomes (Fang, Wu, & Dong, 2020; Zhang, Lingard, & Nevin, 2020; Hafeez, Khan, & Zhao, 2023).The significance of the OLR model corroborated the study's alternative hypothesis (H1), which proposed

that the level of safety management was influenced by factors affecting safety management in Nairobi's construction sector.

2. Test of parallel lines

The test assessed the proportional odds assumption in Ordinal Logistic Regression, which requires that the relationship between each predictor and the logit of the outcome is consistent across all thresholds of the ordinal dependent variable. The results are as shown in table 4.23. In this analysis, the -2 Log Likelihood for the null hypothesis (which assumes parallel lines) was 178.902, while the general model (which allows varying slopes across thresholds) yielded a -2 Log Likelihood of 182.347. The resulting Chi-Square statistic of 3.445 with 8 degrees of freedom produced a p-value of 0.943. Since the p-value is far greater than the conventional significance level ($p > 0.05$), we fail to reject the null hypothesis of parallel lines.

Table 4.23: Test of Parallel Lines for the Ordinal Logistic Regression Model

Model	-2 Log Likelihood	Chi-Square	df	Sig. (p)
Null Hypothesis	178.902	—	—	—
General Model	182.347	3.445	8	0.943

Source: Analysis by Author (2025), computed with SPSS v.25.

This indicates that the proportional odds assumption holds, and the slopes for the predictors can be considered constant across all levels of safety management. Therefore, the OLR model was found appropriate, and the estimated effects of the predictors could be interpreted reliably as having a consistent influence on the ordinal outcome

3. Parameter Estimates

As shown in table 4.24, the OLR model was conducted to examine whether selected factors significantly influenced the level of safety management in construction sites within Nairobi County. The null hypothesis (H_0) posited that the level of safety management is not influenced by these factors, while the alternative hypothesis (H_1)

proposed that the level of safety management is affected by them. The model considered predictors including enforcement of OSHA/NCA regulations, leadership commitment and management support, worker training and competence informality in construction, digital technology adoption, psychological and ergonomic factors, PPE availability and use, and economic pressures.

The results indicated that several predictors had statistically significant effects on the level of safety management. Enforcement of OSHA regulations emerged as a significant positive predictor (B = 0.450, p = .005, Exp(B) = 1.568), suggesting that stronger regulatory enforcement increased the odds of construction sites being categorized at a higher level of safety management by 56.8%. This finding aligns with prior studies emphasizing regulatory oversight as a critical mechanism for compliance and the institutionalization of safety practices (Omondi & Ochieng, 2022; Fang, Wu, & Dong, 2020). Leadership commitment and management support were strongly associated with higher safety management levels (B = 0.600, p = .001, Exp(B) = 1.822), indicating that proactive managerial engagement increased the odds of achieving more mature safety management by 82.2%. Worker training and competence also exhibited a significant positive relationship (B = 0.400, p = .008, Exp(B) = 1.492), with a one-unit increase in training associated with a 49.2% increase in the odds of higher safety management. In contrast, informality in construction demonstrated a significant negative effect (B = -0.550, p = .001, Exp(B) = 0.577), suggesting that greater levels of informal employment reduced the likelihood of higher safety management by 42.3%. PPE availability and use were another significant positive predictor (B = 0.350, p = .029, Exp(B) = 1.419), demonstrating that consistent access and utilization of protective equipment increased the odds of higher safety management by 41.9%.

Table 4.24: Parameter Estimates for the Ordinal Logistic Regression Model.

Predictor (Factor)	B	Std. Error	Wald χ^2	Sig. (p)	Exp(B)	95% CI for Exp(B)
Enforcement of OSHA/NCA Regulations	0.450	0.160	7.910	0.005	1.568	1.146 – 2.146
Leadership commitment & management support	0.600	0.180	11.111	0.001	1.822	1.280 – 2.593
Worker training & competence	0.400	0.150	7.111	0.008	1.492	1.112 – 2.002
Informality in construction	-0.550	0.170	10.467	0.001	0.577	0.413 – 0.805
Digital technology adoption	0.200	0.140	2.041	0.153	1.221	0.928 – 1.607
Psychological & ergonomic factors	0.100	0.150	0.444	0.505	1.105	0.824 – 1.483
PPE availability & use	0.350	0.160	4.785	0.029	1.419	1.037 – 1.942
Economic pressures	-0.300	0.170	3.114	0.078	0.741	0.531 – 1.034

Note. B = regression coefficient (log-odds); SE = standard error; Wald χ^2 = Wald test statistic; p = significance level; Exp(B) = odds ratio; 95% CI is reported for the un-exponentiated coefficient (B), n=88

Source: Analysis by Author (2025), computed with SPSS v.25.

Other predictors, including digital technology adoption (B = 0.200, p = .153, Exp(B) = 1.221) and psychological and ergonomic factors (B = 0.100, p = .505, Exp(B) = 1.105), were not statistically significant. While conceptually important in Resilience Engineering and High-Reliability Organization (HRO) frameworks, limited technology uptake and underreporting of psychosocial risks in Nairobi's construction sector may explain the lack of significance (Li, Ding, & Luo, 2023; Brown et al., 2023). Economic pressures, although showing a negative trend (B = -0.300, p = .078, Exp(B) = 0.741), did not reach conventional significance, suggesting that financial constraints may influence safety management but were not strong enough within this sample to achieve statistical significance (Nnaji, Gambatese, & Karakhan, 2022).

The findings strongly supported the alternative hypothesis (H_1), demonstrating that the level of safety management on construction sites in Nairobi is significantly shaped by regulatory enforcement, leadership commitment, worker training, the use of personal protective equipment (PPE), and the degree of informality within project operations. These results substantiate the theoretical view that systemic strategies and site-level practices are interdependent, jointly determining the overall maturity of safety management within the construction sector.

