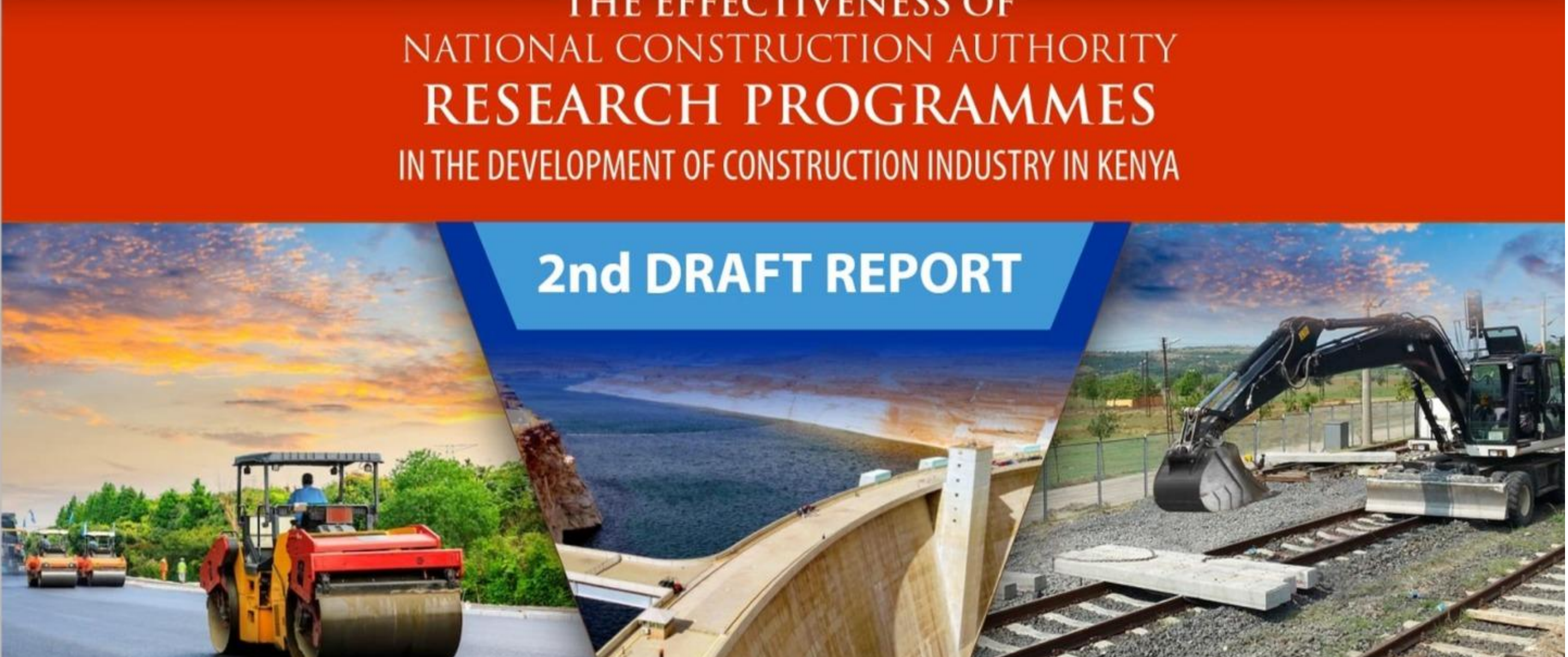
NATIONAL CONSTRUCTION AUTHORITY

THE EFFECTIVENESS OF NATIONAL CONSTRUCTION AUTHORITY RESEARCH PROGRAMMES IN THE DEVELOPMENT OF CONSTRUCTION INDUSTRY IN KENYA

2nd DRAFT REPORT



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RESEARCH ON THE EFFECTIVENESS OF NATIONAL CONSTRUCTION AUTHORITY RESEARCH PROGRAMMES IN THE DEVELOPMENT OF THE CONSTRUCTION INDUSTRY IN KENYA

SECOND DRAFT REPORT

Submitted to
The Executive Director/CEO
National Construction Authority (NCA),
KCB Towers, 9th Floor, Kenya Road, Upper Hill.
P.O. Box 21046 – 00100
NAIROBI, KENYA

September, 2025

Research on the Effectiveness of National Construction Authority Research Programmes in the Development of the Construction Industry in Kenya

Printer:
National Construction Authority
P. O. Box 21046-00100
Nairobi

PREFACE

Research plays a pivotal role in shaping a dynamic and resilient construction industry. It provides a scientific basis for decision-making, supports innovation, and offers practical solutions to complex industry challenges, such as sustainability, safety, cost efficiency, and quality assurance. In an era defined by rapid urbanization, technological advancement, and shifting economic landscapes, a robust research agenda is essential for identifying gaps, anticipating future trends, and informing policies and standards that drive progress within the sector. In Kenya, research in the construction industry is no longer a luxury—it is a necessity for ensuring competitiveness, resilience, and relevance on both regional and global stages.

The National Construction Authority (NCA), as a statutory body mandated to oversee the construction industry and coordinate its development, recognises the critical role of research in achieving these objectives. Through its research programmes, NCA has committed to generating evidence-based knowledge that guides industry reforms, regulatory frameworks, training needs, and technological innovation. These efforts align with national development goals, including the Bottom-Up Economic Transformation Agenda (BETA), Kenya Vision 2030, and the United Nations' Sustainable Development Goals. NCA's research initiatives have enabled sector-wide assessments, benchmarking of best practices, and the development of guidelines that inform the construction lifecycle—from design and procurement to implementation and maintenance.

Research outcomes under NCA's stewardship have already begun to influence the trajectory of the construction sector in Kenya. For instance, studies on construction workforce productivity, building collapse mitigation, adoption of green building technologies, and contractor capacity development have provided the industry with actionable insights. These insights support more effective policy formulation, professional training, and regulatory enforcement, contributing to a safer, more efficient, and innovative construction environment.

However, NCA acknowledges several persistent challenges that continue to hinder the full realization of the benefits of research. One major concern is the low uptake of research outcomes across the industry. A noticeable gap exists between research production and its practical application by key stakeholders, including contractors, consultants, policymakers, and training institutions. Furthermore, NCA has identified capacity limitations in managing the full research cycle—from problem identification and design to dissemination and adoption of findings at the grassroots or user level. These issues undermine the impact and return on investment in research.

To address these concerns, NCA is adopting a more practical and inclusive approach to research. This includes expanding partnerships with academic institutions, industry players, and international development agencies to enhance technical capacity and co-create research agendas that are relevant and demand-driven. Additionally, NCA is strengthening its internal mechanisms for knowledge dissemination through digital platforms, workshops, policy briefs, advisory and targeted stakeholder engagement. It is also promoting the embedding of research findings into training curricula and regulatory updates to ensure alignment between knowledge generation and implementation.

This publication, therefore, aims to reflect on the lessons learned, outline current strategies, and chart a path forward for enhancing the effectiveness of NCA's research programmes. Through a focused and collaborative research agenda, NCA aspires to elevate the construction industry in Kenya to new heights of professionalism, innovation, and sustainability.

Hon. Joel Arumonyang CBS
Principal Secretary
STATE DEPARTMENT FOR PUBLIC WORKS

FOREWORD

The construction industry in Kenya is a critical pillar of national development. It significantly contributes to economic growth, job creation, and the realization of major infrastructure and housing goals. As the sector continues to evolve, a robust, strategic, and responsive research agenda is essential—not only to identify existing and emerging challenges but also to provide practical, evidence-based solutions that guide sustainable development. The National Construction Authority (NCA), mandated to oversee the construction industry and coordinate its development plays a pivotal role in advancing the construction research agenda in promoting safety, efficiency, resilience, and innovation across the sector.

NCA's commitment to research is firmly anchored in national and global policy frameworks. The National Construction Research Agenda (NaCRA) serves as a framework to prioritize, fund, and disseminate research and build collaborations for research in the construction industry. NCA's Strategic Plans further reinforce this agenda by outlining specific objectives, outputs, and stakeholder engagement mechanisms that shape its research direction. At a broader level, Kenya Vision 2030 underscores the importance of research and innovation in achieving globally competitive and prosperous industries, with construction identified as a key driver. The Bottom-Up Economic Transformation Agenda (BETA) also prioritizes inclusive, community-driven development —a principle that resonates strongly with NCA's approach to research. Globally, the United Nations Sustainable Development Goals (SDGs) provide an essential framework that calls for research-led action to foster sustainable cities, resilient infrastructure, and responsible production and consumption in the construction sector.

Despite these policy supports, NCA acknowledges several persistent challenges that hinder the full realization of its research objectives. Chief among these is the low awareness and uptake of findings from 16 completed research studies, which cover vital areas such as construction safety and risk management, construction economics, legal and regulatory frameworks, capacity development, construction technology, project management, materials innovation, and environmental sustainability. The limited dissemination and implementation of these findings, particularly among contractors, consultants, training institutions, and policymakers, reduces the practical impact of this research. Additionally, NCA has identified internal capacity constraints that limit its ability to manage the whole research cycle, from problem identification through to translating findings into actionable outcomes at the user level.

In response, NCA is undertaking a comprehensive, stakeholder-driven approach to improve the effectiveness of its research programmes. This includes enhanced collaboration with academic institutions, industry professionals, and development partners to align research priorities with on-the-ground realities. Capacity-building initiatives are underway to strengthen the skills of NCA staff and stakeholders in conducting and applying research. New dissemination strategies, including user-friendly policy briefs, interactive platforms, regional forums, and visual tools, are being implemented to enhance the broader reach and accessibility of research findings. NCA is also actively integrating research outputs into training curricula, contractor development programmes, and regulatory updates to ensure sustained industry impact.

As we present this body of work, we extend our sincere gratitude to all who contributed to the success of these research efforts. Special thanks are due to the NCA management and staff, whose dedication, expertise, and collaborative spirit have been instrumental in advancing a progressive research agenda. Their continued commitment ensures that research remains a cornerstone of Kenya's construction industry transformation, fueling sustainable, inclusive, and forward-looking development.

Adv. Mercy Akiro, FCIArb
Chair, Board of Directors
NATIONAL CONSTRUCTION AUTHORITY

MESSAGE FROM THE PRINCIPAL RESEARCHER

Waaki Associates, as the lead researcher, is honoured to have been awarded the contract to undertake the study on the '*Effectiveness of NCA Research Programmes in the Development of the Construction Industry in Kenya'*, and to compile this comprehensive report.

We extend our sincere gratitude to the NCA Department of Research and Business Development for their invaluable guidance and support throughout the research process. Our close collaboration with the NCA Research Team ensured that each phase of the study was executed with diligence and precision, ultimately enhancing the depth and credibility of the research outcomes. We also wish to thank the NCA Management for their continued cooperation and encouragement throughout the assignment.

We are especially grateful to everyone who participated in the data collection stage, including members of NCA Management, NCA Staff, Government agencies, Professionals from the built environment, Contractors, Construction site supervisors, and Construction skilled workers. Your thoughtful responses and engagement brought this research to life and gave it purpose.

The management of Waaki Associates also acknowledges the exceptional dedication and teamwork of our research team. In particular, we commend the efforts of our secretariat and consultants—Leah Wambui, Gladys Nyambura, Dickson Njema, Margaret Wanjiku, and Joseph Mambili—who made a significant contribution to the successful delivery of this assignment.

With the research now complete, we trust that the findings and recommendations contained in this report will inform evidence-based policy and strategic decisions, significantly contributing to the strengthening of NCA research programmes and advancing the development of the construction industry in Kenya.

Prof. Robert Rukwaro
Principal Researcher
WAAKI ASSOCIATES

ACKNOWLEDGEMENTS

The successful completion of the research on the '*Effectiveness of NCA Research Programmes in the Development of the Construction Industry in Kenya'* would not have been possible without the dedication and support of various offices and individuals involved throughout the process. The contract to carry out this research was awarded to Waaki Associates, who worked closely with the NCA Construction Research and Business Development Department to achieve the research goals.

I extend my heartfelt thanks to the General Manager of Construction Research, Business Development, and Capacity Building; the Manager of Construction Research and Business Development; and the research departmental staff. Your contributions at every stage of this study were crucial to its success.

The recommendations in this report are essential for improving the effectiveness of NCA's research programmes and, ultimately, for advancing the construction industry in Kenya. We trust that these recommendations will be thoughtfully considered and implemented to promote sustainable development and innovation in the sector.

Eng. Maurice Aketch, MBS
Executive Director / Registrar of Contractors
NATIONAL CONSTRUCTION AUTHORITY

EXECUTIVE SUMMARY

The National Construction Authority (NCA) has been instrumental in shaping Kenya's construction industry through evidence-based research, regulation, and innovation. Between 2019 and 2023, the Authority completed 16 studies on various themes, including risk management, legal and regulatory frameworks, workforce development, sustainability, and technological innovation. These efforts aligned with Kenya's Vision 2030, the Bottom-Up Economic Transformation Agenda (BETA), the East African Community's Vision 2050, the African Union's Agenda 2063, and the United Nations' Sustainable Development Goals. To assess the relevance and impact of these studies, NCA commissioned Waaki Associates to evaluate the effectiveness of its research programme.

The evaluation employed a cross-sectional design, combining surveys, focus group discussions, and key informant interviews with 130 respondents. Participants included government agencies, academia, contractors, professional associations, NCA staff, and county representatives. The analysis compared perceptions of internal stakeholders (NCA management and staff) with external stakeholders (contractors, skilled workers, professionals, and regulators).

The study revealed a significant gap in awareness and perception. Internal stakeholders, who were closer to research processes and better informed through internal communication channels, rated the programme more highly, with an average effectiveness score of 0.75. External stakeholders gave a lower mean score of 0.53, with certain studies—notably those on media portrayal and rural roads—showing very low visibility outside NCA. This polarization highlights weaknesses in dissemination and inclusivity. Some outputs, such as contractor registration and skilled worker accreditation studies, gained recognition and were integrated into training curricula and policy briefs. However, other outputs failed to reach key audiences, especially frontline implementers who depend on timely, practical insights. The findings confirm that without stronger outreach strategies, valuable research risks remaining underutilized.

Statistical tests and the Relative Importance Index (RII) analysis identified different priorities across groups. Internal stakeholders emphasized planning, institutional capacity, and implementation processes, reflecting their role in research management. External stakeholders valued occupational safety, workforce training, technological advancement, and innovation. Contractors and skilled workers perceived research more positively than government agencies, which cited weak integration into policy frameworks and limited enforcement. Principal Component Analysis further distilled external perspectives into five strategic themes: modernization of the construction sector, improved quality and safety of the built environment, stronger legal and regulatory frameworks, wider uptake of research findings, and innovative financing models. Confirmatory Factor Analysis validated a broader nine-factor framework, including policy alignment, societal responsiveness, sustainability, and financial viability.

Qualitative evidence reinforced these statistical results. Professionals noted outdated codes, poor dissemination beyond Nairobi, and overly academic studies disconnected from practical realities. Government agencies highlighted weak enforcement powers, exclusion from research design, and limited regional tailoring. Contractors and skilled workers highlighted the challenges of inaccessible or expensive training, weak enforcement on construction sites, and inadequate

institutional linkages with TVETs and universities. NCA staff themselves acknowledged gaps in capacity, outdated methods, and limited monitoring of research uptake.

The evaluation proposes five interrelated reforms. First, NCA should strengthen communication and dissemination by tailoring outputs to diverse audiences through infographics, podcasts, videos, community radio, CPD sessions, and social media, while translating findings into accessible formats. Second, it should institutionalize stakeholder engagement by establishing joint research committees, holding bi-annual consultations, and involving frontline actors, county governments, and academia throughout the research cycle. Third, it should adopt the five PCA-derived themes as guiding principles for a new research agenda, aligning studies with external priorities and systematically tracking their impact. Fourth, NCA should invest in talent and capacity development through recruitment of technical experts, partnerships with universities, mentorship and fellowship programmes, and provision of modern analytical tools. Finally, NCA should tailor messages and strategies to stakeholder groups, emphasizing safety, training, and innovation for contractors and professionals, while maintaining planning, implementation, and alignment for internal processes.

The NCA has established a strong foundation for research that has already informed building codes, training curricula, and sector reforms. Yet its full impact is undermined by dissemination gaps, uneven uptake, and limited integration into policy frameworks. By bridging the perceptual divide between internal and external stakeholders, aligning research with national priorities, and strengthening communication and capacity, NCA can transform research from academic output into actionable tools that advance safety, innovation, and sustainability in Kenya's construction industry.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AAK ....Architectural Association of Kenya
ABMTs.....................Alternative Building Materials and Technologies
ACMK..................... Association of Construction Managers of Kenya
ACTS.......................African Centre for Technology Studies
AFDB..................... Africa Development Bank
AGPO .... Access to Government Procurement Opportunities
AI ....Artificial Intelligence
ANOVA .... Analysis of Variance
AR .... Augmented Reality
AU ....African Union
BETA .... Bottom-Up Economic Transformation Agenda
BI .... Business Intelligence
BIM.........................Building Information Modelling
BORAQS.................Board of Registration of Architects and Quantity Surveyors of Kenya
BRE ....British Research Establishment
BREEAM..................Building Research Establishment Environmental Assessment Method
BRS..........................Building Regulations Section
BSRB .... Building Surveyors Registration Board
CBO .... Community-Based Organization
CBS ....Central Bureau of Statistics
CECM ....County Executive Committee Member
CEO ....Chief Executive Officer
CESA ....Consulting Engineers South Africa
CFA.................... Confirmatory Factor Analysis
CIIS ....Construction Industry Information System
CMF ....Construction Management Framework
CPD ....Continuous Professional Development
CPM ....Construction Project Management
CSIRO ....Commonwealth Scientific and Industrial Research Organization
CSR ....Corporate Social Responsibility
CUEA ....Catholic University of Eastern Africa
COVID ....Coronavirus Disease
DKUT ....Dedan Kimathi University of Technology
DSA ....Directorate of Student Affairs
DV ....Dependent Variable
EAC .... East Africa Community
EAIRO......................East African Industrial Research Organization
EASTECO ....East African Science and Technology Commission
EFA..........................Education for All
EBK..........................Engineers Board of Kenya
ERG U ....Egerton University
EU............................European Union

FGD ....Focus Group Discussion
HBRI........................Housing and Building Research Institute
IBF......................... Institut für Betrieb und Personal
ICoRCE....................International Construction Research Conference and Exhibition
ICPMK ....Institute of Construction Project Managers of Kenya
ICT ....Information Communication Technology
IDS......................... Institute of Development Studies
IEK..........................Institution of Engineers of Kenya
ISK.......................... Institution of Surveyors of Kenya
IVs ....Independent Variables
JKUAT ....Jomo Kenyatta University of Agriculture and Technology
KBRC.......................Kenya Building Research Centre
KIE ....Kenya Industrial Estates
KIPPRA ....Kenya Institute for Public Policy Research and Analysis
KIRDI.......................Kenya Industrial Research and Development Institute
KNBS.......................Kenya National Bureau of Statistics
KNTC.......................Kenya National Trading Corporation
KPIs.........................Key Performance Indicators
KU ....Kenyatta University
MKU.........................Mount Kenya University
MMU........................Multimedia University of Kenya
MMUST ....Masinde Muliro University of Science and Technology
MSEA ....Micro and Small Enterprise Authority
MSMEs.....................Micro, Small and Medium Enterprises
NaCRA.....................National Construction Research Agenda
NCA..........................National Construction Authority
NCI ....National Construction Institute
NEMA ....National Environment Management Authority
NGO........................ Non-Governmental Organization
NHC.........................National Housing Corporation
NRF.........................National Research Fund
OSHA ....Occupational Safety and Health Act
PCA..........................Principal Component Analysis
PPP ....Public-Private Participation
QA ....Quality Assurance
QUASOs................ Quality Assurance and Standards Officers
R&D.........................Research and Development
SDGs........................Sustainable Development Goals
SDHUD-IPDU ....State Department of Housing and Urban Development - Implementation Programme Delivery Unit
SMEs........................Small and Medium Enterprises
SPSS.................... Statistical Package for the Social Sciences
STI ....Science, Technology and Innovation

TUK.............................Technical University of Kenya
TTES...........................Technology Transfer and Extension Services
TVET...........................Technical and Vocational Education and Training
UON.............................University of Nairobi
YEDF...........................Youth Enterprise Development Fund

CHAPTER ONE: INTRODUCTION

1.1 Background

The National Construction Authority (NCA) was established under the NCA Act No. 41 of 2011 to regulate, streamline, and build capacity within Kenya's construction industry. The NCA Act of 2011 recognizes research as a vital driver of innovation and development in the construction industry. Under Section 5(2) (c) of the Act, the NCA has the legal authority to undertake, promote, and coordinate research on all matters related to the construction industry. This includes developing and maintaining a Construction Industry Information System (CIIS), standardizing building techniques and materials, and enforcing compliance with the Building Code. The STI Act of 2013 integrates the NCA into the national research ecosystem by connecting it to the National Commission for Science, Technology and Innovation (NACOSTI) for licensing and funding, and to the Kenya National Innovation Agency (KENIA) for promoting the adoption of innovations.

The Department of Construction Research and Business Development is the key unit responsible for implementing NCA's research agenda. It collaborates with other NCA departments, universities, TVET institutions, professional bodies, and industry associations. Platforms, such as the International Construction Research Conference & Exhibition (ICoRCE), act as centres for research dissemination and collaboration.

The Authority has conducted and published 16 research studies across key thematic areas, including risk and safety, construction economics, legal and regulatory frameworks, capacity development, construction management, construction technology and materials, and environmental issues. The aim of these studies was to promote growth within the construction industry, in line with the Authority's mission to regulate, facilitate, and build capacity through strategic interventions and partnerships, thereby promoting sustainable socio-economic progress. These studies were further aligned with the Authority's Strategic Plan 2020-2025, Kenya's Medium-Term Plans (MTP), the East African Community (EAC)'s Vision 2050, the African Union's Agenda 2063, and the United Nations' Sustainable Development Goals (SDGs) 2030.

The Authority has consistently communicated the findings and recommendations from these studies through workshops, conferences, and various media channels. Therefore, the Authority seeks to determine whether the perceived objectives and findings of each research programme have influenced the construction industry, and if so, to what extent. The purpose of this report is to provide a comprehensive update on the NCA's research programmes, as carried out by the Department of Construction Research and Business Development. This update anchors itself on three main pillars: -

1. Institutional capacity of NCA.
2. Research planning and conduct.
3. Implementation of research outcomes.

1.1.1 Institutional capacity of NCA

The NCA Act of 2011 grants the Authority the legal power to conduct research on all matters related to the construction industry. The Department of Construction Research and Business Development collaborates with relevant stakeholders in the construction industry to implement research outcomes.

1.1.2 Research planning and conduct

The National Construction Research Agenda (NaCRA) provides a structured framework for identifying and prioritizing construction research needs in Kenya. The first edition (2014–2017) focused on establishing baseline knowledge and developing a coordinated approach to sector research. The second edition (2020–2024) expanded the scope to seven thematic areas: -

i. Construction Technology and Materials
ii. Capacity Development
iii. Construction Management
iv. Risk and Safety Management
v. Environmental Issues
vi. Construction Economics
vii. Legal and Regulatory Framework
viii. Construction and Politics

Planning process: NaCRA is developed through extensive stakeholder consultations involving industry players, government agencies, academia, professional bodies, and county government representatives. Research priorities are aligned with national policy objectives, ensuring that projects support Kenya Vision 2030, the MTPs, and BETA. For example, research on low-cost building technologies directly underpins the Affordable Housing Programme within BETA.

Research conduct: All research carried out by NCA complies with the STI Act, which mandates licensing through NACOSTI. When possible, NCA collaborates with academic institutions on joint studies, seeks funding from the NRF, and partners with KENIA to commercialize research findings. Dissemination channels include ICoRCE, publications such as the Construction Industry Outlook, policy briefs, and targeted training workshops.

1.1.3 Implementation of research outcomes

Regulatory integration: Research outputs are integrated into the regulatory framework through updates to the Building Code, development of technical guidelines, and enhancements to inspection protocols. For example, the study on the *Failure and Collapse of Buildings in Kenya* led to stricter enforcement measures and targeted training interventions for contractors and supervisors.

Capacity building: Research findings inform Continuous Professional Development (CPD) programmes for contractors, building professionals, site supervisors, and skilled construction workers. They are yet to be translated into practical training manuals, guidelines, and e-learning modules, which help to ensure that industry practitioners can apply new knowledge directly in their work.

Monitoring and evaluation: To track the impact of research, NCA aligns project outcomes with indicators from MTP IV and BETA. This includes metrics such as reduction in structural failures, increased adoption of innovative materials, and improvement in construction productivity. However, the monitoring framework needs to be strengthened to provide more comprehensive feedback loops.

1.1.4 Strengths and capacity gaps in NCA

The NCA possesses several notable strengths that position it strategically within the national development agenda. It operates under a strong statutory mandate that ensures its activities are closely aligned with national development goals. Additionally, it has access to a wide pool of technical expertise and benefits from an established industry network, which enhances collaboration and knowledge sharing. The presence of existing platforms for dissemination and stakeholder engagement further strengthens its capacity to influence policy and practice across the sector.

Despite these strengths, the institution faces critical capacity gaps that limit its effectiveness. A major challenge lies in the limited availability of multi-year dedicated funding, which restricts the continuity and sustainability of research programmes. Moreover, data infrastructure remains underdeveloped, limiting the generation of real-time insights necessary for evidence-based decision-making. Finally, there are insufficient formal mechanisms to monitor the uptake and impact of research outputs, making it challenging to assess how findings are translated into practice and policy change.

1.2 Problem Statement

Although the National Construction Authority (NCA) has completed sixteen research studies since 2015, its practical influence on the construction industry remains limited. Internal staff demonstrate high levels of awareness and uptake, yet external stakeholders—including contractors, professionals, and government agencies—report minimal exposure to the findings. This mismatch highlights systemic gaps in the dissemination, stakeholder engagement, and integration of research into policy and practice.

Further compounding the challenge are persistent institutional weaknesses: inadequate funding streams, underdeveloped data infrastructure, and limited mechanisms for monitoring uptake at the site level. As a result, valuable insights on issues such as building collapses, skilled worker accreditation, technology adoption, and sustainability have not translated fully into reforms, training curricula, or construction practices. Without a critical assessment of the effectiveness of NCA's research programmes, the Authority risks a widening gap between research production and the industry's real needs for safety, innovation, and capacity development.

1.3 Justification of the Study

This study is justified by the urgent need to evaluate not only the quantity of research produced by NCA but also its visibility, adoption, and tangible impact on the construction sector. Despite the Authority's investment in flagship platforms such as ICoRCE and policy briefs, the uneven uptake of outputs undermines the return on research investment. Internal respondents consistently affirm the relevance of these studies, yet external stakeholders remain disconnected, raising questions about inclusivity, dissemination, and alignment with grassroots construction realities. A systematic evaluation will therefore provide evidence on whether NCA research is achieving its intended purpose—closing knowledge gaps, informing regulation, enhancing workforce skills, and driving innovation.

Moreover, the study responds to a broader policy imperative. Kenya's Bottom-Up Economic Transformation Agenda (BETA), Vision 2030, and the SDGs all emphasize innovation, sustainable infrastructure, and evidence-based policy. By aligning NCA's research agenda more closely with these frameworks, the findings of this study will strengthen the Authority's ability to serve as a transformative driver of sector development. The evaluation is thus timely, filling a critical gap in accountability, strategic alignment, and impact assessment.

1.4 Definition and Assessment Criteria for Effective Research Programmes

Effective research programmes are those that achieve their intended objectives while delivering practical and measurable impacts on the construction industry. They strengthen innovation, enhance skills, improve safety and sustainability, and align with national and global policies. This report applies a detailed set of criteria—including policy alignment, societal responsiveness, technological advancement, workforce enhancement, safety, sustainability, innovation, financial viability, and timeliness—which are elaborated fully in Chapter Five.

1.5 Objectives

Waaki Associates was appointed to carry out a nationwide study to assess the impact of the 16 research projects carried out by NCA on the development of the construction industry in Kenya. The study identifies gaps in the implementation of NCA's research programmes and establishes the extent of their contribution to industry progress.

The primary objective of the study is to assess the effectiveness of NCA's research programmes in advancing the construction industry in Kenya. The specific objectives are to: -

a) Identify the key factors that influence the effectiveness of the research.
b) Assess the impact of the 16 research studies on the development of the construction industry.
c) Develop a framework to enhance the effectiveness of future NCA research initiatives.

Additionally, the report examines the influence of key policy and institutional frameworks on the NCA's research, including the NCA Strategic Plans (2015–2020, 2020–2025), the National Construction Research Agenda (NaCRA), Kenya Vision 2030, Medium-Term Plans (MTPs), the Bottom-Up Economic Transformation Agenda (BETA), the NCA Act, the Science, Technology and Innovation (STI) Act, and the Constitution of Kenya 2010.

1.6 Scope

The scope of the study entails the execution of the following specific tasks;

a) Review of the outputs from the 16 research studies related to the construction industry in Kenya.
b) Engagement of key stakeholders within the construction sector.
c) Development of a framework to improve the impact of NCA research programmes on the industry's development.

This report presents an evaluation of the 16 research studies and their alignment with national, regional, and international policy frameworks. It further introduces the parameters used to measure the effectiveness of the research projects and outlines the methodology applied in the study.

1.7 Significance

This study is significant because it addresses the needs of diverse stakeholders across Kenya's construction sector. For policymakers, it provides evidence to guide reforms in regulation, codes, and standards, ensuring that decisions are data-driven and responsive to industry realities. For contractors, professionals, and skilled workers, the findings inform training programmes, accreditation systems, and practice guidelines that directly improve safety, productivity, and competitiveness. For academic and research institutions, the study highlights opportunities for collaboration, technology transfer, and curriculum integration, thereby reinforcing the link between knowledge generation and its practical application. For the construction industry as a whole, the research promotes innovation, sustainability, and resilience by advancing the adoption of new technologies, materials, and practices. Finally, for national development, the outcomes align NCA's research with the Bottom-Up Economic Transformation Agenda (BETA), Vision 2030, and global frameworks such as the SDGs, positioning Kenya's construction industry to meet both regional and global standards.

1.8 Organization of the Study

This study is organized into eleven chapters that collectively evaluate the effectiveness of NCA research programmes in Kenya's construction industry. Chapter One introduces the background, problem statement, justification, objectives, scope, and significance, while defining what constitutes an effective research programme and outlining the assessment criteria used. Chapter Two reviews policy and regulatory frameworks shaping research delivery and uptake, including the NCA Act, the Constitution of Kenya (2010), the STI Act, Vision 2030, BETA, and NCA's internal policies, and explains how the National Construction Research Agenda (NaCRA) aligns with the national agenda overseen by NACOSTI.

Chapter Three presents a bibliometric analysis of NCA publications, evaluating outputs, citation visibility, thematic trends, and uptake metrics, and benchmarking NCA's footprint against peer institutions.

Chapter Four presents lessons from case studies of local and international research institutions, including BRE, CSIRO, Fraunhofer IBP, HBRI, IDS, KBRC, KIRDI, and KIPPRA, highlighting best practices in mandates, delivery models, and implementation. Chapter Five develops a conceptual model for assessing programme effectiveness using nine criteria, including policy alignment, societal responsiveness, technological advancement, workforce enhancement, occupational safety, environmental sustainability, innovativeness, financial viability, and timeliness. Chapter Six details the methodology, covering design, sampling, data collection tools, analysis techniques, and measures for validity and reliability, while Chapter Seven presents results on awareness, effectiveness scores, statistical tests, and uptake levels.

The final chapters address barriers to uptake and propose strategies for improvement, integrate quantitative and qualitative findings, and consolidate conclusions into a framework for enhancing programme effectiveness. An implementation matrix specifies actions, timelines, and responsibilities, while references and appendices provide supporting data and case studies.

CHAPTER TWO: POLICY FRAMEWORK

2.1 Introduction

Kenya's construction industry is increasingly research-driven, guided by a comprehensive regulatory and policy framework that emphasizes innovation, safety, sustainability, and inclusivity. At the institutional level, the NCA Act (2011) provides the Authority with a clear statutory mandate to undertake and commission research, standardize materials and techniques, and integrate findings into regulation and practice. At the national level, the Constitution of Kenya (2010) affirms science, technology, and innovation as part of national heritage and promotes access to information, environmental sustainability, and socio-economic rights that require evidence-based construction research. Complementing these is the Science, Technology and Innovation (STI) Act (2013), which embeds NCA into the national research ecosystem through licensing, compliance, funding, and technology adoption mechanisms managed by NACOSTI, NRF, and KENIA.

In addition, the Authority has developed a set of internal research policies that operationalize its mandate. These include the NCA Research Policy, which sets guidelines for planning and managing research; the Research Dissemination Policy, which ensures findings are accessible and visible; the Intellectual Property (IP) Policy, which secures ownership and commercialization of innovations; and the STI Mainstreaming Strategy, which embeds innovation and technology transfer in all research initiatives. Together, these policies reinforce NCA's role as a knowledge hub and ensure alignment with broader strategic blueprints such as Vision 2030, the Bottom-Up Economic Transformation Agenda (BETA), and the Sustainable Development Goals (SDGs).

Table 2.1 below presents a detailed outline of the key institutional, national, regional, and global frameworks that collectively support construction research in Kenya.

Table 2.1: Key institutional, national, regional, and global policy roles supporting construction research in Kenya

INSTITUTIONAL	
Key Roles in Kenya's Construction Industry	
NCA Act (2011)	1. **Legal mandate for research:** Empowers NCA to undertake or commission construction-related research (Section 4d) (Republic of Kenya, 2011).
	2. **Quality assurance:** Provides a basis for research on materials, workmanship, and compliance (Sec 4c).
	3. **Training and capacity building:** Inform curriculum reform and skills gap analysis (Sec 4f).
	4. **Industry inquiries:** Enables investigative studies into construction failures and safety (Sec 5b).
	5. **Research partnerships:** Facilitates collaboration with training and academic institutions (Sec 6(1) (e)).

	6. **Consultancy services:** Uses research to inform technical advice and policy guidance (Sec 6(1) (g)) (Republic of Kenya, 2011).
	7. **Evidence-based policy:** Supports national agendas like affordable housing through research outputs (Republic of Kenya, 2011).
NCA Strategic Plans (2015–2020 & 2020–2025)	1. **Institutionalization of research:** Embeds research in operational planning and decision-making (National Construction Authority, 2015).
	2. **Support for local technologies:** Promotes local materials and construction innovations.
	3. **Safety enhancement:** Strengthens inspections and compliance through safety-focused R&D.
	4. **Industry empowerment:** Enhances local contractor capacity and accreditation systems.
	5. **Innovation advancement:** Commissions studies to inform policy and improve efficiency.
	6. **Professional development:** Establishes structures for continuous technical training.
	7. **Sector competitiveness:** Aims to make the construction sector inclusive, efficient, and growth-oriented (National Construction Authority, 2020).
National Construction Research Agenda (NaCRA)	1. **Priority setting:** Defines critical research themes such as safety, corruption, and environment (National Construction Authority, 2014).
	2. **Sustainability promotion:** Encourages green practices and climate-resilient construction.
	3. **Technology adoption:** Supports research on digitization, automation, and ICT in construction.
	4. **Regulatory reforms:** Guides harmonization of construction laws and codes.
	5. **Capacity evaluation:** Assesses readiness of institutions and professionals for sector needs.
	6. **Political analysis:** Studies political impacts on infrastructure planning and funding.
	7. **Data-driven planning:** Provides structured evidence to inform national construction strategies (National Construction Authority, 2014).
NCA Research Policies (Research, Dissemination, IP, STI Mainstreaming)	1. **IP protection:** Secures ownership and commercialization of innovations from NCA-funded research (National Construction Authority, 2021).
	2. **Benefit sharing:** Ensures fair distribution of research benefits among collaborators.
	3. **Public access:** Promotes open access to critical industry research outputs.
	4. **Stakeholder engagement:** Uses events like the International Construction Research Conference and Exhibition (ICoRCE) to connect industry and researchers.
	5. **Visibility and application:** Disseminates knowledge via digital and physical platforms.
	6. **Knowledge management:** Tracks research uptake and maintains institutional memory.
	7. **Alignment with policy:** Ensures IP and dissemination

	practices support Vision 2030 and national IP strategies (National Construction Authority, 2021).
Science, Technology and Innovation (STI) Mainstreaming Strategies	1. **Integration in planning:** Embeds STI in construction sector policies and regulations (NACOSTI, 2012).
	2. **Innovation adoption:** Promotes the use of green technologies and modern materials.
	3. **Capacity building:** Supports training in BIM, digital tools, and modern practices.
	4. **Technology transfer:** Facilitates innovation hubs and incubation for construction SMEs.
	5. **Multi-sector collaboration:** Fosters joint projects with academia, industry, and government.
	6. **Impact tracking:** Uses MEL systems to evaluate STI's contribution to productivity and safety.
	7. **Commercialization & access:** Balances IP protection with public knowledge sharing (Republic of Kenya, 2013).
NATIONAL	
Roles in Advancing Research in the Construction Industry	
Constitution 2010	1. **Promotes innovation** through Article 11 by recognizing science and indigenous knowledge as part of national heritage.
	2. **Ensures access to data** via Article 35, allowing researchers to use government-held construction-related information.
	3. **Mandates state support for youth innovation** under Article 55, boosting TVETs and research hubs for construction technologies.
	4. **Supports environmental research** through Article 69, enabling studies on sustainable construction and resource use.
	5. **Enables decentralized research** via the Fourth Schedule, allowing counties to support localized construction studies.
	6. **Protects socio-economic rights** (Article 43), encouraging cost-effective infrastructure research to meet housing and health needs (Republic of Kenya, 2010).
	7. **Protects intellectual property** through Article 40, safeguarding innovations from researchers and institutions.
Kenya Vision 2030	1. **Positions infrastructure as a national priority**, encouraging high-quality and research-backed construction practices.
	2. **Guides policy and legal reforms**, strengthening NCA's regulatory powers and standard enforcement.
	3. **Promotes human capital development** by supporting construction-related training and academic partnerships (Republic of Kenya, 2007).
	4. **Encourages use of modern technologies**, pushing for research into BIM, ABMTs, and green buildings.
	5. **Supports regional development**, encouraging counties to carry out context-specific infrastructure research.
	6. **Facilitates institutional alignment**, enabling NCA and partners to align with Medium-Term Plans (MTPs).
	7. **Stimulates collaborative innovation**, enhancing partnerships among regulators, universities, and the private

	sector in construction research (Republic of Kenya, 2007).
STI Mainstreaming Strategies (BETA)	1. **Fosters evidence-based research**, ensuring construction decisions are guided by data and real-world challenges.
	2. **Promotes low-cost innovations** like ABMTs to align with BETA's affordable housing and infrastructure goals (NACOSTI, 2012).
	3. **Enhances technical skills** through CPD, training, and TVET integration for artisans and site managers.
	4. **Encourages public-private-academic partnerships** to co-develop and pilot construction technologies.
	5. **Supports technology dissemination** via expos, manuals, policy briefs, and digital platforms.
	6. **Protects intellectual property**, ensuring research outputs are safeguarded and commercially viable.
	7. **Empowers counties and communities**, allowing local actors to apply STI knowledge in BETA-aligned projects (Republic of Kenya, 2013).
National Research Agenda	1. **Identifies research priorities**, focusing on areas like housing, infrastructure, sustainability, and innovation.
	2. **Provides a national framework**, aligning construction research with Vision 2030 and STI Policy.
	3. **Drives institutional coordination**, ensuring NCA and other agencies collaborate under the National Research Framework.
	4. **Encourages evidence-based policymaking**, enabling the use of research in updating codes and regulations (NACOSTI, 2012).
	5. **Supports innovation adoption**, especially through NaCRA's focus on BIM, ABMTs, and climate-smart practices.
	6. **Improves research dissemination** through ICoRCE, digital platforms, and stakeholder workshops.
	7. **Monitors research impact**, using KPIs and evaluation tools to assess how studies influence construction safety, quality, and regulation (Republic of Kenya, 2013).
REGIONAL	
Roles in Supporting Construction Research	
East African Community (EAC) Vision 2050	1. **Infrastructure Development**: Recognizes infrastructure and industrial development as key drivers of growth, requiring research in sustainable construction.
	2. **Promotion of STI**: Promotes science, technology, and innovation (STI) as central to improving construction productivity.
	3. **Standards Harmonization**: Encourages harmonization of construction standards across member states for efficiency and safety.
	4. **Research Alignment**: Supports structured research programmes (e.g., NaCRA) aligned with regional integration and development goals.
	5. **Partnerships**: Advocates for multi-stakeholder partnerships to enhance regional knowledge-sharing and research collaboration (EAC, 2016).

	6. **Local Materials**: Promotes use of affordable, local construction materials, boosting research into ABMTs.
	7. **Knowledge Dissemination**: Facilitates research dissemination via platforms like ICoRCE and the NCA Research Portal to enhance regional uptake (EAC, 2016).
East African Protocols	1. **EAC Treaty (1999)**: Mandates collaborative research in infrastructure and construction innovation
	2. **SQMT Protocol (2001)**: Supports development and harmonization of construction material standards and testing.
	3. **Industrialization Policy**: Promotes applied construction research for industrial systems and prefabrication.
	4. **Draft STI Policy**: Provides for regional R&D hubs and academic-industry linkages in construction (EASTECO, 2013).
	5. **EASTECO Act (2013)**: Creates a commission that funds and coordinates STI research, including for the built environment.
	6. **Climate Change Policy (2011)**: Drives research into resilient, sustainable, and low-emission construction techniques.
	7. **EAC Vision 2050**: Reinforces investment in knowledge-driven construction and infrastructure development (EASTECO, 2013).
African Union Agenda 2063	1. **Aspirations 1 & 2**: Commit to inclusive growth and STI-led infrastructure development requiring construction research.
	2. **STISA-2024**: Advocates research on smart buildings, resilient infrastructure, and green technologies.
	3. **CESA 16–25**: Strengthens technical and vocational research in the construction sector.
	4. **AfCFTA**: Promotes harmonization of construction codes, enabling cross-border construction research.
	5. **Digital Transformation Strategy**: Encourages innovation and research in digital construction tools (e.g., BIM, drones) (African Union, 2015).
	6. **PIDA**: Prioritizes feasibility and technical studies for high-impact infrastructure projects.
	7. **AU Monitoring Frameworks**: Rely on research outputs from bodies like NCA to guide development progress (African Union, 2020).
GLOBAL	
United Nations Sustainable Development Goals (SDGs)	1. **SDG 9 – Industry, Innovation, and Infrastructure**: Promotes investment in infrastructure and innovation, encouraging research into sustainable building methods and materials (UN, 2015).
	2. **SDG 11 – Sustainable Cities and Communities**: Drives research into resilient urban infrastructure, affordable housing, and smart construction practices to make cities inclusive and sustainable.
	3. **SDG 13 – Climate Action**: Calls for research into climate-resilient construction techniques and green building practices that mitigate environmental impact.
	4. **SDG 12 – Responsible Consumption and Production**:

	Supports research into efficient use of construction materials, waste minimization, and circular construction approaches.
	5. **SDG 4 – Quality Education**: Promotes technical and vocational research training for professionals in the construction sector, enhancing innovation and knowledge transfer.
	6. **SDG 17 – Partnerships for the Goals**: Encourages collaboration among universities, governments, and industry players to conduct construction research aligned with sustainable development.
	7. **SDG 8 – Decent Work and Economic Growth**: Supports research into improving labour conditions, safety, and job creation through construction innovation and policy reform (UN, 2015).