4.7 A Strategy for Effective Safety Management in Construction Sites in Nairobi County

The developed strategy for effective safety management in Nairobi County (Table 4.25) responded to the fragmented and reactive approaches revealed in the findings and literature. It aimed to reframe safety from a compliance burden into a proactive, systemic commitment that strengthens site-level practices while embedding organizational and regulatory reforms. The dual orientation reflects the literature's distinction between safety practices; immediate, operational measures such as PPE and toolbox talks and safety strategies; systemic approaches like leadership accountability, resource allocation, and digital integration (Olutende, Musau, & Okoth, 2021; Wang & Chong, 2024).A central pillar of the strategy is universal worker training, justified both by empirical findings, which showed training as the

strongest predictor of improved safety, and by theory. Accident Causation Models emphasize that latent conditions, such as inadequate competence, heighten vulnerability to unsafe acts (Fang et al., 2020).

Table 4.25: Comprehensive Strategy for Effective Safety Management in Construction Sites in Nairobi County

Strategic pillar	Purpose (what it achieves)	Key actions (concise)	Lead & partners	Timeframe (S/M/L)	Measurable indicators / targets	Evidence from results
1. Vision & Governance (sectoral safety re-frame)	Replace fragmented/reactive approaches with a clear sector vision that treats safety as core to business and public procurement.	Issue a county/sector Safety Vision & Code; make safety a mandatory element of tender evaluation; include safety KPIs in client contracts; adopt Safety Climate & Resilience principles into policy.	NCA, County Gov't, DOSHS, Clients (govt/donors), Contractor associations	S→L	% tenders with safety scoring; % contractors with formal safety policy (target: 100% of public tenders within 18 months)	Sector heterogeneity and policy/practice gap; leadership drives culture.
2. Regulatory strengthening & inspectorate capacity	Make enforcement routine, risk-based and deterrent (not episodic/performative).	Recruit & train more inspectors; implement risk-based inspection schedules; publish inspection results; raise and standardize penalties; use digital inspection scheduling and public dashboards.	DOSHS, NCA, County Gov'ts, Judiciary (for enforcement of penalties)	S→M	Inspector: site ratio; inspections/quarter; % repeat non-compliance penalized (target: inspectorate capacity ↑ 50% in 12–24 months)	Enforcement perceived weak/performative; OSHA enforcement low (mean 2.68).
3. Leadership & organizational accountability	Force contractors to move beyond cosmetic compliance — embed safety into governance, budgets and KPIs.	Require senior management safety sign-off; mandatory safety budget line; annual leadership safety audits; link client	Contractors, NCA, Clients, Auditor bodies	S→M	% firms with signed safety policy & budget; leadership commitment survey score (target: raise mean from 3.23 → 4.0).	Leadership commitment strongly predicts better safety (OLR,

		payments/ratings to safety performance.				Exp(B)=1.822).
4. Universal training & competency framework	Deliver universal, standardized, competency-based training (since training has strongest correlation with safety).	Mandatory induction for all workers before site entry; accredited modular training for supervisors/workers; mobile training units for SMEs; toolbox-talk standard templates; subsidised training vouchers for NCA 6–8.	NCA, Training institutions, Contractor associations, Donors	S→M	% workforce with valid induction certificate; training coverage (target: ≥80% within 12 months); increase in training mean from 3.09 → 4.0.	Worker training has strongest positive Spearman correlation (ρ = 0.60).
5. PPE provisioning, acceptance & ergonomics	Ensure complete, usable PPE is provided and accepted (materials + behaviour).	Make complete PPE provision mandatory; pooled procurement/subsidy schemes for SMEs; require ergonomic/hot-weather PPE; behavior-change campaigns and supervisor enforcement protocols; replace/perishables replacement policy.	Contractors, Suppliers, NCA, DOSHS, NGOs	S→M	% sites with full PPE packages; consistent PPE use rate (target: raise consistent PPE use from current low to ≥70% within 12–18 months)	PPE availability/use is a key positive predictor (ρ = 0.40; OLR Exp(B)=1.419) but consistent provision is low (15% reported).
6. Emergency preparedness & site resilience	Prioritise emergency response planning, drills and real-time learning so sites can adapt/respond safely.	Require site emergency response plans (ERP), regular drills, trained first-responders on site, rescue equipment checks; integrate	Contractors, DOSHS, Emergency services, NCA	S→M	% sites with ERP & drill log; average time to respond in drills; reduction in incident severity.	Resilience approach recommended given complex, non-linear drivers and weak linear

		incident telemetry into site dashboards.				explanation ($R^2 \approx 0.026$).
7. Incident reporting, learning & data use	Create no-blame reporting and closed-loop learning so data drives continuous improvement.	Anonymous and digital reporting channels; mandatory near-miss reporting; central analytics unit in DOSHS/NCA; feedback & visible corrective actions; protect reporters from retaliation.	Contractors, DOSHS, NCA, Worker reps	S→M	Incident reporting rate; near-miss : incident ratio; % corrective actions closed within 30 days (target: ↑ reporting by 50%)	Reporting exists but inconsistent; fear of retaliation deters reporting. Incident reporting mean = 3.09.
8. Subcontracting & supply-chain accountability	Tackle fragmentation from multi-layer subcontracting that dilutes safety responsibility.	Mandatory flow-down safety clauses in contracts; pre-qualification & safety performance checks for subs; retention/withholding clauses for safety breaches; periodic subcontractor audits.	Clients, Main contractors, NCA	S→M	% subcontracts with safety clauses; audit pass rates for subs; reduction in subcontractor-caused incidents.	Subcontracting fragments responsibility and weakens enforcement—clear in interviews and FGDs.
9. Resource mobilization & incentives	Narrow the resource gap that drives corners being cut; re-align financial incentives toward safety.	Mandate minimum safety budgets for projects; tax or procurement incentives for good safety records; safety grant/subsidy window for SMEs; insurer premium discounts tied to safety	Ministry of Finance, NCA, Insurers, Donors	M→L	% firms with dedicated safety budgets; uptake of incentives; resource allocation mean improvement (current mean 2.59 → target 3.5).	Resource allocation for safety is low; economic pressures are high (mean 4.06).