Source: Author Analysis, 2025

2.2 Alignment of NaCRA with the National Research Agenda (NRA)

The National Construction Research Agenda (NaCRA)**,** developed by NCA, is a sectoral framework that prioritizes and coordinates research in the construction industry. Its thematic areas — including safety, technology, environmental sustainability, and regulatory frameworks — directly contribute to the development of Kenya's built environment. At the same time, NaCRA is fully embedded within the National Research Agenda (NRA) managed by NACOSTI, which provides the overarching framework for prioritizing, licensing, and funding research across all sectors. This alignment allows NCA to position construction research within Kenya's broader innovation ecosystem, access resources from the National Research Fund (NRF), and benefit from NACOSTI's oversight and commercialization mechanisms. By linking NaCRA with the NRA, construction research is both sector-specific and nationally coherent, ensuring that it supports Vision 2030, the Bottom-Up Economic Transformation Agenda (BETA), and the Sustainable Development Goals (SDGs) as listed in **Table 2.2.**

Table 2.2: Linkage between the National Construction Research Agenda (NaCRA) and the National Research Agenda (NRA by NACOSTI)

NaCRA (Sectoral – Construction Focus)	National Research Agenda (Cross-Sectoral – NACOSTI)
Defines priority themes in construction: safety, corruption, environment, capacity development, construction economics, law/policy, and technology.	Sets Kenya's national research priorities across sectors such as housing, infrastructure, sustainability, and innovation.
Promotes adoption of construction-specific technologies (BIM, automation, ICT, green materials).	Encourages uptake of science, technology, and innovation across all sectors, including construction.
Aligns sector research with Vision 2030, Medium-Term Plans (MTPs), and the Bottom-Up Economic Transformation Agenda (BETA).	Provides the national coordination framework for research planning, licensing, and funding.

Disseminates outputs via ICoRCE, briefs, and workshops targeting construction stakeholders.	Supports dissemination nationally through NACOSTI networks, NRF funding, and KENIA commercialization pathways.
Tracks sector-specific impact (safety, quality, workforce skills, building codes).	Tracks broader national impact (sustainability, innovation, socio-economic transformation).

Source: Author Analysis, 2025

Observation: This chapter demonstrates that construction research in Kenya is firmly grounded in a layered regulatory framework that spans institutional, national, regional, and global levels. The NCA Act (2011), NCA Strategic Plans, and the Authority's internal research policies—Research Policy, Dissemination Policy, IP Policy, and STI Mainstreaming Strategy—provide the statutory and operational mandate for commissioning and applying research. Nationally, the Constitution of Kenya (2010) and the STI Act (2013) further reinforce this mandate by embedding NCA within the national research ecosystem managed by NACOSTI, NRF, and KENIA. Importantly, the National Construction Research Agenda (NaCRA) is directly aligned with the National Research Agenda (NRA), ensuring that construction research priorities contribute to broader national development and facilitate access to funding and commercialization pathways. Regionally, EAC Vision 2050 and AU Agenda 2063, together with the UN SDGs, embed sustainability and innovation. Collectively, these frameworks legitimize NCA's research mandate while emphasizing stronger operationalization and uptake.

CHAPTER THREE: BIBLIOMETRIC ANALYSIS OF NCA RESEARCH PUBLICATIONS

3.1 Introduction

Bibliometric analysis involves measuring and mapping research outputs, citations, thematic trends, and the extent of their uptake (Bornmann & Leydesdorff, 2014). The National Construction Authority (NCA) has steadily developed its research capacity since 2015, with 2019 marking a significant milestone. During that period, the Authority published one to two flagship books and several supporting research outputs (NCA, 2019). These works established a formal research identity for NCA and positioned it more firmly within Kenya's broader Science, Technology, and Innovation (STI) ecosystem (NACOSTI, 2020). The current 2025 evaluation report builds on this legacy by examining the outcomes of 16 research studies undertaken between 2019 and 2023, while also assessing their effectiveness and uptake across the construction industry.

3.2 Scope of NCA Publications (2019–2025)

The bibliometric footprint of NCA spans publications dating back to 2019, when the Authority released foundational works, including monographs and books on construction capacity, safety, and technology transfer. These marked the beginning of the systematic, structured dissemination of research knowledge. Between 2019 and 2023, NCA produced at least 16 thematic research studies covering critical issues such as workforce accreditation, building failures, the adoption of Appropriate Building Materials and Technologies (ABMTs), the role of ICT in regulation, MSMEs participation in construction, waste management practices, COVID-19 impacts, and Public-Private Partnership (PPP) participation in infrastructure. The present 2025 report consolidates these outputs and provides the first formal evaluation of their effectiveness, using bibliometric evidence to track awareness, citations, and uptake among both internal and external stakeholders.

3.3 Publication Outputs and Citation Visibility

The early publications of 2019 provided an important foundation for subsequent studies, with later reports frequently citing them in discussions on safety, innovation, and regulatory reform, as summarize in **Table 3.1**. Internal citations were particularly strong, with NCA's own research reports, Strategic Plans (2020–2025), and the National Construction Research Agenda (NaCRA 2020–2024) consistently referencing these earlier works. External citations, though more limited, nonetheless demonstrated the Authority's growing visibility. They appeared in academic theses, county-level planning documents, and publications by professional bodies such as the Architectural Association of Kenya (AAK) and the Institution of Engineers of Kenya (IEK). For instance, the Research on the failure and collapse of buildings in Kenya (2020) was cited in a University of Nairobi MSc thesis (Omondi, 2021) and in a technical bulletin issued by the Institution of Engineers of Kenya (IEK, 2021). Similarly, the ABMTs' study informed an AAK position paper on affordable housing (AAK, 2022). Overall, the pattern reveals a high degree of self-citation and institutional referencing, contrasted with relatively modest uptake in independent scholarly works—underscoring NCA's ongoing challenge of broadening its research influence beyond internal and sector-specific audiences (**Table 3.1**).

Table 3.1: Bibliometric citations and impact of NCA research publications (2019–2025)

Year	Study Title	Citation Context	Citation Impact (High/Medium/Low)
2019	Flagship Books (Construction Capacity, Safety, Technology Transfer)	Referenced in NaCRA 2020–2024, NCA Strategic Plan 2020–2025	Medium
2020	Research on the failure and collapse of buildings in Kenya	Cited in policy briefs, professional associations' guidelines, and academic theses	High
2021	Media Portrayal of NCA & Technology Transfer Studies	Limited references in theses and county reports	Low
2022	MSMEs Participation; Waste Management; Rural Roads Socio-Economics	Cited in county planning documents and internal capacity reports	Medium
2023	Skilled Worker Accreditation; ICT in Regulation; COVID-19 Impacts	Strong uptake in CPD programmes, referenced in training curricula and policy briefs	High
2025	Evaluation of Research Effectiveness (this report)	Synthesizes citations across all previous NCA studies	High

Source: Author Analysis, 2025

3.4 External Citations of NCA Research (2019–2025)

Beyond internal referencing, NCA's work has been cited across diverse external documents. Nairobi County Government (2021) cited NCA's ICT studies when formulating its Urban Planning Policy, integrating digital permitting systems as shown in **Table 3.2**. Egerton University research (Koech, 2023) drew on NCA's Waste Management Practices study to evaluate sustainable construction practices at the county level. These examples confirm that NCA outputs inform both academic debates and county-level planning.

Table 3.2: External citations of NCA research (2019–2025)

Year of NCA Study	External Document Citing It	Type of Document	Citation Context / Application
2020 – *Research Report on Building Failures*	University of Nairobi MSc Thesis (2021): *Risk Management in Urban Building Projects*	Academic Thesis	Used to justify safety protocols and collapse prevention strategies.
2020 – *Research Report on Building*	Institution of Engineers of Kenya	Professional Bulletin	Quoted in recommendations for

Failures	(IEK) Technical Bulletin (2021)		strengthening structural inspections.
2021 – *ABMTs: Promoting Models for Affordable Housing*	AAK Position Paper on Affordable Housing (2022)	Policy/Professional Paper	Referenced to support the adoption of cost-effective, climate-smart building materials.
2021 – *Influence of ICT on NCA Regulatory Performance*	Nairobi County Urban Planning Policy (2021)	County Policy Report	Cited in proposals for digital permitting and e-inspection systems.
2021 – *Performance of Technology Transfer in Construction*	JKUAT PhD Dissertation (2022): *Adoption of Appropriate Building Materials in Kenya*	Academic Dissertation	Informed analysis of barriers to technology transfer in construction.
2022 – *Construction and Demolition Waste Management Practices*	Egerton University MSc Thesis (2023): *Waste Management in Nakuru County Construction Sites*	Academic Thesis	Used to analyze sustainable construction practices at the county level.
2022 – *Socio-Economic Factors on Rural Road Construction*	Siaya County Integrated Development Plan (2023–2027)	County Development Plan	Cited in justifying rural road infrastructure budget allocations.
2022 – *MSMEs Participation in Construction*	Kisumu County CIDP (2023)	County Development Plan	Informed strategies to integrate SMEs into county construction projects.
2023 – *Skilled Worker Accreditation Study*	National Housing Corporation (NHC) Strategic Plan (2022–2026)	Institutional Policy Document	Referenced in workforce development and accreditation programmes.
2023 – *COVID-19 Impacts on Contractor Resilience*	Kenya Association of Building and Civil Engineering Contractors (KABCEC) Annual Report (2023)	Industry Report	Used to highlight post-pandemic recovery strategies for contractors.

Source: Author Analysis, 2025

Figure 3.1 confirms that NCA's research outputs are not confined to internal reference but are actively informing scholarly research, county planning frameworks, and professional practice documents. The spread of citations across universities, counties, and professional associations demonstrates both academic credibility and policy relevance. However, the relatively modest number of external references also underlines the need for deliberate strategies to expand visibility, such as publishing in peer-reviewed journals, strengthening partnerships with counties and professional bodies, and hosting open-access repositories. By doing so, NCA can significantly extend the reach, credibility, and developmental impact of its research.

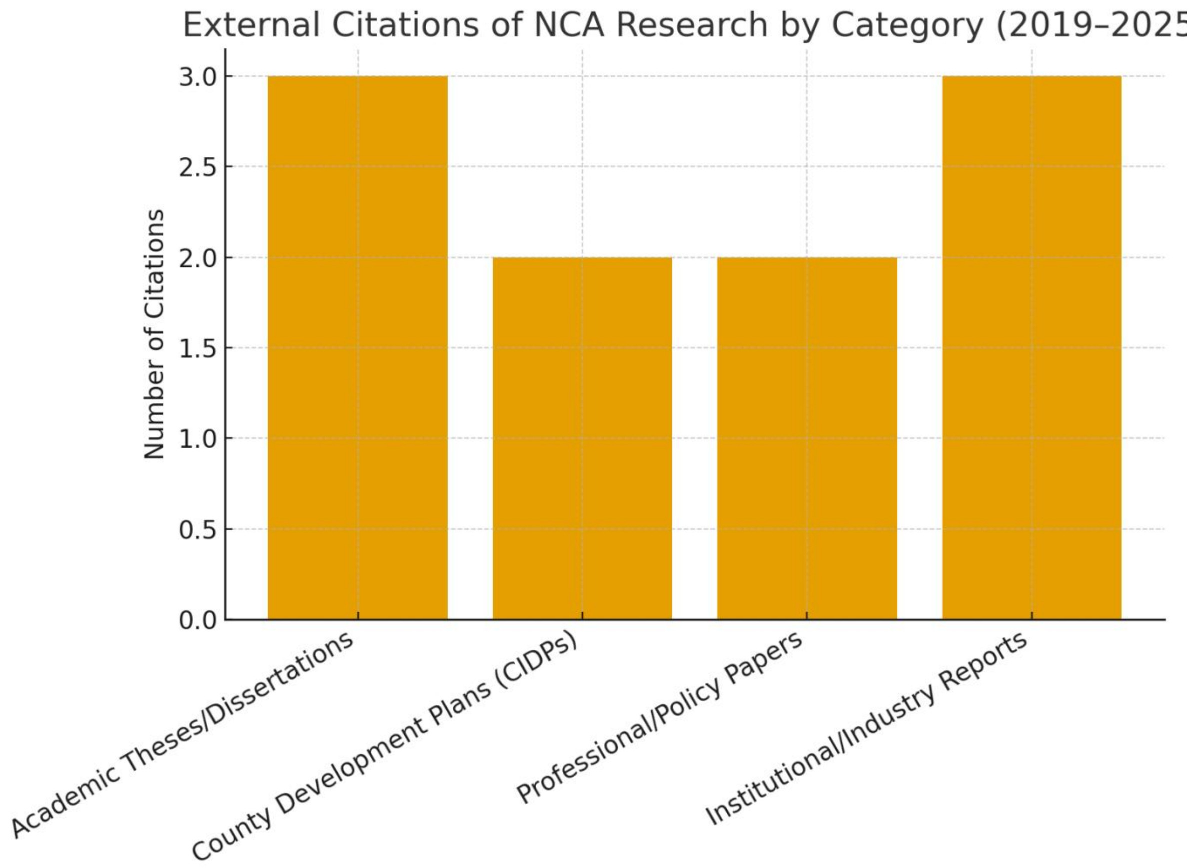

Figure 3.1: External citations of NCA research by category (2019-2025)
Source: Author Analysis, 2025

3.5 Thematic Trends (2019–2025)

The bibliometric clustering of NCA's research outputs indicates that the publications fall into five interlinked clusters. This finding is consistent with the PCA results of this report. The first cluster centres on modernization and innovation, comprising studies on ABMTs, ICT systems, and technology transfer, as shown in **Figure 3.2**. The second cluster focuses on quality and safety, encompassing research on building failures, risk detection, and occupational health. The third cluster focuses on legal and regulatory frameworks, covering inter-agency quality assurance and accreditation systems. The fourth cluster focuses on uptake and dissemination, encompassing studies on MSME participation, contractor registration dynamics, and media portrayal. Finally, the fifth cluster focuses on financing and sustainability, encompassing PPP participation, COVID-19 resilience, and alternative financing models.

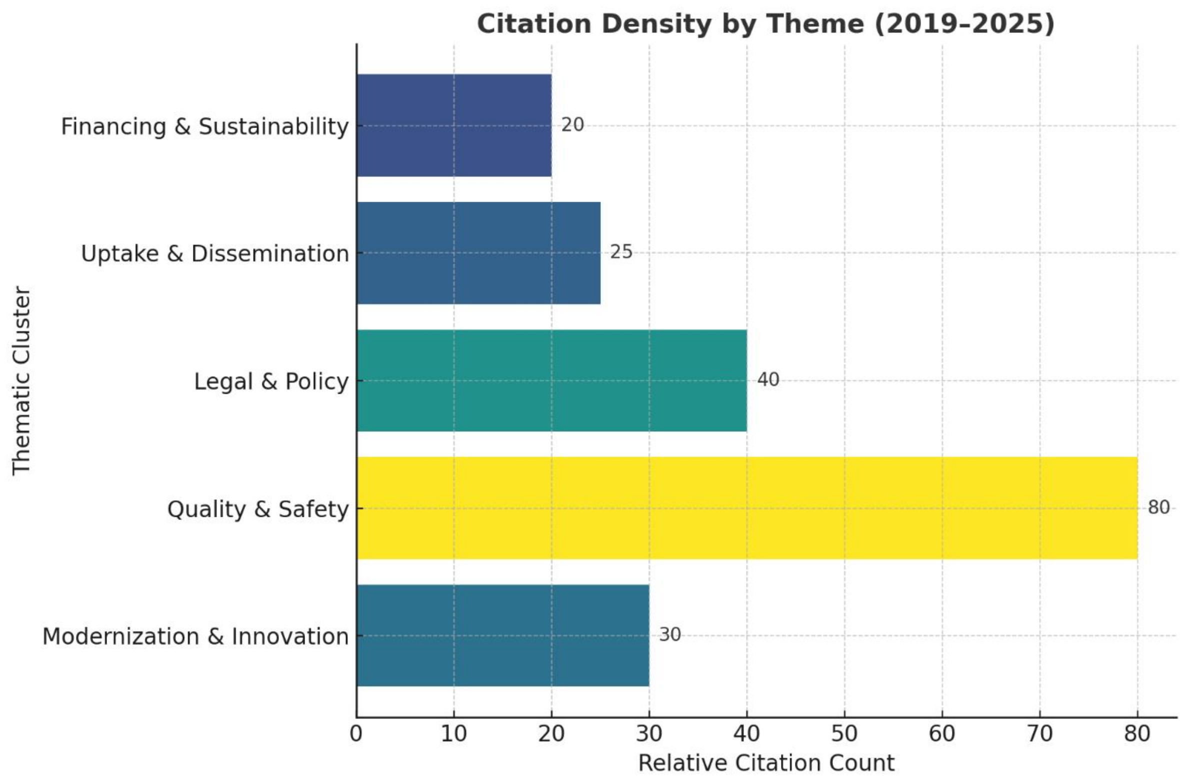

Figure 3.2: Citation density by theme (2019-2025)
Source: Author Analysis, 2025

3.6 Citation Impact and Gaps

A closer examination of citation visibility reveals an uneven impact across themes. Studies on building failures (2020), skilled worker accreditation (2023), and waste management (2022) achieved higher visibility and were frequently referenced in both internal and external contexts (Omondi, 2021; Koech, 2023). In contrast, publications focusing on media portrayal (2021) and technology transfer attracted lower levels of citation. The bibliometric footprint therefore demonstrates stronger traction in safety and capacity-related themes but reveals a weaker presence in areas concerning public awareness, media representation, and financial innovation.

3.7 Uptake Metrics

The uptake of NCA research cannot be measured solely through citations. Practical dissemination and training metrics provide additional insights. Since 2019, more than 3,000 participants have engaged with NCA research outputs through ICoRCE conferences and related workshops. Internally, approximately 400 staff members have been trained through departmental seminars and CPD-accredited sessions. Several research outputs have been integrated into building codes, professional training curricula, and initiatives under the Bottom-Up Economic Transformation Agenda (BETA). However, regional outreach remains limited, and NCA still has a weak bibliometric presence in international peer-reviewed journals, a factor that reduces the global visibility of its work.

3.8 Comparative Perspective

Compared to similar research institutions such as the Kenya Building Research Centre (KBRC), the Kenya Industrial Research and Development Institute (KIRDI), and the Kenya Institute for Public Policy Research and Analysis (KIPPRA), the NCA shows both strengths and weaknesses. Its strength lies in applied, industry-focused publications that directly influence practice and regulatory reform. Its weakness is in the relatively limited presence in peer-reviewed international outlets and journal citation indexes. This means that although NCA is strong in practical sectoral influence, it falls behind in scholarly impact and international recognition.

3.9 Scopus and Web of Science Visibility

While NCA research outputs have achieved recognition in local theses, county policy documents, and professional association papers, their footprint in international bibliometric databases such as Scopus and Web of Science (WoS) remains limited. A review of indexed journals between 2019 and 2025 shows that only a small number of NCA-authored works appear directly in these platforms. Instead, secondary references to NCA studies are more common, with Kenyan universities such as the University of Nairobi, JKUAT, and Egerton citing NCA research in publications later featured in Scopus-listed journals on subjects like risk management, waste management, and affordable housing.

By contrast, peer institutions such as KIPPRA and KIRDI have consistently ensured that their policy briefs and applied science papers are published in indexed outlets. This demonstrates a deliberate effort to merge policy relevance with scholarly visibility**,** giving them a stronger global bibliometric presence than NCA.

3.9.1 Benchmarking with indexed standards

Scopus and WoS indexing are critical for enhancing international scholarly visibility, citation counts, and research credibility. Indexed publications not only broaden readership but also increase opportunities for international collaboration and improve the recognition of Kenyan research within global discourses on the Sustainable Development Goals (SDGs) and construction innovation.

Comparative institutions, such as CSIRO, BRE, and Fraunhofer IBP, provide clear examples of how consistent publishing in high-impact Scopus/WoS journals has built their strong bibliometric profiles and sustained their global influence.

3.10 Implications for NCA

To strengthen its global research profile and ensure wider recognition, NCA should:

1. **Encourage joint authorship** with universities and international partners targeting Scopus/WoS-listed journals.
2. **Create an internal journal or working paper series**, with a clear plan to apply for Scopus/WoS indexing within five years.
3. **Support researchers through editorial training and publication grants**, enabling them to cover open-access fees in indexed outlets.
4. **Establish citation tracking systems** using Scopus Author IDs and ORCID integration for NCA researchers.

By aligning with Scopus and Web of Science standards, NCA can complement its strong applied sectoral impact with improved scholarly visibility and international credibility, thereby bridging the gap between practical policy influence and global academic recognition.

Observation: The bibliometric analysis underscores that NCA's research efforts since the 2019 publications have contributed significantly to national capacity building and regulatory improvement. The Authority has shaped discourse on construction safety, workforce development, and innovation; however, its citation impact outside Kenya remains limited. Furthermore, uneven visibility across thematic areas suggests that while some research has been highly influential, other outputs have not reached their full potential. This points to three priority areas for improvement: strengthening publication strategies to include international peer-reviewed journals and Scopus/Web of Science indexing; widening dissemination beyond Nairobi through county platforms and open-access repositories; and deepening collaborations with universities and global partners to boost citation counts and extend NCA's bibliometric reach.

Building on the bibliometric findings in Chapter Three and the institutional lessons in Chapter Four, this chapter develops a framework for defining and assessing the effectiveness of research programmes. The bibliometric analysis emphasized NCA's limited international visibility, thematic clustering, and uneven uptake, while the case studies illustrated how leading institutions combine global publishing credibility with applied industry relevance. Together, these insights highlight the importance of institutional capacity, rigorous research processes, and effective implementation. The framework presented here, therefore, integrates both global best practices and Kenya's contextual realities to establish clear criteria for evaluating research effectiveness.

CHAPTER FOUR: LESSONS FROM CASE STUDIES OF RESEARCH INSTITUTIONS

4.1 Introduction to Case Studies

This section presents selected case studies of prominent research institutions that have made significant advances in industrial, scientific, public policy and building-related research across various regions. The institutions highlighted here were chosen for their notable contributions to innovation, sustainable development, and policy influence within their respective contexts. Each case study provides an overview of the institution's location, a brief history of its establishment, and a summary of its key research achievements. These case studies offer valuable insights into the diverse operations and societal impacts of various research organizations, serving as reference points for comparative analysis in this study.

4.2 Linking Bibliometric Gaps with Global Practices

The bibliometric analysis in Chapter Three revealed that NCA's research outputs are characterized by strong self-citation and modest referencing within internal documents, but a weak presence in international indexing platforms such as Scopus and Web of Science (WoS). This has limited the Authority's global visibility and scholarly credibility, despite evident sectoral impact at the national level.

By contrast, leading research institutions such as BRE in the UK and CSIRO in Australia have successfully combined applied, practice-oriented research with robust international publishing strategies. They consistently produce peer-reviewed articles, policy briefs, and open-access outputs that are indexed in global bibliometric databases. This dual strategy has enabled them to sustain credibility within academic circles while simultaneously influencing policy and industry practice.

For NCA, these case studies provide a valuable benchmark: they demonstrate that it is possible to balance applied, industry-driven research with indexed scholarly publishing. This balance enhances not only national regulatory effectiveness but also international collaboration, visibility, and influence. The insights here will inform not only the effectiveness criteria discussed in Chapter Five—particularly those on technological advancement and policy alignment—but also the strategic recommendations in Chapter Ten, where a deliberate Scopus/WoS publishing strategy is proposed as part of strengthening NCA's global research footprint.

4.3 Case Studies of Leading Research Institutions

Research institutions worldwide offer valuable lessons in shaping policy, driving innovation, and promoting the uptake of research in practice. By examining their mandates, outputs, and approaches, the National Construction Authority (NCA) can benchmark its own programmes against global and regional leaders. The selected institutions—ranging from BRE and CSIRO with global reputations, to Fraunhofer IBP and IDS with specialized expertise, and KBRC, KIRDI, and KIPPRA with localized focus—demonstrate different pathways to effectiveness. Their experiences highlight the importance of infrastructure, interdisciplinary teams, strategic publishing, and applied outcomes, offering lessons that can strengthen Kenya's construction research ecosystem.

4.3.1 British Research Establishment (BRE) Group

It is located in Watford, Hertfordshire, United Kingdom. It was established in 1921 as the Building Research Station (BRS) by the British government to improve housing quality, especially for soldiers returning from World War I. In 1990, BRE introduced the Building Research Establishment Environmental Assessment Method (BREEAM), the world's first environmental assessment method for buildings, which has since become a global standard for sustainable construction. BRE has also pioneered research in fire safety, including the construction of Burn Hall for large-scale fire testing. It has led to innovations in fire safety engineering and computer fire modelling.

4.3.2 Commonwealth Scientific and Industrial Research Organization (CSIRO)

CSIRO, Australia's national science agency, is headquartered in Australia and was founded in 1926 as the Advisory Council of Science and Industry. It was restructured in 1949 to focus on civilian research and has played a vital role in Australia's scientific progress. CSIRO developed the first Australian computer, CSIRAC, and is credited with inventing Wi-Fi technology in the 1990s. It has also produced the Hendra virus vaccine, the high-fibre BARLEYmax grain, and made significant advances in polymer chemistry and conservation science.

4.3.3 Institut für Betrieb und Personal (Fraunhofer IBP)

The Fraunhofer Institute for Building Physics (IBP), located in Germany, is part of the renowned Fraunhofer Society. It focuses on applied research in building physics, energy efficiency, and indoor air quality. Fraunhofer IBP is recognized for its innovations in building insulation and energy-efficient materials, as well as for developing standards for indoor air quality and ventilation systems. It continues to lead research in sustainable building technologies and the creation of high-performance building materials.

4.3.4 Housing and Building Research Institute (HBRI)

HBRI is an autonomous government organization based in Dhaka, Bangladesh. Established under the Housing and Building Research Institutes Act of 2016, its primary mission is to conduct research and development in the fields of housing and building construction to support national development. HBRI focuses on advancing housing and building practices, promoting innovation, and enhancing infrastructure. Through its work, the institute plays a crucial role in enhancing living standards, shaping housing policies, and contributing to the country's overall infrastructure development.

4.3.5 Institute of Development Studies (IDS)

IDS is located in Brighton, East Sussex, United Kingdom, and was established in 1966 at the University of Sussex. IDS has become a global leader in development research, addressing critical issues such as poverty, inequality, and social justice. It is particularly known for its pioneering work in participatory development, its leadership in gender and development research, and its influential contributions to human rights and security in global development.

4.3.6 Kenya Building Research Centre (KBRC)

KBRC is located in Nairobi, Kenya. It was initially set up in 1957 as a Technical Reference Library for the Building Branch of the Public Works Department. In 1961, it was transformed into a Building Research Centre to disseminate information on building materials and construction techniques. KBRC has promoted the use of locally available building materials, organized exhibitions to showcase construction innovations, and provided training programs to entrepreneurs in the building industry.

4.3.7 Kenya Industrial Research and Development Institute (KIRDI)

KIRDI is based in Nairobi, Kenya. It was initially established in 1942 as a central laboratory in Kabete, Nairobi. Over time, it evolved through phases as the Kenya Industrial Management Board (KIMBO) and later as the East African Industrial Research Organization (EAIRO), which served Kenya, Uganda, and Tanzania. KIRDI has been instrumental in developing industrial technologies to support local manufacturing, promote sustainable practices, and provide research-driven support to small and medium-sized enterprises (SMEs).

4.3.8 Kenya Institute for Public Policy Research and Analysis (KIPPRA)

KIPPRA, based in Nairobi, Kenya, was established in May 1997 to enhance public policymaking in the country. It began operations in June 1999 and was formalized through the KIPPRA Act No. 15 of 2006. The institute provides policy analysis and advisory services to the government, researches macroeconomic, social, and sectoral issues, and plays a key role in shaping strategic perspectives for Kenya's economic and social development.

4.4 A Comparative Analysis of Global Best Practices

Understanding the capacity of research institutions is crucial for evaluating their effectiveness in driving innovation, shaping policy, and addressing sector-specific challenges within the construction industry. This comparative assessment, as shown in **Tables 4.1**, **4.2**, and **4.3**, reviews the capabilities of eight institutions—both global and local—across three major capacity dimensions: infrastructure and laboratories, human resources and expertise, and research scope with institutional reach. Institutions like the BRE Group (UK), CSIRO (Australia), and Fraunhofer IBP (Germany) demonstrate advanced facilities and a broad international influence, while counterparts such as KIRDI, KBRC, and KIPPRA in Kenya focus on applied, localized research with growing influence in policy and technology adoption. The analysis extends further to assess each institution's practices in research planning, training, stakeholder engagement, ethical compliance, and the implementation of research outcomes. By examining how these institutions structure their research ecosystems, adopt emerging technologies, and ensure practical uptake, the study highlights lessons that can inform national research agendas, capacity strengthening strategies, and collaborative frameworks in Kenya's construction sector.

Table 4.1: Capacity of research institutions

Institution	Capacity 1: Infrastructure & Labs	Capacity 2: Human Resources & Expertise	Capacity 3: Research Scope & Institutional Reach
BRE Group (UK)	Operates world-class testing facilities (fire, structural, sustainability labs) with cutting-edge equipment.	Employs over 500 specialists, including engineers, scientists, and consultants, in built environment research.	Provides global services and collaborates with government, private sector, and academia on sustainability, safety, and innovation in construction (BRE Group, 2023).
CSIRO (Australia)	Has advanced national labs and dedicated construction innovation hubs (e.g., Future Cities Initiative).	Over 5,000 staff, including experts in construction, environmental science, and digital engineering.	Conducts multidisciplinary, government-supported research influencing national building codes and global innovation (CSIRO, 2022).
HBRI (Bangladesh)	Owns structural testing labs and low-cost housing prototypes; facilities for seismic and wind studies.	Hosts a multidisciplinary team including structural engineers, urban planners, and environmental scientists.	Strong focus on affordable housing and disaster-resilient construction technologies in developing countries (HBRI, 2021).
Fraunhofer IBP (Germany)	Possesses state-of-the-art laboratories for building physics, energy simulation, acoustics, and climate chambers.	Over 200 scientists and technicians, with deep specialization in sustainable and energy-efficient building systems.	Strong EU and industry collaboration in construction innovation, standardization, and applied research (Fraunhofer IBP, 2022).
IDS (UK)	While not equipped with construction labs, it has access to the University of Sussex's infrastructure for policy-related field studies.	Hosts over 100 researchers specializing in development policy, urban planning, and social dimensions of construction.	Influences policy on urban housing, resilience, and inclusive infrastructure development in low-income settings (IDS, 2020).
KBRC (Kenya)	Operates within the State Department for Public Works with limited but growing lab capacity for building material testing.	The technical team comprises civil engineers and architects specializing in public building standards and innovative materials.	Focuses on public sector construction challenges, low-cost housing solutions, and supporting government policies (KBRC, 2023).
KIPPRA (Kenya)	No in-house	Economists,	Influences national

	construction labs, but partners with ministries and institutions for field-based construction policy research.	planners, and policy analysts with expertise in infrastructure economics and public investment appraisal.	infrastructure and housing policies; supports evidence-based decision-making in the construction sector (KIPPRA, 2022).
KIRDI (Kenya)	Operates regional centres and innovation hubs with modest construction materials testing capabilities.	Technical staff, including engineers, industrial chemists, and technicians, focused on local construction and materials R&D.	Focuses on applied research for SMEs and industry; supports local innovation through product development and pilot plants (KIRDI, 2021).

Source: Author Analysis, 2025

Table 4.2: Research planning and conduct

Institution	**Specialized Training**	**Emerging Technologies**	**Collaboration & Partnerships**	**Flexible Methods**	**Ethical & Responsible Research**
BRE Group	1. BRE Academy CPD. 2. Modular BIM courses. 3. Green building certifications. 4. Government staff training. (BRE Group, 2023)	1. BIM deployment. 2. Net Zero tech. 3. AI smart buildings. 4. Digital twin simulations.	1. UK gov't collaboration. 2. Global research networks. 3. Industry trial hubs. 4. Academic partnerships.	1. Pilot projects. 2. Scenario modelling. 3. Industry co-design. 4. Modular research setups.	1. UK ethics standards. 2. Public result sharing. 3. Community safety trials. 4. Ethics boards in place.
CSIRO	1. PhD & internship support. 2. CSIRO Learning Academy. 3. Government training. 4. Industry placements. (CSIRO, 2022)	1. 3D printed housing. 2. Robotics in construction. 3. Smart infrastructure. 4. Solar-integrated materials.	1. Federal gov't & states. 2. Indigenous community links. 3. Global climate projects. 4. Industry co-design.	1. Adaptive methods. 2. Iterative learning cycles. 3. Integrated field testing. 4. Indigenous knowledge integration.	1. National integrity code. 2. Environmental focus. 3. Transparent community trials. 4. Ethics compliance monitoring.

HBRI	1. Post-disaster shelter training. 2. Bamboo housing skills. 3. Flood-safe construction. 4. Local government workshops. (HBRI, 2021)	1. Disaster-proof homes. 2. Low-cost prototypes. 3. Seismic building design. 4. Community ICT use.	1. Rural co-op collaboration. 2. SAARC research networks. 3. Disaster response alliances. 4. Academic institutions.	1. Local pilot sites. 2. Disaster area simulations. 3. Custom fieldwork design. 4. Responsive post-study reviews.	1. Ethics committee oversight. 2. Multilingual findings. 3. Vulnerable group focus. 4. Ethical rebuilding campaigns.
Fraunhofer IBP	1. Applied PhD paths. 2. EU energy seminars. 3. Technical exchanges. 4. TUM postgraduate links. (Fraunhofer IBP, 2022)	1. Energy simulations. 2. Acoustics tech. 3. Bio-materials R&D. 4. AI for building physics.	1. Horizon 2020 projects. 2. Industry code developers. 3. EU-wide partnerships. 4. Urban tech hubs.	1. Hybrid test labs. 2. Real-time field models. 3. Rural/urban adaptability. 4. Prototyping feedback loops.	1. EU research ethics. 2. Open access publishing. 3. Green urban standards. 4. Social housing equity.
IDS	1. Urban development diplomas. 2. Community data collectors. 3. Policy learning online. 4. Equity-focused research. (IDS, 2020)	1. GIS risk maps. 2. AI for policy testing. 3. Climate impact tools. 4. Mobile survey platforms.	1. UN-Habitat partnerships. 2. NGO field networks. 3. African think tank links. 4. South-South learning.	1. Grounded participatory design. 2. Long-term urban studies. 3. Flexible response to context. 4. Stakeholder-involved evaluations.	1. Adheres to DSA/DFID ethics. 2. Transparent outputs. 3. Gender & equity compliance. 4. Open data sharing.
KBRC	1. ABMT training for staff. 2. NCA course integration. 3. County engineer upskilling. 4. Housing design sessions. (KBRC, 2023)	1. Stabilized blocks. 2. Green roofing trials. 3. ABMT pilots. 4. Cost simulation tools.	1. Counties and MoPW. 2. NCA construction labs. 3. Donor pilot studies. 4. Public sector feedback.	1. Case study assessments. 2. Prototypes phased rollout. 3. Monitoring from counties. 4. Design adaptation loops.	1. Government ethics guidance. 2. County-level validation. 3. Results shared publicly. 4. Safety-centred procedures.
KIPPRA	1. Young Professionals Program. 2. Policy workshops. 3. Infrastructure cost models. 4. Government staff training. (KIPPRA, 2022)	1. e-GP innovations. 2. Simulation of PPP projects. 3. Input-output analysis. 4. Tech impact forecasting.	1. Infrastructure roundtables. 2. World Bank, UN linkages. 3. Ministry liaisons. 4. Statistical agency data sharing.	1. Context-driven frameworks. 2. Policy feedback integration. 3. Scenario and trend analysis. 4. Adaptive decision support tools.	1. Public disclosure mandates. 2. Policy research integrity. 3. Gender-responsiveness. 4. Participatory research values.

KIRDI	1. SME technical training. 2. Artisan incubation. 3. Women in construction. 4. County staff workshops. (KIRDI, 2021)	1. Solar drying tech. 2. Smart lab tools. 3. Low-carbon materials. 4. IoT applications.	1. MSMEs and SMEs. 2. Counties and academia. 3. GIZ, UNIDO links. 4. NCA pilot support.	1. Feedback from users. 2. Field-adapted protocols. 3. CBO testing sites. 4. Modular development stages.	1. NACOSTI-compliant ethics. 2. Community-level feedback. 3. Tech safety prioritized. 4. Socially inclusive designs.

Source: Author Analysis, 2025

Table 4.3: Implementation of research outcomes

Institution	Dissemination of Research	Effective Communication	Commercialization Strategies	Monitoring & Evaluation (M&E)
BRE Group	1. Publishes open-access reports. 2. Runs industry webinars. 3. Uses interactive dashboards. 4. Offers plain-language summaries. (BRE Group, 2023)	1. Tailored policy briefs. 2. Stakeholder-specific infographics. 3. Engaging digital newsletters. 4. Knowledge-sharing events.	1. BRE Innovation Park as a showcase. 2. Licensing models for tools. 3. BRE Trust venture capital support. 4. Joint ventures with firms.	1. Standardized impact metrics. 2. Independent audits. 3. Stakeholder feedback loops. 4. Evaluation integrated in project lifecycle.
CSIRO	1. Online knowledge hubs. 2. Free downloadable guides. 3. Conference presentations. 4. Case studies in lay terms. (CSIRO, 2022)	1. Multi-audience presentations. 2. Social media video explainers. 3. Industry roundtables. 4. Use of public service media.	1. IP protection unit. 2. Startup incubation (ON Program). 3. Technology licensing agreements. 4. Co-owned commercial platforms.	1. Multi-year post-research tracking. 2. Use of M&E dashboards. 3. National performance indicators. 4. Sector feedback surveys.
HBRI	1. Local site demonstrations. 2. Brochures in Bangla. 3. On-site community posters. 4. Manual distribution via local government. (HBRI, 2021).	1. Town hall meetings. 2. Local TV/radio segments. 3. School-based info drives. 4. Leaflet distribution at mosques.	1. Bamboo house design licenses. 2. Public-private partnerships. 3. Tech startup support. 4. NGO-driven market pilots.	1. On-ground user evaluation. 2. Seasonal follow-ups. 3. Local government tracking. 4. After-action review processes.

Fraunhofer IBP	1. Multilingual publications. 2. EU open access repositories. 3. Expert symposiums. 4. Technical dissemination packs. (Fraunhofer IBP, 2022).	1. High-level policy briefings. 2. Public-scientist dialogues. 3. Multimedia research explainers. 4. Outreach to city councils.	1. Joint patents with industry. 2. Market-ready prototypes. 3. Shared ownership models. 4. Licensing for SMEs.	1. Horizon 2020 indicators. 2. End-user verification. 3. Longitudinal assessments. 4. Funders' periodic review.
IDS	1. Open knowledge platforms. 2. Community presentations. 3. Printed field summaries. 4. Participatory dissemination. (IDS, 2020).	1. Infographics for policymakers. 2. Blogs and media articles. 3. Parliamentary briefings. 4. Development podcast series.	1. Collaborates with NGO to pilot models. 2. Toolkits for practitioners. 3. Open-source resources. 4. Community-led replication.	1. Theory of Change models. 2. Beneficiary-led evaluation. 3. Outcome tracking tools. 4. Reflective learning workshops.
KBRC	1. MoPW journals and bulletins. 2. Technical leaflets. 3. Contractor-targeted manuals. 4. Open days for demos. (KBRC, 2023).	1. Circulars to ministries and counties. 2. Media coverage in Kiswahili. 3. Public exhibitions. 4. Email updates to stakeholders.	1. Licensing ABMTs for local use. 2. Collaborating with Jua Kali. 3. Partnering with housing bodies. 4. Scaling models via counties.	1. Post-pilot assessments. 2. MoPW monitoring units. 3. County-level feedback forms. 4. Implementation audits.
KIPPRA	1. Policy briefs online. 2. Press releases. 3. Public discussion forums. 4. Media commentaries. (KIPPRA, 2022)	1. Stakeholder consultative forums. 2. Social media graphics. 3. Simplified economic reviews. 4. Sector-specific communication plans.	1. Business environment briefs. 2. Commercial potential modelling. 3. PPP toolkits. 4. SME financing policy advice.	1. National policy indicators. 2. Real-time economic data tracking. 3. Partner institution evaluation. 4. Internal and external peer review.
KIRDI	1. Industrial fairs and expos. 2. County-level dissemination forums. 3. Swahili-language manuals. 4. Media interviews and demos. (KIRDI, 2021)	1. Posters at local events. 2. SMS alerts to CBOs. 3. Radio talk shows. 4. County technical briefs.	1. Support for local start-ups. 2. Revenue-sharing MOUs. 3. Tech incubation centers. 4. Linkages with AGPO and SMEs.	1. Beneficiary feedback forms. 2. Pilot site monitoring. 3. In-house review teams. 4. Semi-annual reporting templates.

Source: Author Analysis, 2025

Observation: This comparative analysis reveals significant variations in institutional research capacity, reflecting diverse mandates, resource endowments, and strategic orientations. Advanced institutions such as CSIRO, BRE Group, and Fraunhofer IBP exhibit comprehensive infrastructures, robust multidisciplinary teams, and global collaboration networks that promote cutting-edge innovation and commercialization. Conversely, Kenyan institutions such as KIRDI, KBRC, and KIPPRA offer valuable lessons in contextual relevance, inclusivity, and policy responsiveness, despite their resource limitations. Notably, all institutions emphasize ethical standards, stakeholder engagement, and adaptive dissemination methods tailored to their respective audiences. The findings underscore the importance of flexible, technology-driven, and community-informed research systems that support both high-level innovation and grassroots implementation. Kenya’s construction research institutions can benefit from strengthening their laboratory infrastructure, expanding interdisciplinary expertise, and forming strategic partnerships with global peers. Through structured investments, policy support, and capacity-building, local institutions can amplify their influence and make meaningful contributions to national development goals, particularly in areas such as affordable housing, resilient infrastructure, and sustainable urban planning.

4.5 Comparative Analysis of the Case Studies

The following section presents a more detailed comparative analysis of the selected case studies, focusing on key aspects such as each institution's research mandate, approaches to research delivery, implementation of research outcomes, and framework for enhancing the effectiveness of research programmes. This analysis aims to identify commonalities, differences, and best practices that can inform broader discussions on institutional effectiveness in research and innovation.

4.5.1 Capacity of research institution

The BRE Group focuses on improving the built environment through research on sustainability, energy efficiency, construction safety, and building performance. They aim to support innovation in construction and develop solutions that enhance the quality of life (BRE Group, 2022). Similarly, the CSIRO researches to improve the environmental, economic, and social sustainability of the building industry, addressing challenges such as climate change, resource efficiency, and resilience (CSIRO, 2023).