		compliance.				
10. Technology & real-time, data-driven improvement	Use low-cost digital tools to scale inspections, reporting and learning—particularly for SMEs.	Deploy simple mobile reporting/apps; SMS/USSD options for low-tech crews; central dashboard for regulators; pilot analytics for hotspot detection; provide digital training to small contractors.	NCA, DOSHS, Tech partners, Donors	S→M	% sites using digital reporting; time from report → action; digital adoption increase (baseline mean ~3.27).	Digital adoption moderate but underutilized; tech can help when designed for low-cost/low-skill contexts.
11. Psychosocial & ergonomic interventions	Reduce fatigue/stress and ergonomic risks that increase accidents.	Enforce hours/rosters to limit overtime; mandated rest breaks; ergonomic tools/equipment; supervisor training in human factors; worker well-being counselling/referral.	Contractors, DOSHS, Unions	S→M	% sites with fatigue management policy; reduction in fatigue-related incidents; psychosocial/ergonomic index improvement (baseline mean 3.81).	Psychosocial & ergonomic factors strongly influence safety (mean = 3.81).
12. Formalization & labour protections	Reduce informality (a strong negative driver) by improving contracts, registration and worker protections.	Incentivise formal hiring (tax benefits, access to training); require worker registration on project rolls; promote collective worker representation and grievance channels; labour inspections focused on informal sites.	Ministry of Labour, NCA, DOSHS, Unions	M→L	% workforce on formal contracts; informality index reduction (target: measurable drop from baseline mean 3.90)	Informality shows strong negative association with safety (ρ = -0.50).

13. Monitoring, evaluation & adaptive learning (MEL)	Measure, iterate and publish outcomes so the strategy evolves with evidence.	Sector dashboard with KPIs; annual safety scorecards by NCA/DOSHS; randomized pilots (SME PPE subsidy, training models); publish lessons & sector progress.	NCA, DOSHS, Academia, Donors	S→L	Annual sector safety score; change in key predictors (training, enforcement, PPE); published evaluation reports.	Spearman Model fit and low linear R^2 suggest need for adaptive, systems monitoring.
14. Communication, participation & safety climate	Shift attitudes: make safety a shared value through participation, recognition and consistent communication.	Worker safety committees; participatory toolbox talks; safety champions; recognition & non-financial rewards for safe teams; regular two-way communication channels.	Contractors, Workers' reps, DOSHS	S→M	Safety climate survey scores; % sites with worker safety committees; improvement in management commitment & PPE use.	Workers report top-down communication and weak safety climate— participation will strengthen internalization.

Note: "Lead and partners" indicates the primary accountable bodies to operationalize each pillar (DOSHS = Directorate of Occupational Safety and Health Services; NCA = National Construction Authority); Timeframes are denoted as follows: S = Short-term (0–12 months), M = Medium-term (1–3 years), and L = Long-term (3+ years).

Source: Author

By mandating induction and standardized toolbox talks, the strategy moves training from discretionary practice to institutionalized norm. This aligns with Resilience Engineering, which highlights competence as a foundation for adaptive capacity (Hafeez, Khan, & Zhao, 2023).

The second pillar (regulatory enforcement and inspectorate capacity) addresses the persistent enforcement gaps identified in Nairobi (Omondi & Ochieng, 2022). Weak and episodic oversight sustains reactive compliance and a weak safety climate. By recommending risk-based inspections, expanded inspectorate staffing, and transparent reporting, the strategy reframes enforcement as proactive and deterrent rather than symbolic. This is consistent with Safety Climate Theory, which argues that workers' compliance is strongly shaped by perceptions of organizational and regulatory commitment (Brown, Chen, & Patel, 2023).

Equally critical is the emphasis on leadership accountability and governance. Literature consistently links leadership commitment with reduced accident rates and stronger safety culture (Ahmad, Ali, & Khan, 2022). In Nairobi, where contractors often treat safety as a cost, requiring leadership sign-off on budgets and annual safety audits ensures safety is embedded in decision-making rather than relegated to site supervisors. This operationalizes High-Reliability Organization (HRO) Theory, which identifies leadership vigilance and redundancy as essential for safety in high-risk contexts (Hallowell, Hinze, & Behm, 2021).

The strategy also strengthens PPE provisioning and acceptance, directly addressing empirical findings of low compliance and partial availability (Olutende et al., 2021). Barriers such as affordability, discomfort, and poor enforcement have limited PPE use in Nairobi. By combining pooled procurement for SMEs with behavioral campaigns and supervisor follow-up, the strategy targets both supply and demand-side constraints. In Accident Causation terms, PPE acts as an immediate control, but systemic provisions ensure its sustained effectiveness.

The pillar on emergency preparedness and resilience reflects insights from Resilience Engineering, recognizing Nairobi's volatile construction environment marked by informality, fluctuating resources, and regulatory inconsistency (Xu, Li, & Wang, 2024). By embedding drills, first responder training, and adaptive response systems, the strategy shifts from post-incident reaction to anticipation and learning. Closely linked is the incident reporting and learning system, which counters chronic underreporting due to fear of retaliation (Chacha, 2020). Anonymous reporting and corrective feedback loops align with Safety Climate Theory's call for trust-based systems (Brown et al., 2023), creating conditions for continuous improvement.

The strategy is particularly innovative in confronting informality and subcontracting, structural challenges that dilute accountability and weaken safety enforcement in Nairobi (Chacha, 2020). Mandating contractual safety clauses, worker registration, and subcontractor audits directly tackles informality, which was negatively correlated with safety performance. This addresses a key gap in the literature, as

global models often assume formalized project environments (Zhang, Lingard, & Nevin, 2020).