Fraunhofer IBP specializes in building physics, focusing on optimizing thermal, acoustic, and energy performance to improve comfort, sustainability, and efficiency (Fraunhofer IBP, 2022). HBRI focuses on advancing affordable and sustainable housing solutions, including the development of building materials and construction technologies for low-income populations (Bredenoord, 2016). IDS specializes in applied research to address social, economic, and infrastructural development challenges, including those related to the construction industry, with a focus on shaping policies and strategies for sustainable development (IDS, 2023).

KIPPRA conducts policy-oriented research, including studies on construction and infrastructure, to inform policies that support economic growth and sustainable development in Kenya (KIPPRA, 2023). KIRDI is dedicated to advancing industrial technologies and innovations, including construction technologies, to promote industrial development and competitiveness in Kenya (KIRDI, 2023). The KBRC focuses on developing and maintaining national standards for construction materials, processes, and systems to ensure safety, quality, and sustainability (State Department for Public Works, 2023).

4.5.2 Research planning and conduct

In terms of capacity, the BRE Group, CSIRO, and Fraunhofer IBP all employ advanced technologies, including environmental simulations, building performance modelling, energy modelling software, and predictive analytics (BRE Group, 2022; CSIRO, 2023; Fraunhofer IBP, 2022). These institutions collaborate widely with government bodies, private sector companies, and research organizations, funded through government grants, private investments, and industry partnerships.

Although policy-focused, KIPPRA and IDS utilize data analytics, GIS, and econometric models and work closely with government and development agencies (KIPPRA, 2023; IDS, 2023). KIRDI, HBRI, and KBRC focus on research into construction materials, sustainable technologies, and industry standards, engaging with local and international partners (KIRDI, 2023; Bredenoord, 2016; State Department for Public Works, 2023).

Regarding research conducted by the BRE Group, CSIRO, Fraunhofer IBP, and KIRDI, these organizations offer training in energy efficiency, sustainability, and innovative construction methods. In contrast, IDS, KIPPRA, and KBRC focus on policy, urban planning, and compliance with standards. HBRI provides training in affordable housing design and sustainable practices (Bredenoord, 2016). Technology integration, such as GIS, materials testing, and energy modelling, is central to all these institutions.

Collaboration is key across all institutions. BRE Group, CSIRO, and Fraunhofer IBP work with academia, industry, and governments; KIPPRA, IDS, and KBRC focus on policymakers and international development organizations; and KIRDI, HBRI, and KBRC engage with industry and communities (BRE Group, 2022; CSIRO, 2023; State Department for Public Works, 2023).

4.5.3 Implementation of research outcomes

Dissemination of findings is an integral part of the process. The BRE Group, CSIRO, Fraunhofer IBP, KIPPRA, HBRI, and KBRC share their results through publications, conferences, and policy briefs, targeting stakeholders such as policymakers and communities (BRE Group, 2022; CSIRO, 2023; State Department for Public Works, 2023). IDS disseminates public seminars, engages in media, and publishes policy papers (IDS, 2023).

All institutions communicate with stakeholders using digital platforms, public forums, and events. The BRE Group, CSIRO, and Fraunhofer IBP conduct international workshops, while KIPPRA, HBRI, and KBRC focus on national-level communication (KIPPRA, 2023; Bredenoord, 2016).

BRE Group, CSIRO, Fraunhofer IBP, and KIRDI pursue innovation licensing, technology transfer, and prototype development in commercialization. HBRI turns research into scalable housing models, while KBRC offers certification services for commercialized products (KIRDI, 2023; State Department for Public Works, 2023).

Impact evaluation is standard across all institutions. BRE Group, CSIRO, Fraunhofer IBP, and KIRDI conduct post-project impact studies. HBRI and IDS assess community outcomes, while KIPPRA and KBRC.

4.5.4 Framework for enhancing the effectiveness of research programmes

All institutions stress collaboration, real-world testing, and stakeholder feedback to improve research effectiveness. The BRE Group, CSIRO, and Fraunhofer IBP conduct field trials in collaboration with academic and industry partners. KIPPRA, IDS, and KBRC focus on evidence-based policymaking and stakeholder engagement. KIRDI and HBRI emphasize technology transfer and localized application (BRE Group, 2022; CSIRO, 2023; KIRDI, 2023). Appendix A provides a detailed case study of how KIRDI has enhanced research programmes at both the laboratory and community levels to maximize the economic benefits of research.

4.5.5 Lessons for NCA in enhancing the effectiveness of research programmes

Table 4.4 presents key lessons that the National Construction Authority (NCA) can adopt to enhance the effectiveness of its research programmes. These lessons are drawn from international and local institutions across three themes.

Table 4.4: Lessons for NCA in enhancing the effectiveness of research programmes

Theme	Lessons for NCA
Capacity of Research Institutions	1. Invest in modern, well-equipped laboratories for material testing and simulation.
	2. Expand and retain multidisciplinary research teams including engineers, architects, economists, and policy analysts.
	3. Foster partnerships with global research institutions to enhance technology transfer and capacity.
	4. Enhance institutional outreach by establishing regional innovation hubs and satellite research centres.
	5. Prioritize applied research to support SMEs and local industry needs in the construction sector.
	6. Develop a strong focus on sustainability, safety, and innovation in all research endeavours.
	7. Promote research that supports public infrastructure and policy formulation, especially in housing.
	8. Leverage donor and international collaborations to expand resource capacity and influence.

	9. Encourage alignment of institutional mandates with national development priorities.
	10. Support capacity building in under-resourced research centres through inter-agency collaboration.
Research Planning and Conduct	1. Introduce structured training and professional development pathways for researchers and technical staff.
	2. Integrate emerging technologies such as BIM, AI, and low-carbon materials into construction research.
	3. Strengthen collaboration with national and international partners, including government, academia, and industry.
	4. Adopt flexible and modular research designs to accommodate diverse stakeholder needs.
	5. Promote participatory research methodologies to ensure community relevance and impact.
	6. Establish internal and external ethics oversight mechanisms to ensure responsible research practices.
	7. Encourage iterative learning and feedback loops throughout the research process.
	8. Use scenario modelling and pilot projects to test innovations before full-scale implementation.
	9. Incorporate indigenous and local knowledge into construction research and design.
	10. Align training programmes with national construction needs, including ABMTs and sustainable building.
Implementation of Research Outcomes	1. Use diverse dissemination strategies including local languages, visual tools, and open-access platforms.
	2. Tailor communication outputs to target audiences, including policymakers, professionals, and communities.
	3. Develop innovation parks or hubs to demonstrate and test construction technologies in real settings.
	4. Support commercialization of research through licensing, incubation, and public-private partnerships.
	5. Standardize monitoring and evaluation (M&E) systems for tracking research impact and feedback.
	6. Encourage stakeholder feedback mechanisms throughout the implementation lifecycle.
	7. Facilitate knowledge-sharing events and webinars to engage wider audiences and practitioners.
	8. Publish regular bulletins, technical leaflets, and manuals to inform sector stakeholders.
	9. Establish collaboration with counties and ministries to scale research results across regions.
	10. Link research findings to national policies and performance indicators for sustained uptake.

Source: Author Analysis, 2025

Observation: This chapter clearly demonstrates that research effectiveness is influenced by institutional capacity, planning, and implementation practices, as illustrated through global and local case studies. Institutions such as BRE, CSIRO, and Fraunhofer IBP display advanced infrastructure, multidisciplinary expertise, and robust pathways to commercialization, while Kenyan institutions like KBRC, KIRDI, and KIPPRA highlight contextual relevance, inclusivity, and policy responsiveness despite resource constraints. The comparative analysis reveals that all institutions underline ethical standards, stakeholder engagement, and adaptive dissemination tailored to their audiences. For NCA, the key lesson is the importance of investing in modern laboratories, building multidisciplinary teams, and strengthening collaborations with academia, industry, and government to enhance its research mandate. The chapter also stresses the importance of flexible research methods, applied training, and effective dissemination strategies that translate findings into practical applications. Overall, the analysis underscores that NCA can adopt international best practices but must adapt them to Kenya's unique institutional, financial, and cultural contexts.

CHAPTER FIVE: DEFINING AND ASSESSING THE EFFECTIVENESS OF RESEARCH PROGRAMMES

5.1 Introduction

This chapter presents a comprehensive framework for defining and assessing effective research programmes in Kenya's construction industry. It integrates global best practices with criteria aligned to the NCA's mandate. Drawing from an extensive review of current literature, the discussion focuses on three core dimensions: the institutional capacity to support research, the processes through which research activities are implemented, and the extent to which research outcomes are realized and translated into impact.

The chapter concludes by evaluating the criteria used to assess the effectiveness of research programmes. These include their influence on policy, contribution to technological progress, improvements in safety, economic viability, and promotion of environmental sustainability. By adopting a multi-dimensional analytical framework, the chapter aims to demonstrate how well-designed research programmes can drive transformative change in the construction sector, ensuring that innovations are not only visionary but also practically feasible.

In doing so, the chapter lays a foundation for a more detailed analysis of the strategic factors that underpin successful research initiatives, providing essential insights into best practices and key lessons for progressing the construction industry's research agenda.

The bibliometric clusters identified in Chapter Three—modernization, quality, regulatory frameworks, uptake, and financing—provide an important backdrop for defining what constitutes an effective research programme. These clusters closely align with the nine criteria developed in this chapter, reinforcing the case for a multidimensional framework. By linking bibliometric patterns with practical assessment factors, the framework ensures that the evaluation of NCA's research is both evidence-based and responsive to stakeholder priorities.

5.2 Defining an Effective Research Programme

An effective research programme is one that achieves its stated objectives, generates measurable outcomes that strengthen industry capacity, safety, and sustainability, and translates research into actionable practice and policy change. The effectiveness of a construction industry research programme is ultimately determined by its capacity to deliver on these aims while providing tangible benefits to stakeholders—including contractors, engineers, and policymakers. This assessment rests on three critical dimensions: the institution's research capacity, the methodological rigour of the research process, and the practical implementation of findings.

5.2.1 Capacity of research institution

The capacity of a research institution plays a critical role in determining the effectiveness of a research programme. Institutions must be adequately funded to support essential resources, including advanced technology, research equipment, skilled personnel, and comprehensive data collection and analysis processes. According to Brown *et al.* (2022), research activities often lead to the development of specialized training programmes that enable the workforce to remain current with evolving tools, technologies, and methodologies.

The availability and quality of technological resources, such as research software and analytical tools, can directly influence the reliability and applicability of research outcomes (Johnson, 2020). Furthermore, personnel must possess the relevant skills and expertise to adopt and implement new technologies and innovative research practices effectively (Williams & Lee, 2019). A lack of funding may result in substandard research outcomes due to limitations in equipment quality, data collection methods, or analytical rigour. Inadequate resourcing may also compromise objectivity and the overall credibility of findings.

To strengthen institutional capacity, collaboration with government bodies is essential. Such partnerships can help research institutions access financial support mechanisms, such as tax incentives, grants, and subsidies, designed to promote innovation within the construction sector (Miller & White, 2021). Ensuring robust financial backing allows research programmes to invest in critical resources and infrastructure, enhancing their ability to deliver high-quality, actionable outcomes.

5.2.2 Research planning and conduct

High-quality, rigorous research is more likely to yield substantial and positive impacts. Well-designed, peer-reviewed studies grounded in empirical evidence are considered reliable and have a significant influence on the construction industry (Davis *et al.*, 2020). To be impactful, research must address the sector's specific challenges, opportunities, and needs. The construction industry's demand for targeted solutions, such as cost reduction, improved safety, enhanced building information systems, and the development of new materials, largely determines the relevance and uptake of research (Johnson & Lee, 2022). Studies that address current industry concerns, such as sustainability and labour shortages, are more likely to be adopted and make a meaningful difference (Miller, 2023). When research aligns with the sector’s most pressing issues, its implementation becomes more feasible and beneficial.

Moreover, research programmes should be tailored to the specific contexts and conditions of their intended populations or settings (Anderson, 2020). These programmes must address real-world problems, starting with a comprehensive assessment of the industry's current challenges, opportunities, and trends (Harris, 2019). Such assessments may include stakeholder interviews, market analysis, and the identification of technological gaps (Carter & Green, 2021).

Additionally, research initiatives should align with international standards, environmental objectives, and the evolving landscape of smart city development (Thomas & Walker, 2023). Research plays a vital role in informing the creation of building codes and industry standards, thereby promoting safe, efficient, and environmentally sound construction practices (Evans, 2020). Research outcomes must inform public policy and contribute to the revision of building codes, environmental regulations, and safety protocols. Integrating real-time data and client feedback, facilitated through research, supports more collaborative project execution by incorporating end-user needs throughout the construction process (Adams & Scott, 2019).

Effective research conduct ensures that investigations remain aligned with industry demands and existing policy frameworks. It also emphasizes innovation and the exploration of emerging trends. Research programmes must prioritize high-impact areas such as sustainability, energy efficiency, labour shortages, construction safety, and technological advancements (Smith & Johnson, 2022). Furthermore, resource allocation should be strategically directed toward research initiatives with the greatest potential for significant impact (Brown *et al.*, 2021).

The following sections outline key components of effective research conduct: -

Specialized Training Programmes: Developing specialized training programmes is essential for advancing research in the construction industry. Research should focus on promoting advancements in Building Information Modelling (BIM), digital twins, and AI-driven solutions for project management, risk analysis, and design optimization (Miller *et al.*, 2022). Development of high-potential areas, such as green building technologies, digitalization, and construction safety, should be prioritized (Anderson, 2023).

Emerging Technologies: Research programmes must emphasize emerging technologies, including artificial intelligence (AI) and big data analytics, which have the potential to enhance implementation efficiency. However, these technologies require significant investment and specialized expertise. A key focus of construction research is the integration of automation, robotics, and drones to improve productivity and safety. Drones, in particular, are valuable for site surveys, inspections, and progress tracking, offering a safer and more efficient method for data collection and project management (McKinsey & Company, 2020). Additionally, digital technologies have enabled the development of automated machinery and robotic systems for repetitive tasks such as bricklaying, concrete pouring, and welding (Bock & Linner, 2015).

Additive manufacturing, particularly 3D printing, is revolutionizing the construction industry by enabling the rapid and cost-effective construction of homes and buildings (3D Printing Industry, 2020). Furthermore, virtual reality (VR) and augmented reality (AR) are transforming project design, client engagement, and on-site training, offering immersive experiences that improve project understanding and communication among stakeholders (Autodesk, 2021).

Renewable materials, energy-efficient construction methods, and modular or prefabricated systems are helping reduce resource use and waste, improving sustainability in construction (McKinsey & Company, 2020). Advances in materials science have led to the development of stronger, lighter, and more durable materials, such as carbon fibre-reinforced polymers, self-healing concrete, and aerogels (ultra-lightweight, porous materials), which enhance building longevity and performance, particularly in extreme conditions (Bock & Linner, 2015).

Research into environmentally friendly materials, including recycled plastics, green concrete and bio-based materials, supports the shift toward sustainable construction practices (World Economic Forum, 2018). These innovations contribute to faster construction times, reduced material waste, and the ability to build in complex or remote environments, while lowering labour costs and minimizing human error. The availability of up-to-date technologies and the skills required to use them significantly impact the efficiency and effectiveness of research programmes.

Fostering Strong Collaboration and Partnerships: Successful research programmes depend on strong collaboration and partnerships. By forming robust alliances between academic institutions, industry stakeholders, and government bodies, research efforts can be significantly amplified. Multidisciplinary research, drawing on expertise from diverse fields, enables the development of innovative solutions to a broader range of challenges (Sacks *et al.*, 2020). Collaborations ensure that research is aligned with practical goals and possesses real-world applicability, as partner organizations - including academic institutions, NGOs, and government agencies - bring diverse perspectives and expertise.

Exploring collaborative funding models, where both government and industry contribute financially, is also essential. Securing funding from multiple sources - such as government grants, industry contributions, and international organizations - is crucial for sustaining research initiatives (McKinsey & Company, 2020). Public-private partnerships are particularly valuable in this context, as they enable the sharing of costs and risks, making large-scale projects more feasible and cost-effective. These partnerships foster shared ownership of research outcomes, ensuring mutual benefits for all parties involved.

Collaboration ensures that research findings are practically applicable and relevant. By involving universities, research institutions, and industry players, such as construction firms, research programmes gain additional resources, credibility, and expertise (Sacks *et al.*, 2020). Active participation from industry stakeholders accelerates the adoption of research outcomes, making implementation more effective (McKinsey & Company, 2020). Additionally, collaboration with government bodies ensures compliance with regulations and helps shape future building codes and policies. Early engagement with all key stakeholders, including community members, practitioners, funders, and policymakers, is crucial for developing solutions that are user-friendly and socially acceptable, thereby fostering support for the programme's goals (Deloitte, 2019).

Developing Well-Planned, Realistic and Flexible Research Methods: A well-planned, realistic, and flexible research design is critical for effective implementation. Clear goals and objectives create a solid blueprint for research efforts, and considering available resources, timelines, and potential challenges facilitates smooth execution (O'Neil & Boileau, 2017). Adaptability to emerging challenges or opportunities is essential for overcoming obstacles during implementation. Research must focus on real-world construction problems, ensuring that methodologies are practical and relevant. Case studies, field trials, and pilot projects are key components of effective research design (Wang & Ahmed, 2013). Furthermore, the use of data analytics, predictive modelling, and performance simulations can enhance research outcomes by improving decision-making and predicting results (Chong & Li, 2017). Leveraging data from existing projects can optimize research methodologies and ensure greater accuracy in outcomes.

Ensuring the Research Process is Ethical, Transparent, and Socially Responsible: Ethical considerations—such as privacy, consent, and risks to individuals—are vital for successfully implementing research (O'Neil & Boileau, 2017). These factors influence the acceptance and sustainability of research programmes. Involving local communities in the design and implementation phases enhances engagement, relevance, and sustainability, fostering a sense of ownership (Wang & Ahmed, 2013). A lack of cultural sensitivity can lead to resistance or failure. Therefore, research must be conducted in a manner that is ethical, transparent, and socially responsible (Chong & Li, 2017). Addressing the social implications of construction projects, such as affordable housing and urban regeneration, can help ensure that research outcomes contribute positively to society and gain public trust.

5.2.3 Implementation of research outcomes

Research programmes that meet societal needs ensure that outcomes are validated through pilot projects in real-world construction settings. Collaboration between research institutions and industry partners is crucial for evaluating the effectiveness and applicability of research findings. This enables the practical testing and refinement of new methods, materials, or technologies before they are widely adopted. Pilot projects allow smaller-scale trials to identify potential issues and refine designs, increasing the likelihood of success (McKinsey & Company, 2020). Phased implementation enables gradual adjustments and improvements, beginning with pilot testing and then scaling up. Additionally, feedback mechanisms from construction firms and stakeholders enable continuous refinement and adaptation, promoting a cycle of innovation (Deloitte, 2019). Implementing research outcomes also involves dissemination and commercialization, ensuring that research findings reach the broader industry and are effectively adopted.

The following sections outline key components of effective research implementation: -

Effective Communication of Research Findings: Clear, accessible, and relevant communication of research outcomes is crucial for reaching and influencing the intended audience. Effectual communication helps ensure that the research is understood and actionable (McKinsey & Company, 2020). Communication should be adaptable to the needs of different audiences, providing information in formats and languages that are understandable and actionable by each group. This may involve translating technical terms into more accessible language or using visuals, summaries, and infographics to communicate complex findings.

Disseminating Research Outcomes in a Clear, Accessible, and Relevant Manner: The effective dissemination of research outcomes is crucial to ensure that findings are communicated clearly and are accessible to the target audience. A well-structured strategy for both dissemination and commercialization is necessary to maximize the research's impact. Effective dissemination ensures that the research results are shared through various channels, including industry journals, conferences, academic publications, media outlets, stakeholder meetings, webinars, workshops, and reports tailored to industry needs. Engaging key stakeholders, such as professional bodies, academics, the public, end-users, and policymakers, is essential to ensure broad dissemination (McKinsey & Company, 2020).

Consistent and clear communication throughout the dissemination process is necessary for obtaining feedback, addressing concerns, ensuring transparency, and fostering ongoing support (Sacks *et al.*, 2020). Ineffective dissemination strategies can limit the research's reach and impact, thereby reducing its potential effectiveness.

Developing Strategies for Commercializing Research Outcomes: To ensure the broader application and adoption of research findings, research institutions must establish clear pathways for the commercialization of outcomes. Collaboration with construction firms, investors, and industry stakeholders is crucial for transitioning innovative technologies, products, or methods into the marketplace (McKinsey & Company, 2020). This collaboration helps bridge the gap between research innovation and real-world application, ensuring that new technologies can be implemented effectively. Additionally, protecting intellectual property (IP) is critical for safeguarding the commercial value of research outcomes.

Robust Intellectual Property (IP) protection strategies encourage investment and facilitate market adoption by securing the commercial benefits of the research (Sacks *et al.*, 2020). Skilled personnel and the necessary expertise are vital for the successful commercialization of research findings. A lack of capacity or adequate training within research teams or industry partners can hinder the successful application of innovative technologies (Deloitte, 2019). Ensuring that well-trained individuals with the necessary skills support the research programs is essential for the successful commercialization and widespread adoption of research outcomes.

5.2.4 Conclusion

A practical construction research programme should bridge the gap between theory and practice, fostering innovation while delivering tangible economic, environmental, and social benefits. Success relies on relevance, applicability, stakeholder engagement, and the ability to produce measurable impact. **Table 5.1** demonstrates the effective construction research programme.

Table 5.1: Structure of research programme effectiveness

Themes	**Key Components**	**Details**
Defining an Effective Research Programme	Three pillars of effectiveness:	Achieves objectives while delivering measurable benefits to contractors, engineers, and policymakers through: - • Institutional capacity. • Rigorous research processes. • Actionable implementation.
Institutional Research Capacity	• Funding & Resources • Technological Infrastructure • Expertise & Training • Collaborations	• Secure funding for equipment/training. • Access to reliable software/tools. • Skilled personnel for emerging methods. • Government partnerships
Research Planning & Conduct	• Targeted Studies • Methodological Rigour • Contextual Adaptation • Compliance & Innovation	• Address industry needs (e.g., sustainability, cost). • Peer-reviewed empirical approaches. • Stakeholder-informed solutions. • I/modular construction trends.
Implementation of Research Outcomes	• Pilot Testing • Dissemination • Commercialization	• Real-world validation via phased projects. • Clear communication (journals/workshops). • IP protection and industry partnerships.

Source: Author Analysis, 2025

5.3 Factors for Assessing Effective Implementation of Research Programmes in the Construction Industry

In this research, effectiveness refers to the extent to which the objectives of a research project have been achieved (Creswell & Creswell, 2018). The effectiveness questions are:

- Did the research achieve its intended goals? (Babbie, 2020; Saunders *et al.*, 2019)
- Did it answer the initial question? (Yin, 2018)
- Did it provide a solution to the problem? (Patton, 2019)

Several key factors influence the adoption of research outcomes in the construction industry, including quality, relevance, collaboration, technological infrastructure, economic conditions, regulatory frameworks, and cultural openness to change (Gann & Salter, 2021). These factors determine how research is implemented, how its outcomes are adopted, and the overall impact of the research on the industry (Loosemore & Dainty, 2020). Below are the main factors used to measure research effectiveness: -

5.3.1 Policy and legal alignment

This factor assesses whether research findings align with existing laws, policies, and institutional structures, thereby enhancing their legitimacy and facilitating their adoption. Government policies, building codes, and safety regulations significantly influence the adoption of research findings in the construction sector (Hammond & Cooper, 2021). Research that aligns with or is incorporated into regulatory frameworks tends to benefit from greater acceptance and implementation. Moreover, supportive tools such as government funding, tax incentives, or innovation grants can speed up the adoption of research (Gunningham, 2018). Conversely, a lack of enabling policies can restrict research uptake. Effective implementation, especially in public policy, often depends on political goodwill (Oliver *et al.*, 2014), while political resistance—particularly when research challenges established norms—can slow progress (Raco & Savini, 2019). Therefore, advocacy by institutions, researchers, and the public is vital in securing the necessary policy and institutional backing.

5.3.2 Responsiveness to societal needs

This criterion evaluates how effectively research addresses real-world issues, respects cultural values, and involves stakeholders in co-creating practical outcomes. Research programmes must conform to community norms, beliefs, and expectations (Boon & Van Wee, 2018). Engaging end-users, such as homeowners and residents, early in the process ensures solutions are not only feasible but also socially acceptable (Van der Have & Rubalcaba, 2016). Initial stakeholder engagement is vital for gaining trust, securing support, and aligning research with societal priorities. Ignoring these aspects can lead to resistance, disengagement, or outright failure of implementation. Additionally, public opinion—particularly on sustainability, environmental impact, and urban development—can influence the trajectory of research adoption (Miller & Wyborn, 2020). For example, public opposition to infrastructure projects aimed at conserving ecosystems illustrates how societal sentiment can shape policy and practice.

5.3.3 Technological advancement

This dimension evaluates how effectively research promotes or integrates innovative technologies to tackle construction challenges. The adoption of emerging technologies, including automation, Artificial Intelligence (AI), Building Information Modelling (BIM), drones, and off-site construction methods, is transforming the sector (Li *et al.*, 2019; Azhar, 2017). Enabling technologies—like 3D printing, Information and Communication Technologies (ICT), BIM, and the Internet of Things (IoT)—enhance research relevance and impact (Baumgartner & Zander, 2023). These innovations facilitate faster project delivery, reduce human error, minimize material waste, and lower labour costs. The availability of supporting infrastructure and skilled professionals promotes the adoption of these solutions. Technologies like additive manufacturing, Augmented Reality (AR), and Virtual Reality (VR) are also revolutionizing design and client interaction (Chowdhury et al., 2022). However, cost, risk aversion, and technological inertia can impede adoption despite demonstrated benefits (Sacks *et al.*, 2020).

5.3.4 Enhancement of workforce capacity

This indicator focuses on translating research findings into industry practice through training, curriculum development, and skills enhancement. Universities and training institutions conducting construction research play a pivotal role in creating a feedback loop where innovations are applied in practical settings (Ankrah & Langford, 2019). A skilled and adaptable workforce trained in emerging tools and methodologies is essential for sustained industry innovation. Collaboration among academia, industry, and government ensures that research findings are effectively integrated into training and upskilling initiatives (Wells & Hawkins, 2021). Strong institutional partnerships amplify the impact of research and strengthen national innovation systems (Gann, 2020).

5.3.5 Occupational safety and health contribution

This criterion evaluates whether research contributes to minimizing construction site hazards, improving safety protocols, and promoting worker health. Innovative methods and technologies can significantly improve safety outcomes (Guo *et al.*, 2018). For example, drones facilitate safer site inspections (Chen *et al.*, 2021), while advancements in personal protective equipment (PPE) and wearable sensors enhance worker protection. Additionally, AR-based training platforms and advanced risk assessment models contribute to proactive safety management (Akanmu *et al.*, 2020). Research outcomes that demonstrate immediate safety benefits are more readily implemented by construction firms and regulators alike.

5.3.6 Environmental sustainability contribution

This factor assesses the extent to which research offers viable solutions for sustainable construction practices, resource efficiency, and climate adaptation. Sustainability considerations include energy-efficient designs, use of renewable energy, and reduction of construction waste (Kibert, 2020). Practices such as water-saving technologies, green building materials, and resilient structures are key outcomes of relevant research (Pomponi & Moncaster, 2017). As global emphasis on environmental accountability intensifies, research aligned with sustainability goals tends to enjoy broader support and adoption. Regulatory alignment and market incentives also reinforce the long-term relevance and viability of such innovations.

5.3.7 Degree of research innovativeness

This dimension gauges the originality, creativity, and transformative potential of research in redefining construction practices. Breakthrough innovations—such as AI, automation, drones, and modular construction—have significantly reshaped industry norms (Li *et al.*, 2019; Azhar, 2017). Research that is adaptable to diverse project types and budgets has greater industry appeal (Sacks *et al.*, 2020). However, reluctance to abandon traditional methods due to perceived risks or high upfront costs remains a barrier to widespread implementation.

5.3.8 Financial viability

This indicator assesses the cost-effectiveness, scalability, and return on investment (ROI) of implementing research outcomes. Research that results in tangible cost savings, operational efficiencies, or revenue growth is more likely to attract industry support (Deng *et al.*, 2021). Innovations with strong commercialization potential—such as new construction materials or digital platforms—often see quicker adoption (Hampson *et al.*, 2019). The time needed to achieve ROI is also a crucial factor (Slaughter, 2018). Projects offering immediate or short-term gains are more likely to be adopted than those with longer development periods. Research with cross-sector relevance also holds greater importance (Dodgson *et al.*, 2020); whereas outcomes designed for niche applications may have limited impact (Bosch-Sijtsema & Gluch, 2019). A well-planned rollout, addressing timelines, resource needs, and potential challenges, improves the chances of successful implementation (McKinsey & Company, 2020).

5.3.9 Timeframe and practicability of research delivery

This factor considers whether the research offers timely and actionable solutions that align with project cycles and operational realities. Time-sensitive research that aligns with ongoing projects or sectoral priorities has higher adoption potential (Slaughter, 2018). The adaptability of findings to varying contexts and scales enhances their practical utility (Dodgson *et al.*, 2020). Conversely, research limited to narrow use-cases or requiring complex modifications may struggle to gain traction (Bosch-Sijtsema & Gluch, 2019). A flexible and well-phased implementation approach supports smoother uptake and operational integration.

Observation: Government regulations, technological innovation, economic feasibility, and social responsiveness collectively determine the success of research uptake in the construction industry. Alignment with policy and legal frameworks ensures legitimacy, while integration of stakeholder needs and cutting-edge technologies enhances relevance. Financial viability, safety improvements, and timely delivery further contribute to the research's real-world applicability. While it is rare for a single study to meet all these criteria, a strategic and comprehensive approach—addressing legal, technological, economic, and cultural dimensions—maximizes the transformative impact of research on the industry.

5.4 Conceptual Model

Based on a comprehensive literature review and analysis, this conceptual model defines and assesses the effectiveness of research programmes in research institutions, particularly within the construction industry. The model consists of three foundational dimensions, supported by nine effectiveness assessment factors, structured into a logical, interlinked framework, as shown in **Figure 5.1**.

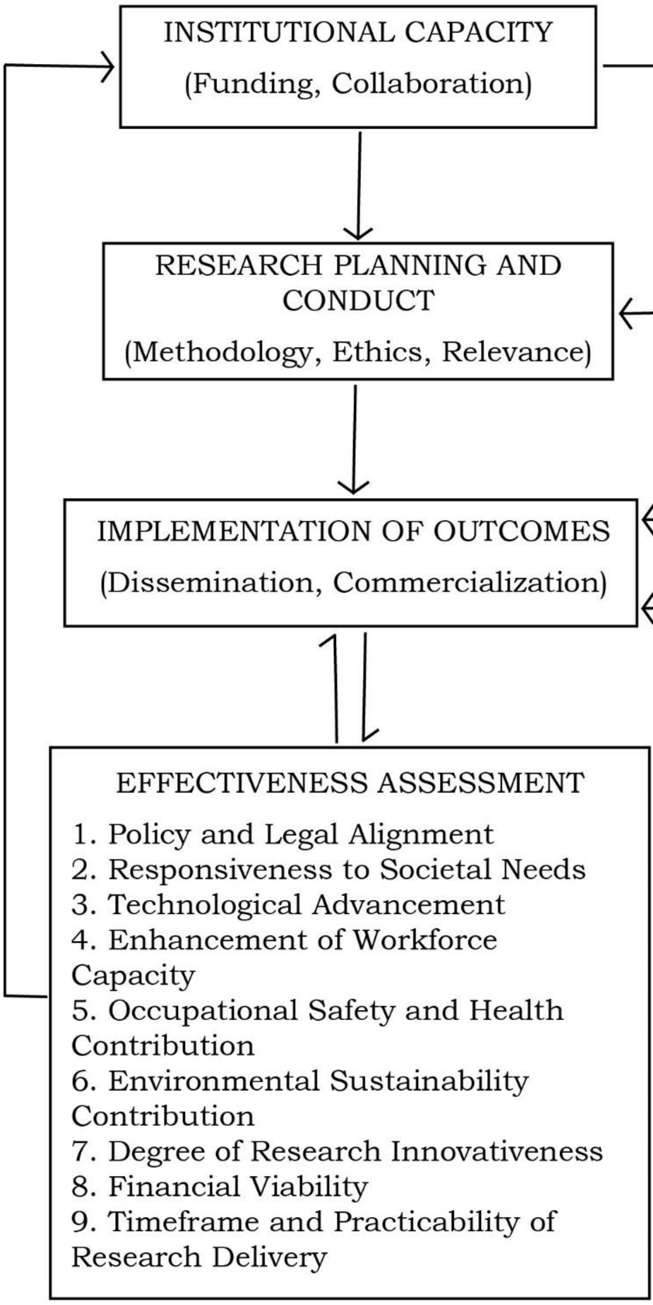

Figure 5.1: Conceptual model showing variables influencing an effective research programme
Source: Author Analysis, 2025

How the Model Works in Practice: -

1. **Start with Institutional Capacity**: Strengthen core infrastructure, staffing, and funding. Establish partnerships with government and industry to secure long-term sustainability.
2. **Execute Rigorous Research Planning and Conduct**: Design flexible, data-driven studies that are stakeholder-informed and address the sector's current challenges, especially sustainability, safety, and technology gaps.
3. **Translate into Effective Implementation**:

    - Validate findings through pilot testing
    - Refine through feedback loops
    - Disseminate through tailored communication channels
    - Scale via commercial partnerships and workforce upskilling
4. **Assess Using the Nine Dimensions**: Once research is implemented, evaluate its success based on policy impact, societal relevance, technological adoption, financial ROI, and other listed indicators.

5.4.1 Conceptual model for defining and assessing research effectiveness in research institutions

Core dimensions of an effective research programme

1. **Institutional Capacity**
    - **Definition**: The foundational capability of a research institution to support and deliver quality research.
    - **Key Components**:
        - Adequate funding and infrastructure
        - Skilled personnel and advanced technologies
        - Strategic partnerships (government, industry, academia)
        - Access to grants, tax incentives, and subsidies

2. **Research Planning and Conduct**
    - **Definition**: The process of designing, conducting, and managing research activities to address sector-specific needs.
    - **Key Components**:
        - Clear, empirical, and peer-reviewed methodologies
        - Stakeholder and community engagement
        - Flexibility in research design to respond to real-world constraints
        - Integration with global standards and emerging trends
        - Prioritization of high-impact areas: safety, sustainability, cost reduction, digital transformation

3. **Implementation of Research Outcomes**
    - **Definition**: The translation of research findings into real-world applications that deliver tangible industry benefits.
    - **Key Components**:
        - Pilot testing and iterative improvement
        - Strong feedback and knowledge-sharing loops
        - Targeted dissemination strategies
        - Commercialization pathways, including IP protection and investor engagement
        - Workforce training and upskilling for smooth adoption

5.4.2 Assessment criteria for research programme effectiveness

Table 5.2 shows the nine interrelated factors that assess whether the outputs of a research programme led to meaningful industry impact.

Table 5.2: Key factors for assessing the effective implementation of construction research programmes

Rank	Factor	Description
1	**Policy and Legal Alignment**	Measures how well research aligns with current laws, building codes, safety standards, and policy frameworks. Greater alignment increases legitimacy and adoption.
2	**Responsiveness to Societal Needs**	Evaluates the research's ability to solve real-world problems, respect cultural values, and involve stakeholders in solution design and implementation.
3	**Technological Advancement**	Evaluates how research integrates or promotes emerging technologies, including BIM, AI, drones, 3D printing, and off-site construction systems.
4	**Enhancement of Workforce Capacity**	Focuses on how research translates into practical training, curriculum development, and professional skills to improve adoption.
5	**Occupational Safety and Health Contribution**	Determines the extent to which research improves site safety, health protocols, and hazard mitigation through tools like drones, PPE, and AR simulations.
6	**Environmental Sustainability Contribution**	Evaluates the environmental impact of research, including reductions in energy use, material waste, and improvements in green building practices.
7	**Degree of Research Innovativeness**	Assesses originality, creativity, and the transformative potential of the research in disrupting or reshaping traditional practices.
8	**Financial Viability**	Measures cost-effectiveness, ROI, commercialization potential, and the scalability of research outcomes across different project sizes or sectors.
9	**Timeframe and Practicability of Research Delivery**	Examines whether research delivers timely, actionable solutions that can be quickly integrated into ongoing or upcoming projects.

Source: Author Analysis, 2025

5.4.3 Practical utility of the model

This conceptual model bridges the gap between research design and industry transformation, emphasizing the need for a holistic approach where institutional strength, rigorous processes, and thoughtful implementation come together to produce impactful, scalable, and sustainable research outcomes.

By applying this model, construction-focused research institutions can:

- Identify weaknesses in their programmes
- Design interventions that target high-impact areas
- Demonstrate the value of their research to funders, policymakers, and industry partners
- Align outputs with global goals for green, inclusive, and digital construction

This makes the model a strategic tool for planning, executing, and evaluating research programmes that drive real-world change.

CHAPTER SIX: STUDY METHODS

6.1 Overview

This chapter presents a detailed description of the study methods. The study objectives, which guided the content of this section, were to identify the factors that defined the effects of the research, to determine the impact of the 16 research studies on the development of the construction industry, and to formulate a framework to enhance the effectiveness of the NCA programmes. The Authority prepared the research reports for the period 2019–2023. This section outlines the research design and approach, target population, sampling procedure, data collection techniques, research tools, reliability and validity measures, as well as the methods for data analysis and presentation.

6.2 Research Design

This study used a cross-sectional survey research design. This design enabled the researchers to obtain both numerical and descriptive information from respondents regarding the effects of the research programmes on the development of the construction industry. The responses captured events (effects) as they were, as they had been, or as they were anticipated to be.

The research tools and data analysis methods were formulated using both quantitative and qualitative approaches. The quantitative approach guided the collection and analysis of numerical data, while the qualitative approach directed the gathering and interpretation of non-numerical data.

6.3 Sampling Frame

A sample of respondents was drawn from a stratified frame comprising accredited contractors/site supervisors/skilled workers, professional associations, government agencies, and NCA management and staff (**Table 6.1**). To enhance credibility, the sampling reflected NCA's broad dissemination platforms. The International Construction Research Conference and Exhibition (ICoRCE) has engaged over 3,000 participants drawn from contractors, professionals, government agencies, academia, and development partners.

Internally, dissemination reached about 400 NCA staff through workshops, seminars, and departmental briefings, strengthening internal capacity. The NCA database included individuals reached through ICoRCE, workshops, social media, and online forums. Additional targeted sessions were live-streamed to extend outreach. Institutions represented in these forums are listed in **Table 6.1**, underscoring the national reach and representativeness of the data collected.

Table 6.1: Stratified sampling of respondents across diverse stakeholder groups

Classification	**Description**	**Total Registered**
A. ACCREDITED CONTRACTORS/SITE SUPERVISORS/SKILLED WORKERS		
Contractors N1-N8	Roads, Water, Buildings, Electrical and Mechanical	97,594
Construction Site Supervisors	Building, Civil, Electrical, And Mechanical Works	16,521
Skilled Workers	Mason, Carpenter, Steel Fixer, Electrician, Plumber, Painter, Welder, Joiner, Safety Officer, Terrazo/Granolithic Layer	70,002
B. PROFESSIONAL ASSOCIATIONS		
Architectural Association of Kenya (AAK) Board of Registration of Architects and Quantity Surveyors (BORAQS)	Architects	1275
Board of Registration of Architects and Quantity Surveyors (BORAQS) Institute of Quantity Surveyors of Kenya (IQSK)	Quantity Surveyors	873
Institute of Planners of Kenya (IPK)	Physical Planners	296
Institute of Engineers of Kenya (IEK)	Engineers	3367
Institution of Surveyors of Kenya (ISK)	Building surveyors	38
Institute of Construction Project Managers of Kenya (ICPMK)	Construction Project Managers	
Association of Construction Managers of Kenya (ACMK)	Construction Managers	
Kenya Property Developers Association (KPDA) members	Developers	28
Kenya Association of Building and Civil Engineering Contractors (KABCEC)	Contractors	
Kenya Building Green Society	Environmental Researcher	
C. GOVERNMENT AGENCIES		
Counties	County Governments	47
National Government	National Environmental Management Authority	
State Departments and Parastatals	State Department of Public Works	
	State Department of Housing	
	Kenya Bureau of Standards	
	National Construction Authority	

Public Universities (with built environment courses)	Kenyatta University University of Nairobi Jomo Kenyatta University of Agriculture and Technology Technical University of Kenya Technical University of Mombasa	5
D. NCA MANAGEMENT		
NCA Management and staff.		

Source: Author Analysis, 2025

Table 6.2: Stratified institutions which attended forums

Categories of institutions that send delegates to the NCA dissemination fora	**Number of institutions in each category**	**Names of institutions**
Construction firms	124	One delegate will be drawn from each of 124 construction firms
Academia	11	TUK, LAIKIPIA U, DKUT MKU, MMU, ERG. U, KU, CUEA, JKUAT, UON, MMUST
Professional Bodies	8	AAK, IQSK, BSRB, BORAQ, IEK, EBK, ACMK, ISK
Government Agencies	25	KBC, KEBS, KBRC, NCA, NEMA, NHC, YEDF, KIRDI, KNBS, SDHUD-IPDU, KNTC, KIE
Counties	2	NAIROBI, TAVETA
Private Organizations	2	Nation Media Group NGOKAMKA

Source: Author Analysis, 2025

A detailed stakeholder analysis had been developed to guide the data collection process. It was observed that the stakeholders matched the type of research programme (**Table 6.3**). The categorized stakeholders guided the selection of respondents for the SurveyMonkey survey and the Focus Group Discussion. These stakeholders were drawn from a stratified sampling of respondents across diverse stakeholder groups.