Equally critical is the inclusion of psychosocial and ergonomic interventions, reflecting a growing recognition that fatigue, stress, and poor ergonomics undermine safety performance (Westgaard & Winkel, 2022; Brown et al., 2023). In Nairobi's congested, poorly resourced worksites, these risks are particularly acute. Enforcing rest schedules, providing ergonomic tools, and integrating well-being support broaden safety management beyond physical hazards, consistent with global calls for more holistic frameworks.

The technology and real-time monitoring pillar contextualize digital innovations such as BIM and IoT, within Nairobi's resource-constrained environment. While global literature highlights their value (Li, Ding, & Luo, 2023; Xu, Li, & Wang, 2024), uptake in Nairobi has been minimal. By focusing on low-cost, mobile-based reporting systems, the strategy adapts global insights to local realities, ensuring feasibility for SMEs and informal contractors.

The strategy emphasizes monitoring, evaluation, and adaptive learning to ensure iterative implementation. Given the sector's complexity and the limits of linear models, adaptive monitoring allows continual refinement, aligning with Resilience Engineering's focus on learning and flexibility. It integrates empirical priorities with theory, addressing training, enforcement, PPE, leadership, and informality through pillars balancing immediate practices and systemic reforms. Theoretically, it operationalizes Accident Causation by addressing latent conditions, strengthens Safety Climate via leadership and reporting reforms, applies HRO principles to governance, and extends Resilience Engineering to Nairobi's fragmented sector.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter synthesizes the study's key findings and situates them within the wider discourse on construction safety management. It draws conclusions from the empirical evidence, emphasizing structural, organizational, and contextual factors influencing safety outcomes in Nairobi's construction sector. It also proposes recommendations to address gaps through policy, organizational, and site-level interventions. Collectively, these elements establish a basis for shifting from fragmented, reactive practices toward a more integrated and resilient safety culture.

5.2 Summary of Findings

5.2.1 The Level of Safety Management in Construction Sites in Nairobi County

The assessment of safety management levels across construction sites in Nairobi County revealed a sector in transition, balancing between emerging formal structures and persistent informal practices. While larger contractors displayed relatively developed systems that included hazard inspections, PPE provision, and routine safety briefings, these measures were inconsistent across the broader industry. The dominance of small and informal contractors, often operating with limited oversight, fragmented the sector's safety culture. Compliance was found to rely heavily on external enforcement rather than internal commitment, reflecting a culture where safety is performed for inspection rather than embedded as an operational norm.

Leadership emerged as the defining differentiator in safety outcomes. Projects led by managers who treated safety as integral to performance demonstrated stronger compliance and worker morale. In contrast, leadership indifference; especially among SMEs, translated into superficial adherence and reactive interventions. Safety was frequently perceived as a cost rather than an investment, resulting in limited allocation of resources and insufficient emphasis on worker training. This managerial

shortfall perpetuated a culture where speed and productivity outweighed preventive action, undermining long-term safety performance.

Systemic challenges compounded organizational weaknesses. Informality, limited regulatory capacity, and scarce financial resources eroded consistency in implementing safety standards. Informal sites, which form a substantial portion of Nairobi's construction activity, lacked structured reporting, reliable PPE provision, or basic training mechanisms. Workers often faced unsafe conditions with little recourse, reinforcing a cycle of underreporting and stagnation in safety learning. These findings underscored that the root causes of poor safety performance lie in institutional and structural deficiencies rather than individual worker negligence.

The psychosocial dimension further illuminated the human experience of unsafe work. Fatigue, fear of job loss, inadequate pay, and the absence of trust between workers and management intensified vulnerability to accidents. Integrating psychosocial wellbeing into safety frameworks thus emerged as essential to advancing safety maturity. The study concluded that Nairobi's construction sector remains at a low to moderate level of safety management maturity; characterized by fragmented enforcement, uneven leadership commitment, and pervasive informality. These conditions reaffirm the need for an integrated, multi-level strategy that aligns regulatory reform, leadership accountability, and worker empowerment to achieve the study's broader aim of effective and sustainable safety management in construction.

5.2.2 Factors Influencing Safety Management in Construction Sites in Nairobi County

The study established that the effectiveness of safety management in Nairobi's construction sites is governed by a web of interrelated factors spanning regulatory, organizational, economic, technological, and psychosocial dimensions. Safety outcomes were not determined by compliance alone but reflected the broader institutional and cultural structures underpinning the industry. Weak regulatory enforcement emerged as a critical limitation; inspections were predictable, reactive, and largely symbolic, fostering temporary compliance rather than sustainable

behavioral change. This dynamic revealed that without consistent authority and accountability, enforcement mechanisms fail to embed safety as a normative value within construction practice.

Leadership commitment proved to be the single most decisive influence on safety performance. Sites where leaders visibly prioritized safety exhibited stronger compliance, open communication, and worker confidence, while cost-driven leadership models perpetuated unsafe practices and fragmented safety climates. Training further reinforced this divide: formal contractors provided structured programs that improved hazard awareness, whereas informal sites lacked any systematic training, leaving workers underprepared and vulnerable. The uneven access to safety education reflected broader disparities in sectoral maturity, with implications for the city's overall capacity to institutionalize preventive safety systems.

Informality, pervasive across much of Nairobi's construction landscape, amplified systemic weaknesses by eroding accountability and limiting oversight. Workers in informal settings operated without formal hazard reporting, reliable PPE access, or regulatory protection, producing a two-tier system in which safety was contingent on organizational form rather than universal right. Limited technological adoption and constrained resources compounded these challenges. Despite global progress in digital monitoring and safety analytics, most local firms remained reliant on manual supervision, hindered by affordability and skill barriers. This gap underscored the need for contextually adaptive innovations that align with Nairobi's economic realities.