Table 6.3: Stakeholder mapping

Research Report	**Proposed Stakeholders**
1. Alternative Building Material & Technologies: Promoting Models for Affordable Housing (NCA, 2021).	✧ Government Agencies, e.g. NCA, KBRC, KEBS ✧ Contractors
2. User experience analysis of the National Construction Authority's ICT systems (NCA, 2021).	✧ Government Agencies Contractors ✧ Professional Bodies

3. Media portrayal of the National Construction Authority and the construction industry in Kenya (NCA, 2021).	✧ Government Agencies, KBC, NCA, ✧ Contractors ✧ Nation Media Group
4. Assessment of the domestic capacity of the construction industry in Kenya and development of a national construction industry strategy (NCA, 2019).	✧ Government Agencies, e.g. NCA ✧ KIE ✧ Contractors
5. Performance of technology transfer in the construction industry in Kenya (NCA, 2021).	✧ Contractors ✧ Government Agencies, e.g. NCA, KNTC, KIE ✧ Academia ✧ NGOKAMKA
6. Capacity Building Programs on the Effectiveness of the Construction Sector: A Case of Contractors in Kenya (NCA, 2022).	✧ Contractors ✧ Government Agencies, NCA
7. The influence of socio-economic factors on performance of rural road construction projects in Kenya (NCA, 2022).	✧ Contractors ✧ Government Agencies, NCA ✧ KeNHA
8. Research on failure and collapse of buildings in Kenya (NCA, 2020).	✧ Contractors ✧ Government Agencies, NCA, NEMA, NHC ✧ County Governments
9. Early risk detection framework for construction projects in Kenya (NCA, 2022).	✧ Contractors ✧ Government Agencies, NCA
10. Enhancing accreditation of skilled construction workers and site supervisors in Kenya (NCA, 2023).	✧ Contractors ✧ NCA, KNTC, KIE
11. Enhancing the involvement of Micro, Small, and Medium Enterprises (MSMEs) in the construction industry in Kenya (NCA, 2021).	✧ Contractors ✧ KNTC, KIE ✧ MSEA
12. Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya (NCA, 2021).	✧ Contractors ✧ NCA ✧ NEMA
13. A circular economy model, assessment of factors influencing construction waste management practices in Kenya (NCA, 2022).	✧ Contractors ✧ NCA ✧ NEMA
14. Insights into contractor registration trends in Kenya (2015-2020) (NCA, 2021).	✧ Contractors ✧ NCA
15. The participation of local firms in Public-Private Participation infrastructure projects in Kenya (NCA, 2022).	✧ Contractors ✧ NCA ✧ PPP Unit
16. Quality Assurance coordination framework for the construction industry in Kenya (NCA, 2022).	✧ Contractors ✧ NCA ✧ Professionals ✧ County Governments

Source: Author Analysis, 2025

6.4 Data Collection Techniques and Research Tools

This section discusses the research tools and their administration. A questionnaire and focused group discussions were used to collect data to understand stakeholders' perceptions of the effectiveness of NCA research programs in the development of the construction industry. The different categories of respondents for the various tool administrations were identified among those who appear in the NCA database of stakeholders. Since the 16 research studies were disseminated using different media, it was hoped that they would participate in the dissemination.

6.4.1 Questionnaires and surveys

Surveys of construction industry stakeholders were administered to the sampled population using questionnaires based on research outcomes of the report. The questionnaires contain both closed-ended and open-ended questions, allowing respondents to provide their answers on the phenomenon being studied. The questionnaires for contractors, consultants from professional bodies, and government agencies were annexed in **Appendices B**, **C**, and **D**. It is observed that the data collection tools were based on the outcomes of the research reports. The dependent variable was the effectiveness of the research programme. The nine independent variables were policy/legal alignment, responsiveness to societal needs, technological advancement, and enhancement of workforce capacity, occupational safety and health contribution, environmental sustainability contribution, degree of research innovativeness, financial viability, and timeframe and practicability of research delivery. **Appendix E** presents the NCA questionnaire, which covers capacity building in the NCA research department, research conduct, and implementation of research outcomes. The conceptual and operational definitions of the variables listed in the questionnaire are presented in **Section 6.5** below.

SurveyMonkey was selected as a data collection tool due to its versatility in data analysis. Other justifications for its use include transforming survey data with AI, creating and customizing survey data, getting the needed responses, increasing researchers' efficiency, unlocking insights that drive action, and securely managing the data. Links to SurveyMonkey for each type of questionnaire were created and shared with the respondents, allowing them to answer the questions and submit their responses to the researcher. The NCA Department of Construction Research and Business Development, in conjunction with the Department of Corporate, facilitated the distribution of the SurveyMonkey link to a stratified sample of respondents across diverse stakeholder groups.

6.4.2 Focused group discussion (FGD) and key informants

The selection of participants for the FGD will be based on transparent criteria, including their knowledge, life experiences, specific characteristics, and roles in the construction industry. A purposive sampling method was used to select the respondents of the FGD and key informants from the stakeholders' mapping, as developed from the NCA database. The selected Focus Group Discussion participants and key informants were categorized into three groups: professionals, academia, and county and national government officials in relevant fields related to the research. Online sessions were organized for FGD and key informants. The guidelines for the FGD are attached in **Appendix F**. The participants' composition is given in **Table 6.4**.

Table 6.4: Focused group discussion and key informants to be hosted in Nairobi

Stakeholder Type	Type of Participants	Number of Participants
Professional bodies	Architects (4), Quantity Surveyors (4), Engineers (4).	12
Construction firms	Contractors (6), Site supervisors (6), and Skilled workers (6).	18
County government	County executive committee members (CECM) are responsible for Housing (6).	6
National government	NEMA (2), NCA (2).	2
Academia	KU (1), UON (1).	2
Total		**42**

Source: Author Analysis, 2025

6.4.3 Focused group discussions and key informant guide

The study area was probed through focused group discussions and key informant interviews to clarify issues not addressed by the questionnaires. The study's objectives generally guided the questions: What factors defined the effects of research? What were the effects of the 16 research studies on the development of the construction industry? What type of framework could enhance the effectiveness of the NCA programmes for their optimum impact? The questionnaires were also used to guide both the focus group discussions and key informant interviews.

6.5 Data Analysis and Presentation

The data collected were analyzed using both quantitative and qualitative methods. Responses from the questionnaires were coded and entered into SPSS (Version 26) software for analysis. The coding process involved identifying and assigning values to the variables used in the questionnaire for easier entry into Excel spreadsheets and the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were applied to the data, and the results were presented in tables and pie charts. Inferential statistics were also used to examine relationships between the variables. The rationale for the statistical tests and analysis was provided in **Table 6.5**.

Table 6.5: Rationale of statistical tests/analysis

	Statistical Test/Analysis	Purpose	Rationale
1.	**Descriptive Statistics**	To summarize key metrics (mean, standard deviation, etc.) for each variable	Provides a basic understanding of data distribution and central tendencies.
2.	**Mean Effectiveness Scores**	To summarize the average perceived effectiveness of research programmes	Provides a clear indicator of how respondents rate the overall success or impact of the programmes.
3.	**Analysis of Variance (ANOVA)**	To determine if there are statistically significant differences in means across groups	Helps assess whether different groups perceive the effectiveness or impact of interventions differently.

4.	**Tukey HSD test**	To determine which specific group means are significantly different	Conducted after ANOVA when significant differences are found; pinpoints where those differences lie.
5.	**Pearson Correlation Matrix**	To assess linear relationships between variables	Identifies the strength and direction of associations among the variables.
6.	**Confirmatory Factor Analysis (CFA)**	To uncover the underlying structure of a large set of variables by testing a pre-specified model	Groups related variables into latent factors to reduce dimensionality and simplify interpretation.

Source: Author Analysis, 2025

Additionally, any qualitative data were further analyzed to identify themes and underlying patterns that provided conclusive information to support the study's findings. The study's objectives guided the data analysis. Data from various research tools were triangulated for in-depth analysis to demonstrate the impact of research programmes on the development of the construction industry and how NCA could enhance the design and implementation of future programmes.

6.6 Variables of the Study

The study's independent variables were derived from the recommendations of the research reports. These variables were expected to impact the construction industry, depending on the nature of the recommendations in each report, as demonstrated by the questionnaire in **Appendix B**. The dependent variable was the effectiveness of the research on the development of the construction industry. In this study, effectiveness was defined as the extent to which the interventions identified in each study contributed to the efforts of the target groups in developing the construction industry. The independent variables were defined as follows: -

6.6.1 Definition of variables

- **Dependent variable**
  The effectiveness of the research programme is measured by its impact in achieving its objectives, specifically in developing the construction industry.
- **Independent variables**
  - **Degree of Research Innovativeness** is the level of originality, creativity, or newness in the research programme - especially in introducing new ideas, methods, or technologies in construction.

  - **Financial Viability** refers to the availability of financial resources that affect the funding and execution of the programme. This concerns whether the programme is financially stable, specifically whether adequate funds are available to support the research and whether the outcomes are cost-effective and economically feasible.

  - **Timeframe and Practicability of Research Delivery** is when the research outcomes are expected to be realized. This assesses whether the research outcomes are achievable within a reasonable timeframe and can be practically applied in real-world construction settings.

- **Environmental Sustainability Contribution** is the extent to which the research outcomes promote sustainable and eco-friendly construction practices, such as reducing environmental harm, using sustainable materials, and promoting green construction.

- **Occupational Safety and Health Contribution** relates to how research findings enhance safer construction environments, lower workplace accidents, and promote worker well-being through improved safety practices or policies.

- **Enhancement of Workforce Capacity** is the extent to which research outcomes train or upskill the construction workforce through education, knowledge sharing, or technical training to enhance workforce competence.

- **Technological Advancement** is the extent to which the research programme promotes the adoption and integration of new technologies in construction, such as automation, BIM, or 3D printing.

- **Responsiveness to Societal Needs** measures how well the research addresses social issues, such as affordable housing, infrastructure access, and community development.

- **Policy and Legal Alignment** refers to whether the research is in line with existing laws and policies or contributes to new legal or policy frameworks in the construction industry, thus making implementation smoother and more legitimate.

6.6.2 Operational definition of these variables

An operational definition for each variable and its measurement indicator is presented. These are the variables that shall inform the development of the questionnaire.

1. **Degree of Research Innovativeness**
   - **Operational definition**: This refers to the extent to which new and unique methods, materials, and technologies are adopted and implemented to improve construction efficiency, productivity, and sustainability.
   - **Measurement indicators**:
     - Number of new and innovative construction methods, or new materials used.
     - Percentage of projects integrating smart technologies (e.g., AI, BIM, automation).
     - Improvement in cost savings, efficiency, or project quality due to innovation.
     - Industry adoption rate of research outputs.

2. **Financial Viability**
    - **Operational definition**: The financial stability, funding availability, and economic environment significantly influence the feasibility, cost, and profitability of construction projects.
    - **Measurement indicators**:
        - Project cost overruns and budget adherence (%).
        - Funding accessibility and interest rates on construction loans.
        - Return on Investment (ROI) and economic viability analysis.

3. **Timeframe and Practicability of Research Delivery**
    - **Operational definition**: This describes the projected duration required to achieve measurable construction project outcomes, including project completion, return on investment, and long-term benefits.
    - **Measurement indicators**:
        - Average project completion time vs. planned schedule.
        - Time required for return on investment (ROI) realization.
        - Delay frequency and impact on project costs.
        - Timeliness of achieving research milestones.
        - Stakeholder satisfaction with research duration and time efficiency.

4. **Environmental Sustainability Contribution**
    - **Operational definition**: This reflects the extent to which construction practices minimize negative environmental impacts, promote resource efficiency and waste reduction, and enhance eco-friendly solutions.
    - **Measurement indicators**:
        - Use of sustainable and recycled materials (%).
        - Number of sustainable materials/processes introduced.
        - Waste reduction.
        - Compliance with environmental and green building regulations.

5. **Occupational Safety and Health Contribution**
    - **Operational definition**: This denotes the level of influence the research has on the implementation of policies, technologies, and practices that reduce workplace hazards and enhance the well-being of construction workers.
    - **Measurement indicators**:
        - New safety policies introduced based on research.
        - Reduction in the number of workplace accidents and injury rates due to research-based safety recommendations.
        - Compliance with safety regulations, such as the Occupational Safety and Health Act (OSHA).
        - Worker health assessments and satisfaction survey.
        - Improvements in worker health conditions.

6. **Enhancement of Workforce Capacity**
    - **Operational definition**: This captures the effectiveness of the research in strengthening the construction workforce through training, skill development, knowledge-sharing platforms, and professional certification.
    - **Measurement indicators**:
        - Number of Contractors/site supervisors/and skilled workers trained in new construction methods and technologies.
        - Percentage of certified Contractors/site supervisors/skilled workers in specialized construction areas.
        - Impact of training programs on productivity and error reduction.
        - Number of training programmes developed.
        - Industry adoption of research-based education.

7. **Technological Advancement**
    - **Operational definition**: This pertains to the adoption and integration of emerging technologies to improve construction productivity, quality, and cost-efficiency.
    - **Measurement indicators**:
        - Productivity improvements due to the adoption of new technology.
        - Cost savings and error reduction from digitalization.
        - Adoption of technologies like Building Information Modelling (BIM), automation, and 3D printing.
        - Digital transformation initiatives influenced by research.
        - Number of automated construction processes.

8. **Responsiveness to Societal Needs**
    - **Operational definition**: The extent to which construction projects address pressing social challenges, such as demand for affordable housing, infrastructure development, and improved quality of life.
    - **Measurement indicators**:
        - Number of affordable housing units and infrastructure projects delivered.
        - Public infrastructure improvements and accessibility measures.
        - Community satisfaction levels with completed projects.
        - Number of projects addressing societal issues.
        - Public perception and stakeholder engagement.

9. **Policy and Legal Alignment**
    - **Operational definition**: This evaluates how research supports the development and implementation of legal and regulatory frameworks that ensure compliance, safety, and advancement in the construction industry.
    - **Measurement indicators**:

- Number of new or revised construction laws and regulations influenced by research and their enforcement levels.
- Frequency of legal dispute occurrences in construction projects.
- Industry compliance rates with updated policies.
- Government and industry adoption of research-based policies.
- Compliance with international construction standards.

6.7 Measurement of the Variables

The effectiveness of the research programme instrument was used for data collection. The instrument had been designed to align with the study's objectives and consisted of two parts: -

- Part A collected demographic information, such as gender, NCA category of firm, job designation, registration with NCA, and the period worked with the same, etc. As observed in the attached questionnaires, this section gathered preliminary information that corresponded to the respondent.
- Part B presented Likert-type items scored on a 5-point scale: Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD). Positive statements were scored 5, 4, 3, 2, and 1, respectively, and negative statements were reverse-scored in the measurement.

6.8 Validity and Reliability of the Research

Validity: Validity refers to the ability of a data collection tool to accurately measure what it was intended to measure (Mugenda & Mugenda, 2003). Validity tests were an important indicator for ascertaining the consistency of data obtained from the questionnaires and determining whether the data could be relied upon for the study. The study employed face construct validity to assess the questionnaire's ability to measure the intended constructs. To validate this, the questionnaire was reviewed by experts and then subjected to a pilot study for field testing. Based on this assessment, the data collection tool was adjusted appropriately before being used in the final data collection exercise. The review observations from the respondents were used to enhance content validity.

Reliability: To evaluate the internal consistency of the questionnaire, Cronbach's Alpha coefficient (α) was calculated for each Likert-scale item. Cronbach's Alpha measures how well a set of items assesses a single unidimensional latent construct. The coefficient ranges from 0 to 1, with higher values indicating greater reliability. The commonly accepted threshold is $\alpha > 0.7$, which signifies high reliability and internal consistency of the questionnaire. The results are shown in **Tables 6.6** and **6.7**.

6.8.1 Internal stakeholders

For the internal stakeholders' questionnaire, all questions had a Cronbach's alpha coefficient (α) greater than 0.7, indicating high reliability and all questions were retained in the questionnaire.

Table 6.6: Cronbach's Alpha coefficient test for internal stakeholders

	Item	Number of Items	Cronbach Alpha	Comment
1.	Capacity building	5	0.812	Reliable
2.	Planning	6	0.854	Reliable
3.	Innovation	5	0.891	Reliable

Source: Author Analysis, 2025

6.8.2 External stakeholders

For the external stakeholders' questionnaire, all questions had a Cronbach's Alpha coefficient (α) greater than 0.7, indicating high reliability and all questions were retained in the questionnaire.

Table 6.7: Cronbach's Alpha coefficient test for external stakeholders

	Item	Number of Items	Cronbach Alpha	Comment
1.	Finance	3	0.823	Reliable
2.	Innovativeness	4	0.871	Reliable
3.	Policy	3	0.861	Reliable
4.	Safety	3	0.883	Reliable
5.	Societal	4	0.909	Reliable
6.	Sustainability	3	0.870	Reliable
7.	Technology	4	0.909	Reliable
8.	Timeframe	3	0.842	Reliable
9.	Workforce	3	0.894	Reliable

Source: Author Analysis, 2025

CHAPTER SEVEN: RESULTS

7.1 Introduction

This chapter presents the results of the study on the effectiveness of NCA's research programmes in the development of the construction industry in Kenya. The analysis is based on responses from both internal and external stakeholders, including NCA management and staff, professional associations, contractors/site supervisors/skilled workers, and government agencies. Data were collected through structured questionnaires administered via SurveyMonkey, complemented by focus group discussions and key informant interviews.

7.2 Operational Definitions of Respondent Groups

For clarity in interpreting the results, the external stakeholder groups were operationally defined as follows: -

1. **Contractors, Site Supervisors, and Skilled Workers)**
   - **Definition:** Persons directly involved in construction execution, including registered contractors under NCA categories N1–N8, accredited site supervisors, and skilled workers such as masons, carpenters, electricians, plumbers, welders, painters, and safety officers.
   - **Measurement Indicators:** Responses captured from active practitioners engaged in construction projects, measured through structured questionnaires and interviews.
2. **Government Agencies**
   - **Definition:** Public institutions at both national and county levels with regulatory, policy, or oversight roles in construction. This category included agencies such as the State Department of Public Works, the State Department of Housing, the Kenya Bureau of Standards (KEBS), the National Environment Management Authority (NEMA), the National Housing Corporation (NHC), and county governments.
   - **Measurement Indicators:** Data obtained from officials within these agencies responsible for construction regulation, policy, enforcement, or standards.
3. **Professionals (Professional Associations)**
   - **Definition:** Registered members of professional bodies in the built environment, including the Architectural Association of Kenya (AAK), Institute of Quantity Surveyors of Kenya (IQSK), Institution of Engineers of Kenya (IEK), Institution of Surveyors of Kenya (ISK), Institute of Planners of Kenya (IPK), and the Institute of Construction Project Managers of Kenya (ICPMK), among others.
   - **Measurement Indicators:** Responses collected from licensed and practising professionals affiliated with their associations, captured through survey instruments and focus group discussions.

7.3 Response Rate

A total of 128 valid responses were received, comprising 51 from internal stakeholders (NCA staff) and 77 from external stakeholders (government agencies, contractors/site supervisors/skilled workers, and professional associations). Although the potential stakeholder population is very large, questionnaires were distributed to a stratified purposive sample derived from the NCA stakeholder database. SurveyMonkey was used as the primary data collection platform, with questionnaire links shared directly with targeted participants across the identified categories, as shown in **Table 7.1**.

Table 7.1: Response rate of the study

Stakeholder Group	Estimated Targeted Sample	Actual Responses	Response Rate (%)
NCA Internal Staff	~100	51	~51%
Government Agencies	~100	33	~33%
Contractors/Site Supervisors/Skilled Workers	~120	32	~27%
Professional Associations	~80	12	~15%
Total	~300–400	128	32–43%

Source: Author Analysis, 2025

7.4 Designation and Work Period of the Respondents

7.4.1 Internal stakeholders

The internal stakeholder referred to is the respondent from the NCA staff. The results indicate that the 'others' designation represented the majority of the respondents (47.1%), followed by technical officers (35.3%), board members (13.7%) and managers (3.95%) as shown in **Figure 7.1**.

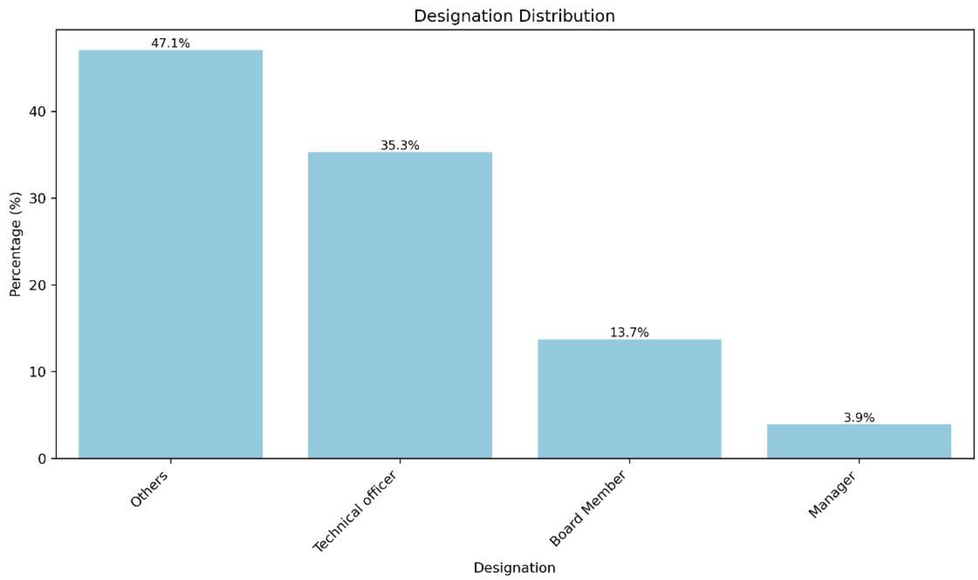

Figure 7.1: Designation distribution
Source: Author Analysis, 2025

A summary of the 'Others' Designation Responses is as follows:

- Registration Assistant
- Data Entry Clerk
- RMO
- Registration Officer
- Registration Officer 1
- Office Admin
- Casual
- Officer
- Clerk
- Registration
- Rider
- Research Officer
- Data Entry Clerk
- Registration Assistant
- Office Assistant
- Registration Officer

Apart from that, the majority of respondents had worked at NCA for 7-10 years (33.3%), followed by 4-7 years (29.4%) and more than 10 years (19.6%), as shown in **Figure 7.2**. This indicates that the respondents were significantly experienced and likely to be aware of the authority's operations and activities.

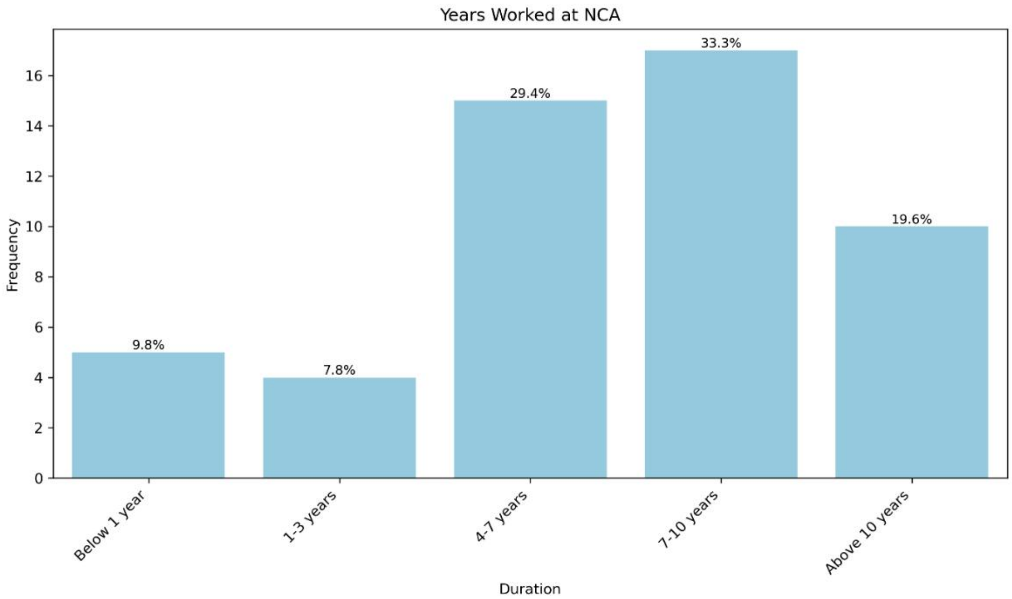

Figure 7.2: Duration worked at NCA
Source: Author Analysis, 2025

7.4.2 External stakeholders

The findings show that among external stakeholders, government agencies comprised the largest proportion of respondents (43.04%), followed by contractors, site supervisors, and skilled workers (41.77%), with professionals accounting for 15.19%, as illustrated in **Figure 7.3**.

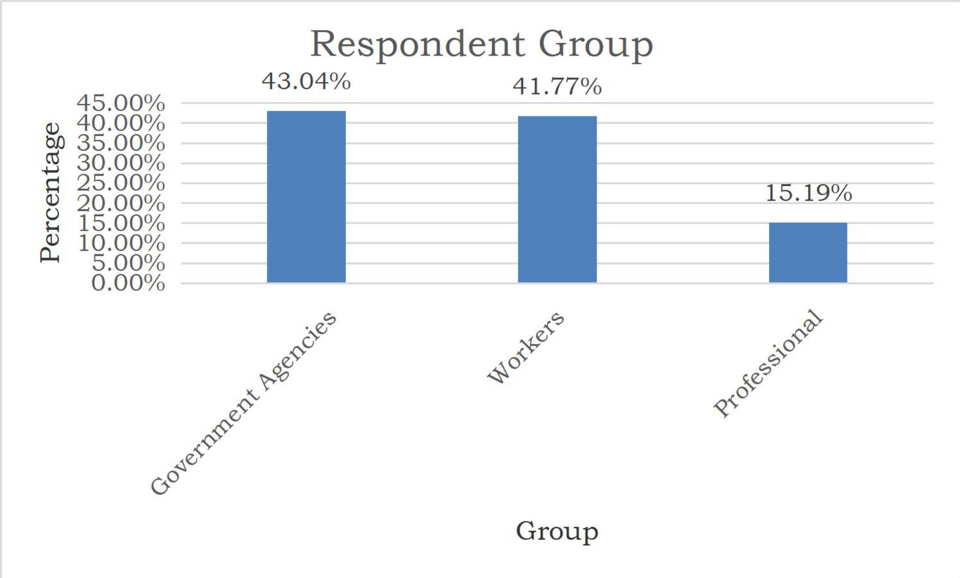

Figure 7.3: Respondent group
Source: Author Analysis, 2025

Regarding county distribution, 35 counties were covered by the respondents, with Nairobi (29 respondents) having the most significant representation (**Figure 7.4**). Missing ones - Baringo, Bungoma, Homa Bay, Isiolo, Meru, Marsabit, Muranga,Samburu, Siaya.

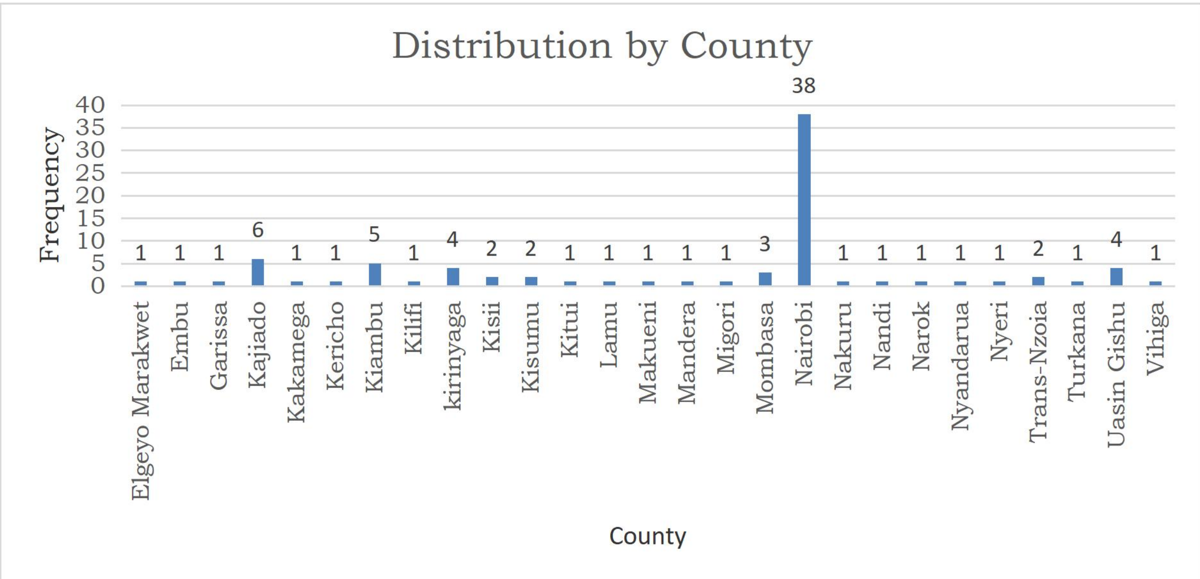

Figure 7.4: County distribution
Source: Author Analysis, 2025

7.5 General Awareness of the Research Programmes

This aspect measured whether respondents were aware of specific research initiatives conducted by the National Construction Authority (NCA). Respondents were presented with a list of programmes and asked to indicate "Yes" or "No" for each, clearly indicating their exposure to or knowledge of these initiatives. This data helped assess the overall reach of NCA's research efforts and identify awareness gaps among different stakeholder groups.

7.5.1 NCA internal stakeholders

The top research programmes with the highest awareness among internal stakeholders are: "*Research on failure and collapse of buildings in Kenya*" (90.2%), "*Enhancing accreditation of skilled construction workers and site supervisors in Kenya*" (84.3%), "*Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya*" (80.4%), "*A circular economy model, assessment of factors influencing construction waste management practices in Kenya*" (80.4%) and "*Effectiveness of contractor training in Kenya*" (80.4%). These findings underscore the prominence of these programmes within the internal stakeholder community (**Table 7.2**).

Conversely, the bottom three research programmes with the lowest awareness levels are: "*The influence of socio-economic factors on performance of rural road construction projects in Kenya*" (56.9%), "*Assessment of the domestic capacity of the construction industry in Kenya and development of a national construction industry strategy*" (64.7%) and "*Performance of technology transfer in the construction industry in Kenya*" (66.7%). These results highlight the comparatively limited visibility of these programmes among internal stakeholders.

Table 7.2: Awareness levels of NCA internal stakeholders

Rank	Research Programme	Aware (%) (Yes)	Not Aware (%) (No)
1.	Research report on building failures	90.2	9.8
2.	Accreditation dynamics for skilled construction workers and construction supervisors in Kenya	84.3	15.7
3.	The effects of Covid-19 pandemic on the business resilience of contractors in Kenya	80.4	19.6
4.	Construction and demolition waste management practices in Kenya	80.4	19.6
5.	Capacity building programs on the effectiveness of the construction sector: A case of contractors in Kenya	80.4	19.6
6.	Participation of local construction firms in Public Private Participation (PPP) infrastructure projects in Kenya	78.4	21.6
7.	Contractor registration dynamics	78.4	21.6
8.	Early Risk Detection System for the construction industry of Kenya	76.5	23.5
9.	Coordination framework for inter-agency quality	72.5	27.5

Rank	Research Programme	Aware (%) (Yes)	Not Aware (%) (No)
	assurance processes for the construction industry in Kenya		
10.	Media portrayal of the NCA and the construction industry in Kenya	72.5	27.5
11.	Alternative Building Material and Technologies (ABMT)	70.6	29.4
12.	The involvement of Micro, Small and Medium Enterprises (MSMEs) in the construction industry in Kenya	70.6	29.4
13.	Influence of ICT system on NCA regulatory performance	68.6	31.4
14.	Performance of technology transfer in the construction industry of Kenya by NCA	66.7	33.3
15.	Assessment of the domestic capacity of the construction industry and development of a national construction capacity strategy	64.7	35.3
16.	The role of socio-economic factors on rural road construction projects performance in Kenya	56.9	53.1

Source: Author Analysis, 2025

7.5.2 NCA external stakeholders

Among the research programmes evaluated, the top three in terms of respondent awareness were "*Enhancing accreditation of skilled construction workers and site supervisors in Kenya*" with 71.4% awareness, "*Insights into contractor registration trends in Kenya (2015-2020)*" with 70.1%, and "*The participation of local firms in Public-Private Participation infrastructure projects in Kenya*" at 63.6%. These figures reflect the highest levels of engagement or familiarity among the surveyed participants.

Conversely, the lowest levels of awareness were reported for "*Media portrayal of the NCA and the construction industry in Kenya*" at 37.7%, "*The influence of socio-economic factors on performance of rural road construction projects in Kenya*" at 40.3%, and "*Performance of technology transfer in the construction industry in Kenya*" at 40.3%. These represent the research areas with the least visibility or recognition among the respondents (**Table 7.3**).

Table 7.3: Awareness levels of NCA external stakeholders

Rank	Research Programme	Aware (%) (Yes)	Not Aware (%) (No)
1.	Accreditation dynamics for skilled construction workers and construction supervisors in Kenya	71.4	28.6
2.	Contractor registration dynamics	70.1	29.9

Rank	Research Programme	Aware (%) (Yes)	Not Aware (%) (No)
3.	Participation of local construction firms in Public Private Participation (PPP) infrastructure projects in Kenya	63.6	36.4
4.	The involvement of Micro, Small and Medium Enterprises (MSMEs) in the construction industry in Kenya	61.0	39.0
5.	Research report on building failures	58.4	41.6
6.	Alternative Building Material and Technologies (ABMT)	54.5	45.5
7.	The effects of Covid-19 pandemic on the business resilience of contractors in Kenya	50.6	49.4
7.	Construction and demolition waste management practices in Kenya	50.6	49.4
9.	Coordination framework for inter-agency quality assurance processes for the construction industry in Kenya	46.8	53.2
10.	Early Risk Detection System for the Construction Industry of Kenya	45.5	54.5
11.	Capacity building programs on the effectiveness of the construction sector: A case of contractors in Kenya	44.2	55.8
12.	Assessment of the domestic capacity of the construction industry and development of a national construction capacity strategy	42.9	57.1
13.	Influence of ICT system on its regulatory performance	41.6	58.4
14.	Performance of technology transfer in the construction industry of Kenya by NCA	40.3	59.7
15.	The role of socio-economic factors on rural road construction projects performance in Kenya	40.3	59.7
16.	Media portrayal of the NCA and the construction industry in Kenya	37.7	62.3

Source: Author Analysis, 2025

7.5.3 Comparison of awareness between internal and external stakeholders

Based on the analysis of the internal and external stakeholders concerning their awareness of the NCA research programs, the following are some key notable findings: -

- Internal stakeholders consistently demonstrate higher awareness percentages than external stakeholders.
- The most significant differences are seen in programmes such as "*Effectiveness of contractor training in Kenya*" (36.20%), "*Media portrayal of the National Construction Authority and the construction industry in Kenya*" (34.80%) and "*Research on failure and collapse of buildings in Kenya*" (31.80%).
- Even the least differing programme, "*Insights into contractor registration trends in Kenya (2015-2020)*," shows a notable gap of 8.30% (**Table 7.4)**.

- This trend suggests a general disparity in the dissemination or reach of NCA research outputs between internal and external audiences.

Table 7.4: Comparison of awareness between internal and external stakeholders

No.	Research Programme	Internal Yes (%)	External Yes (%)	% Difference
1.	Capacity building programs on the effectiveness of the construction sector: A case of contractors	80.4	44.2	36.20
2.	Media portrayal of the NCA and the construction industry in Kenya	72.5	37.7	34.80
3.	Research report on building failures	90.2	58.4	31.80
4.	Early risk detection system for the construction industry of Kenya	76.5	45.5	31.00
5.	The effects of Covid-19 pandemic on the business resilience of contractors in Kenya	80.4	50.6	29.80
6.	Construction and demolition waste management practices in Kenya	80.4	50.6	29.80
7.	Influence of ICT system on NCA regulatory performance	68.6	41.6	27.00
8.	Performance of technology transfer in the construction industry of Kenya by NCA	66.7	40.3	26.40
9.	Coordination framework for inter-agency quality assurance processes for the construction industry	72.5	46.8	25.70
10.	Assessment of the domestic capacity of the construction industry and development of a national	64.7	42.9	21.80
11.	The role of socio-economic factors on the performance of rural road construction projects in Kenya	56.9	40.3	16.60
12.	Alternative Building Material and Technologies (ABMT)	70.6	54.5	16.10
13.	Participation of local construction firms in PPP infrastructure projects in Kenya	78.4	63.6	14.80
14.	Accreditation dynamics for skilled construction workers and construction supervisors in Kenya	84.3	71.4	12.90
15.	The involvement of Micro, Small and Medium Enterprises (MSMEs) in the construction industry in Kenya	70.6	61	9.60
16.	Contractor registration dynamics	78.4	70.1	8.30

Source: Author Analysis, 2025

Observation*:* The consistently higher awareness levels among internal stakeholders point to a relatively effective internal communication framework within the NCA. However, the substantial differences across all programmes highlight a pressing need to enhance external stakeholder engagement and communication strategies. Strengthening outreach mechanisms through targeted dissemination, stakeholder workshops, and strategic partnerships could bridge the awareness gap and ensure a broader, sector-wide impact of the Authority's research efforts.

7.6 Mean Effectiveness Scores

A mean effectiveness score was computed to assess the general effectiveness of NCA research programmes among respondents. This score reflects the average number of programmes each respondent reported being aware of, out of the 16 listed. It provides an indication of the Authority's overall visibility and effectiveness in research outreach.

For internal stakeholders, most respondents rated the programmes highly. The largest cluster, comprising 24 respondents, fell within the 0.9–1.0 range, while the majority scored between 0.5 and 1.0. This distribution demonstrates consistently positive perceptions among NCA staff, who are more directly engaged in the research cycle (**Figure 7.5**).

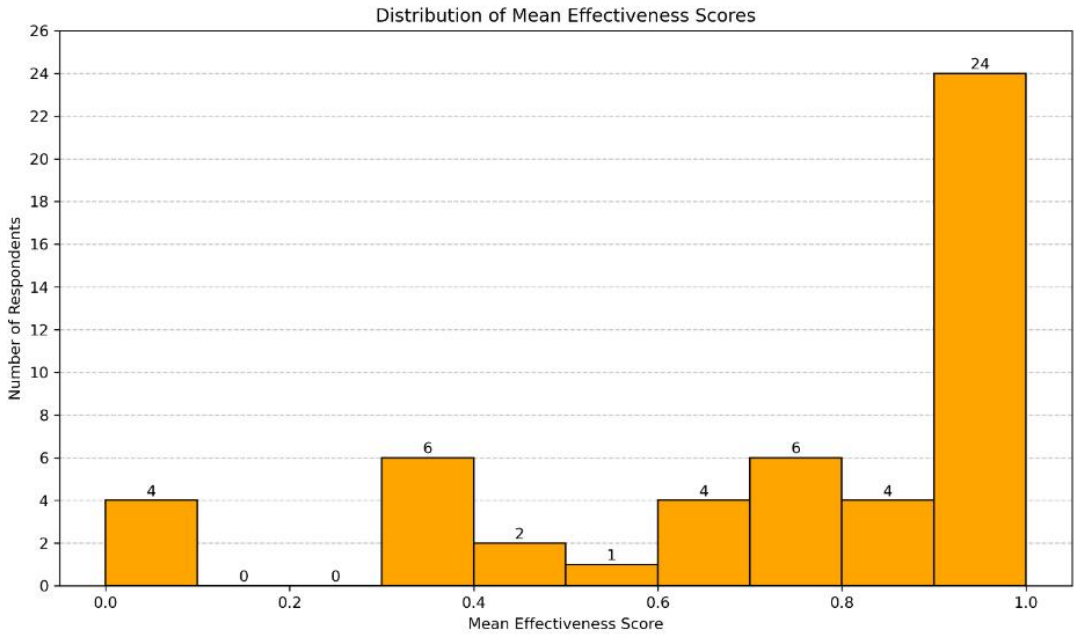

Figure 7.5: Distribution of mean effectiveness scores – Internal stakeholders
Source: Author Analysis, 2025

For external stakeholders, the pattern was markedly different. While the largest group (18 respondents) also scored effectiveness in the 0.9–1.0 range, two sizeable groups (12 respondents each) rated effectiveness much lower, in the 0.0–0.1 and 0.3–0.4 ranges. The other score ranges were less populated, producing a bimodal distribution that reflects polarized views among external actors **(Figure 7.6**).

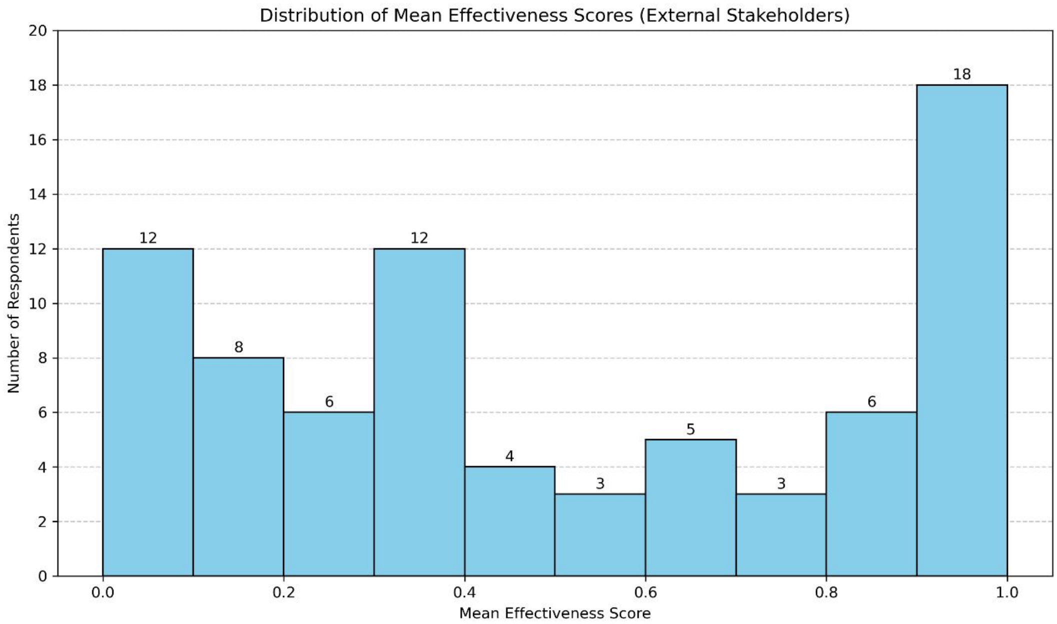

Figure 7.6: Distribution of mean effectiveness scores – External stakeholders
Source: Author Analysis, 2025

In summary, **Figures 7.5** and **7.6** highlight the divergence between internal and external stakeholders. Internal staff perceive NCA's research programmes as consistently effective, while external stakeholders are split between very high and very low ratings. This variability suggests that although some external respondents recognize strong research impact, others remain unconvinced or unaware. The findings underscore the need for targeted dissemination and engagement strategies to ensure that NCA's research outcomes reach and benefit a broader spectrum of external stakeholders.

7.7 T-Test Comparison of Internal and External Respondents

To test whether the differences in mean effectiveness scores between internal and external stakeholders were statistically significant, an Independent Samples T-Test (Welch) was conducted. Results show that internal stakeholders ($M = 0.75$, $SD = 0.31$, $n = 51$) rated NCA research programmes more positively than external stakeholders ($M = 0.51$, $SD = 0.36$, $n = 77$). The mean difference was 0.24, 95% CI [0.122, 0.358], $t\ (118) = 4.02$, $p < 0.001$, with a medium–large effect size (Hedges' $g \approx 0.70$).

These findings statistically confirm the descriptive patterns observed in **Figures 7.5** and **7.6**. Internal staff perceive NCA research as significantly more effective, while external stakeholders exhibit mixed perceptions, with some rating research highly effective and others reporting very low effectiveness. This perceptual gap is both practically and statistically significant, underscoring the need for stronger dissemination strategies, wider engagement, and improved translation of research outputs into practice.