Psychosocial conditions (fatigue, low wages, pressure from supervisors, and minimal worker voice) were deeply embedded in the safety environment, reinforcing unsafe behaviors and diminishing resilience. The inconsistent provision and use of PPE reflected not only material scarcity but also weak enforcement and cultural disengagement. Economic constraints permeated all dimensions, with safety frequently subordinated to cost efficiency and short-term gains. Collectively, these findings reveal that construction safety in Nairobi operates within a fragile

equilibrium shaped by interacting systemic forces. Advancing the study's overall aim therefore requires a paradigm shift from fragmented interventions toward an integrated, multi-level approach that strengthens leadership, institutional capacity, and worker empowerment as the foundation for sustainable safety management.

5.2.3 Relationship between Safety Management Level and Influencing Factors in Construction Sites in Nairobi County

The analysis revealed that the level of safety management within Nairobi's construction sector is shaped by the interaction of multiple systemic factors rather than by straightforward causal relationships. The interplay between worker competence, leadership commitment, regulatory enforcement, and the availability of personal protective equipment determined the overall maturity of safety systems. Training emerged as the most influential driver, reinforcing the principle that safety competence must be deliberately developed and sustained. Leadership commitment and consistent enforcement were equally vital, setting the organizational tone for compliance and accountability. Yet, the persistence of informal employment practices undermined these gains, weakening institutional control and discouraging hazard reporting.

These findings position Nairobi's construction industry within a transitional phase of safety maturity; one where foundational measures are present but unevenly applied. The sector's performance reflects a fragile balance between progress and regression, constrained by informality, limited resources, and reactive practices. Advancing toward effective safety management therefore requires aligning human, regulatory, and organizational dimensions within an integrated framework. This understanding directly informed the study's overarching aim of developing a strategy that transcends fragmented interventions and builds a cohesive, adaptive system capable of embedding safety as a core organizational value rather than a regulatory formality.

5.2.4 A strategy for Effective Safety Management in Nairobi County Construction Sites

The study established that achieving effective safety management in Nairobi's construction sector demands a shift from fragmented and reactive practices toward an integrated, system-oriented framework. The strategy developed under this objective connects operational interventions at the site level with broader institutional and policy reforms, recognizing that sustainable safety cannot be attained through isolated actions such as PPE provision or toolbox talks alone. Instead, safety must be understood as a collective organizational and sectoral responsibility underpinned by competent training, reliable enforcement, and a culture of leadership accountability.

At the core of the proposed framework are interdependent pillars designed to strengthen worker competence through universal safety training, ensure consistent provision of ergonomically suitable PPE, enhance emergency preparedness, and institutionalize systems for incident reporting and learning. At the systemic level, the framework embeds regulatory reinforcement, leadership accountability, reforms in subcontracting practices, psychosocial and ergonomic interventions, and the integration of digital monitoring tools to support adaptive learning and oversight. These measures collectively reframe safety from a compliance obligation to a strategic component of productivity and organizational resilience.

Aligned with the study's fundamental objective, this framework offers a context-sensitive and theoretically grounded pathway for reform. It applies Accident Causation Models to address latent systemic weaknesses, strengthens Safety Climate through leadership visibility and consistent enforcement, integrates HRO principles to promote vigilance and accountability, and employs Resilience Engineering to build adaptability within dynamic and high-risk environments. Through this alignment of theory and practice, the study presents a coherent model capable of advancing Nairobi's construction industry toward sustained, preventive, and resilient safety performance.

5.3 Conclusions of the Study

5.3.1 The Level of Safety Management in Construction Sites in Nairobi County

Safety management in Nairobi's construction sector remains at a formative stage; supported by policy but undermined by inconsistent implementation, weak enforcement, and widespread informality. Safety performance is primarily shaped by leadership commitment, with value-driven organizations demonstrating stronger compliance and engagement than those guided by cost considerations. Achieving effective safety management, therefore, requires a fundamental shift from externally driven compliance to proactive, leadership-led, and culturally embedded practices. These findings highlight the need for institutional reforms that integrate psychosocial wellbeing, worker empowerment, and accountability into a preventive and learning-oriented framework capable of sustaining both safety and productivity in Nairobi's construction industry.

5.3.2 Factors Influencing Safety Management in Construction Sites in Nairobi County

Effective safety management in Nairobi's construction sector requires more than regulatory compliance; it depends on the alignment of leadership commitment, consistent enforcement, structured training, and attention to worker wellbeing within an integrated system. Informality, weak oversight, and financial constraints continue to fragment the safety culture, highlighting that lasting improvement emerges from coordinated institutional, organizational, and workforce action. In line with the study's aim, these findings underscore the need for a holistic, context-sensitive strategy that strengthens governance, embeds leadership in safety, fosters continuous skill development, addresses psychosocial risks, and leverages practical technological solutions to build a resilient and sustainable safety framework.

5.3.3 Relationship between Safety Management Level and Influencing Factors in Construction Sites in Nairobi County

Safety management within Nairobi's construction sector is shaped by an intricate interplay of organizational commitment, regulatory strength, and workforce capacity rather than by isolated variables. The findings reveal that safety maturity depends on the alignment of worker training, leadership engagement, effective enforcement, and the mitigation of informality. Informal employment structures continue to erode accountability and learning, while weak PPE implementation and inconsistent managerial oversight hinder systemic progress. Advancing safety performance therefore requires an integrated and preventive framework that unites training, regulation, and leadership into a coherent culture of resilience across construction sites.

5.3.4 A Strategy for Effective Safety Management in Nairobi County Construction Sites

Sustainable safety management in Nairobi's construction sector can only be achieved through an integrated framework that connects everyday site practices with broader organizational and systemic reforms. The strategy developed positions safety as a fundamental organizational and sectoral priority, anchored in worker training, consistent regulatory enforcement, and committed leadership. By addressing informality, enhancing institutional capacity, and embedding adaptive mechanisms such as digital monitoring and continuous learning, the framework offers a practical and resilient model for advancing safety governance. In doing so, it fulfills the study's overarching aim of providing a comprehensive, context-sensitive strategy capable of transforming Nairobi's construction industry from fragmented, reactive compliance toward enduring, preventive safety excellence.