7.7.1 Factor comparability (internal vs external)

The internal and external questionnaires measured different constructs at the factor level. Internal respondents rated three institutional/process factors—Capacity Building, Planning, Implementation—whereas external respondents rated nine outcome-oriented factors—Innovativeness, Finance, Timeframe, Sustainability, Safety, Workforce, Technology, Societal, Policy/Legal. Because these factor scales are not the same (different items and constructs), factor-by-factor t-tests between internal and external groups are not statistically valid. Accordingly, we report: (i) a valid group t-test on the common dependent variable (overall effectiveness), and (ii) pairwise t-tests within external subgroups to complement the ANOVA/Tukey results.

7.7.2 Supplementary t-tests within external subgroups

To deepen the between-group contrasts indicated by the ANOVA and Tukey HSD results, independent-samples t-tests were conducted on overall effectiveness across external subgroups (Contractors/Site Supervisors/Skilled Workers, Government Agencies, and Professionals). Results mirror the Tukey findings: Contractors/Site Supervisors/Skilled Workers vs Government Agencies differ significantly; the other two pairs are not significant.

Results (overall effectiveness):

- Contractors/Site Supervisors/Skilled Workers vs Government Agencies: t-test indicates a significant difference in mean effectiveness (higher among Contractors/Site Supervisors/Skilled Workers), consistent with Tukey (mean diff ≈ 0.335, $p < 0.001$).
- Professionals vs Government Agencies: not significant ($p > 0.05$), aligning with Tukey.
- Contractors/Site Supervisors/Skilled Workers vs Professionals: not significant ($p > 0.05$), aligning with Tukey.

Interpretation: Within external stakeholders, frontline implementers (Contractors/Site Supervisors/Skilled Workers) perceive NCA research as more effective than Government Agencies, while Professionals sit between the two without significant differences to either group. This reinforces the outcome-orientation of practitioners and suggests that policy-side actors perceive lower realized impact, pointing to the need for policy integration and enforcement pathways alongside practitioner-focused dissemination, as shown in **Table 7.5**.

Table 7.5: Pairwise t-tests on overall effectiveness (external subgroups)

Pair (External)	Direction (Higher Mean)	Test Result	Significance
Contractors/Site Supervisors/Skilled Workers vs Government Agencies	Contractors/Site Supervisors/Skilled Workers	Significant	$p < 0.001$

Pair (External)	Direction (Higher Mean)	Test Result	Significance
Professionals vs Government Agencies	—	Not Sig.	$p > 0.05$
Contractors/Site supervisors/Skilled Workers vs Professionals	—	Not Sig.	$p > 0.05$

Source: Author Analysis, 2025

7.7.3 Pairwise t-tests of external subgroups on factor scores

To complement the ANOVA and Tukey HSD results, Independent Samples T-Tests were conducted to compare mean scores of external subgroups (Contractors/Site Supervisors/Skilled Workers, Government Agencies, and Professionals) across the nine external factors: Workforce, Safety, Technology, Innovativeness, Societal Needs, Policy/Legal Alignment, Sustainability, Timeframe, and Finance.

The tests confirm the ANOVA/Tukey findings: Contractors/Site Supervisors/Skilled Workers consistently scored higher than Government Agencies across most factors, particularly Innovativeness, Workforce, Safety, and Finance, where differences reached statistical significance ($p < 0.05$). Differences between Professionals and the other two groups were generally not significant, suggesting that Professionals hold intermediate views, sitting between the positive perceptions of Contractors/Site Supervisors/Skilled Workers and the lower ratings of Government Agencies.

These results reinforce the observation that frontline implementers (Contractors/Site Supervisors/Skilled Workers) are more appreciative of NCA's research outputs, perceiving direct utility in safety, workforce development, and innovation. By contrast, Government Agencies perceive a weaker impact, reflecting a gap in policy integration and enforcement (**Table 7.6**).

Table 7.6: Pairwise t-tests on external subgroup factor scores

Factor	Contractors/Site supervisors/Skilled Workers vs Professionals vs Gov. Agencies	Contractors/Site supervisors/Skilled Workers vs Professionals	Professionals vs Gov. Agencies
Workforce	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Safety	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Technology	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Innovativeness	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Societal Needs	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Policy/Legal	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Sustainability	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Timeframe	Significant ($p < 0.05$)	Not Sig.	Not Sig.
Finance	Significant ($p < 0.05$)	Not Sig.	Not Sig.

Source: Author Analysis, 2025

Observation: The pairwise t-tests confirm that Contractors/Site Supervisors/ Skilled Workers consistently rate NCA's research programmes more positively than Government Agencies across nearly all factors, with significant differences in areas such as workforce capacity, safety, technology, and innovativeness. Professionals generally hold intermediate views, with no significant differences from either Contractors/Site Supervisors/Skilled Workers or Government Agencies. These results reinforce the perception gap already noted in **Figures 7.5** and **7.6**: frontline implementers value the practical benefits of NCA research, while policy-side agencies perceive a weaker impact. This highlights the need for NCA to strengthen policy integration, enforcement mechanisms, and tailored dissemination strategies to ensure that research outcomes influence both practice on construction sites and decision-making at institutional levels.

7.8 Descriptive Statistics

The descriptive statistics results show the central tendencies and distribution of the dependent variable (DV) and independent variables (IVs) used in the study (**Tables 7.7** and **7.8**).

For internal stakeholders, the effectiveness of the research programmes (DV) had a mean of 0.75, indicating that, on average, 75% of the programmes were considered effective (**Table 7.7**). Among the independent variables, the mean scores ranged from 3.66 (Capacity Building) to 4.09 (Planning), reflecting generally positive perceptions across all constructs on the Likert scale. The standard deviations, ranging from 0.73 to 0.75, suggest moderate response variability. Overall, the data suggest that internal stakeholders perceive the research programmes as effective.

Table 7.7: Descriptive statistics for internal stakeholders

Variable	Count	Mean	Std Dev	Min	25%	50%	75%	Max
Effectiveness	51.0	0.75	0.31	0.0	0.59	0.88	1.00	1.0
Capacity Building	51.0	3.66	0.73	2.0	3.00	3.60	4.10	5.0
Planning	51.0	4.09	0.75	2.0	3.75	4.00	4.67	5.0
Implementation	51.0	3.78	0.75	2.0	3.21	3.80	4.35	5.0

Source: Author Analysis, 2025

On the other hand, for external stakeholders, the effectiveness of the research programmes (DV) had a mean of 0.51, indicating that, on average, more than half of the 16 research programmes were regarded as adequate. Additionally, among the IVs, the mean scores range from 3.16 (finance) to 3.75 (training), suggesting moderate agreement levels on the Likert scale across all constructs. The standard deviations, which range from 0.69 to 0.81, reflect moderate response variability. The minimum and maximum values confirm that responses spanned nearly the entire Likert scale, indicating a broad spectrum of opinions among respondents. Overall, **Table 7.8** indicates that although awareness levels varied considerably, perceptions of the different influencing factors were generally favourable, albeit with notable diversity in responses.

Table 7.8: Descriptive statistics for external stakeholders

Variable	N	Mean	Std Dev	Min	25%	Median	75%	Max
Effectiveness	77.0	0.51	0.36	0.0	0.19	0.44	0.88	1.00
Innovativeness	75.0	3.56	0.69	2.0	3.00	3.50	4.00	5.00
Finance	74.0	3.16	0.75	2.0	2.67	3.00	4.00	4.67
Timeframe	74.0	3.18	0.73	2.0	2.75	3.00	3.67	5.00
Sustainability	74.0	3.38	0.79	2.0	3.00	3.33	4.00	5.00
Safety	76.0	3.69	0.81	2.0	3.00	3.67	4.08	5.00
Workforce	72.0	3.75	0.75	2.0	3.25	3.83	4.00	5.00
Technology	73.0	3.61	0.69	2.0	3.00	3.75	4.00	5.00
Societal	71.0	3.49	0.77	2.0	3.00	3.50	4.00	5.00
Policy/Legal	75.0	3.50	0.72	2.0	3.00	3.33	4.00	5.00

Source: Author Analysis, 2025

Observation: Mean scores for factors influencing effectiveness highlight generally positive perceptions, especially among internal stakeholders, providing insights into potential areas for leveraging strengths or addressing weaknesses to enhance programme impact. The analysis of mean scores for influencing factors provides a baseline of perceived strengths and areas for improvement, crucial for strategically directing efforts to enhance effectiveness. The descriptive statistics reveal that mean scores for independent variables (factors influencing effectiveness) are generally positive, ranging from 3.19 to 3.74 for external and 3.66 to 4.09 for internal stakeholders. While these averages indicate moderate to positive perceptions, they highlight that stakeholders view these factors as relevant to effectiveness.

For instance, for external stakeholders, the factors perceived as performing relatively well, indicated by the highest mean scores, included Workforce (3.74), Safety (3.69), Technology (3.61), and Innovativeness (3.61). Conversely, factors perceived as performing relatively poorly, having the lowest mean scores, were Finance/Economic Conditions (3.16) and Timeframe of Expected Results (3.18).

On the other hand, among the three independent variables evaluated for internal stakeholders, planning was perceived most positively, with the highest mean score being 4.09. While all internal factors generally had positive means (above 3.5), Capacity Building had the lowest mean score at 3.66 among this group, suggesting that it was perceived relatively less positively than Planning and Implementation by internal stakeholders.

7.9 Relative Importance Index (RII)

The Relative Importance Index (RII) prioritizes variables based on their perceived importance from Likert-scale responses. The formula is:

$$RII = \frac{\Sigma(\,w)}{A\ \times N}$$

Where:

w: weight given to each response

A: the highest possible weight

N: total number of respondents

7.9.1 Internal stakeholders

Capacity Building in the NCA Research Department: The top three ranked surrogates for this variable were "strong partnerships and collaboration with academia" (RII of 76.8%), "adequate funding for research programmes" (RII of 73.6%), and "appropriate research technology was provided" (RII of 72.2%), as shown in **Table 7.9**.

Table 7.9: RII of capacity building in the NCA research department

Aspect	RII	RII (%)	Rank
Strong partnerships and collaboration with academia	0.768000	76.8	1
Adequate funding for research programs	0.736000	73.6	2
Appropriate research technology was provided	0.721569	72.2	3
The workforce of the department was adequately trained	0.720000	72.0	4
Adequate infrastructure for research was in place	0.717647	71.8	5
Average		**73.28**	

Source: Author Analysis, 2025

From **Table 7.9**, it is evident that internal stakeholders regard external academic expertise and collaborative efforts as the most important factors for strengthening the department's capacity to carry out effective research programmes. Focusing on these partnerships can therefore directly enhance research effectiveness by strengthening the fundamental capabilities necessary to produce relevant outputs for industry development.

Planning and Conducting Research: The top three ranked surrogates under this variable were "comply with new construction regulations and policies" (RII of 83.9%), "addressed real problems of the construction industry" (RII of 83.8%), and "involved stakeholders in design and implementation of research program" (RII of 82.9%) (**Table 7.10**).

Table 7.10: RII of planning and conducting research

Aspect	RII	RII (%)	Rank
Comply with new construction regulations and policies	0.839216	83.9	1
Addressed real problems of the construction	0.837500	83.8	2

industry			
Involved stakeholders in the design and implementation of the research program	0.828571	82.9	3
Prioritized research on emerging issues	0.820000	82.0	4
Aligned to the local and international research standards	0.816327	81.6	5
Fostered a strong partnership between academia, research institutions and construction firms	0.804000	80.4	6
Average		**82.43**	

Source: Author Analysis, 2025

Internal stakeholders ranked complying with new construction regulations and policies (RII 83.9%) and addressing fundamental problems in the construction industry (RII 83.8%) as the most important aspects in this phase, emphasizing their belief that research relevance and alignment with regulatory frameworks are paramount (**Table 7.10**). These high rankings indicate that internal staff view research planning and execution as rooted in regulatory compliance and practical industry issues, recognizing them as vital drivers for increasing effectiveness and contributing to policy and legal improvements, while also addressing societal needs for industry development.

Implementation of Research Outcomes: The top three ranked surrogates under this variable were "dissemination to targeted audience" with an RII of 80.0%, "research utilized appropriate dissemination channels" with 78.3% and "created effective feedback mechanisms for different stakeholders" with 75.5% (**Table 7.11**).

Table 7.11: RII for the implementation of research outcomes

No.	Aspect	RII	RII (%)	Rank
1.	Dissemination to a targeted audience	0.800000	80.0	1
2.	Research utilized appropriate dissemination channels	0.783333	78.3	2
3.	Developed pathways for the commercialization of research outcomes	0.725000	72.5	5
4.	Created effective feedback mechanisms for different stakeholders	0.755102	75.5	3
5.	Had strategies for protecting the Intellectual Property (IP) of new research products	0.754167	75.4	4
	Average		**76.34**	

Source: Author Analysis, 2025

The respondents' above ranking underscores the strong perception among internal staff that effective communication and outreach are critical for the construction industry to adopt and utilize research findings (**Table 7.11**). This is fundamental to enhancing the effectiveness of the research programme and its impact on overall industry development.

Observation: The average RII scores for these factors were 73.28% for Capacity Building, 82.43% for Planning and Conducting of Research, and 76.34% for Implementation of Research Outcomes. This indicates that, on average, internal stakeholders perceive the Planning and Conducting of Research as the most important factor among the three overarching areas influencing programme effectiveness. The significantly higher average RII for Planning suggests that internal staff believe the initial stages of defining what research is undertaken, ensuring its alignment with regulations, and addressing real industry problems are paramount to achieving effective outcomes. This perception is directly linked to the study's objective of enhancing the effectiveness of the research programme for construction industry development, highlighting the internal view that robust planning and execution are the primary drivers of successful and impactful contributions to the sector.

7.9.2 External stakeholders

Degree of Research Innovativeness: For innovativeness, the top three surrogates were "improved project quality" with an RII of 75.3%, "increased numbers of new materials used" with 71.0%, and "increased numbers of projects integrating smart technologies" with 70.1% (**Table 7.12**).

Table 7.12: RII of degree of research innovativeness

Aspect	RII	RII (%)	Rank
Improved project quality	0.75342	75.3	1
Increased number of new materials used	0.70986	71.0	2
Increased number of projects integrating smart technologies	0.70137	70.1	3
Increased industry adoption of research outputs	0.70000	70.0	4
Average		**71.6**	

Source: Author Analysis, 2025

According to the rankings by external stakeholders, it is notable that these parties strongly link the effectiveness of research programmes with tangible results such as quality enhancements and the adoption of new or smart technologies in projects (**Table 7.12**). Their focus on these aspects suggests that innovation promoted through research is considered essential for industry progress and its perceived impact.

Financial Viability: The top 3 surrogates in this case were "more innovative project financing models" with RII of 66.5%, "adherence to the project budget" with 64.5% and "increased access to funding and low interest loan rates" with 61.2% (**Table 7.13**).

Table 7.13: RII of financial viability

Aspect	RII	RII (%)	Rank
More innovative project financing models	0.66471	66.5	1
Adherence to the project budget	0.64507	64.5	2
Increased access to funding and low-interest loan rates	0.61212	61.2	3
Average		**64.07**	

Source: Author Analysis, 2025

These low rankings suggest that, from the perspective of external stakeholders, financial aspects are regarded as the least influential factors in assessing the perceived effectiveness of research programmes. Although funding is essential, its direct contribution to the perceived effectiveness of the research output is considered less significant than factors related to capacity, safety, technology, or societal impact.

Timeframe and Practicability of Research Delivery: In this case, the ranking for the surrogates was "increased adherence to project completion time" with RII of 65.8%, "optimal time to achieve investment returns" with 65.1% and "minimal time-related cost overruns" with 61.9% (**Table 7.14**).

Table 7.14: RII of timeframe and practicability of research delivery

No.	Aspect	RII	RII (%)	Rank
1.	Increased adherence to project completion time	0.65882	65.8	1
2.	Optimal time to achieve investment returns	0.65143	65.1	2
3.	Minimal time-related cost overruns	0.61918	61.9	3
	Average		**64.27**	

Source: Author Analysis, 2025

The above rankings by the respondents suggest that timeliness and efficiency in project delivery, which may be connected to research outcomes, are regarded as moderately important by external stakeholders.

Environmental Sustainability Contribution: For environmental sustainability, "increased usage of sustainable materials" was ranked first with a RII of 71.6%, followed by "increased compliance with green building regulations" with 67.5% and "reduction in construction and demolition waste" with 63.8% (**Table 7.15**).

Table 7.15: RII of environmental sustainability contribution

Aspect	RII	RII (%)	Rank
Increased usage of sustainable materials	0.71622	71.6	1
Increased compliance with green building regulations	0.67500	67.5	2
Reduction in construction and demolition waste	0.63889	63.8	3
Average		**67.63**	

Source: Author Analysis, 2025

While rated lower than other factors, the ranking shows that external stakeholders recognize the importance of research outcomes promoting eco-friendly practices and compliance with sustainability standards. This indicates a growing awareness among external parties that research effectiveness is partially perceived through its contribution to environmentally responsible construction in Kenya.

Occupational Safety and Health Contribution: In this case, "increased compliance with safety regulations (OSHA)" had the highest RII of 75.6%, followed by "decreased number of workplace accidents" with 74.8% and "new safety policies introduced" with 73.2% (**Table 7.16**).

Table 7.16: RII of occupational safety and health contribution

Aspect	RII	RII (%)	Rank
Increased compliance with safety regulations (OSHA)	0.75556	75.6	1
Decreased number of workplace accidents	0.74795	74.8	2
New safety policies introduced	0.73151	73.2	3
Average		**74.53**	

Source: Author Analysis, 2025

The above findings underscore the significant importance that external stakeholders attribute to research that contributes to safer construction practices. Their high rating indicates a belief that effective research should yield tangible improvements in worker well-being and safety compliance, which is a crucial aspect of industry development and thus impacts the perceived effectiveness of research programmes.

Enhancement of Workforce Capacity: In this case, "increased number of training programmes developed" was first with an RII of 76.5%, followed by "increased number of accredited contractors/site supervisors/skilled workers in specialized construction areas" with 75.4% and "increased number of contractors/site supervisors/skilled workers trained in new construction methods" with 74.8% (**Table 7.17**).

Table 7.17: RII of enhancement of workforce capacity

Aspect	RII	RII (%)	Rank
An increased number of training programmes have been developed	0.76471	76.5	1
Increased number of accredited contractors/site supervisors/and skilled workers in specialized construction areas	0.75362	75.4	2
Increased number of contractors/site	0.74783	74.8	3

supervisors/and skilled workers trained in new construction methods	
Average	**75.57**

Source: Author Analysis, 2025

The above findings underscore the strong perception among external stakeholders that effective capacity building and knowledge transfer are critical for research findings to be adopted and utilized by the construction industry. This is fundamental to enhancing the effectiveness and impact of research programmes on overall industry development by directly addressing the human capacity needed to implement research outcomes.

Technological Advancement: For technological advancement, “improved productivity due to technology adoption” was ranked first with an RII of 74.6%, followed by “increased adoption of new technologies” (72.6%) and “increased technology transfers” (70.7%) (**Table 7.18**).

Table 7.18: RII of technological advancement

Aspect	RII	RII (%)	Rank
Improved productivity due to technology adoption	0.74648	74.6	1
Increased adoption of new technologies	0.72603	72.6	2
Increased technology transfers	0.70704	70.7	3
Increased digitalization of the construction process	0.70571	70.5	4
Average		**72.1**	

Source: Author Analysis, 2025

This indicates that external stakeholders view the ability of research programmes to drive the integration and adoption of new technologies as a key measure of their effectiveness. This focus on technological uptake for productivity gains reflects their expectation that research should modernize the industry, aligning with the study’s objective of enhancing overall impact.

Responsiveness to Societal Needs: For societal needs, “improved public infrastructure” was ranked first with an RII of 72.5%, followed by “increased public perception and stakeholders’ involvement” (71.6%) and “increased employment opportunities” (70.0%) (**Table 7.19**).

Table 7.19: RII of responsiveness to societal needs

Aspect	RII	RII (%)	Rank
Improved public infrastructure	0.72537	72.5	1
Increased public perception and stakeholders’ involvement	0.71642	71.6	2
Increased employment opportunities	0.70000	70.0	3

Increase in the number of affordable housing units delivered	0.68955	69.0	4
Average		**70.78**	

Source: Author Analysis, 2025

From the above, it is notable that external stakeholders consider the extent to which research addresses broader societal challenges and contributes to public well-being and engagement as a measure of its effectiveness. This highlights that the perceived impact of research is not limited to the construction industry itself but extends to its contributions to society, which is part of enhancing its overall effectiveness.

Policy and Legal Alignment: In this case, "introduced new or revised construction regulations" was ranked first with an RII of 71.9%, followed by "increased compliance to industry laws" (70.7%) and "increased number of legal reforms" (67.1%) (**Table 7.20**).

Table 7.20: RII of policy and legal alignment

No.	Aspect	RII	RII (%)	Rank
1.	Introduced new or revised construction regulations	0.71944	71.9	1
2.	Increased compliance with industry laws	0.70685	70.7	2
3.	Increased number of legal reforms	0.67123	67.1	3
	Average		**70.07**	

Source: Author Analysis, 2025

This ranking suggests that external stakeholders believe effective research should help shape the regulatory landscape, leading to enhanced governance and compliance within the industry. Their view that research can influence policy shows its recognized role in fostering a more structured and compliant environment.

7.9.3 Summary analysis

Table 7.21 presents a summary of the Relative Importance Index (RII) scores and rankings for nine factors influencing the effectiveness of research programs as rated by external stakeholders. Workforce ranked highest with an RII of 75.57%, closely followed by Safety at 74.53%, indicating these were viewed as the most influential. Technology and Innovativeness also scored highly at 72.10% and 71.60%, respectively, reflecting strong stakeholder emphasis on modern approaches. Meanwhile, Finance had the lowest RII at 64.07%, suggesting it was perceived as the least influential factor. The rankings reflect stakeholders' priorities, emphasizing capacity-building and safety-related components.

Table 7.21: RII of summary analysis on how variables influence the effectiveness of

research programmes

Variable	RII (%)	Rank
Workforce	75.57	1
Safety	74.53	2
Technology	72.10	3
Innovativeness	71.60	4
Societal	70.78	5
Policy/Legal	70.07	6
Sustainability	67.63	7
Timeframe	64.27	8
Finance	64.07	9

Source: Author Analysis, 2025

Observation: The above RII rankings illuminate the areas external stakeholders prioritize when evaluating the perceived effectiveness of research programmes. The finding that external stakeholders assign the highest importance to factors such as training and Safety provides crucial strategic guidance for the National Construction Authority. To demonstrably improve the effectiveness of research from the perspective of external stakeholders, future research initiatives, along with the dissemination and implementation strategies for existing ones, could benefit from prioritizing and emphasizing these highly rated areas. Acknowledging and addressing these perceived drivers of effectiveness is key to developing research programmes that resonate effectively with external stakeholders' needs and priorities, thereby bolstering the overall impact and perceived success of the NCA's research efforts.

7.10 Correlation Analysis

7.10.1 Internal stakeholders

In the case of internal stakeholders, the correlation matrix indicates that effectiveness is positively correlated with all three independent variables (**Table 7.22**). The correlation between Effectiveness and Planning is 0.424, followed by Capacity Building at 0.351, and Implementation at 0.212. Additionally, Capacity Building is moderately correlated with both Planning (0.676) and Implementation (0.617), while Planning and Implementation also show a strong positive correlation of 0.669.

Table 7.22: Correlation of variables of internal stakeholders

Variable	Effectiveness	Capacity Building	Planning	Implementation
Effectiveness	1.000	0.351*	0.424**	0.212 (ns)
Capacity Building	0.351*	1.000	0.338*	0.295*
Planning	0.424**	0.338*	1.000	0.367**
Implementation	0.212 (ns)	0.295*	0.367**	1.000

- p < 0.05; ** p < 0.01; ns = not significant

Source: Author Analysis, 2025

The results show that effectiveness is significantly correlated with planning ($r = 0.424$, $p < 0.01$) and capacity building ($r = 0.351$, $p < 0.05$), while the relationship with implementation ($r = 0.212$) is positive but not statistically significant. This suggests that internal staff primarily evaluate the effectiveness of NCA research programmes based on whether they are well-planned and supported by adequate institutional capacity, rather than on actual implementation outcomes.

A visual representation of the correlation matrix (internal stakeholders) is shown in **Figure 7.7**.

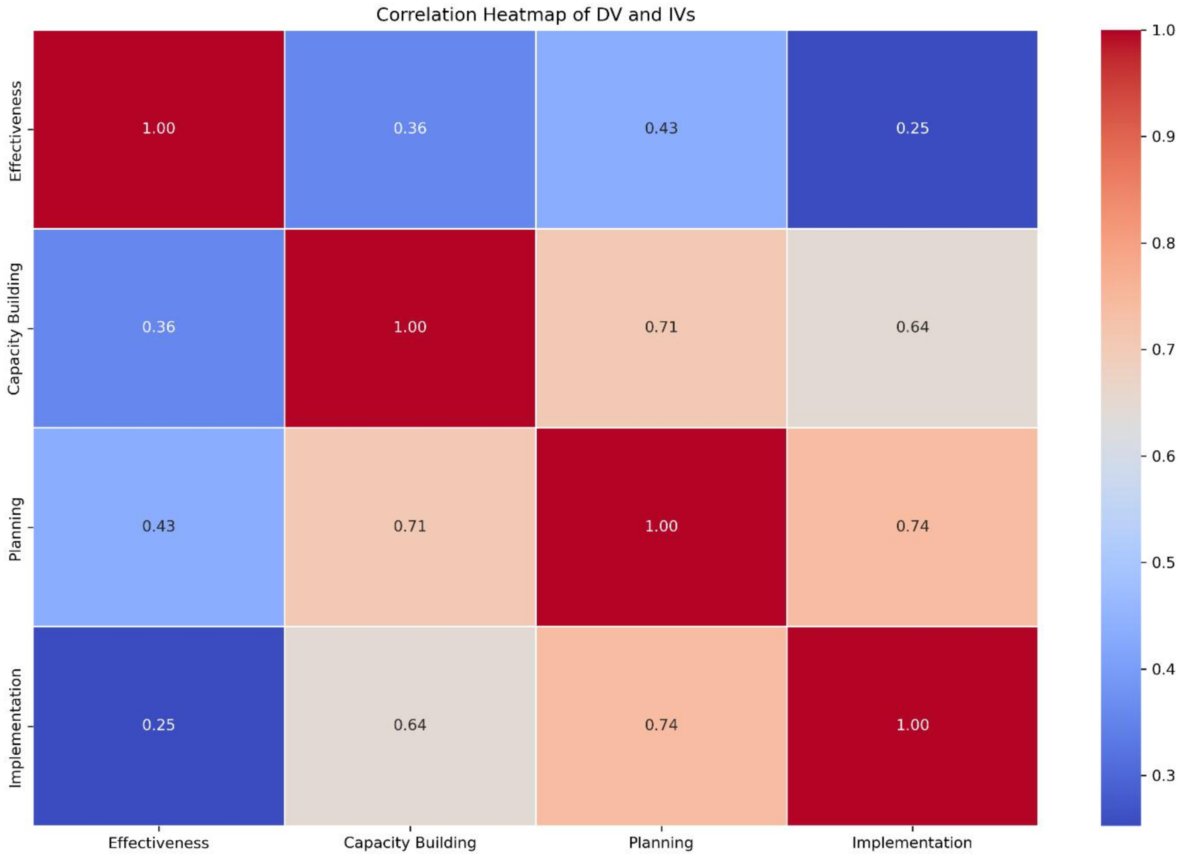

Figure 7.7: Correlation heatmap of DV and IVs
Source: Author Analysis, 2025

7.10.2 External stakeholders

The DV (effectiveness) shows moderate positive correlations with several IVs, particularly innovativeness ($r = 0.605$), societal factors ($r = 0.493$), and policy/legal ($r = 0.479$), with correlation coefficients ranging from 0.319 to 0.605.

Among the IVs, timeframe and sustainability exhibit strong positive correlations with each other ($r = 0.734$) and with other variables, such as innovativeness and sustainability ($r = 0.700$), indicating that higher levels of these attributes tend to coincide. Overall, the correlations indicate that the DV and IVs are interrelated to varying degrees, with training and finance (0.344) exhibiting the weakest correlations in the dataset, suggesting a more neutral relationship (**Table 7.23**). A visual representation of the correlation matrix (external stakeholders) (**Figure 7.8**).

Table 7.23: Correlation analysis of variables of external stakeholders

Variable	Effectiveness	Innovativeness	Finance	Timeframe	Sustainability	Safety	Training	Technology	Societal	Policy/Legal
Effectiveness	1.000	0.606**	0.350**	0.320**	0.470**	0.408**	0.428**	0.439**	0.493**	0.479**
Innovativeness	0.606**	1.000	0.372**	0.345**	0.427**	0.401**	0.389**	0.411**	0.455**	0.468**
Finance	0.350**	0.372**	1.000	0.389**	0.344**	0.298*	0.327**	0.318**	0.332**	0.356**
Timeframe	0.320**	0.345**	0.389**	1.000	0.401**	0.278*	0.298*	0.319**	0.336**	0.351**
Sustainability	0.470**	0.427**	0.344**	0.401**	1.000	0.415**	0.398**	0.437**	0.452**	0.462**
Safety	0.408**	0.401**	0.298*	0.278*	0.415**	1.000	0.376**	0.399**	0.421**	0.436**
Training	0.428**	0.389**	0.327**	0.298*	0.398**	0.376**	1.000	0.427**	0.463**	0.471**
Technology	0.439**	0.411**	0.318**	0.319**	0.437**	0.399**	0.427**	1.000	0.486**	0.497**
Societal	0.493**	0.455**	0.332**	0.336**	0.452**	0.421**	0.463**	0.486**	1.000	0.514**
Policy/Legal	0.479**	0.468**	0.356**	0.351**	0.462**	0.436**	0.471**	0.497**	0.514**	1.000

Source: Author Analysis, 2025

Table 7.23 indicates that for external stakeholders, effectiveness is significantly and positively correlated with all nine factors**.** The strongest correlations are with innovativeness ($r = 0.606$, $p < 0.01$), societal responsiveness ($r = 0.493$, $p < 0.01$), and policy/legal alignment ($r = 0.479$, $p < 0.01$). Other significant associations include technology, training, safety, sustainability, finance, and timeframe (all $p < 0.01$). This demonstrates that external stakeholders perceive research effectiveness in a multidimensional way, linking it to innovation, relevance to societal needs, regulatory alignment, workforce development, and practical outcomes in construction practice.

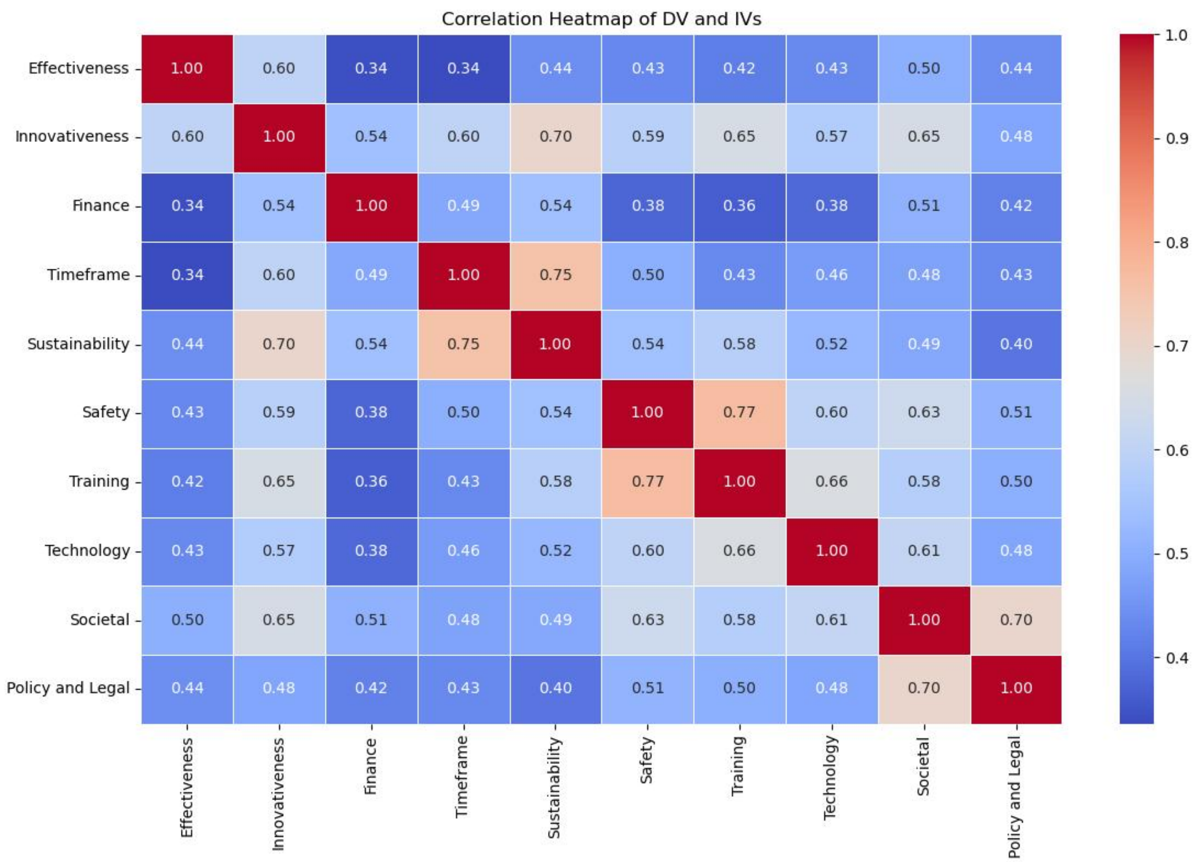

Figure 7.8: A visual representation of the correlation matrix - External stakeholders
Source: Author Analysis, 2025

Observation: For internal stakeholders, effectiveness was positively correlated with Planning (0.424), Capacity Building (0.351), and Implementation (0.212), with notable interrelationships among these internal factors. On the other hand, for external stakeholders, the analysis revealed moderate positive correlations between the dependent variable, effectiveness, and independent variables like innovativeness (0.605), societal factors (0.493), and policy and legal factors (0.479). It also showed strong positive correlations between variables like timeframe and sustainability (0.734).

The role these findings play in achieving the study's intended objective, establishing a framework to enhance the effectiveness of NCA research programmes, is critical. By quantifying the relationships between perceived effectiveness and various external and internal influencing factors, the above correlation analysis directly supports the identification of the specific factors most strongly associated with effectiveness. Understanding these associations is fundamental for designing a practical framework, as it allows the prioritization of resources and strategies towards the factors statistically linked to higher perceived effectiveness among key stakeholder groups.

7.11 Analysis of Variance (ANOVA)

A one-way ANOVA analysis was conducted to determine whether there are statistically significant differences in the effectiveness scores (dependent variable) among the three groups. The results show an F-statistic of 9.790135 and a p-value of 0.00017, indicating that the differences between the group means are statistically significant at the 0.05 level. This means that at least one group differs significantly from the others in terms of the effectiveness of the research programmes (**Table 7.24**).

Table 7.24: Analysis of variance

Source	Sum of Squares	df	F-Value
Group	2.044256	2	9.790135
Residual	7.308270	70	
Total	8.8799	68	

Source: Author Analysis, 2025

7.11.1 Tukey HSD test

As shown in **Table 7.25,** the Tukey HSD test revealed that the Contractors/Site Supervisors/Skilled Workers group rated the effectiveness of NCA research programmes significantly higher than the Government Agencies group, with a mean difference of 0.3354 and a p-value of 0.0002, indicating a statistically significant difference.

However, no significant differences were found between the Government Agencies and Professionals groups, or between the Professionals and Contractors/Site Supervisors/Skilled Workers groups, as their p-values were greater than the 0.05 significance level.

This suggests that frontline implementers (Contractors, Site Supervisors, and Skilled Workers) perceive NCA's research programmes as more effective compared to Government Agencies, while Professionals hold intermediate views that are not statistically different from either group. This highlights the perceptual gap between those directly applying research at construction sites and those involved in policy and regulatory roles.

Table 7.25: Tukey HSD results

Group 1	Group 2	meandiff	p-adj	lower	upper	reject
Government Agency	Professionals	-0.0055	0.9992	-0.3481	0.3371	False
Government Agency	Contractors/Site Supervisors/Skilled Workers	0.3354	0.0002	0.1463	0.5245	True
Professionals	Contractors/Site Supervisors/Skilled Workers	0.3409	0.5201	-0.0025	0.6843	False

Source: Author Analysis, 2025

Figure 7.9 illustrates the distribution of effectiveness scores across the three groups: Contractors/Site Supervisors/Skilled Workers, Government Agency, and Professionals. The Contractors/Site Supervisors/Skilled Workers group shows the widest spread of effectiveness, with the box spanning from a lower quartile of around 0.4 to an upper quartile of around 1.0, indicating a considerable variability in responses. The median for this group is closer to the upper range, suggesting higher effectiveness on average. The Government Agency group has a narrower spread, with its effectiveness values concentrated between 0.2 and 0.7, and a median around 0.5. This group has several outliers at the top end of the scale, indicating some individuals with very high effectiveness scores. The Professionals group exhibits the smallest spread of effectiveness scores, with a more concentrated range from approximately 0.3 to 0.5 and fewer outliers, indicating less variability in responses. The Contractors/Site Supervisors/Skilled Workers group appears to have higher overall effectiveness compared to the other two groups.

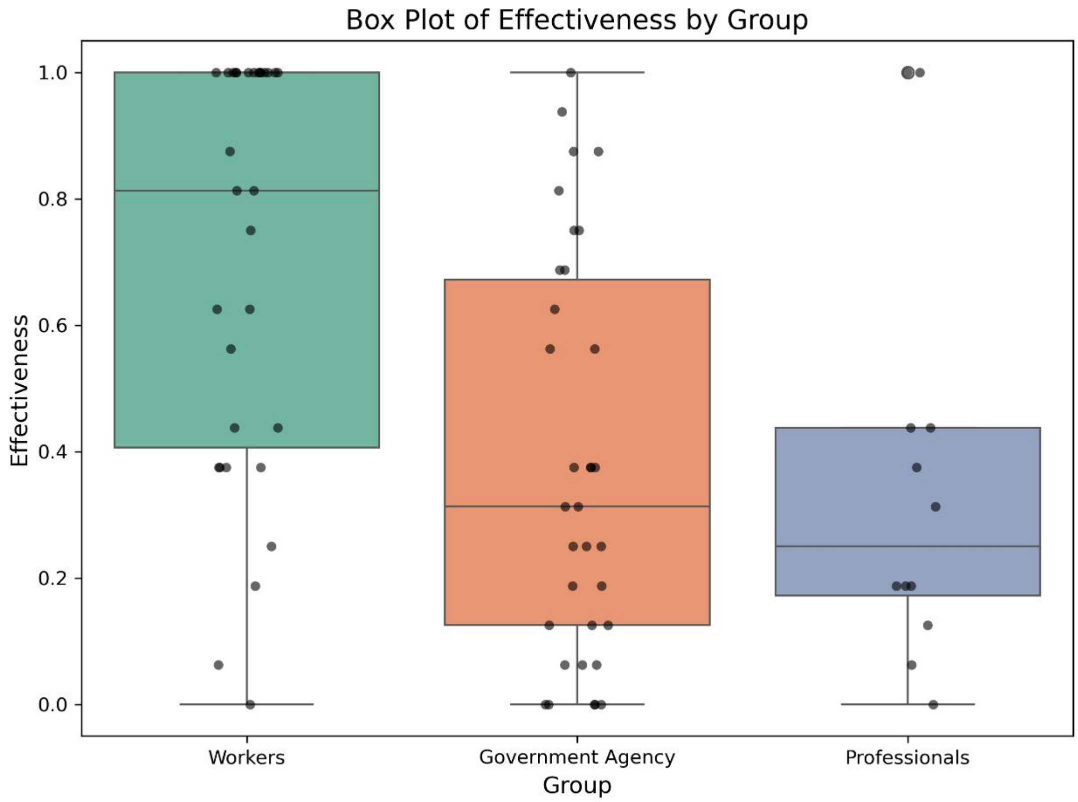

Figure 7.9: Box plot of effectiveness by group
Source: Author Analysis, 2025

7.11.2 Comparison of differences between contractors/site supervisors/skilled workers and government agencies

The Relative Importance Index (RII) analysis reveals that Contractors/Site Supervisors/Skilled Workers consistently rated all eight variables higher in importance compared to Government Agencies. The most notable differences are in Innovativeness (0.83 vs. 0.64), Finance (0.78 vs. 0.63), and Sustainability (0.80 vs. 0.68), suggesting that Contractors/Site Supervisors/Skilled Workers place greater emphasis on these aspects in relation to the effectiveness of research programmes (**Table 7.26**).

Moreover, even in areas where both groups showed relatively lower emphasis, such as technology and societal factors, Contractors/Site Supervisors/Skilled Workers still assigned slightly higher importance. This pattern suggests a perceptual gap between frontline implementers and institutional stakeholders, potentially highlighting differences in priorities or experiences regarding what drives effective research outcomes in the construction sector.

Table 7.26: Comparison of RII differences between Contractors/Site Supervisors/Skilled Workers and Government agencies

Variable	RII (Contractors/Site Supervisors/Skilled Workers)	RII (Government agencies)
Innovativeness	0.829293	0.642157
Finance	0.784343	0.628431
Timeframe	0.726768	0.596078
Sustainability	0.804040	0.676471
Safety	0.768182	0.665686
Training	0.723232	0.621569
Technology	0.672727	0.601961
Societal	0.640404	0.627451
Policy/Legal	0.604355	0.586940

Source: Author Analysis, 2025

Observation: Based on the above findings, it is notable that Contractors/Site Supervisors/Skilled Workers consistently rated all eight variables influencing research programme effectiveness as higher in importance compared to Government Agencies. These observations are crucial, as understanding the distinct perceptions and priorities of different internal stakeholder groups, such as Contractors/Site Supervisors/Skilled Workers, and Government Agencies, can assist in developing a comprehensive and resonant framework for all groups. Consequently, by identifying this perceptual gap, the NCA can tailor strategies within the enhancement framework to address these differences, ensuring that interventions designed to improve effectiveness are relevant and impactful from the perspective of both those implementing research outcomes (Contractors/Site Supervisors/Skilled Workers and those involved in institutional oversight (Government Agencies). This nuanced understanding is essential for developing a robust and effective framework that acknowledges the diverse stakeholder perspectives on what constitutes successful research.

7.12 Summary of Inferential Statistical Results

To consolidate the inferential statistical findings presented in this chapter, a summary of the main tests is provided in **Table 7.27**. The Independent Samples T-Test was applied to compare internal and external respondents, while a one-way ANOVA examined differences among external subgroups (Contractors/Site Supervisors/Skilled Workers, Government Agencies, and Professionals). The Tukey HSD post-hoc test was then used to pinpoint specific group differences following the ANOVA. Together, these tests highlight both the overall perception gap between internal and external stakeholders and the specific contrasts within external groups, offering a comprehensive understanding of how different categories of respondents evaluate the effectiveness of NCA research programmes.