5.4 Recommendations of the Study

This study tackled the problem of unsafe construction environments in Nairobi County, where safety management is weak, fragmented, and reactive despite the sector's economic importance. It aimed to assess safety levels, identify influencing

factors, examine their interrelationships, and develop an effective strategy. Findings revealed that although practices like PPE use, toolbox talks, and hazard inspections were present, they were inconsistently applied, particularly in small and informal projects. Leadership commitment, worker training, and regulatory enforcement proved decisive, while informality and economic pressures undermined safety. Consequently, the strategy combined site-level practices with organizational and regulatory measures, reframing safety as a proactive, sustainable priority rather than a compliance obligation.

Practically, the study recommends institutionalizing universal worker training under NCA and DOSHS through mandatory, competency-based programs for all workers, adaptable to emerging risks. Enforcement should be reinforced via enhanced inspectorate capacity, risk-based inspections, transparent compliance disclosure, and deterrent penalties. At the organizational level, safety must be embedded in governance through leadership budget sign-off, linking appraisals to safety performance, and requiring dedicated resource allocation, positioning safety as an investment. PPE should be complete, consistent, ergonomic, and supported by pooled procurement for smaller firms. Addressing informality requires flow-down safety clauses, worker registration, and formalized contracts. Psychosocial and ergonomic risks, such as fatigue, stress, and poor conditions, must be integrated, while low-cost mobile and USSD tools should support hazard reporting, monitoring, and feedback, even in informal or resource-limited contexts.

Theoretically, this study shows that construction safety in fragmented, resource-constrained contexts cannot be fully explained or advanced through linear models. By integrating Accident Causation, Safety Climate, High-Reliability Organization (HRO), and Resilience Engineering, it demonstrates that effective safety management arises from the interplay of site-level practices and organizational strategies. The findings extend these frameworks into informal, heterogeneous settings like Nairobi, showing how safety climate and resilience theories can be localized to contexts of resource scarcity, weak regulation, and informality. The study reconceptualizes safety as an adaptive system in which leadership

commitment, enforcement, worker competence, and cultural change interact to shape outcomes.

Methodologically, the study demonstrates both the strengths and limits of its approaches. Quantitative methods like correlation and regression revealed significant associations but explained little variance, indicating that construction safety outcomes stem from complex, interdependent factors beyond linear models. This underscores the need for methodological innovation, including systems-based approaches such as causal loop modelling, longitudinal case studies, and network analysis to capture dynamic interactions among regulatory, organizational, and workforce conditions. The mixed-methods design was vital in exposing lived realities of informality, psychosocial risks, and underreporting; dimensions often neglected in construction safety research. Future studies should extend this methodological pluralism to deepen understanding in developing-country contexts.

The study acknowledges limitations in terms of scope, methodology, and generalizability. The research focused on Nairobi County and therefore may not fully capture the diversity of safety challenges across Kenya or other developing economies. Time and resource constraints limited the extent of longitudinal analysis, while underreporting and reliance on self-reported data may have introduced biases. Nevertheless, these limitations do not diminish the contribution of the study; rather, they point to areas for further research, such as comparative analyses across counties, longitudinal studies of safety culture change, and deeper exploration of informal sector dynamics.

This study develops a context-specific, empirically grounded, and theory-informed strategy for effective safety management in Nairobi's construction sector. It tackles unsafe construction environments by identifying needed changes (worker training, enforcement, leadership, PPE, and informality) and showing how systemic integration sustains improvements. The findings fill a literature gap, extend theory into informal, resource-constrained contexts, and suggest methodological directions for future research. Crucially, they offer policymakers, regulators, and contractors a

roadmap to shift safety from a reactive obligation to a proactive and resilient organizational priority.

5.5 Areas for Future Studies

Building on the findings of this study, several avenues for further research can enhance understanding of safety management in Nairobi's construction sector.

1. Longitudinal studies are needed to examine how safety culture, leadership commitment, and regulatory interventions develop over time, providing insight into the processes through which safety maturity is achieved in both formal and informal settings.
2. The informal sector's influence on safety requires deeper investigation to uncover the socio-economic and cultural factors that sustain informal practices and to identify strategies for improving compliance and worker protection in heterogeneous work environments.
3. The potential of technology in safety management remains underexplored. Research could focus on how digital tools, mobile applications, or low-cost reporting systems can support hazard monitoring, compliance, and organizational learning, particularly among smaller and informal contractors.
4. Psychosocial and ergonomic dimensions merit further study to understand how fatigue, stress, job insecurity, and limited worker voice affect safety behaviors, and how interventions that integrate worker wellbeing can strengthen overall safety frameworks.

Exploring these areas can build on this study's contributions, providing evidence and insights to guide the evolution of Nairobi's construction industry toward proactive, resilient, and sustainable safety management.

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APPENDICES

Appendix I: Interview Schedule

I am Elvis Shisya, a student at the Jomo Kenyatta University of Agriculture and Technology pursuing a master's degree in Construction Project Management. Your support in participating in this interview will help in developing "**A Strategy for Effective Safety Management in Construction Sites in Nairobi County,"** a topic that also serves as a requirement for the award of the said degree.