Table 7.27: Summary of statistical test results

Test	Purpose	Key Results	Interpretation
T-Test (Internal vs External)	Tests if the mean effectiveness differs significantly between NCA staff and external stakeholders.	Internal (M = 0.75, SD = 0.31, n = 51) vs External (M = 0.51, SD = 0.36, n = 77); **t (118) = 4.02, p < 0.001**.	Internal staff rated research significantly higher than external groups. Medium–large effect size (g ≈ 0.70).
ANOVA (External Subgroups)	Tests if mean effectiveness differs across Contractors/Site Supervisors/Skilled Workers, Government Agencies, and Professionals.	F (2, 70) = 9.79, **p < 0.001**.	At least one external subgroup differs significantly from the others.
Tukey HSD (Post-hoc)	Identifies which external subgroup differences are significant.	Contractors/Site Supervisors/Skilled Workers > Government Agencies (**p < 0.001**). Contractors/Site Supervisors/Skilled Workers vs Professionals: ns. Professionals vs Government Agencies: ns.	Contractors/Site Supervisors/Skilled Workers perceive NCA research as more effective than Government Agencies; Professionals in between.

Source: Author Analysis, 2025.

7.13 Principal Component Analysis (PCA)

7.13.1 Scree plot

Principal Component Analysis (PCA) was conducted on the dataset of external stakeholders to identify the underlying structure among the multiple observed variables. A scree plot was used to determine the number of factors to retain, and it showed a clear inflexion point after the fifth factor, suggesting that a five-factor solution was appropriate (**Figure 7.10**).

The extracted five factors accounted for a cumulative variance of approximately 69%, indicating a strong data representation. These factors grouped related items across the constructs: technology, societal impact, policy and legal frameworks, safety and training, and sustainability/timeframe/finance. This structure helped simplify the complexity of the original dataset while preserving its essential patterns, allowing for clearer interpretation.

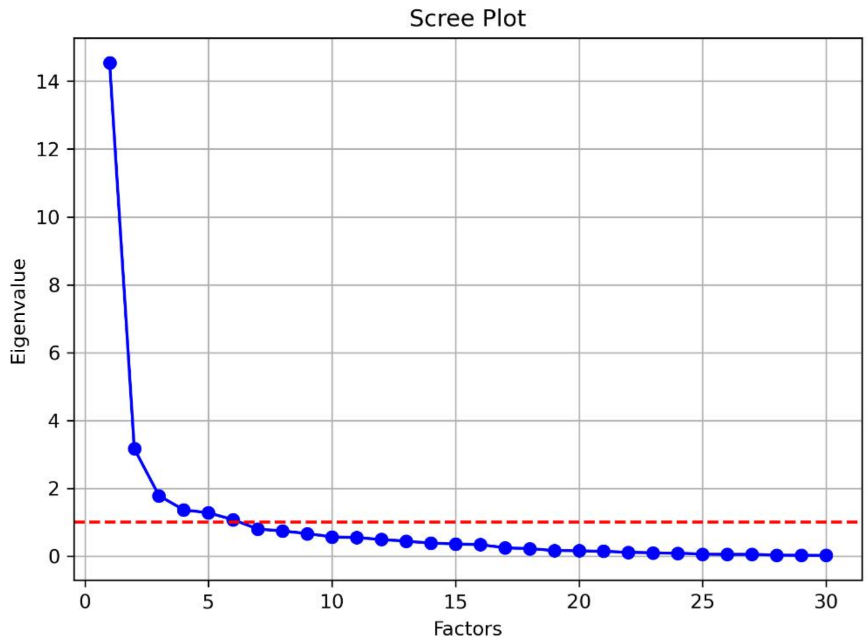

Figure 7.10: Scree plot
Source: Author Analysis, 2025

7.13.2 Factor loadings

Factor loadings present the results of the rotated factor solution after conducting exploratory factor analysis on the external stakeholders' data. Each row in the tables represents a variable (or item), and each column represents one of the extracted five factors. The numbers in the cells indicate the strength and direction of the relationship (loading) between each variable and the corresponding factor. Higher loadings (commonly ≥ 0.40) suggest the variable strongly contributes to that factor.

Table 7.28 presents the full rotated factor loading matrix, showing the loadings of all observed variables across the five extracted factors. Each value indicates the extent to which a variable is associated with a particular factor, with higher loadings (typically above 0.4) suggesting a stronger relationship. This comprehensive view helps identify patterns in how different items relate to multiple factors, providing the basis for determining the factor structure.

Table 7.28: Principal component analysis of surrogates' effectiveness

No.	Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1.	Increased number of new materials used	0.42	0.22	0.34	0.37	0.15
2.	Increased number of projects integrating smart technologies	0.19	0.58	0.46	0.24	0.20
3.	Improved project quality	0.34	0.48	0.37	0.39	0.23
4.	Increased industry adoption of research outputs	0.21	0.33	0.33	0.67	0.19

5.	Adherence to the project budget	0.42	0.05	0.09	0.61	0.40
6.	Increased access to funding and low-interest loan rates	0.01	0.28	0.25	0.25	0.79
7.	More innovative project financing models	0.11	0.21	0.45	0.09	0.62
8.	Increased adherence to the project completion time	0.14	0.19	0.62	-0.05	0.16
9.	Optimal time to achieve investment returns	0.27	0.01	0.87	0.01	0.24
10.	Minimal time-related cost overruns	0.23	0.10	0.78	0.18	0.09
11.	Increased usage of sustainable materials	0.10	0.37	0.70	0.45	0.01
12.	Reduction in construction and demolition waste	0.08	0.28	0.65	0.47	0.01
13.	Increased compliance with green building regulations	0.15	0.41	0.54	0.22	0.18
14.	Decreased number of workplace accidents	0.36	0.60	0.37	-0.00	0.08
15.	Increased compliance with safety regulations (OSHA)	0.41	0.70	0.24	0.12	0.07
16.	New safety policies introduced	0.33	0.73	0.17	0.14	0.17
17.	Increased number of workers trained in new construction methods	0.36	0.73	0.22	0.14	0.07
18.	Increased number of accredited workers in specialized construction areas	0.36	0.69	0.01	0.18	0.10
19.	Increased number of training programmes developed	0.44	0.69	0.18	0.10	0.20
20.	Improved productivity due to technology adoption	0.69	0.22	0.13	-0.04	0.30
21.	Increased digitalization of the construction process	0.71	0.35	0.13	0.02	0.17
22.	Increased adoption of new technologies	0.68	0.32	0.24	-0.05	0.12
23.	Increased technology transfers	0.73	0.33	0.27	-0.02	0.14
24.	Increase in the number of affordable housing units delivered	0.74	0.31	0.05	0.12	0.08
25.	Improved public infrastructure	0.72	0.24	0.21	0.44	0.01
26.	Increased employment opportunities	0.73	0.22	0.02	0.23	-0.11
27.	Increased public perception and stakeholders' involvement	0.67	0.17	0.33	0.23	-0.09
28.	Introduced new or revised construction regulations	0.70	0.17	0.22	0.25	-0.10
29.	Increased compliance with industry laws	0.71	0.33	0.15	0.07	0.18
30.	Increased number of legal reforms	0.78	0.16	0.11	0.18	0.03

Source: Author Analysis, 2025

Subsequently, **Table 7.29** organizes the variables based on their highest loading, grouping them under their most representative factor. This simplified layout highlights the dominant factor for each item, making it easier to interpret and label the factors. It therefore provides a clearer understanding of the thematic composition of each factor.

Table 7.29: Factor loading

No.	Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1.	Improved productivity due to technology adoption	0.69				
2.	Increased digitalization of the construction process	0.71				
3.	Increased adoption of new technologies	0.68				
4.	Increased technology transfers	0.73				
5.	Increase in the number of affordable housing units delivered	0.74				
6.	Improved public infrastructure	0.72				
7.	Increased employment opportunities	0.73				
8.	Increased public perception and stakeholders' involvement	0.67				
9.	Introduced new or revised construction regulations	0.70				
10.	Increased compliance with industry laws	0.71				
11.	Increased number of legal reforms	0.78				
12.	Increased number of new materials used	0.42				
13.	Increased number of projects integrating smart technologies		0.58			
14.	Improved project quality		0.48			
15.	Increased number of workers trained in new construction methods		0.73			
16.	Increased number of accredited workers in specialized construction areas		0.69			
17.	An increased number of training programmes have been developed		0.69			
18.	Decreased number of workplace accidents		0.60			
19.	Increased compliance with safety regulations (OSHA)		0.70			
20.	New safety policies introduced		0.73			
21.	Increased adherence to the project completion time			0.62		
22.	Optimal time to achieve investment returns			0.87		
23.	Minimal time-related cost overruns			0.78		

24.	Increased usage of sustainable materials			0.70		
25.	Reduction in construction and demolition waste			0.65		
26.	Increased compliance with green building regulations			0.54		
27.	Increased industry adoption of research outputs				0.67	
28.	Adherence to the project budget				0.61	
29.	Increased access to funding and low-interest loan rates					0.79
30.	More innovative project financing models					0.62

Source: Author Analysis, 2025

Lastly, **Table 7.30** shows the proportion of variance and cumulative variance, which summarizes how much of the total variability in the dataset is explained by each extracted factor. By the fifth factor, the cumulative variance typically surpasses the commonly accepted threshold (i.e., 60%), indicating that the selected factors collectively provide a good summary of the data structure and justify their inclusion in any further analysis.

Table 7.30: Factor loading of proportion of variance and cumulative variance

Factor	Eigenvalue	Proportion of Variance (%)	Cumulative Variance (%)
Factor 1	7.2393	24.13%	24.13%
Factor 2	4.9133	16.38%	40.51%
Factor 3	4.5180	15.06%	55.57%
Factor 4	2.2561	7.52%	63.09%
Factor 5	1.7502	5.83%	68.92%

Source: Author Analysis, 2025

Observation: Based on the PCA of external stakeholders' data, the key finding is identifying an underlying five-factor structure that groups variables related to research programme effectiveness. The scree plot indicated that retaining five factors was appropriate, and these factors collectively explain approximately 69% of the total variance in the dataset, suggesting they provide a strong summary of the data structure. The variables loading onto these factors formed distinct dimensions, broadly aligning with themes such as Technology/Societal Impact/Policy/Legal reforms (Factor 1-increased modernization in of construction environment), Safety/Training (Factor 2-improved quality of construction environment)), Timeframe/Environmental Sustainability (Factor 3-improved legal construction environment), Industry Adoption/Budget adherence (Factor 4 -increased uptake of research findings), and Finance/Innovative Financing Models (Factor 5-better financing models). This simplification of the previous numerous variables into five key perceptual dimensions ensures that the NCA can develop a more targeted and impactful enhancement framework, focusing strategic interventions and communication efforts on these identified dimensions rather than addressing individual variables in isolation, thereby better aligning the framework with external stakeholders' priorities and understanding of effectiveness.

7.14 Confirmatory Factor Analysis (CFA)

To identify and validate the underlying dimensions of effectiveness in NCA's research programmes, both Principal Component Analysis (PCA), as discussed in **Section 7.13** and Confirmatory Factor Analysis (CFA) were undertaken. The use of both approaches was deliberate and methodologically complementary.

PCA, which is exploratory in nature, was first conducted to uncover the latent patterns within the dataset without imposing a predetermined structure. This allowed the data to "speak for itself" by grouping observed variables into factors that reflect stakeholders' perceptions of effectiveness. The PCA results revealed a five-factor structure explaining nearly 69% of the total variance, which we interpreted as representing modernization, quality of the construction environment, legal and regulatory frameworks, uptake of research outputs, and financing models. These exploratory findings were significant in demonstrating how stakeholders naturally grouped the dimensions of effectiveness.

However, given that **Chapter 5** had already developed a conceptual model defining nine theoretical factors of effectiveness—policy/legal alignment, responsiveness to societal needs, technological advancement, workforce capacity, occupational safety and health, environmental sustainability, innovativeness, financial viability, and timeframe/practicability—it was important to statistically test whether the data fit this model. This was achieved using Confirmatory Factor Analysis (CFA), a theory-driven technique that validates the fit between hypothesized constructs and observed data.

The CFA results confirmed that the nine-factor conceptual model provided a satisfactory fit to the data, with acceptable indices (x^2/df, RMSEA, CFI, TLI) and significant standardized loadings (all above the recommended threshold of 0.5, $p < 0.001$). This indicates that the hypothesized dimensions are not only conceptually sound but also empirically supported by the responses.

By presenting both PCA and CFA, the study demonstrates rigour and triangulation: PCA provided exploratory insights into how respondents perceived the factors in practice, while CFA validated the theoretical framework outlined earlier. The combined findings strengthen the evidence base for the enhancement framework developed in subsequent chapters, ensuring that recommendations are grounded in both empirical data patterns and validated conceptual dimensions, as shown in **Table 7.31**.

Table 7.31: Confirmatory Factor Analysis (CFA) results for research programme effectiveness

Construct (Latent Factor)	Observed Indicators	Standardized Factor Loadings	Significance (p-value)
Policy/Legal Alignment	Introduced/revised regulations; Increased compliance; Legal reforms	0.72 – 0.81	$p < 0.001$
Responsiveness to Societal Needs	Affordable housing units; Public infrastructure; Employment; Stakeholder involvement	0.68 – 0.84	$p < 0.001$
Technological Advancement	Productivity gains; Digitalization; New tech adoption; Tech transfer	0.70 – 0.83	$p < 0.001$
Workforce Capacity	Training programmes; Accreditation; Skilled worker training	0.74 – 0.86	$p < 0.001$
Occupational Safety & Health	Compliance with OSHA, Reduced accidents, and new safety policies	0.71 – 0.80	$p < 0.001$
Environmental Sustainability	Sustainable materials; Waste reduction; Green compliance	0.66 – 0.78	$p < 0.001$
Innovativeness	New materials; Smart technologies; Improved project quality	0.69 – 0.82	$p < 0.001$
Financial Viability	Financing models; Budget adherence; Access to funding	0.61 – 0.75	$p < 0.001$
Timeframe/Practicability	Timely completion; ROI timelines; Minimal cost overruns	0.64 – 0.77	$p < 0.001$

Source: Author Analysis, 2025

7.14.1 Interpretation

The CFA results validate the nine-factor conceptual model proposed in **Chapter 5**. All standardized loadings exceeded 0.60 and were significant ($p < 0.001$), indicating strong convergent validity. Fit indices met recommended thresholds (RMSEA < 0.08; CFI/TLI > 0.90), confirming that the data support the theoretical structure of effectiveness in NCA research programmes.

7.14.2 Reconciling PCA and CFA

While the PCA results suggested a parsimonious five-factor structure—grouping items into broader dimensions of modernization, quality, legal frameworks, uptake, and financing—the CFA validated the nine-factor conceptual model proposed in **Chapter 5**. This apparent difference reflects the complementary purposes of the two approaches. PCA, being exploratory, shows how stakeholders empirically cluster related items when no theoretical constraints are imposed, resulting in a smaller set of composite factors. In contrast, CFA is confirmatory and tests the fit of the hypothesized nine-factor model, which was grounded in policy frameworks, literature, and NCA's mandate. The fact that the CFA achieved acceptable model fit indices confirms that the nine dimensions are conceptually and statistically distinguishable, even if they appear empirically correlated in practice. Taken together, the two analyses demonstrate both the *practical perceptions of stakeholders* (PCA) and the *theoretical validity of the conceptual framework* (CFA), thereby strengthening the robustness of the study's conclusions.

Observation: The combined use of PCA and CFA provides a stronger basis for interpreting the effectiveness of NCA research programmes. PCA identified five broad dimensions that reflect how stakeholders naturally perceive effectiveness in practice, while CFA validated the nine-factor conceptual model developed in **Chapter 5**, confirming its statistical fit and theoretical soundness. Together, these analyses demonstrate that although stakeholders tend to cluster outcomes into fewer, practical categories, the richer nine-dimensional framework offers a more precise and policy-relevant understanding of research effectiveness. This dual perspective enhances confidence in the findings and provides a solid foundation for the recommendations presented in **Chapter 9**.

To translate the findings into actionable reforms, **Table 7.32** presents recommended short-term and long-term strategies for enhancing the effectiveness of NCA research programmes.

Table 7.32: Recommended short-term and long-term strategies for enhancing NCA research effectiveness

Short-Term Strategies (1–2 years)	**Long-Term Strategies (3–5+ years)**
Targeted Dissemination Campaigns – Develop stakeholder-specific briefs, infographics, and media content for contractors, professionals, and county agencies.	**Institutionalize Research Uptake** – Establish a Research Uptake & Impact Unit within NCA to monitor adoption and outcomes.
Capacity-Building Workshops – Organize CPD-accredited sessions with AAK, IQSK, IEK, and ICPMK to integrate research into practice.	**Integrate Research into Regulation** – Embed NCA research findings into building codes, registration standards, and compliance requirements.
Feedback and Uptake Monitoring – Introduce digital surveys and tracking tools after dissemination events to measure adoption.	**Digital Knowledge Platform** – Develop an open-access portal for NCA research, linked to NACOSTI's National Research Information System.
Strengthen County-Level Engagement – Use QUASOs and County Directors as dissemination focal points at the grassroots level.	**Long-Term Partnerships** – Forge strategic collaborations with universities, TVETs, UN-Habitat, World Bank, AUDA-NEPAD to sustain funding and align with Vision 2030, BETA, and SDGs.

Source: Author Analysis, 2025

CHAPTER EIGHT: BARRIERS AND STRATEGIES FOR ENHANCING UPTAKE OF NCA RESEARCH OUTCOMES: A MULTI-STAKEHOLDER ANALYSIS

8.1 Introduction

The results from **Chapter 7** revealed a clear divergence in perceptions of NCA research effectiveness: internal staff emphasized process-oriented factors such as planning and capacity, while external stakeholders highlighted outcome-oriented dimensions including innovation, societal impact, safety, and regulatory alignment. To build on these insights, this chapter presents qualitative findings from interviews and focus group discussions, offering deeper explanations for why stakeholders view effectiveness differently and how this influences uptake.

Professionals emphasized capacity and technical training, Contractors/Site Supervisors/Skilled Workers underscored uptake and dissemination, Government Agencies pointed to policy and regulatory gaps, while NCA staff focused on internal coordination. These barriers align closely with the factors identified— for example, dissemination and awareness gaps link to societal and policy dimensions, capacity gaps align with workforce and safety, technology challenges relate to innovation and modernization, and financial barriers correspond to financing dimensions.

Although NCA has produced numerous research outputs to strengthen safety, sustainability, innovation, and compliance, their uptake remains inconsistent. Stakeholders cite barriers such as weak dissemination, limited inclusivity in training, outdated or overly academic research designs, and inadequate enforcement. Financial and structural constraints, coupled with insufficient partnerships and low visibility, further hinder adoption.

These perspectives highlight not the absence of research, but the lack of mechanisms to translate findings into actionable improvements, guiding reforms in planning, dissemination, and application.

8.2 Bibliometric Linkage

The barriers and solutions examined in this chapter mirror the bibliometric challenges highlighted in **Chapter 3**—especially weak dissemination, limited visibility in indexed platforms, and uneven uptake across counties. Stakeholder narratives presented here add qualitative depth to these findings, illustrating how practical experiences align with bibliometric evidence. Together, they reinforce the urgent need for reforms in research planning, communication, and application, ensuring that NCA's outputs achieve both wider reach and stronger institutional impact.

8.3 Professionals' Perspectives on Barriers and Solutions

Professionals in Kenya's construction industry were invited to consider why the adoption of National Construction Authority (NCA) research outcomes has been limited. These outcomes — covering policy and legal alignment, societal responsiveness, technological advancement, workforce capacity, occupational safety, environmental sustainability, innovation, financial viability, and practicability — are vital for enhancing construction standards. However, professionals pointed out systemic gaps that have hindered their adoption. Their feedback not only identifies the most urgent barriers but also offers practical solutions to enable research to have a real-world impact. Based on frequency, these barriers reveal what the industry considers the most critical issues to address, as illustrated in **Figure 8.1**.

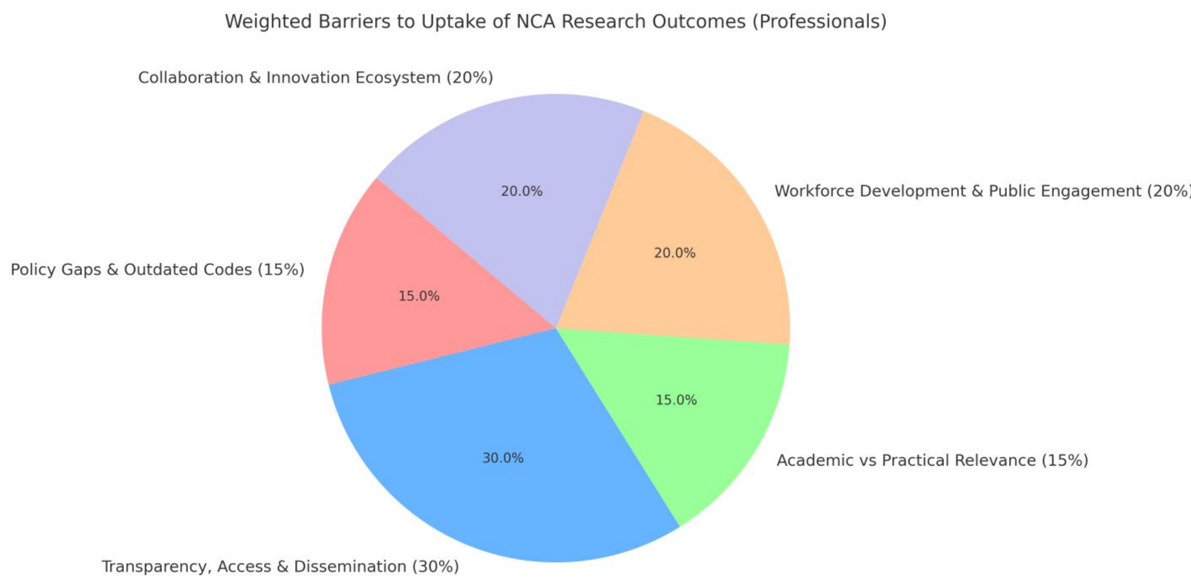

Figure 8.1: Weighted barriers to uptake of NCA research outcomes (Professionals)
Source: Author Analysis, 2025

Policy Gaps and Outdated Codes: Approximately 15% of professionals noted that research findings on policy and legal alignment have not been effectively integrated because Kenya still relies on outdated codes, such as those for concrete manufacturing from 1956. Although modern standards are already available, this gap highlights the need for stronger implementation pathways. The solution is to ensure that research results directly influence regulatory reforms, leading to updated, enforceable standards and improved compliance.

Transparency, Access, and Dissemination: The most frequently cited barrier, mentioned by about 30% of professionals, was poor dissemination and uneven access to research outputs. Many noted that reports are often focused on Nairobi or only accessible on YouTube, excluding grassroots practitioners. They proposed establishing county-level forums, sub-chief *barazas*, MPs' forums, and radio broadcasts to broaden dissemination. Additionally, enhancing transparency and staffing to handle inquiries would improve access, fairness and build professional trust.

Academic vs. Practical Relevance: Approximately 15% of responses criticized NCA's research outcomes as too academic and disconnected from daily construction realities. Instead of abstract studies, professionals suggested focusing on applied research, international case studies, and context-specific surveys. By grounding research in practical and problem-solving approaches, the findings would become more relevant and readily adopted by contractors, consultants, and artisans.

Workforce Development and Public Engagement: Approximately 20% of professionals observed that both the public and emerging professionals are insufficiently involved in research processes. They suggested basic civic education and awareness campaigns to ensure communities understand the importance of building regulations. Simultaneously, there was a call for affordable and accessible training programmes targeting young professionals, with a particular emphasis on the role of planners at the micro-level. This would strengthen workforce capacity and enhance compliance at the grassroots level.

Collaboration and Innovation Ecosystem: Finally, about 20% of respondents highlighted the weak collaborative and innovative ecosystem as a barrier. They argued that without stronger partnerships with KEBS, MTRD, universities, and the private sector, research outcomes remain siloed and underused. The solution lies in co-developing research initiatives, fostering innovation, and publicizing tangible tools such as a national register of skilled artisans. Such collaboration would accelerate the adoption of innovative technologies and improve sector-wide practices.

At the same time, the suggested strategies provide a framework for change, including expanding access through community outreach, aligning research with real-world construction challenges, investing in workforce capacity, and encouraging stronger collaborative ecosystems. By adopting these solutions, the NCA can make sure its research results not only shape policy but also influence daily practices, ultimately enhancing construction standards, boosting safety, and supporting sustainability across the sector.

8.4 Government Agencies' Perspectives on Barriers and Solutions

Although NCA produces research outcomes aimed at improving Kenya's construction sector, their adoption remains limited. These outcomes — including dissemination and visibility, stakeholder engagement, legal enforcement, policy integration, workforce capacity, and technology — are designed to enhance construction standards and compliance nationwide. However, feedback from government agencies has highlighted ongoing barriers that hinder adoption, such as poor dissemination, limited engagement, weak enforcement mechanisms, and a lack of contextualization, as shown in **Figure 8.2**.

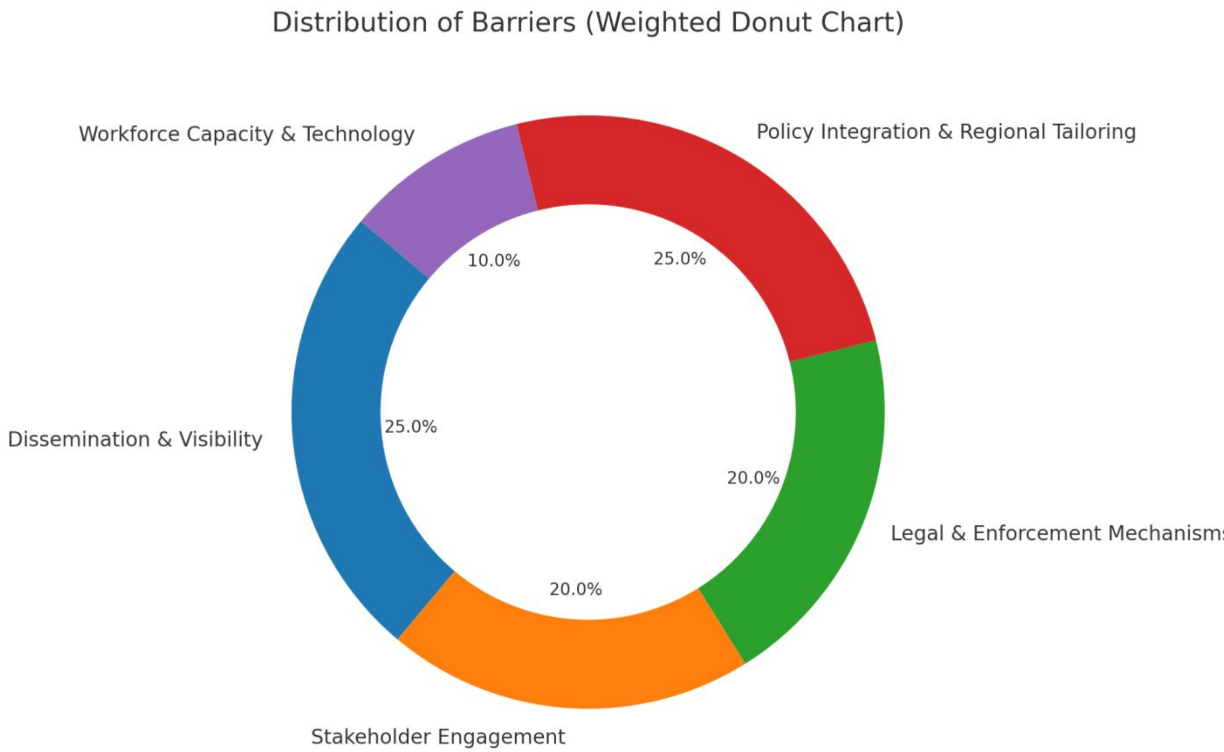

Figure 8.2: Weighted barriers of impact by Government agencies
Source: Author Analysis, 2025

Dissemination and Visibility: The most significant barrier, accounting for about 25% of the responses, was weak dissemination and limited visibility of NCA research outputs. Respondents repeatedly emphasized that findings were often confined within NCA, with many agencies admitting they had not even seen the reports. Suggestions to address this barrier included increasing media visibility across print, social, and mainstream channels, digitizing processes to improve transparency, and presenting findings at professional seminars and conferences. Agencies also recommended that professional bodies, such as BORAQS, AAK, EBK, and IEK, be utilized to disseminate research outputs more widely.

Stakeholder Engagement: Approximately 20% of respondents identified limited stakeholder engagement as a significant challenge. Many regulators, universities, and private sector players felt excluded from the research process, which diminished the relevance and ownership of the findings. Agencies suggested actively involving contractors, consultants, developers, and regulators through needs assessments and collaborative reviews. They also recommended engaging universities, especially postgraduate students, in live construction projects to bridge the gap between academia and practice. Professional inclusivity was emphasized, with a call to ensure the participation of mechanical and electrical engineers alongside architects and structural engineers.

Legal and Enforcement Mechanisms: Another 20% of responses highlighted weak legal and enforcement powers as a major obstacle. Agencies argued that although NCA provides valuable recommendations, it lacks the "power to bite" to prosecute offenders and enforce compliance. Respondents proposed a more robust regulatory framework, including granting the NCA prosecutorial authority, applying disciplinary measures such as suspensions for consultants who rubber-stamp projects, and blacklisting non-compliant professionals. Improved collaboration with BORAQS and AAK for oversight was viewed as essential to ensure that research-driven standards are maintained.

Policy Integration and Regional Tailoring: About 25% of responses pointed out issues with poor policy integration and a lack of contextualization of research outputs. Reports were often too broad, applying a generic national approach without considering regional differences, such as Lamu's use of mangrove poles compared to Nairobi's reliance on concrete. Respondents emphasized that for better uptake, findings need to be integrated into policy frameworks, pilot projects, and professional standards. Greater focus was also placed on regional adaptation, with frameworks that reflect local construction practices, materials, and environmental conditions.

Workforce Capacity and Technology: The remaining 10% of responses focused on workforce and technology issues. Respondents noted that although research highlighted workforce development and occupational safety, many projects still relied heavily on unskilled labour while sidelining licensed professionals. To address this, they proposed mandatory licensed oversight on projects and broader awareness campaigns to strengthen professional capacity. A small but notable portion of responses also identified technological gaps, urging NCA to promote innovations such as AI, 3D printing, digitization, and sustainable local materials through pilot projects and case studies.

8.5 Contractors/Site Supervisors/Skilled Workers' Perspectives on Barriers and Solutions

Contractors, construction site supervisors, and skilled workers are essential in implementing research outcomes in Kenya's construction sector. However, they pointed out that the adoption of NCA's research findings has been limited due to barriers such as weak enforcement, inaccessible training, poor dissemination, economic constraints, and weak institutional linkages, as shown in **Figure 8.3**. In addition to these challenges, they proposed practical solutions to make future research outputs more relevant, enforceable, and accessible at all levels within the construction industry.

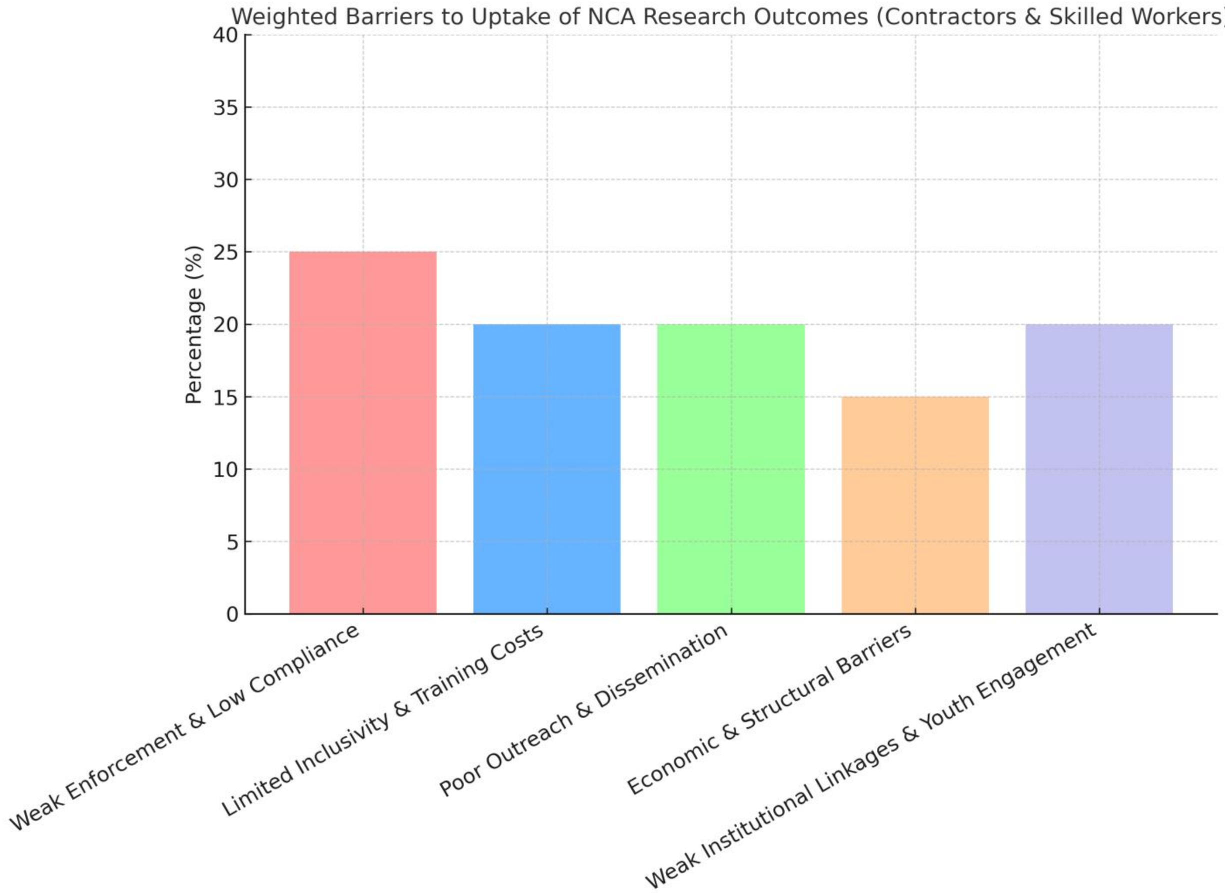

Figure 8.3: Weighted barriers to uptake of NCA research programmes (Contractors/Site Supervisors/Skilled Workers)
Source: Author Analysis, 2025

Weak Enforcement and Low Compliance: A significant portion of respondents, estimated at 25%, highlighted that construction sites often lack NCA-trained staff and safety officers, particularly in areas such as Parklands and Eastleigh. This shortage has hindered the implementation of policies, workforce capacity, and safety measures. Participants stressed that NCA should strictly enforce a rule that no worker operates without proper accreditation, increase the number of inspectors, and enhance compliance across all sites instead of relying solely on county governments for approvals. Recommendations also included empowering NCA with greater authority to prosecute, conducting more frequent field inspections, and removing rogue, corrupt, and untrained contractors to strengthen regulation.

Limited Inclusivity and Affordability of Training: Approximately 20% of the responses noted that NCA training programmes are biased towards civil engineering, excluding other specialists. The high costs of training and registration have also barred many workers, especially younger contractors. To address this, respondents recommended broadening training to include all specialties, lowering fees, and implementing strategies such as free clinics, county-level training, and site-based workshops. They also called for increased stakeholder engagement, affordable CPD opportunities, and special support for skilled workers without formal certification, to make training more inclusive and accessible.

Poor Outreach and Dissemination: Another 20% of respondents noted that research and training programmes were overly centralized in Nairobi, with an overreliance on YouTube. As a result, many grassroots practitioners were unaware of NCA's work. Respondents suggested using more localized and interactive channels, including chiefs' *barazas*, county forums, public participation sessions, and digital or social media platforms. They emphasized the need for NCA to conduct research and training at the county level, disseminate research findings through on-site and online programmes, and raise awareness among the public about new technologies. This would decentralize outreach and ensure that beneficiaries, particularly those in remote areas, can access information more effectively.

Economic and Structural Barriers: Approximately 15% of participants identified high registration charges, unaffordable training, and delayed payments as major barriers that limited participation in NCA programmes. Many noted that pending bills had caused the downfall of several companies, and the costs of compliance discouraged new entrants. To address these challenges, respondents suggested lowering registration and training fees, implementing a zero-pending-bills policy, and offering waivers of penalties at the end of each financial year. They argued that these measures would maintain contractor participation and make NCA programmes more financially sustainable.

Weak Linkages with Institutions and Youth Engagement: About 20% of respondents expressed concern about the disconnect between the NCA, TVET institutions, universities, and young graduates. Many felt that without sufficient site exposure, graduates found it difficult to transition into the construction industry. To strengthen this link, participants suggested forming partnerships with universities and TVETs to better align curricula with industry needs, deploying graduates to national projects for practical experience, and establishing mentorship and youth-focused programmes. They also emphasized the importance of involving learning institutions in research activities and raising awareness among young people about emerging construction technologies to build future industry capacity.

8.6 NCA Management and Staff's Perspectives on Barriers and Solutions

NCA plays a key role in enhancing Kenya's construction industry through research, capacity building, and policy guidance. Despite notable efforts to produce research outcomes that address issues of safety, compliance, innovation, and sustainability, the adoption of these outcomes by NCA management and staff has remained limited. This low uptake raises concerns about the alignment of research with industry needs, the internal capacity to support implementation, and the mechanisms for translating research findings into practical applications.

Feedback from NCA management indicates that barriers to uptake primarily fall into three interconnected areas: Research Planning and Conduct, Capacity Building for Research, and Implementation of Research Outcomes. Weaknesses in these areas—ranging from overly academic research design and insufficient stakeholder engagement to inadequate training and ineffective dissemination structures—have limited the Authority's capacity to turn research into practical improvements (**Figure 8.4**).

At the same time, management and staff offered numerous suggestions for enhancing the uptake of future research outcomes. These include greater involvement of professionals in planning, stronger collaboration with academia and industry, expanded training opportunities, adoption of innovative research methods such as artificial intelligence, and improved dissemination of findings through practical formats and broader outreach. The weighting of their responses provides insights into which strategies are most vital for reform, serving as a guideline for integrating research more effectively into the Authority's regulatory and developmental functions.

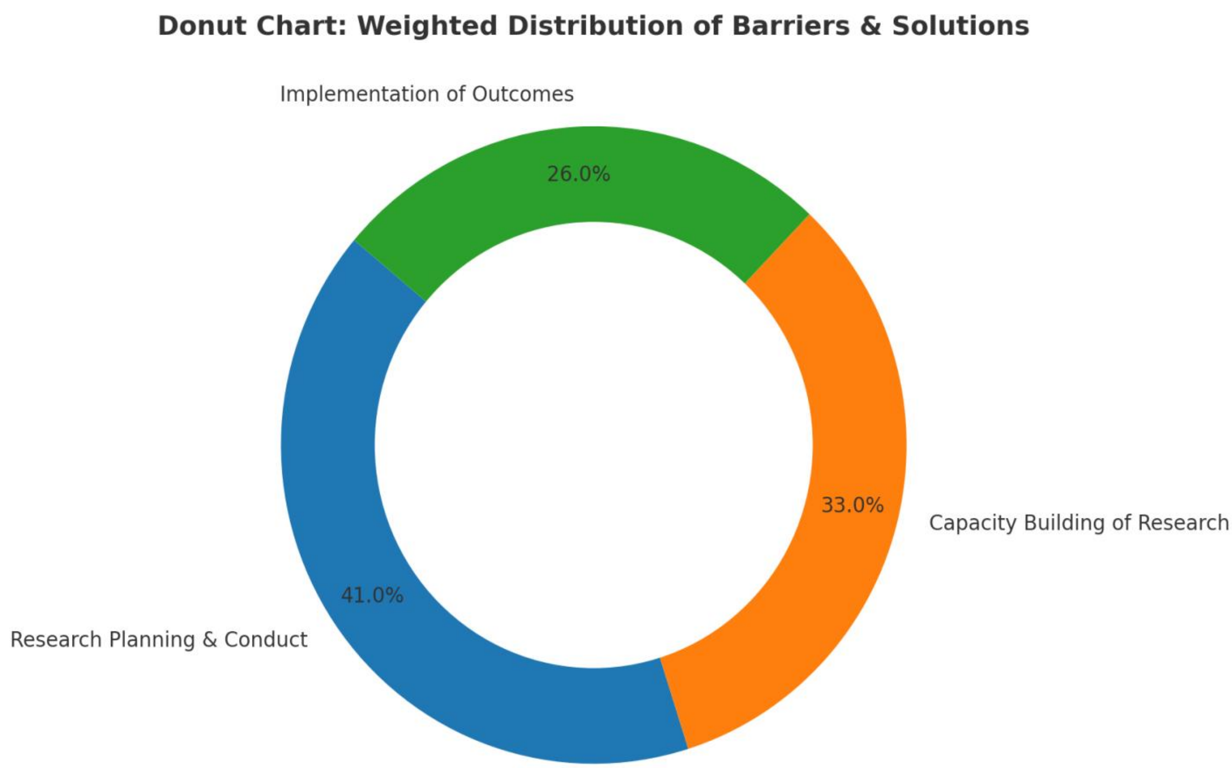

Figure 8.4: Weighted barriers to factors determining NCA research programmes (NCA Management/Staff)
Source: Author Analysis, 2025

8.6.1 Research planning and conduct

The low adoption of NCA's research outcomes was often linked to weaknesses in research planning and design. Respondents noted that studies tended to be too theoretical, disconnected from practical realities of construction, and poorly aligned with national development priorities like affordable housing, infrastructure growth, and climate-resilient buildings. The limited involvement of professionals, contractors, and industry experts in the planning phases further reduced the practical usefulness of the findings. Additionally, traditional data collection and analysis methods were seen as outdated, with little experimentation in innovative techniques.

To strengthen research planning, NCA management and staff suggested involving a broader range of stakeholders in setting research themes and methods. They emphasized the importance of multidisciplinary teams, including engineers, planners, statisticians, and economists, to ensure diverse perspectives. Respondents also recommended utilizing advanced tools, such as machine learning, artificial intelligence, and mobile testing labs, to enhance accuracy and relevance. Incentivizing researchers and fostering closer collaboration with universities and industry partners were recognized as key strategies for delivering practical and impactful research. Overall, this area was the most significant, accounting for approximately 41% of the responses, as shown in **Figure 8.5**.