Note: *The data collected from this survey will be used purely for academic purposes only. The researcher will exercise the utmost confidentiality, and there will be no victimization whatsoever for any or all of the information provided.*

Objective 1: To establish the level of safety management in construction sites in Nairobi County

1. How would you describe the current safety practices (such as PPE use, hazard inspections, or toolbox talks) implemented at your construction site? *Justification: This question seeks firsthand accounts of operational practices, directly addressing site-level safety practices discussed in the literature.*
2. In your experience, how consistently are these safety practices enforced across projects, and what factors influence compliance? *Justification: This probes the effectiveness and enforcement of safety practices, linking to literature highlighting inconsistent PPE use and weak supervisory follow-up in Nairobi's construction sector.*
3. What role do leadership and organizational policies play in shaping safety practices and priorities at your site? *Justification: This question explores the strategic side of safety management (leadership commitment, safety culture) emphasized in Safety Climate Theory and HRO Theory.*
4. What challenges or barriers do you face in implementing and sustaining safety management practices on-site? *Justification: Directly tied to gaps identified in the literature—resource limitations, informality, weak regulation, and economic pressures.*

5. From your perspective, what improvements or strategies would make safety management more effective and sustainable in Nairobi's construction sector? *Justification: This forward-looking question provides qualitative insights into potential strategies, addressing the research gap of aligning practices with systemic strategies*

Objective 2: To determine the factors influencing the level of safety management in construction sites in Nairobi County.

1. How would you describe management's role and commitment to safety on your construction site? *Justification: Management leadership is consistently identified as a critical factor influencing safety outcomes.*
2. What challenges do you face in consistently using personal protective equipment (PPE) on site? *Justification: PPE adoption is often hindered by cost, comfort, and enforcement issues.*
3. In your experience, how does the availability of safety training influence workers' safety practices? *Justification: Training frequency and quality strongly shape workers' knowledge and behavior.*
4. How do cultural attitudes and perceptions among workers affect compliance with safety rules? *Justification: Safety culture and shared beliefs significantly determine adherence to procedures.*
5. What role do regulatory inspections and enforcement play in influencing safety practices on your site? *Justification: Regulatory frameworks such as OSHA 2007 influence compliance but often face enforcement challenges.*
6. How does communication between management, supervisors, and workers affect safety performance? *Justification: Effective communication ensures shared understanding of risks and safety procedures.*
7. Can you describe how resource allocation (budget, equipment, staffing) impacts safety management on site? *Justification: Limited resources are a barrier to sustained safety management.*
8. What motivates workers on your site to comply (or not comply) with safety regulations? *Justification: Behavioral motivation factors—such as incentives or penalties—affect compliance.*

9. What role does subcontracting or workforce composition play in influencing safety practices? *Justification: Multi-tier subcontracting complicates safety oversight and accountability.*
10. From your perspective, what are the biggest barriers to achieving higher safety standards in Nairobi's construction industry? *Justification: Open-ended synthesis question to capture unanticipated or emerging factors beyond existing literature.*

Thank you for contributing to the improvement of the safety and health effort on construction sites in Kenya.

Mr. Elvis Shisya, Jomo Kenyatta University of Agriculture & Technology, Department of Construction Management, P. O Box 00200 Nairobi, Kenya.Tel: +254(0)702 033 883 Email: shisya.wameyo@jkuat.ac.ke

Appendix II: Focus Group Discussion Guide

I am Elvis Shisya, a student at the Jomo Kenyatta University of Agriculture and Technology pursuing a master's degree in Construction Project Management. Your support in participating in this discussion will help in developing "**A Strategy for Effective Safety Management in Construction Sites in Nairobi County,"** a topic that also serves as a requirement for the award of the said degree.

Note: *The data collected from this survey will be used purely for academic purposes only. The researcher will exercise the utmost confidentiality, and there will be no victimization whatsoever for any or all of the information provided.*

Objective 1: Establishing the Level of Safety Management in Construction Sites in Nairobi County

Subject Area	Main Question	Probes (Follow-up Prompts)
General Perception	How would you describe the overall state of safety management on construction sites in Nairobi?	- Do you think safety has improved or worsened in recent years? - What indicators make you feel safety is strong or weak?
Safety Practices	What common safety practices (e.g., PPE use, toolbox talks, inspections) have you observed on sites, and how consistently are they applied?	- Are PPEs always provided, and are they good quality? - How often are toolbox talks or inspections carried out? - Do smaller and larger sites differ in consistency?
Compliance & Enforcement	To what extent do workers and supervisors follow safety requirements, and what challenges affect compliance?	- What motivates compliance with safety rules? - What makes it difficult for workers or supervisors to comply? - How do penalties or inspections affect compliance?
Leadership & Supervision	In your experience, how do site managers or supervisors influence the way safety is managed on construction sites?	- Do managers actively monitor safety or delegate it? - How does supervisor behavior affect worker safety attitudes? - Can you share an example where leadership improved or weakened safety?
Reporting & Monitoring	How are accidents, near misses, or hazards usually reported and	- Who is responsible for reporting incidents? - Are workers encouraged to

	addressed on sites, and how effective is this process?	report hazards without fear? - What happens after a report is made—are actions taken?
Variations Across Projects	Do you notice differences in safety management between large projects (government or multinational funded) and smaller or informal sites? If yes, what are they?	- What makes large projects different in terms of safety? - What challenges are more common in small or informal projects? - Do workers feel more protected in one type of site than the other?
Worker Experience	From a worker's point of view, how safe do you feel working on Nairobi's construction sites? What contributes to this feeling?	- What specific risks do you face daily? - Do you feel management cares about your safety? - What makes you feel unsafe or secure at work?
Improvement Areas	In your opinion, what areas of safety management on construction sites in Nairobi need the most urgent improvement?	- Should improvements focus more on training, enforcement, or equipment? - What one change would make the biggest difference for workers? - How should government and contractors work together to improve safety?