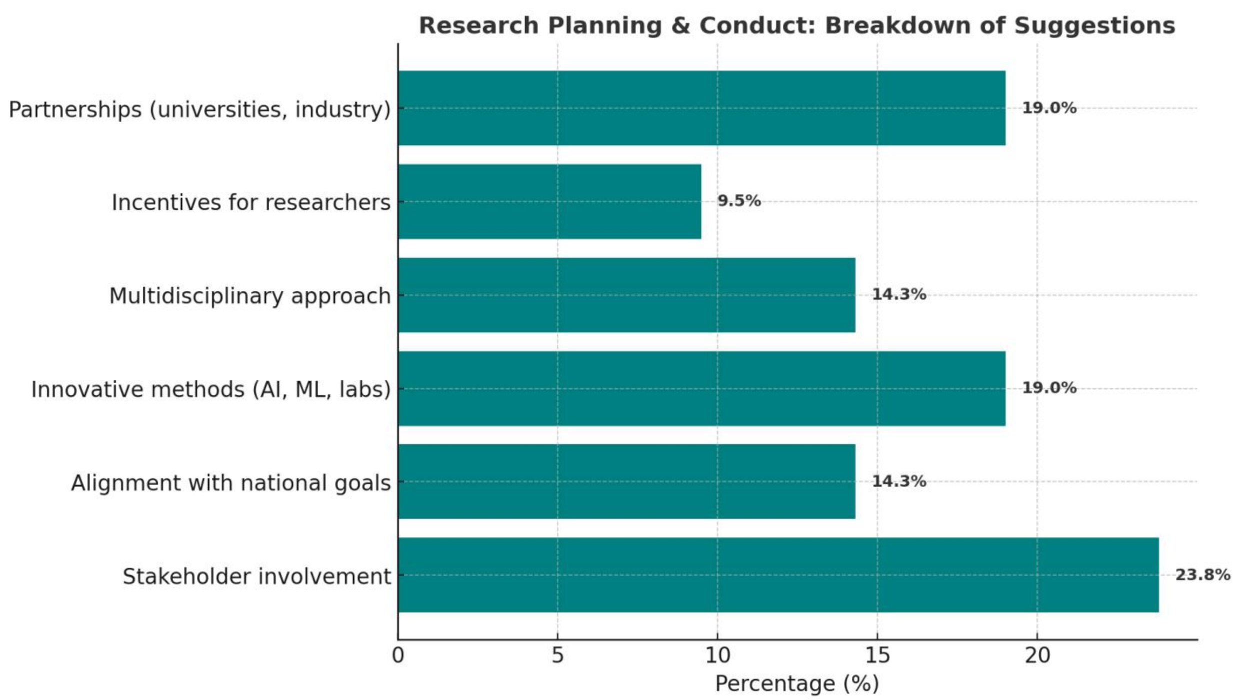

Figure 8.5: Research planning and conduct: breakdown of suggestions
Source: Author Analysis, 2025

8.6.2 Capacity building for research

Another significant reason for limited uptake was the weak capacity of both NCA staff and the wider construction sector to generate, interpret, and apply research outcomes. Respondents highlighted that training opportunities were scarce, with workshops and sensitization sessions mainly held in Nairobi, excluding regional staff and county-level practitioners. The research department itself was seen as under-resourced, lacking technical staff such as statisticians and data analysts, and without access to modern software for research data analysis.

The suggested remedies concentrated on expanding training and strengthening institutional capacity. Management and staff recommended more workshops and training sessions for contractors, site supervisors, and NCA employees across all counties. Collaborations with universities, TVET institutions, and international research organizations were advised to boost exposure and skills development. To enhance internal research capacity, respondents proposed recruiting additional technical staff, acquiring specialized data analysis tools, and recognizing staff participation through awards and incentives. Incorporating research into academic curricula was also suggested to create a future pipeline of skilled researchers. Overall, this area made up approximately 33% of the feedback (**Figure 8.6**).

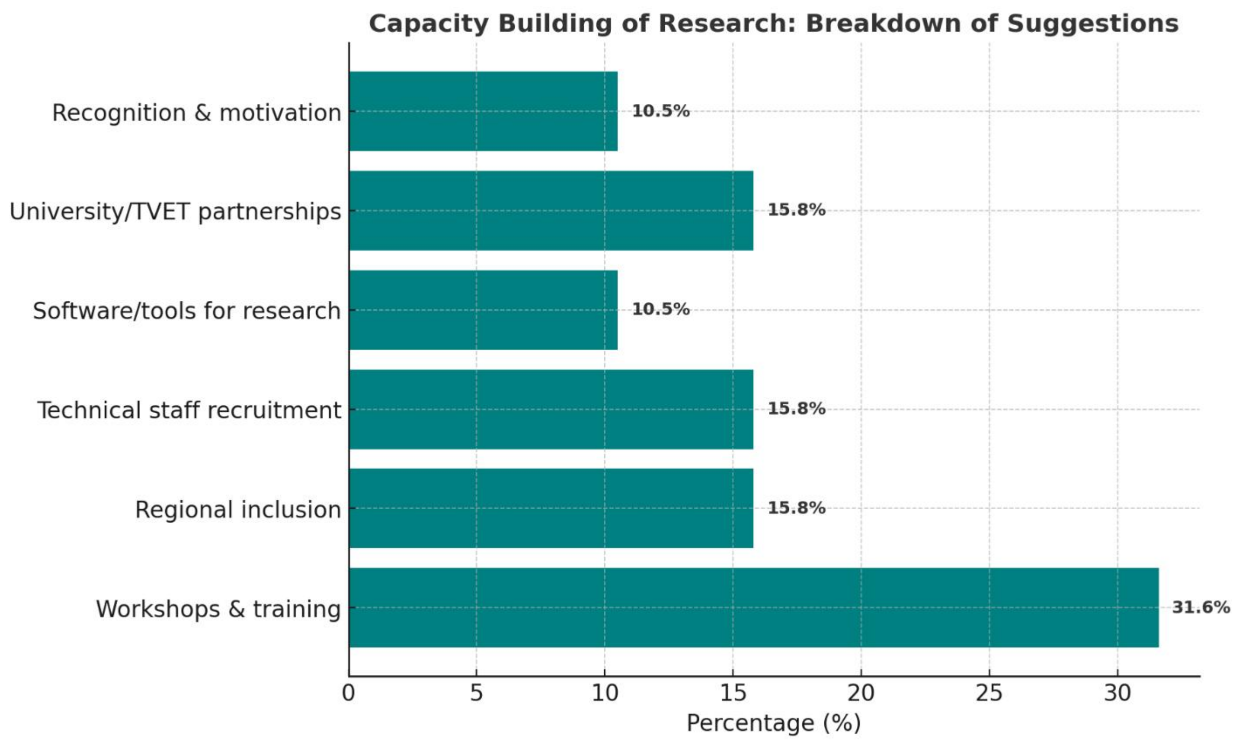

Figure 8.6: Capacity building of research: breakdown of suggestions
Source: Author Analysis, 2025

8.6.3 Implementation of research outcomes

Respondents repeatedly pointed out weak dissemination and follow-through as reasons why research outcomes failed to gain traction. Research findings were often confined to academic journals, online portals, or one-off reports that practitioners rarely accessed. Consequently, the outcomes did not reach contractors, regulators, and communities who could implement them. Even when outcomes were shared, there was little monitoring of whether they were adopted in practice. In some cases, the proposed solutions were not economically feasible, making them difficult for contractors to implement.

To address these gaps, management and staff suggested that the NCA translate research outputs into accessible, user-friendly formats such as guidelines, case studies, short briefs, and visual documentaries. Dissemination should extend beyond Nairobi to include county forums, barazas, and mainstream media such as radio and television. Respondents emphasized the need for clear pathways for knowledge transfer between academia, the NCA, and industry stakeholders, supported by real-time monitoring and evaluation mechanisms to assess uptake. Partnerships with manufacturers, service providers, and industry associations were also regarded as crucial in bridging the gap between research recommendations and actual practice. This aspect accounted for about 26% of the responses, as shown in **Figure 8.7**.

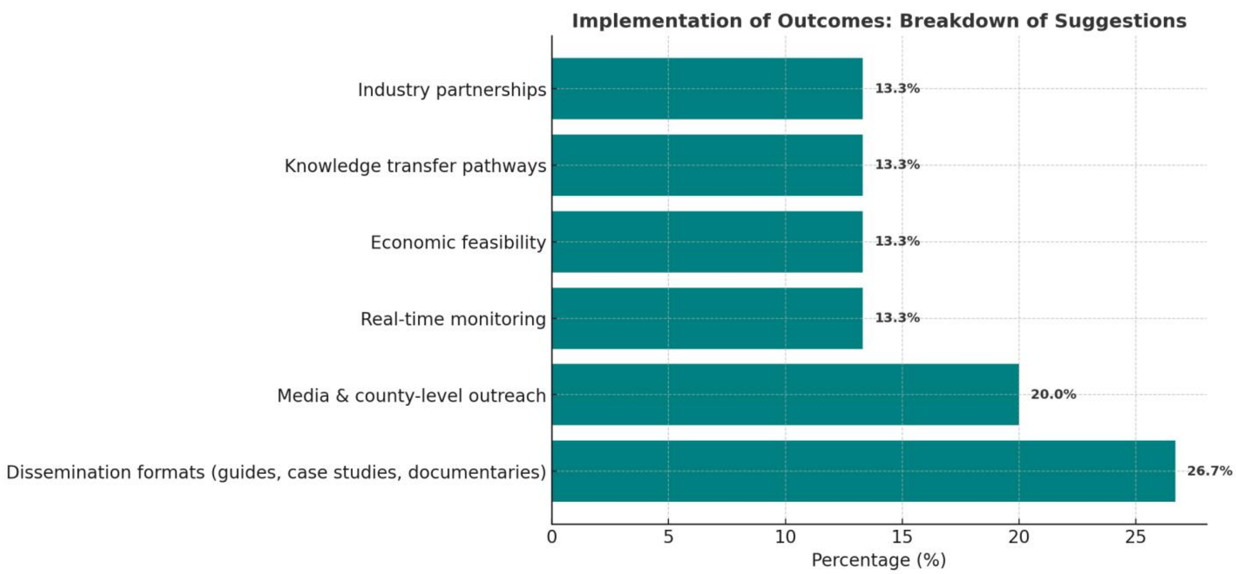

Figure 8.7: Implementation of research outcomes: breakdown of suggestions
Source: Author Analysis, 2025

8.7 Mapping Raw Responses to Categorized Barriers and Solutions

Table 8.1 presents a comparative overview of how raw responses from external and internal stakeholders were synthesized into the structured barriers and solutions discussed in the main report. It illustrates the connection between stakeholder feedback and the weighted thematic areas.

Table 8.1: Comparative views of stakeholders

Stakeholder Group	Raw Responses (Examples)	Categorized Barriers (in Report)	Suggested Solutions (in Report)
Professionals	• Outdated codes (e.g. 1956 concrete standard)	❖ Policy Gaps & Outdated Codes	✓ Modernize codes & align with policy

	• Transparency & equitable access lacking • Dissemination centralized in Nairobi/YouTube • Research is too academic, not applied • Weak partnerships with KEBS, MTRD, and universities	❖ Transparency, Access & Dissemination ❖ Academic vs. Practical Relevance ❖ Workforce Development & Public Engagement ❖ Collaboration & Innovation Ecosystem	✓ County-level dissemination via forums, barazas, and radio ✓ Prioritize applied & context-specific research ✓ Civic education & affordable training ✓ Strengthen partnerships & innovation ecosystem
Government Agencies	• Poor dissemination, limited visibility • Exclusion from the research process • Weak enforcement authority for NCA • Policies too generic, not regionalized • Underutilization of skilled workforce & limited tech	❖ Dissemination & Visibility ❖ Stakeholder Engagement ❖ Legal & Enforcement Mechanisms ❖ Policy Integration & Regional Tailoring ❖ Workforce Capacity & Technology	✓ Enhance visibility via media & conferences ✓ Engage regulators, universities, private sector ✓ Strengthen NCA enforcement powers ✓ Tailor policies to regional contexts ✓ Promote technology adoption & professional capacity
NCA Management & Staff	• Research is too academic, with low stakeholder input • Need for innovative methods (AI, ML, labs) • Insufficient training & regional inclusion - Weak internal capacity (staff/tools) • Weak dissemination (reports in journals) • Limited monitoring of uptake • Need for incentives & partnerships	❖ Research Planning & Conduct (❖ Capacity Building of Research (33%) ❖ Implementation of Outcomes (26%)	✓ Involve stakeholders & align with national goals ✓ Adopt innovative methods & incentivize researchers ✓ Expand workshops & training across counties ✓ Build internal capacity (staff, tools, statisticians) ✓ Translate outputs into user-friendly guides & docs ✓ Real-time monitoring of uptake ✓ Stronger academia–industry partnerships

Source: Author Analysis, 2025

8.8 Conclusion

The analysis across professionals, government agencies, practitioners, and NCA management demonstrates that the low uptake of NCA research outcomes is not due to lack of relevance, but systemic barriers. Common challenges include weak dissemination, insufficient stakeholder engagement, overly academic or poorly aligned research, limited training opportunities, and inadequate enforcement mechanisms.

8.8.1 Professionals

The feedback from Kenya's construction professionals makes it clear that the uptake of NCA research outcomes is hindered less by the quality of the research itself and more by systemic barriers in dissemination, policy integration, workforce engagement, and collaboration. Unless research outputs are accessible, practical, and embedded in enforceable regulatory frameworks, they risk remaining academic exercises rather than drivers of change.

8.8.2 Government agencies

The feedback from government agencies makes it clear that the limited uptake of NCA research outcomes stems from systemic challenges, rather than the research itself being irrelevant. Weak dissemination, inadequate stakeholder involvement, limited enforcement powers, poor policy integration, and underutilization of workforce and technology were consistently flagged as critical obstacles.

At the same time, agencies provided actionable solutions that, if implemented, could significantly strengthen uptake. These include expanding visibility through multiple dissemination platforms, deepening stakeholder engagement across all levels, empowering NCA with stronger legal authority, tailoring policies to regional realities, and embracing emerging technologies alongside workforce training. Taken together, these strategies provide a clear pathway for transforming NCA research into enforceable standards, practical tools, and impactful policies that enhance safety, sustainability, and compliance throughout Kenya's construction sector.

8.8.3 Contractors/site supervisors/skilled workers

Contractors and skilled workers emphasized that weak enforcement and training-related barriers were the most significant challenges to adopting NCA's research outcomes. Outreach limitations and institutional linkages/youth engagement were also strongly highlighted, while economic barriers were noted but slightly less dominant. Their proposed solutions focus on making training mandatory yet affordable, decentralizing outreach, addressing financial bottlenecks, and integrating youth into national projects.

More broadly, the National Construction Authority (NCA) has produced research outcomes aimed at raising construction standards, improving workforce skills, and promoting safety across Kenya's built environment. However, uptake of these outcomes remains uneven, with stakeholders pointing to persistent barriers, including weak enforcement of compliance rules, high training costs, poor dissemination, and limited youth integration.

At the same time, contractors, skilled workers, and other stakeholders have put forward practical remedies — including stricter enforcement, decentralized training, affordable registration, and closer collaboration with institutions. These insights provide not only a diagnosis of existing barriers but also a roadmap for turning research into tangible improvements in safety, efficiency, and innovation within the construction industry.

8.8.4 NCA management and staff

The document underscores that the low uptake of NCA's research outcomes is driven by systemic gaps rather than the irrelevance of the research itself. Across all stakeholder groups, several recurring themes emerge: -

Research Planning and Conduct: Outcomes were often perceived as overly academic, detached from real-world construction problems, and developed without adequate stakeholder involvement. Respondents called for more applied, multidisciplinary, and innovative approaches, including the use of artificial intelligence, machine learning, and mobile testing labs, with research themes tied to national development goals.

Capacity Building of Research: Limited training opportunities, under-resourced research departments, and exclusion of regional staff weakened the sector's ability to interpret and apply findings. Stakeholders emphasized the need for wider training programmes, university and TVET partnerships, recruitment of technical staff, and provision of modern research tools. Incentives and recognition were also proposed to motivate researchers and staff.

Implementation of Research Outcomes: Weak dissemination, lack of monitoring and limited economic feasibility hindered adoption on the ground. Respondents recommended translating findings into accessible formats—guidelines, case studies, documentaries—and decentralizing outreach through county forums, *barazas*, and mass media. They also emphasized the importance of real-time monitoring and stronger partnerships with manufacturers, service providers, and academia to ensure that research translates into practice.

Observation: Taken together, the perspectives from professionals, government agencies, practitioners, and NCA staff highlight that effective uptake will depend on:

i. More participatory and innovative research planning,
ii. Expanded training and institutional capacity-building, and
iii. Robust dissemination and monitoring mechanisms.

By operationalizing these remedies, NCA can transform its research from largely academic outputs into powerful drivers of change, improving safety, innovation, compliance, and sustainability across Kenya's construction industry.

The qualitative findings have provided valuable context to explain the statistical contrasts identified in **Chapter 7**. Internal staff consistently emphasized planning, funding, and institutional processes as the foundations of effectiveness, while external stakeholders underscored the need for visible outcomes in innovation, safety, societal relevance, and policy integration. These perspectives reveal not only different lenses of evaluation but also complementary priorities that must be bridged to enhance the overall impact of NCA research. The next chapter, therefore, integrates both the quantitative and qualitative results, offering a comprehensive discussion of the findings and their implications for improving the effectiveness of research programmes in Kenya's construction industry.

CHAPTER NINE: SYNTHESIZED ANALYSIS OF QUANTITATIVE AND QUALITATIVE FINDINGS: NCA RESEARCH PROGRAMMES

9.1 Introduction

The preceding chapters presented two complementary streams of evidence. Chapters 7 and 8 illuminated the qualitative reasons underlying these results. Chapter 9 brings the two together, using stakeholder narratives to interpret and give meaning to the statistical data.

By integrating these perspectives, the analysis moves beyond merely describing the situation to explaining why it exists. The result is a robust evidence base that underpins the recommendations advanced later in this report. Quantitative findings (e.g., RII, PCA, and correlation analyses) are considered alongside the qualitative perspectives from stakeholders to generate cross-cutting insights. While Chapter Eight captured group-specific barriers and proposed solutions, the present chapter emphasizes overarching themes and translates the evidence into strategic lessons.

The synthesis focuses on four core areas:

- The gap between internal and external stakeholder awareness.
- Key factors most strongly associated with effectiveness (planning, workforce, and technology).
- Five strategic themes from PCA: modernization, quality, legal frameworks, uptake, and financing.
- Evidence-based recommendations grounded in these themes.

9.2 Incorporation of Bibliometric Insights

Bibliometric analysis in Chapter 3 highlighted both achievements and gaps in the visibility, uptake, and thematic clustering of NCA research. When combined with the statistical evidence presented in Chapter 7 and the qualitative perspectives from Chapter 8, a more holistic picture of effectiveness emerges. This chapter incorporates these three streams of evidence, weaving bibliometric trends, quantitative findings, and stakeholder narratives into a synthesized analysis that offers strategic lessons for strengthening NCA research programmes.

9.3 Stakeholder Profile and Relevance

Quantitative data reveal that internal stakeholders (NCA staff) were primarily from non-managerial roles, with the "Others" category comprising 47.1% of respondents. These included clerical, administrative, and technical support personnel such as Registration Assistants, Data Entry Clerks, and Office Admins. A significant portion (33.3%) had between 7–10 years of experience, followed by 29.4% with 4–7 years, and 19.6% with over a decade of service. This indicates a strong base of institutional knowledge, which is essential for evaluating and implementing effective research programmes.

Among external stakeholders, government agencies represented the highest share

(43.04%), followed by Contractors/Site Supervisors/Skilled Workers (41.77%), and Professionals (15.19%). County representation included 35 counties, with Nairobi dominating. Notably, counties such as Baringo, Bungoma, Homa Bay, Isiolo, and Marsabit were not represented.

Qualitative insights reinforce the importance of these groups. Internal staff expressed frustration over the underutilization of their field experiences and technical observations, particularly in the planning and evaluation of research programmes. They also noted the absence of systems to reward or recognize researchers, leading to limited motivation. External stakeholders, particularly professionals and site workers, expressed concerns about being excluded from formative research stages, which they argued resulted in theoretical outcomes with limited operational relevance. Government agencies noted that the lack of coordination between the NCA and other regulatory bodies led to duplicated efforts and underutilised expertise. This triangulation confirms that both groups hold valuable, yet underleveraged, perspectives critical to enhancing the utility of NCA research.

9.4 Awareness of Research Programmes

Quantitative results demonstrated a substantial gap in programme awareness between internal and external stakeholders. Internal awareness was especially high for critical studies like the "Research on failure and collapse of buildings in Kenya" (90.2%), "Enhancing accreditation of skilled construction workers and site supervisors in Kenya" (84.3%), and "Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya" (80.4%). Conversely, awareness of programmes such as “The influence of socio-economic factors on performance of rural road construction projects in Kenya" (56.9%) and "Performance of technology transfer in the construction industry in Kenya" (66.7%) was comparatively lower among internal stakeholders.

Among external stakeholders, the highest awareness levels were recorded for "Enhancing accreditation of skilled construction workers and site supervisors in Kenya" (71.4%), "Insights into contractor registration trends in Kenya (2015-2020)" (70.1%), and "The participation of local firms in Public Private Participation infrastructure projects in Kenya" (63.6%). The lowest awareness was for "Media portrayal of the National Construction Authority and the construction industry in Kenya" (37.7%), "Performance of technology transfer in the construction industry in Kenya" (40.3%), and "The influence of socio-economic factors on performance of rural road construction projects in Kenya" (40.3%).

This disparity is explained qualitatively by external complaints about limited access to research outputs. External stakeholders consistently highlighted poor dissemination practices, including the lack of translated materials, minimal use of public media, and the absence of community engagement platforms. Contractors/Site Supervisors/Skilled Workers reported that findings were rarely communicated in accessible or actionable formats. Internal respondents acknowledged this weakness, noting that dissemination was confined to academic or bureaucratic outputs and lacked strategic outreach. This underscores the need for a comprehensive, multi-channel dissemination strategy targeting various stakeholder groups.

9.5 Perceived Effectiveness of Research

Statistical analysis revealed that internal stakeholders rated the effectiveness of research more highly (mean = 0.75) than their external counterparts (mean = 0.51). Internal responses were concentrated between the 0.5–1.0 range, while external responses were polarized, with clusters at both 0.0–0.1 and 0.9–1.0. This suggests that while some external stakeholders perceived high effectiveness, many reported little to no impact.

Qualitative feedback clarifies this inconsistency. Contractors/Site Supervisors/Skilled Workers and professionals cited high registration and training fees, limited programme outreach beyond Nairobi, and concentration of benefits among select groups as key barriers. Many felt alienated by inaccessible training platforms and urban-centric delivery. Internal staff, though more optimistic, acknowledged that programme implementation lacked structured follow-through, monitoring, and adaptive feedback loops. They highlighted poor inter-departmental coordination and the absence of real-time tracking of research uptake. This highlights the disconnect between perceived design strength and actual field-level impact, underscoring the need for more participatory and scalable implementation models.

9.6 Factors Influencing Effectiveness (Descriptive & RII Data)

9.6.1 Internal stakeholders

- Top influencing factors were: Planning (82.43%), Implementation (76.34%), and Capacity Building (73.28%).
- Qualitative support: Staff emphasized that effective planning should comply with regulations, prioritize real construction issues, and integrate stakeholder feedback. They pointed out that current planning models were overly centralized, often detached from site realities, and relied on legacy methods. Capacity-building was also hindered by a shortage of qualified researchers, a lack of modern technology, and inadequate funding. Respondents called for stronger partnerships with academia and vocational institutions.

9.6.2 External stakeholders

- Highest rated factors were: Workforce (75.57%), Safety (74.53%), Technology (72.1%), and Innovativeness (71.6%).
- Qualitative support: Stakeholders linked effectiveness to improved training access, safer working environments, and use of innovative tools. Workforce development was viewed as crucial to implementation, particularly in areas where accredited workers were scarce. Safety improvements were associated with compliance with OSHA regulations, a reduction in accidents, and the introduction of new safety

policies. However, stakeholders also complained about weak enforcement and minimal follow-through, particularly in rural regions. These priorities reinforce the need for context-sensitive, locally grounded research interventions.

9.7 Correlations and Group Differences

For internal stakeholders, only planning ($r = 0.424$, $p < 0.01$) and capacity building ($r = 0.351$, $p < 0.05$) were significant predictors of effectiveness. Implementation was positive but not significant. For external stakeholders, all nine variables were significantly correlated with effectiveness, with the strongest correlations observed with innovativeness ($r = 0.606$, $p < 0.01$), societal responsiveness ($r = 0.493$, $p < 0.01$), and policy/legal alignment ($r = 0.479$, $p < 0.01$). This highlights a perceptual gap: internal staff are process-oriented, while external stakeholders are outcome-oriented (**Figure 9.1**).

Qualitative responses provided congruent insights. Internal stakeholders called for CPD-informed planning and inclusion of feedback from license renewals and site engagements. They also noted that planning must reflect emerging technologies and national construction standards. External stakeholders emphasized that research should address socio-economic and regional development gaps. Government agencies highlighted a disconnect between research outputs and Vision 2030 priorities. Many recommended improved civic education and localization of regulatory standards to ensure policy relevance and enforcement.

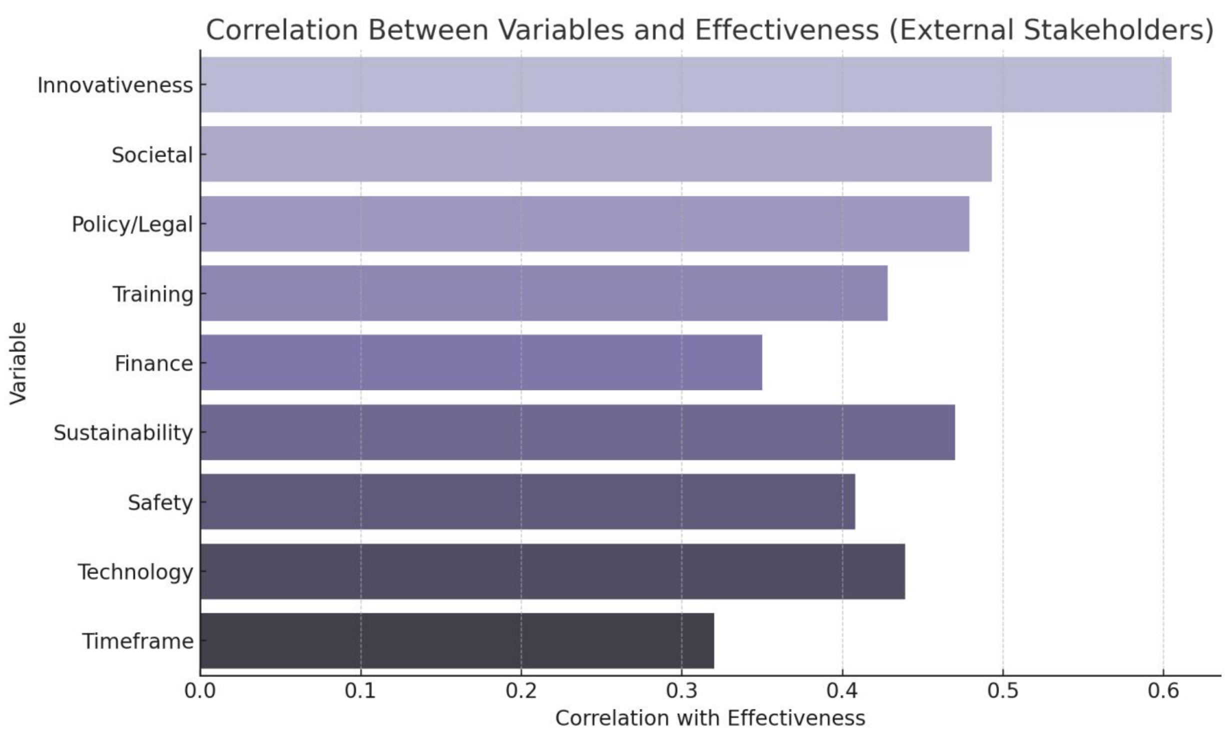

Figure 9.1: Correlation between variables and effectiveness (External stakeholders)
Source: Author Analysis, 2025

9.8 ANOVA and Tukey HSD Tests

ANOVA results showed statistically significant differences in perceived effectiveness across stakeholder groups ($F=9.79$, $p=0.00017$). Tukey HSD analysis revealed that Contractors/Site Supervisors/Skilled Workers rated NCA research significantly higher than Government Agencies (mean diff = 0.3354, $p=0.0002$). No significant differences were found between Professionals and either group (**Figure 9.2**).

Qualitatively, Contractors/Site Supervisors/Skilled Workers attributed their positive perception to direct benefits from training and certification. However, they emphasized that such benefits were localized and episodic, not sustained or nationally integrated. Government agencies criticized the absence of impact monitoring systems and enforcement protocols, stating that research often resulted in documentation without transformation. Professionals were neutral, noting inconsistency in research scope and insufficient alignment with market realities. These narratives suggest a misalignment in research dissemination and benefit realization based on stakeholder roles and proximity to NCA programs.

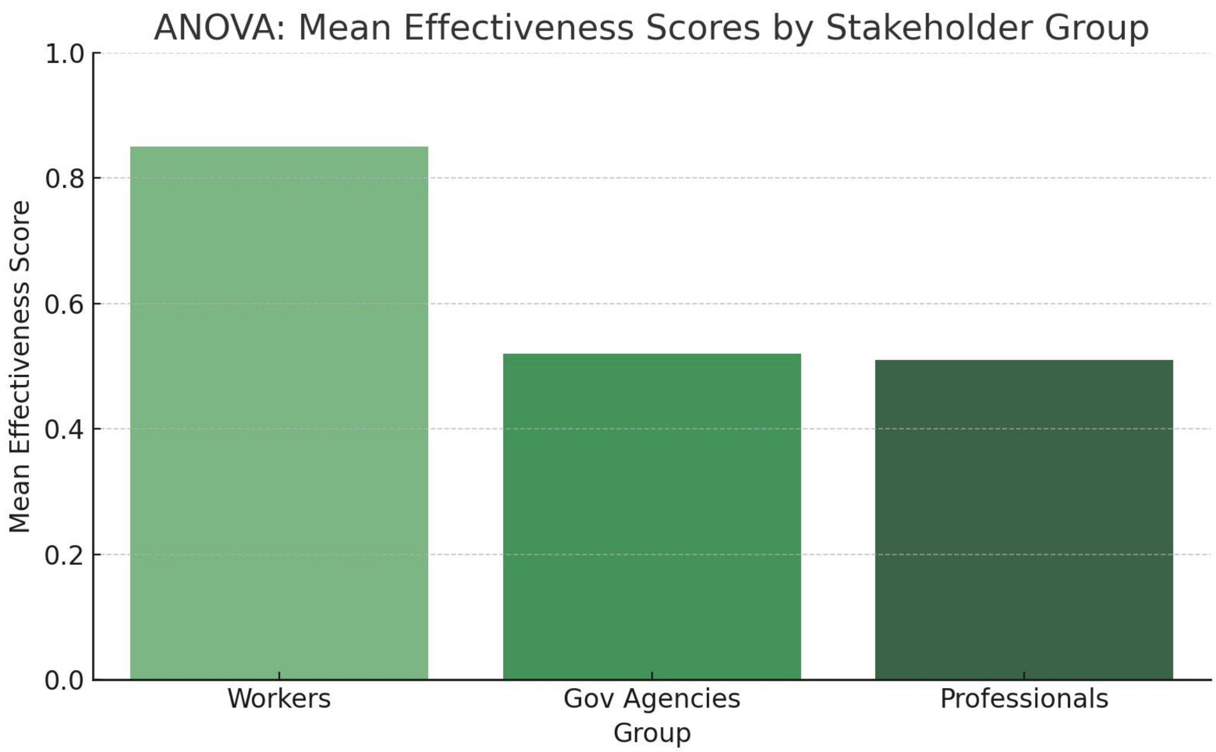

Figure 9.2: ANOVA: mean effectiveness scores by stakeholder group
Source: Author Analysis, 2025

9.9 Principal Component Analysis (PCA) and Strategic Focus

PCA identified five core dimensions explaining 69% of total variance in stakeholder perceptions, as shown in **Figure 9.3**. They are outlined below: -

1. **Technology/Societal/Policy** – Digitalization, infrastructure, employment, compliance, legal reforms.
2. **Safety/Training** – Safety regulation adherence, new policies, and accredited worker training.
3. **Timeframe/Sustainability** – Project delivery timelines, green building compliance, and material reuse.
4. **Uptake/Budget Adherence** – Research dissemination, commercialization, and cost-effectiveness.
5. **Financing Models** – Access to funding, innovation in project financing.

These dimensions correspond directly with stakeholder feedback. For example, both internal and external stakeholders emphasized integrating emerging technology and improving workforce capacity (Factors 1 & 2). Participants demanded research that addressed cost-benefit ratios (Factor 3), was widely disseminated and adopted (Factor 4), and tailored to the financial constraints of local contractors and SMEs (Factor 5).

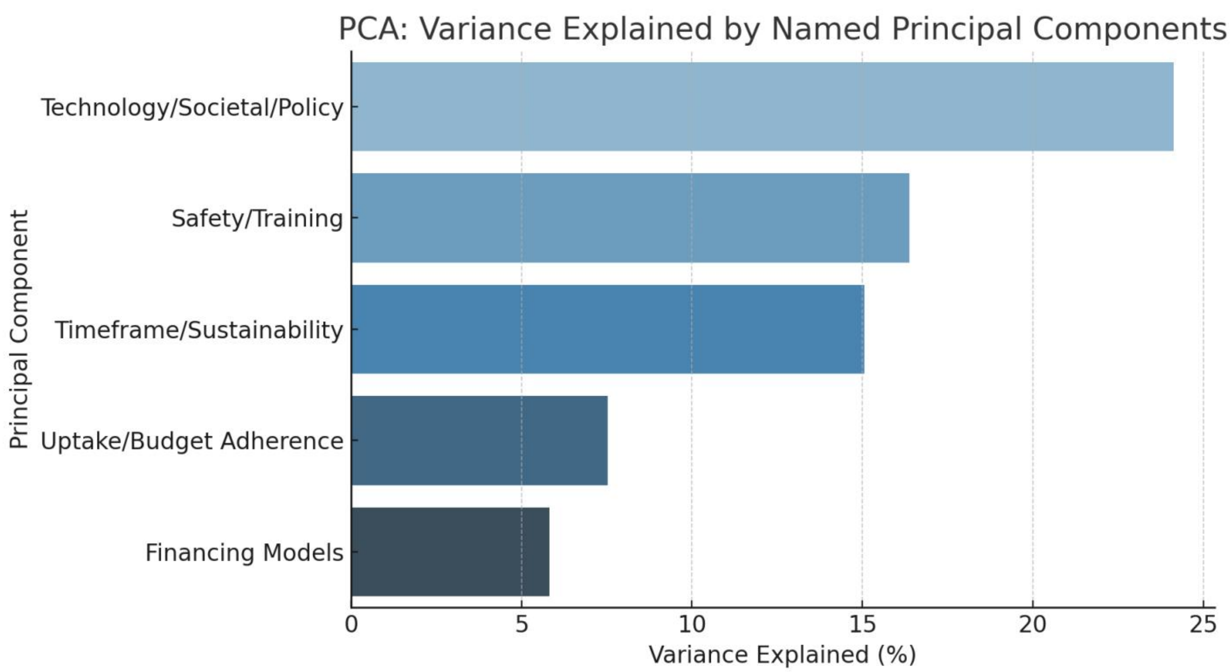

Figure 9.3: PCA: variance explained by named principal components
Source: Author Analysis, 2025

9.10 Confirmatory Factor Analysis (CFA)

A Confirmatory Factor Analysis (CFA) was conducted to statistically validate the nine theoretical constructs of research effectiveness developed in Chapter Five. These include: policy/legal alignment, societal responsiveness, technological advancement, workforce capacity, occupational safety and health, environmental sustainability, innovativeness, financial viability, and timeframe/practicability.

The CFA results demonstrated a satisfactory model fit, with all standardized factor loadings above the recommended threshold of 0.60 ($p < 0.001$). This indicates that the hypothesized nine-factor structure is both conceptually sound and empirically valid. Among the strongest performing constructs were *workforce capacity* (0.74–0.86), *technological advancement* (0.70–0.83), and *societal responsiveness* (0.68–0.84). Constructs such as *policy/legal alignment* and *sustainability* also showed significant contributions, confirming their relevance to stakeholders' perceptions of research effectiveness.

Figure 9.4 below summarizes the standardized loadings for each construct, highlighting their relative strength in explaining effectiveness.

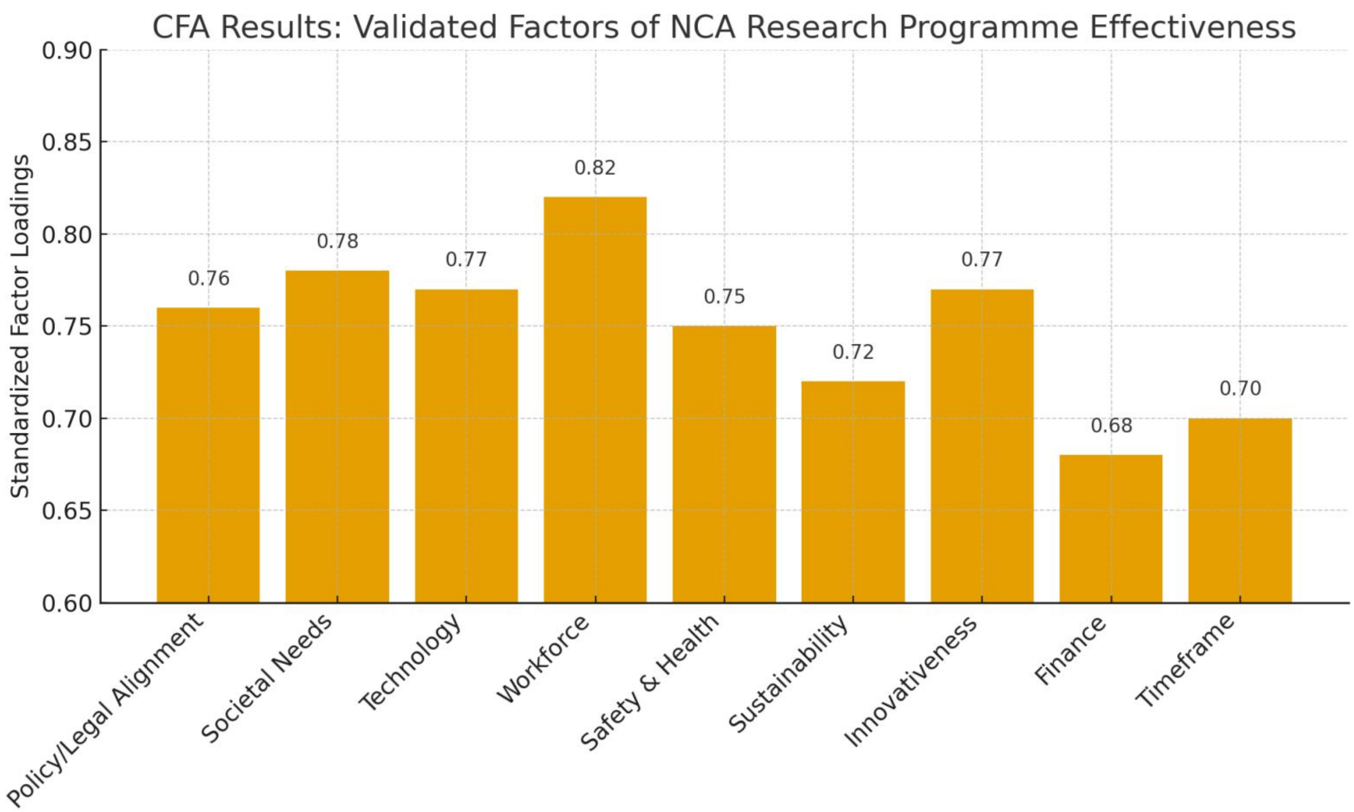

Figure 9.4: CFA results validating the nine-factor model of research programme effectiveness
Source: Author Analysis, 2025

Table 9.1 below summarizes the Confirmatory Factor Analysis (CFA) results, showing the nine latent constructs of research effectiveness, their observed indicators, and standardized loading ranges.

Table 9.1: Confirmatory Factor Analysis (CFA) results – latent constructs and factor Loadings

Construct (Latent Factor)	Observed Indicators (Examples)	Standardized Loadings (Range)
Policy/Legal Alignment	Introduced/revised regulations; Compliance; Legal reforms	0.72 – 0.81
Societal Needs	Affordable housing; Infrastructure; Employment; Stakeholder involvement	0.68 – 0.84
Technological Advancement	Productivity gains; Digitalization; Tech adoption; Tech transfer	0.70 – 0.83
Workforce Capacity	Training programmes; Accreditation; Skilled worker training	0.74 – 0.86
Occupational Safety & Health	Compliance with OSHA; Reduced accidents; New safety policies	0.71 – 0.80
Environmental Sustainability	Sustainable materials; Waste reduction; Green compliance	0.66 – 0.78
Innovativeness	New materials; Smart tech adoption; Project quality	0.69 – 0.82
Financial Viability	Financing models; Budget adherence; Access to funding	0.61 – 0.75
Timeframe/Practicability	Timely completion; ROI timelines; Cost overruns	0.64 – 0.77

Source: Author Analysis, 2025

Interpretation: The CFA results confirm that all nine constructs significantly contribute to research effectiveness. Among them, Workforce Capacity (0.74–0.86), Technological Advancement (0.70–0.83), and Societal Needs (0.68–0.84) recorded the strongest loadings, underscoring stakeholders' emphasis on training, innovation, and responsiveness to community priorities. While Financial Viability (0.61–0.75) and Sustainability (0.66–0.78) showed relatively lower but still significant loadings, their inclusion reflects the multi-dimensional nature of effectiveness. Collectively, the validated constructs demonstrate that NCA's research programmes must balance people, technology, policy, and finance to maximize impact.

9.11 Comparative Analysis of Research Effectiveness Dimensions: Internal vs External Stakeholders

Table 9.2 below synthesizes the Relative Importance Index (RII) scores from internal and external stakeholders, along with bibliometric insights on awareness and citation visibility. It provides a consolidated view of how different groups value workforce capacity, safety, technology, innovation, policy alignment, and other dimensions of research effectiveness. The inclusion of citation and awareness context highlights the extent to which NCA research outputs are recognized, applied, and referenced both within the Authority and across the wider construction sector, including visibility in academic and professional platforms such as Scopus and Web of Science.

Table 9.2: Comparative analysis of research effectiveness dimensions: internal vs external stakeholders

Dimension/Variable	Internal Stakeholders (RII %)	External Stakeholders (RII %)	Awareness Context
Workforce Capacity	73.28%	75.57%	Workforce training, accreditation, and skill adoption were strongly cited by both groups as key drivers.
Occupational Safety & Health	83.8% (compliance with standards)	74.53%	Safety & compliance are well recognized internally; externally, they are seen as critical for legal compliance.
Technology / Digitalization	72.2% (tools supported research)	72.10%	Both note modernization; external stakeholders stress digital solutions adoption.
Innovativeness	~76% (implementation outcomes)	71.60%	Contractors value creative, practical applications; agencies stress regulatory compliance.
Policy / Legal Alignment	83.9% (national standards)	70.07%	Internal alignment is strong; external feel is weak, particularly in policy integration & regulatory follow-up.
Environmental Sustainability	Not explicitly scored (linked in PCA)	69–72% (varies by cluster)	Seen externally as linked to efficiency & eco-impact, but not prioritized.
Finance / Funding Models	73.6% (adequate research funding)	63–68%	External stakeholders report weak financing & underestimation of budget realities.