Objective 2: To determine the factors influencing the level of safety management in construction sites in Nairobi County

Subject Area	Main Question	Probes (Follow-up prompts)
Regulatory Enforcement	How effective do you think government inspections and enforcement of safety laws are on construction sites in Nairobi, and what challenges exist in ensuring compliance?	- Can you give examples of inspections you have witnessed? - Do contractors take inspections seriously? - What happens when inspectors are absent? - How effective are penalties or fines in your opinion?
Organizational Safety Culture & Leadership Commitment	In your experience, how do managers and supervisors demonstrate (or fail to demonstrate) commitment to safety, and how does this influence worker behavior on site?	- Do managers talk about safety regularly? - How do supervisors react when workers break rules? - Have you worked on sites where leadership genuinely prioritized safety? - How does leadership behavior affect your own safety practices?
Worker Training &	What kinds of safety training	- Do toolbox talks or inductions happen

Competence	have you received on site, and how do you think training (or lack of it) affects safety performance?	regularly? - What topics are usually covered in training? - How useful was the training in preventing accidents? - How does lack of training affect new or inexperienced workers?
Informality in the Workforce	Many construction workers in Nairobi work without formal contracts. How does this informality affect safety practices and accountability on sites?	- How does job insecurity affect reporting of hazards? - Are safety rules followed more on formal vs informal sites? - Have you ever seen workers punished for raising safety concerns? - Do informal sites provide PPE or training?
Technology Adoption	What role do you think technology (e.g., digital reporting, BIM, safety apps) can play in improving safety on Nairobi's construction sites, and what prevents wider use?	- Have you ever used or seen safety-related technology on site? - Which technologies do you think could help most (apps, sensors, digital checklists)? - What challenges prevent adoption (cost, skills, awareness)? - Do small contractors differ from large contractors in tech use?
Psychosocial & Ergonomic Factors	How do working conditions such as long hours, stress, or fatigue affect your ability to follow safety rules and avoid accidents?	- How do you feel when working overtime or under pressure? - Does fatigue affect concentration or PPE use? - Do supervisors consider worker well-being when pushing deadlines? - Can you share examples where stress contributed to accidents?
Personal Protective Equipment (PPE)	What challenges do workers face in consistently using PPE (e.g., affordability, comfort, enforcement), and what could improve its proper use?	- Are you always provided with PPE by employers? - What happens if PPE is missing or damaged? - How comfortable is PPE in Nairobi's weather conditions? - What would motivate workers to use PPE consistently?
Economic Pressures	How do financial constraints (for both workers and contractors) influence decisions about prioritizing safety measures on construction projects?	- How do contractors balance costs and safety? - Do workers ever pay for their own PPE? - How do tight project deadlines affect safety decisions? - Can you recall times when cost-cutting compromised safety?

Appendix III: Survey Questionnaire

I am Elvis Shisya, a student at the Jomo Kenyatta University of Agriculture and Technology pursuing a master's degree in Construction Project Management. Your support in filling out this questionnaire will help in developing "**A Strategy for Effective Safety Management in Construction Sites in Nairobi County,"** a topic that also serves as a requirement for the award of the said degree.

Note: *The data collected from this survey will be used purely for academic purposes only. The researcher will exercise the utmost confidentiality, and there will be no victimization whatsoever for any or all of the information provided.*

In what category of contractors under the National Construction Authority (NCA) is this firm registered?

Number	*Category Range*	*(Indicate Category)*
1	Category 1-2	
2	Category 3-4	
3	Category 5-6	
4	Category 7-8	

On a scale of 1 to 5, please indicate your level of agreement with each of the following statements by ticking (☑) the appropriate box.

Where: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Objective 1: To establish the level of safety management in construction sites in Nairobi County

No.	Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1	Safety training is regularly conducted for all workers on this site.	☐	☐	☐	☐	☐

2	Workers consistently use the required personal protective equipment (PPE).	☐	☐	☐	☐	☐
3	Management demonstrates strong commitment to enforcing safety policies.	☐	☐	☐	☐	☐
4	OSHA 2007 safety regulations are adequately implemented and enforced here.	☐	☐	☐	☐	☐
5	Safety practices on this site are sufficient to prevent accidents/injuries.	☐	☐	☐	☐	☐
6	Adequate resources (budget, equipment, safety officers) are allocated to safety.	☐	☐	☐	☐	☐
7	Communication on safety issues is clear and effective between all stakeholders.	☐	☐	☐	☐	☐
8	Accident/incident reporting is encouraged, and records are properly maintained.	☐	☐	☐	☐	☐

Objective 2: To determine the factors influencing the level of safety management in construction sites in Nairobi County.

No.	Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1	Enforcement of OSHA 2007 and NCA regulations strongly influences safety management on sites.	☐	☐	☐	☐	☐
2	Leadership commitment and management support determine how seriously safety is prioritized.	☐	☐	☐	☐	☐
3	Regular worker training and competence development significantly improve safety outcomes.	☐	☐	☐	☐	☐

4	Informality in construction work (e.g., casual labor, lack of contracts) undermines safety efforts.	☐	☐	☐	☐	☐
5	Adoption of digital technologies (e.g., BIM, IoT, reporting apps) enhances site safety management.	☐	☐	☐	☐	☐
6	Psychosocial and ergonomic conditions (e.g., stress, fatigue, poor housing) affect worker safety.	☐	☐	☐	☐	☐
7	Availability, affordability, and proper use of PPE influence safety management on construction sites.	☐	☐	☐	☐	☐
8	Economic pressures (tight budgets, deadlines) reduce investment in safety measures.	☐	☐	☐	☐	☐
9	In your opinion, what other factors significantly influence safety management in Nairobi County construction sites? *(Open-ended)*					

Please return your completed questionnaire in the enclosed envelope to

Mr. Elvis Shisya, Jomo Kenyatta University of Agriculture & Technology, Department of Construction Management, P.O Box 00200 Nairobi, Kenya.Tel: +254(0)702 033 883 Email: shisya.wameyo@jkuat.ac.ke

Appendix IV: Research Authorization

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **773382**

Date of Issue: **02/February/2024**

RESEARCH LICENSE

This is to Certify that Mr.. Elvis Shisya Wameyo of Jomo Kenyatta University of Agriculture and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: A Strategy for Effective Safety Management in Construction Sites in Kenya for the period ending : 02/February/2025.

License No: **NACOSTI/P/24/32779**

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