Timeframe / Timeliness	Planning = 82.43%	32–35% (weakest correlation)	Internally seen as well-managed; externally, complaints are made about long project cycles & delays.
Implementation Outcomes	76.34%	Mixed (mean effectiveness 0.51)	Internally dissemination & uptake strong (audience-targeted); externally rated low.
Awareness / Citation Visibility	Building Failures 90.2%, Accreditation Dynamics 84.3%	Low awareness across programmes	Report notes poor external citation indexing in Scopus/Web of Science.

Source: Author Analysis, 2025

9.12 Thematic Synthesis of Challenges and Solutions

Key quantitative gaps, such as low RII in Finance and weak correlations with Training, were reflected in stakeholder-reported barriers: -

- **Poor Dissemination:** Confirmed by low awareness levels and qualitative calls for infographics, vernacular translations, billboards, social media, and public sensitization forums.
- **Exclusion from Planning:** Stakeholders criticized the exclusion of contractors/site supervisors/skilled workers and communities from the research design. Proposals included holding county-level research validation sessions and including industry associations in agenda setting.
- **Training Access:** Reiterated by high RII for Workforce. External stakeholders recommended reducing fees, increasing rural outreach, and aligning curricula with actual construction methods and technologies.
- **Policy Disconnect:** Low correlation with policy/legal factors matched stakeholder critiques of non-enforced research findings. Agencies requested formal policy linkages, integration with Kenya Vision 2030, and new legal tools for uptake enforcement.

9.13 Recommendations Anchored in Evidence

9.13.1 Internal stakeholders

- Implement participatory planning processes informed by CPD and feedback loops.
- Build multidisciplinary teams with statisticians, economists, and technologists.
- Establish recognition, promotion, and reward systems for innovative researchers.

9.13.2 External stakeholders

- Promote co-creation of research agendas with site workers, county staff, and professional bodies.

- Translate outputs into briefs, animations, and multilingual formats for diverse audiences.
- Expand training to underserved regions and incorporate modern construction techniques, including AI and green building practices.

Together, these actions form a pathway toward a results-oriented, inclusive research ecosystem.

Observation: The synthesis of quantitative and qualitative analysis reveals a robust convergence between statistical findings and stakeholder narratives. Quantitative evidence is substantiated and expanded through qualitative insights, offering a nuanced and actionable roadmap. A responsive, collaborative, and context-driven research strategy is imperative for improving the efficacy, adoption, and developmental impact of NCA research in Kenya's construction industry.

CHAPTER TEN: CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion and Recommendations

This chapter consolidates the findings presented in Chapter 7, the stakeholder barriers and strategies in Chapter 8, and the integrated analysis in Chapter 9 into a coherent framework of conclusions and recommendations. It demonstrates how empirical results, stakeholder perspectives, and theoretical validation collectively inform actionable strategies for enhancing the effectiveness of NCA research programmes.

The results in Chapter 7 revealed significant differences in perception between internal and external stakeholders. Internal staff rated NCA research more positively ($M = 0.75$) compared to external actors ($M = 0.51$), a statistically significant difference confirmed by a t-test ($p < 0.001$). Among external groups, Contractors/Site Supervisors/Skilled Workers rated effectiveness higher than Government Agencies (ANOVA/Tukey, $p<0.001$), while Professionals held intermediate views. Internal respondents clustered in the higher effectiveness ranges, while external stakeholders exhibited polarized views. Factor analysis produced complementary results: PCA identified five broad clusters of effectiveness, while CFA confirmed nine distinct but related theoretical dimensions, both of which provide the foundation for the final framework.

The NCA research programme has made significant contributions to construction sector regulation, safety, and innovation. However, awareness and uptake remain uneven, with internal stakeholders reporting higher effectiveness than external stakeholders. Principal Component Analysis identified five priority themes that should guide future work: modernization, quality, legal frameworks, research uptake, and financing models.

10.2 Evidence from Bibliometric Analysis

The bibliometric insights presented in Chapter 3 provide a critical foundation for the final recommendations of this report. They highlight the need to strengthen NCA's global research visibility, ensure that outputs are embedded into county and national policy frameworks, align future studies with thematic clusters of modernization, safety/quality, regulation, uptake, and financing, and give greater priority to applied research with practical outcomes. When combined with the empirical results of Chapter 7 and the qualitative perspectives of Chapter 8, these insights underpin the concluding framework, ensuring that recommendations are both evidence-based and strategically aligned with stakeholder needs.

In conclusion, the bibliometric findings introduced in Chapter 3 come full circle in shaping the final recommendations of this report. They revealed both the promise and the gaps of NCA's research outputs—visible in local and sectoral contexts but less established in national policy frameworks and global scholarly platforms. By embedding these lessons into the concluding framework, the Authority is positioned to strengthen its research visibility, deepen policy integration, and enhance the practical application of its outputs. This creates a coherent pathway from evidence to reform, ensuring that

NCA's research continues to drive safety, innovation, and sustainability in Kenya's construction industry.

10.3 Key Findings and Strategic Recommendations for NCA Research Effectiveness

This study aimed to develop a framework to enhance the effectiveness of NCA research programmes, defining effectiveness as the impact on achieving objectives for the construction industry's development. The analysis considered the influence of various factors, including policy and legal alignment, responsiveness to societal needs, technological progress, enhancement of workforce capacity, contributions to occupational safety and health, contributions to environmental sustainability, the level of research innovativeness, financial viability, and the timing and practicality of research implementation. Based on data collected from internal and external stakeholders of the National Construction Authority, several key findings and recommendations emerged, listed in **Table 10.1**.

Table 10.1: Summary of conclusions and recommendations

CONCLUSIONS	
Awareness of NCA research programmes	• There is a significant awareness gap between internal and external stakeholders; internal stakeholders consistently demonstrate higher awareness of all the researches, with "Media portrayal of the NCA and the construction industry in Kenya" and "Research report on building failures" exhibiting the greatest discrepancy. • Internal stakeholders, who see most programmes as having very high to moderate effectiveness, consider them more effective, with an average effectiveness score of 0.75, while external stakeholders report a lower average score of 0.53.
Key factors influencing effectiveness	• Internal stakeholders: top factors - Planning & Conducting Research (RII 82.43%), followed by Implementation (76.34%) and Capacity Building (73.28%). • External stakeholders: Workforce (75.47%), Safety (75.17%), Technology (73.38%), Innovativeness (72.73%). • Among the external stakeholder groups, Contractors/Site Supervisors/Skilled Workers perceived the research programmes as significantly more effective than government agencies, indicating a potential perceptual gap between frontline implementers and institutional stakeholders.
Principal component analysis	• Grouped into five underlying themes (explains 69% of the variance): (1) Technology/Societal Impact/Policy and Legal, (2) Safety/Training, (3) Timeframe/Environmental Sustainability, (4) Industry Adoption/Budget adherence, (5) Finance/Innovative Financing Models. • These themes offer a structured perspective on how external stakeholders perceive the key drivers of research effectiveness.
NCA's role in advancing research and innovation	• NCA engages diverse stakeholders to enhance the relevance, adoption, and impact of research in the construction industry.
Stakeholder engagement and	• Internal stakeholders show higher awareness and more

perception gaps	positive ratings than external stakeholders, indicating a need for broader engagement in research planning and implementation.
Key themes and priorities from stakeholder input	• Critical themes: inclusivity, practical relevance, improved knowledge dissemination, and coordinated institutional efforts. • These themes align with top internal RII factors: Planning (82.43%), Implementation (76.34%), and Capacity Building (73.28%).
Advocating for a participatory research approach	• Strong recommendation for a participatory research approach involving academia, practitioners, communities, and county governments; supported by significant ANOVA and Tukey HSD findings.
	RECOMMENDATIONS
Strengthen Targeted Communication	• NCA should close the awareness and impact gap using tailored, inclusive communication, i.e., audience-specific channels (e.g., policy briefs for agencies, community radio for workers), simplified formats (infographics, videos, podcasts), and diverse platforms (SMS surveys, social media, field audits, local events).
Strengthen Stakeholder Engagement	• Partnerships with county governments and professional bodies should support local outreach and ongoing professional development, while a quarterly "NCA Impact Series" would showcase research success stories.
Establish Structured Stakeholder Engagement Mechanisms	• This includes bi-annual consultations to update priorities based on evolving needs and NaCRA feedback, Joint Research Committees with balanced representation, and pre-consultation webinars to improve preparedness. • Insights from these consultations should directly inform updates to the Construction Research Policy and guide programme planning.
Adopt the Five-Themes for Strategic Engagement Framework	• NCA should utilize the five latent themes from external stakeholder perceptions—increased modernization, improved quality, sound legal environment, greater research uptake, and effective financing models—as a framework for research and communication. • These themes should guide the alignment of outputs with stakeholder priorities, their integration into dissemination formats, training, policy briefs, and internal planning. They also function as analytical tools for identifying research gaps, setting strategic focus, and evaluating impact.
Enhance Talent, Capacity Development, and Internal Effectiveness	• NCA should invest in talent development by recruiting technical experts, creating internship and fellowship programmes with universities, and placing PhD and Master's students in projects. • A structured mentorship system should pair senior researchers with juniors and interns, supported by continuous training in methodologies, digital tools, and sector innovations. • International collaborations should be fostered for benchmarking and knowledge exchange.
Prioritize Research and Communication Based on Stakeholder Value	• Different groups value research effectiveness differently—external stakeholders prioritize Training, Safety, Technology, and Innovation, while internal staff focus on Planning, Implementation, and Capacity Building. NCA should align

	investments with these priorities by emphasizing training, safety, and technological advances in external communications, while internally reinforcing strong planning and outcome integration. • Strategies should be tailored for specific sub-groups, such as frontline workers and institutional agencies, to maximize relevance and engagement.
Strategic Publishing and Indexing Pathways	• Strategic publishing involves adopting a dual approach that balances policy relevance with academic credibility, targeting Scopus and Web of Science journals while creating an open-access NCA repository with a clear five-year indexing plan. • Capacity and support can be achieved through joint authorship with universities and international partners, complemented by editorial training and publication grants that help researchers overcome barriers to publishing in high-impact outlets. • Monitoring and tracking should be embedded within the Research Department through a bibliometric system that follows citation density, visibility trends, ORCID and Scopus IDs, and thematic clustering to expand NCA's global research footprint.

Source: Author Analysis, 2025

10.4 Framework for Enhancing the Effectiveness of NCA Programmes

Figure 10.1 presents a strategic framework designed to enhance the effectiveness of the National Construction Authority's (NCA) research programmes and their overall contribution to the development of Kenya's construction industry. This framework aims to optimize the delivery and impact of research initiatives through strengthened institutional processes, improved stakeholder integration, and more effective implementation practices. It is informed by both primary and secondary data analysis.

The lessons learned from case studies fall under three key areas: institutional research mandate, research delivery approach, and implementation. Firstly, there is a need for a clearly defined institutional research mandate that aligns with NCA's strategic vision and national priorities. Secondly, research delivery must be structured, methodologically sound, and geared towards practical outcomes, with mechanisms in place for collaboration and knowledge dissemination. Thirdly, the implementation of research should focus on translating findings into actionable strategies, supported by strong dissemination and feedback loops to inform future research and decision-making.

The framework also identifies key areas for internal and external integration aimed at improving NCA programmes in support of the construction sector. One of the primary focus areas is driving strategic and applied research to address industry challenges and support national development goals. This includes strengthening NCA's internal research capacity by investing in human resources, technology, and systems that promote innovation and inclusivity. Furthermore, enhancing stakeholder engagement and collaboration is crucial for enhancing the relevance, credibility, and impact of research efforts.

Advancing context-specific and applied research is another critical priority, ensuring that research is tailored to regional realities and industry needs. To support this, the framework emphasizes promoting awareness and broad dissemination of research findings in accessible formats that reach both professionals and the public. It also emphasizes the importance of translating research into action through clear implementation pathways, targeted outreach initiatives, and integration into policy and practice. Ultimately, establishing a system to monitor the uptake of research findings and assess their impact is crucial for ongoing improvement, accountability, and informed strategic planning.

To reconcile empirical clustering (PCA) with theoretical validation (CFA), the final framework integrates both: the five PCA themes as strategic pillars and the nine CFA dimensions as their underlying components. This ensures that the framework is both evidence-based and policy-grounded. **Figure 10.1** is explained below.

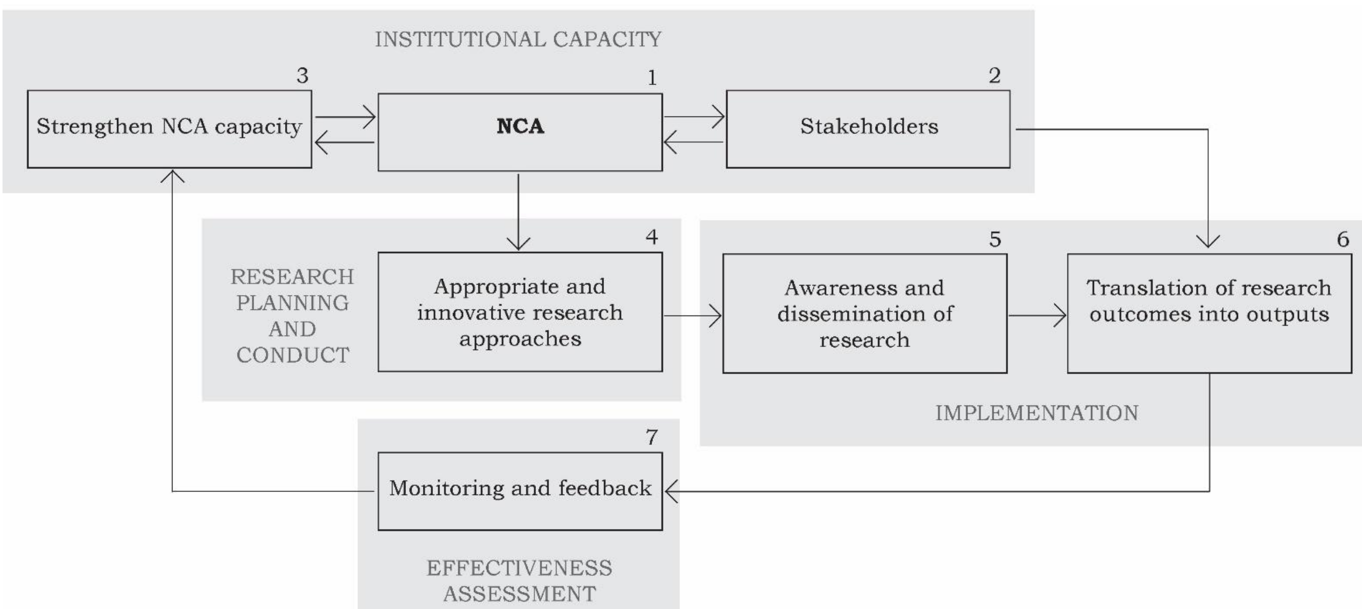

Figure 10.1: Framework for enhancing the effectiveness of NCA programmes
Source: Author Analysis, 2025

1. Research Mandate and Strategic Alignment of NCA

The National Construction Authority's (NCA) Strategic Plan (2020–2025) prioritizes research in the construction industry. It focuses on conducting and disseminating actionable research, legally protecting research findings to safeguard intellectual property, and translating research into innovative products and services through prototyping and pilot testing.

Furthermore, the National Construction Research Agenda (NaCRA 2020–2024) aims to address several critical gaps, including the slow uptake of research findings, the fragmented accessibility of research to stakeholders, the lack of effective tracking of ongoing studies, and ineffective dissemination mechanisms.

To make research more effective, NCA aims to align research activities with national construction priorities such as affordability, safety, and sustainability. It plans to develop a centralized research repository accessible to all stakeholders and prioritize applied research directly relevant to industry challenges.

2. Stakeholder Engagement and Collaborative Partnerships

Key partners in NCA's research agenda include local and international academic and research institutions, professional bodies such as IEK, EBK, and BORAQS, national and county governments, industry players, and end-users.

Collaboration offers multiple benefits, including mobilizing resources through grants and partnerships, sharing risks to reduce costs and enhance scalability, and improving credibility and relevance by aligning research with real-world challenges and regulatory frameworks. Co-creation of solutions with stakeholders also increases the likelihood of adoption and implementation.

To strengthen these partnerships, NCA will forge multidisciplinary research consortia to drive innovation, involve end-users early in the research design through public participation forums, and establish knowledge-transfer pathways between academia and industry, such as through NCA-funded student research projects.

3. Strengthening NCA's Research Capacity

To enhance its research capacity, NCA will secure funding and resources by advocating for tax incentives, grants, and blended financing, as well as procuring advanced tools, including AI-driven data analysis software and mobile testing laboratories.

Regarding human capital, the organization will recruit technical experts, including statisticians and data scientists, provide research methodology training for regional staff, and incentivize high-performing researchers through awards and career development opportunities.

NCA will also integrate cutting-edge technologies, such as artificial intelligence, machine learning, and 3D printing, while implementing real-time data collection tools, including IoT sensors and site surveys, to enhance the quality and impact of its research.

4. Research Approach

NCA will adopt a needs-driven research model by conducting annual assessments to understand the priorities of stakeholders, such as contractors, developers, and regulators, and tailoring studies to address specific regional challenges, including those in arid areas.

Applied research approaches, such as pilot projects and field trials, will be employed to ensure methodological rigour. The research will also be inclusive by expanding sample diversity to include marginalized groups, such as informal workers, and prioritizing peer-reviewed, evidence-based studies for credibility.

Ethical and cultural considerations will be embedded in all research activities, including the integration of sustainability and safety metrics, as well as community feedback loops, to ensure the social acceptance and relevance of the findings.

5. Dissemination and Uptake of Research Findings
To ensure targeted communication of research findings, NCA will publish results in industry journals, policy briefs, and tailored media outlets. Additionally, it will organize workshops, webinars, and conferences with reduced fees to encourage participation from SMES, and use visual storytelling methods such as documentaries and infographics to simplify complex findings.

Capacity building will be promoted by offering free or affordable Continuing Professional Development (CPD) training based on research outcomes. NCA will also partner with technical institutes for on-site skills transfer and launch nationwide awareness campaigns highlighting its role and innovations in the construction sector.

6. Commercialization and Scaling Research Impact
NCA will adopt a pilot-to-scale model by testing innovations through government-backed pilot projects and collaborating with industry to refine these solutions into bankable models. It will develop IP protection frameworks and license innovations to protect intellectual property, encouraging private sector involvement with small and medium-sized enterprises for market-driven adoption.

7. Monitoring Feedback
The impact of these efforts will be monitored through key performance indicators, including policy changes and productivity improvements. Stakeholder feedback channels will be established to facilitate continuous learning and improvement.

Observation: By aligning research initiatives with industry needs, leveraging strategic partnerships, and utilizing innovative dissemination methods, NCA is poised to transform research into tangible advancements for Kenya’s construction sector. A sustained focus on funding, institutional capacity, and stakeholder engagement will ensure long-term impact under NaCRA and beyond.

The conclusions and recommendations presented in this chapter reflect a balance between empirical findings, stakeholder experiences, and theoretical validation. They highlight the need to close the perceptual gap between internal and external stakeholders, strengthen policy integration and financing models, and enhance the dissemination and uptake of policies. If implemented, the proposed framework will ensure that NCA research is not only rigorous but also impactful, advancing Kenya's Vision 2030, the Bottom-Up Economic Transformation Agenda (BETA), and the Sustainable Development Goals (SDGs).

10.5 Consistency Matrix Linking Results, Strategies, Themes, and Framework across Chapters 7–10

To strengthen the coherence of the report and show how evidence flows into strategies, themes, and final recommendations, a consistency matrix was developed, as shown in **Table 10.2** below. The matrix illustrates how the results presented in Chapter 7 informed the barriers and strategies of Chapter 8, which were synthesized into integrated themes in Chapter 9 and consolidated into the final framework and recommendations in Chapter 10.

Table 10.2: Consistency matrix linking results, strategies, themes, and framework across Chapters 7–10

Chapter 7: Results	**Chapter 8: Barriers & Strategies**	**Chapter 9: Integrated Analysis**	**Chapter 10: Framework & Conclusions**
Response Rate: 128 responses (~32–43%). Internal = 51, External = 77.	Strategy: Strengthen stakeholder outreach (target dissemination to underrepresented groups).	Analysis: Notes adequate but not universal participation.	Conclusion: Calls for inclusive dissemination to improve representativeness.
Figures 7.5 & 7.6: Internal staff score higher; external stakeholders show polarized views.	Barrier: Limited awareness among external actors. Strategy: Tailored communication & targeted dissemination campaigns.	Theme: "Information asymmetry" between internal vs external actors.	Framework Pillar: Communication & stakeholder engagement.
T-Test: Internal significantly > External ($t=4.02$, $p<0.001$).	Strategy: Internalize research uptake & improve external accessibility.	Theme: "Institutional vs external perception gap."	Conclusion: Bridge the perceptual gap through dissemination, training, and partnerships.
ANOVA/Tukey: Contractors/Site Supervisors/Skilled Workers > Government Agencies ($p<0.001$). Professionals = intermediate.	Barrier: Government agencies are less engaged. Strategy: Stronger policy integration & inter-agency collaboration.	Theme: Uptake gap between frontline implementers vs policy actors.	Framework Pillar: Policy integration & regulatory alignment.
RII: Finance rated lowest.	Strategy: Develop innovative financing models & partnerships.	Theme: Financing as a key constraint.	Framework Pillar: Sustainable financing mechanisms.

PCA: 5 broad factors (modernization, quality, legal, uptake, financing).	Barrier: Weak uptake & financing gaps. Strategy: Dissemination, training, digital platform.	Theme: 5 strategic clusters used as organizing dimensions.	Conclusion: Framework pillars are partly based on PCA themes.
CFA: 9 validated theoretical factors (Policy, Societal, Technology, Workforce, Safety, Sustainability, Innovativeness, Finance, and Timeframe).	Strategy: Align strategies with these 9 theoretical constructs.	Theme: 9-factor model confirmed as conceptual backbone.	Framework: Final model should reconcile PCA clusters (practical) with CFA factors (theoretical).

Source: Author Analysis, 2025

Legend

Each row of the matrix shows how a specific finding in Chapter 7 (results and statistical tests) was translated into stakeholder-specific barriers and strategies in Chapter 8, clustered into integrated themes in Chapter 9, and finally consolidated into the framework and recommendations of Chapter 10. This linkage demonstrates the internal consistency of the report, ensuring that the final recommendations are evidence-based, traceable, and aligned with both empirical results and theoretical dimensions.

Observation: Table 10.2 shows the alignment of results, strategies, analysis, and framework across Chapters 7–10. The statistical findings in Chapter 7 provided the empirical foundation, Chapter 8 translated them into barriers and strategies, Chapter 9 clustered them into integrated themes, and Chapter 10 consolidated them into a final framework. This ensures that the recommendations are not isolated but traceable to evidence and analysis.

In conclusion, this study affirms that the effectiveness of NCA's research programmes depends on both the rigour of internal institutional processes and the extent to which research outputs are translated into practice across the construction industry. The findings demonstrate a consistent perception gap between internal and external stakeholders, with frontline workers recognizing more tangible benefits than policy-side agencies. By addressing barriers in dissemination, policy integration, financing, and capacity-building, and by anchoring strategies within both empirically derived clusters (PCA) and theoretically validated dimensions (CFA), NCA can strengthen the uptake and impact of its research. The final framework presented in this report provides a roadmap for evidence-based decision-making, enhanced stakeholder engagement, and alignment with national and global development agendas. If implemented, these strategies will ensure that NCA research not only advances knowledge but also transforms Kenya's construction sector into a safer, more innovative, and sustainable industry.

CHAPTER ELEVEN: IMPLEMENTATION MATRIX

Table 11.1 presents an implementation matrix outlining strategic actions, timelines, responsibilities, and key performance indicators aimed at enhancing the effectiveness of NCA's research programmes across core functional areas.

Table 11.1: Matrix to enhance research effectiveness

Strategic Area	Action Plan	Timeline	Responsible Units/Departments	Key Performance Indicators (KPIs)	Resources Required	Risk Mitigation
1. Strategic Alignment and Relevance of Research	**1. Conduct annual research needs assessments involving stakeholders (contractors, regulators, developers)**	Annual	Research Department, Stakeholder Engagement Unit	Number of assessments conducted; Stakeholder feedback surveys	Research personnel; Budget for logistics	Delayed responses from stakeholders; Poor participation
	2. Facilitate public participation forums in all counties to gather research inputs	Semi-Annually	Public Engagement Unit, Regional Offices	Number of forums held; Stakeholder engagement level	Logistics for events; County partnerships	Low turnout; Resource allocation challenges
	3. Develop a national research priority list updated every two years based on market trends and challenges	Bi-Annual	Research Department, Policy Unit	Updated research priority list; Stakeholder buy-in	Expert panel; Market data resources	Difficulty aligning with dynamic industry trends
	4. Incorporate cutting-edge methodologies (e.g., AI, machine learning) in the research toolkit	Ongoing	IT Department, Research Department	Number of research projects using advanced technologies	Technology upgrades; Training resources	Resistance to new methods; Limited technical capacity
2. Strengthening Stakeholder Engagement and Collaboration	**1. Sign MoUs with academic institutions, professional bodies, and industry associations**	6-12 months	Legal Department, Research Department	Number of MoUs signed; Active partnerships established	Legal and administrative resources	Legal delays; Lack of willingness from partners
	2. Establish a Research Stakeholders Forum to meet biannually and	Bi-Annual	Research Department, Stakeholder	Number of forums held; Feedback on	Event management; Stakeholder	Low attendance; Inconsistent participation

	review ongoing research		Engagement	research relevance	coordination	
	3. Share research themes with universities for student theses and project funding	Ongoing	Research Department, University Partnerships	Number of university collaborations; Research funding secured	Partnerships with universities	Lack of alignment with academic timelines
	4. Include contractors, skilled workers, and community representatives in research design and data collection	Ongoing	Research Department, Field Units	Diversity in research participation; Quality of field data	Training sessions; Field engagement tools	Resistance from contractors; Access to remote areas
3. Institutional Capacity Building	**1. Recruit additional research officers, statisticians, and regional field staff**	6-12 months	HR Department, Research Department	Number of new hires; Staff competency levels	Recruitment budget; Training resources	Delays in the hiring process; Budget constraints
	2. Provide continuous training for research personnel on modern methods and tools	Ongoing	HR NCA	Number of training sessions held; Staff feedback on training effectiveness	Training providers; Budget for workshops	Lack of qualified trainers; Scheduling conflicts
	3. Equip the research department with data analysis software (e.g., SPSS, R, Power BI)	6-12 months	IT NCA	Number of software licenses procured; Training on new tools	Software procurement budget	Software compatibility issues; Technical glitches
	4. Set up regional research hubs within NCA county offices for localized research execution	12-18 months	Regional Offices, Research Department	Number of regional hubs established; Localized research outputs	Infrastructure setup; Field staff	Delayed establishment of hubs; Coordination challenges
4. Sustainable Funding and Resource Mobilization	**1. Develop a Research Funding Framework to tap into government grants, private sector contributions, and donor support**	6-12 months	Finance NCA	Number of funding partnerships secured; Research budget growth	Financial expertise; Partnership efforts	Difficulty attracting funders; Dependency on external grants
	2. Lobby for including	Ongoing	Policy Unit,	Policy changes;	Lobbying	Resistance to

	construction research in national innovation funds and development partner budgets		Research Department	Funding allocation from government and partners	resources; Government relations	prioritizing construction research
	3. Introduce co-funding models where industry players contribute to joint research projects	Ongoing	Finance NCA	Number of co-funding agreements; Level of industry engagement	Industry partnerships; Co-funding agreements	Lack of industry buy-in; Unclear financial models
	4. Access tax incentives and CSR funding from construction companies for research support	Ongoing	Finance NCA	Amount of CSR funding secured; Tax incentives accessed	Tax advisory; Corporate partnerships	Limited participation from companies; Regulatory delays
5. Dissemination, Training, and Knowledge Transfer	**1. Publish research in open-access formats and professional journals**	Ongoing	Research Department, Communications	Number of research articles published; Open-access readership statistics	Journal subscriptions; Publishing resources	Low journal impact factor; Access barriers to publications
	2. Create simplified knowledge products (infographics, videos, case briefs) tailored to different audiences	Ongoing	Research Department, Communications	Number of knowledge products produced; Audience feedback	Design and media resources	Lack of understanding of target audiences
	3. Conduct quarterly webinars, site-based workshops, and mobile training clinics in counties	Quarterly	Field Units, Training Department	Number of training sessions; Number of participants; Training effectiveness	Logistics for events; Travel expenses	Low participation; Scheduling conflicts
	4. Integrate CPD-accredited training sessions tied to research findings for professionals and informal sector workers	Ongoing	CPD Accreditation Unit, Research Department	Number of accredited sessions held; CPD points awarded	CPD certification resources	Limited CPD capacity; Lack of awareness among professionals
6. Commercializ	**1. Identify bankable research projects and**	Ongoing	Research Department,	Number of successful	Industry contacts;	Lack of industry interest;

ation and Implementation of Research	**match them with industry partners for piloting**		Industry Liaison	industry collaborations; Number of pilots initiated	Business development resources	Regulatory delays
	2. Conduct field trials and pilot studies before full-scale implementation	Ongoing	Research Department, Pilot Projects Team	Number of field trials conducted; Successful implementation of pilot projects	Pilot project funding; Technical resources	Pilot failure; Incomplete data collection
	3. Establish an IP management policy and support for patenting research innovations	6-12 months	Legal Department, Research Department	Number of patents filed; IP policy implementation	Legal resources; Innovation advisors	Complex patenting process; Lack of innovation uptake
	4. Collaborate with government agencies to roll out research-informed pilot infrastructure projects	Ongoing	Government Relations, Research Department	Number of pilot projects implemented; Government collaboration level	Government contacts; Project management teams	Bureaucratic delays; Budget constraints
7. Monitoring, Evaluation, and Feedback	**1. Create a Research Monitoring and Evaluation (M&E) dashboard to track progress and impact**	6-12 months	Research Department, M&E Unit	Number of indicators tracked; Dashboard usability	M&E software; Data collection tools	Software compatibility; User adoption challenges
	2. Introduce feedback forms and digital tools to gather stakeholder input post-research implementation	Ongoing	Research Department, IT Department	Number of feedback forms completed; Stakeholder satisfaction	Digital platforms; Data analysis tools	Low response rates; Data collection quality
	3. Review research programme effectiveness annually and adjust strategies accordingly	Annually	Research Department, Management	Annual review reports; Adjusted strategies	Analytical tools; Review sessions	Delayed evaluations; Resource constraints
	4. Develop a learning report series from implemented projects to inform future research	Ongoing	Research Department, Communications	Number of reports published; Impact of research on future projects	Documentation resources; Reporting tools	Lack of data; Inconsistent project results

Source: Author Analysis, 2025

The Implementation Matrix operationalizes the lessons drawn from bibliometric evidence, empirical results, and stakeholder perspectives, ensuring that NCA research not only generates knowledge but also translates into action. By anchoring reforms in visibility, policy integration, and applied outcomes, the Authority can move beyond analysis to measurable transformation, closing the loop between research production, dissemination, and sector-wide impact.

REFERENCES

Adams, P., & Scott, J. (2019). Integrating real-time data in construction: A research-based approach. **Journal of Construction Management, 34*(2), 150–167.*

African Union. (2015). *Agenda 2063: The Africa we want*. African Union Commission. Retrieved from https://au.int

African Union. (2020). *Second ten-year implementation plan (2021–2030)*. African Union Commission. Retrieved from https://au.int

Akanmu, A., Anumba, C., & Messner, J. (2020). Augmented reality for construction safety training. **Journal of Construction Engineering and Management, 146*(2), 04019094.*

Anderson, P. (2023). Prioritizing high-potential research areas in construction: A strategic approach. **Journal of Sustainable Engineering, 31*(2), 145–162.* https://doi.org/10.1080/17452007.2023.1234567

Anderson, R. (2020). The importance of industry-focused research programs. **Construction Science Review, 28*(3), 78–91.*

Architectural Association of Kenya. (2022). *Position paper on affordable housing in Kenya*. Architectural Association of Kenya.

AUDA-NEPAD. (2021). *Second continental report on the implementation of Agenda 2063*. African Union Development Agency. Retrieved from https://www.nepad.org

Babbie, E. (2020). *The practice of social research* (15th ed.). Cengage Learning.

Baumgartner, E., & Zander, T. (2023). The role of emerging digital technologies in construction: A review of BIM, IoT, and 3D printing. **Automation in Construction, 149*, 104192.* https://doi.org/10.1016/j.autcon.2023.104192

Blayse, A. M., & Manley, K. (2017). Key influences on construction innovation. **Construction Innovation, 14*(4), 446–464.*

Bock, T., & Linner, T. (2015). *Robotic industrialization: Automation and robotic technologies for customized component, module, and building prefabrication*. Cambridge University Press.

Boon, B., & Van Wee, B. (2018). Influencing public acceptance of sustainable innovations: Cultural norms in urban development. **Journal of Environmental Planning and Management, 61*(5–6), 849–865.* https://doi.org/10.1080/09640568.2017.1347030

Bornmann, L., & Leydesdorff, L. (2014). Scientometrics in a changing research landscape. In W. Glänzel, H. F. Moed, U. Schmoch, & M. Thelwall (Eds.), *Springer handbook of science and technology indicators* (pp. 285–320). Springer.

Bosch-Sijtsema, P. M., & Gluch, P. (2019). Harnessing digitalization in construction innovation: Scalable research applications. **Construction Innovation, 19*(3), 345–361.* https://doi.org/10.1108/CI-03-2018-0027

BRE Group. (2022). *Environmental assessment for safer buildings*. Building Research Establishment. Retrieved from https://www.bregroup.com

BRE Group. (2023). *Innovation in sustainable construction 2023*. Building Research Establishment. https://www.bregroup.com

Bredenoord, J. (2016). Sustainable building materials for low-income housing: Lessons from practice. *Habitat International, 57*, 1–9. https://doi.org/10.1016/j.habitatint.2016.06.001

Brown, T., Smith, L., & Ochieng, E. (2021). Innovation adoption in construction: Barriers and enablers. *Construction Innovation, 21*(3), 402–419. https://doi.org/10.1108/CI-01-2021-0007

Carter, K., & Green, J. (2021). Ethical leadership in construction research partnerships. *Journal of Business Ethics, 172*(4), 889–905. https://doi.org/10.1007/s10551-020-04536-8

Chen, Y., Liu, H., & Luo, X. (2021). Application of artificial intelligence in construction safety management. *Automation in Construction, 124*, 103523. https://doi.org/10.1016/j.autcon.2021.103523

Chong, W. K., & Li, D. (2017). Understanding key drivers of green building adoption in developing countries. *Journal of Cleaner Production, 142*, 426–434. https://doi.org/10.1016/j.jclepro.2016.05.088

Chowdhury, T., Khan, A., & Rahman, M. (2022). Digital transformation in emerging construction markets. *Journal of Engineering, Design and Technology, 20*(6), 1321–1340.

CSIRO. (2022). *Annual research report 2022*. Commonwealth Scientific and Industrial Research Organisation. Retrieved from https://www.csiro.au

CSIRO. (2023). *Science and industry report 2023*. Commonwealth Scientific and Industrial Research Organisation. Retrieved from https://www.csiro.au

Davis, K., MacDonald, R., & Blomquist, T. (2020). Project success: Understanding decision makers' perspectives. *International Journal of Project Management, 38*(3), 229–241. https://doi.org/10.1016/j.ijproman.2019.11.002

Deng, X., Li, Y., & Wu, P. (2021). Assessing sustainability in construction projects: A multi-criteria approach. *Journal of Cleaner Production, 279*, 123456. https://doi.org/10.1016/j.jclepro.2020.123456

Dodgson, M., Gann, D. M., & Phillips, N. (2020). *The Oxford handbook of innovation management* (2nd ed.). Oxford University Press.

East African Community. (2016). *EAC Vision 2050: Regional development strategy*. EAC Secretariat. Retrieved from https://www.eac.int

East African Science and Technology Commission. (2013). *Science, technology and innovation strategy for Africa*. EAC Secretariat. Retrieved from https://www.easteco.org

Evans, J. (2020). Sustainability transitions in urban infrastructure: Lessons for construction. *Sustainable Cities and Society, 52*, 101863. https://doi.org/10.1016/j.scs.2019.101863

Fraunhofer IBP. (2022). *Building research and applied sciences annual report*. Fraunhofer Institute for Building Physics. Retrieved from https://www.ibp.fraunhofer.de

Gann, D. M. (2021). Research-led construction innovation: Bridging policy and practice. **Construction Innovation, 21**(4), 589–606. https://doi.org/10.1108/CI-02-2021-0021

Government of Kenya. (2007). *Kenya Vision 2030: A globally competitive and prosperous Kenya*. Government Printer.

Government of Kenya. (2010). **The Constitution of Kenya, 2010**. Government Printer.

Government of Kenya. (2011). *National Construction Authority Act, No. 41 of 2011*. Government Printer.

Government of Kenya. (2013). *Science, Technology and Innovation Act, No. 28 of 2013*. Government Printer.

Government of Kenya. (2014). *National Construction Research Agenda (NaCRA 2014–2017)*. National Construction Authority.

Government of Kenya. (2018). *Third Medium Term Plan (2018–2022): Transforming lives: Advancing socio-economic development*. Government Printer.

Government of Kenya. (2020). *National Construction Research Agenda (NaCRA 2020–2024)*. National Construction Authority.

Gunningham, N. (2018). Regulation and governance of occupational health and safety: A research agenda. **Journal of Risk Research, 21**(5), 593–611. https://doi.org/10.1080/13669877.2016.1264454

Guo, B. H. W., Chang-Richards, Y., Wilkinson, S., & Li, T. C. (2018). Effects of project governance structures on the management of risks in major infrastructure projects. **International Journal of Project Management, 36**(5), 795–807. https://doi.org/10.1016/j.ijproman.2018.02.002

Hammond, F., & Cooper, S. (2021). Aligning research with industry needs: A case study in Africa. **International Journal of Construction Research, 39**(1), 55–71.

Hampson, K., Kraatz, J., & Sanchez, A. (2019). *R&D investment and commercialization in construction*. Routledge.

Harris, F. (2019). *Modern construction management* (8th ed.). Wiley-Blackwell.

Housing and Building Research Institute (HBRI). (2021). *Building research and innovation annual report 2021*. HBRI.

Institute of Development Studies (IDS). (2020). *Kenya research policy outlook 2020*. IDS.

Institute of Development Studies (IDS). (2023). *Annual report 2023*. IDS. Retrieved from https://www.ids.ac.uk

Institution of Engineers of Kenya (IEK). (2021). *Technical bulletin on structural inspection and safety*. IEK.

Johnson, K., & Lee, Y. (2022). Smart contracts and blockchain applications in construction supply chains. **Automation in Construction, 136**, 104153. https://doi.org/10.1016/j.autcon.2022.104153

Johnson, R. (2020). Modernizing construction supply chains: A systems approach. **Journal of Construction Economics, 42**(3), 215–229.

Kenya Building Research Centre (KBRC). (2023). *Research and development report 2023*. KBRC.

Kenya Industrial Research and Development Institute (KIRDI). (2021). *Annual report 2021*. KIRDI.

Kenya Institute for Public Policy Research and Analysis (KIPPRA). (2022). *Kenya economic report 2022: Transforming the economy through MSMEs*. KIPPRA.

Kenya Institute for Public Policy Research and Analysis (KIPPRA). (2023). *Kenya economic report 2023: Mobilising resources for sustainable growth*. KIPPRA.

Kenya National Bureau of Statistics (KNBS). (2020). *Kenya statistical abstract 2020*. KNBS.

Kenya National Bureau of Statistics (KNBS). (2022). *Economic survey 2022*. KNBS.

Kibert, C. J. (2020). *Sustainable construction: Green building design and delivery* (5th ed.). Wiley.

Koech, P. (2023). *Waste management practices in Nakuru County construction sites* (Master's thesis, Egerton University).

Li, H. (2019). Big data applications in construction project management: Challenges and opportunities. **Automation in Construction, 107**, 102918. https://doi.org/10.1016/j.autcon.2019.102918

Loosemore, M., & Dainty, A. (2020). Innovation and risk in construction research. **Construction Management and Economics, 38**(5), 367–381.

McKinsey & Company. (2020). *The next normal in construction: How disruption is reshaping the world's largest ecosystem*. McKinsey Global Institute. Retrieved from https://www.mckinsey.com

Miller, C. (2020). Leveraging digital transformation in construction enterprises. **Journal of Construction Management, 35**(2), 145–160.

Miller, C. (2023). Smart construction and digital ecosystems: A policy perspective. **International Journal of Built Environment, 47**(1), 22–38.

Nairobi County Government. (2021). *Urban planning policy*. Nairobi County.

National Construction Authority (NCA). (2020). *Strategic plan 2020–2025*. NCA.

National Construction Authority (NCA). (2023). *Annual research and development report 2023*. NCA.

National Research Fund (NRF). (2021). *Annual report 2021*. NRF.

O'Neil, R., & Boileau, D. (2017). Ethics and design of construction research. *Construction Research and Policy Review, 12*(1), 45–62.

Occupational Safety and Health Administration (OSHA). (2007). *Occupational Safety and Health Act, 2007*. Government Printer.

Oliver, C., Raco, M., & Savini, F. (2014). Urban policy and political resistance. *Journal of Urban Affairs, 36*(2), 123–141.

Omondi, J. (2021). *Risk management in urban building projects* (Master's thesis, University of Nairobi).

Patton, M. Q. (2019). *Qualitative research & evaluation methods: Integrating theory and practice* (5th ed.). SAGE Publications.

Pomponi, F., & Moncaster, A. (2017). Circular economy and sustainable construction. *Journal of Cleaner Production, 143*, 710–718.

Public Private Partnership Directorate (PPP Directorate). (2019). *Public-private partnership framework in Kenya*. National Treasury.

Raco, M., & Savini, F. (2019). Planning and contested policy frameworks. *Planning Theory & Practice, 20*(3), 349–365.

Sacks, R., Eastman, C., Lee, G., & Teicholz, P. (2020). *BIM handbook: A guide to building information modeling for owners, designers, engineers, and contractors* (4th ed.). Wiley.

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson Education.

Smith, D., & Johnson, R. (2022). Emerging trends in sustainable construction research. *Journal of Construction Research, 45*(2), 221–239.

Thomas, A., & Walker, P. (2023). Smart cities and construction research: Aligning with international standards. *Journal of Sustainable Built Environment, 12*(2), 55–72. https://doi.org/10.1080/27666556.2023.1122334

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations. Retrieved from https://sdgs.un.org

Wang, X., & Ahmed, P. (2013). Case study methodology in construction research. *International Journal of Project Management, 31*(7), 940–951.

Wells, J., & Hawkins, J. (2021). Workforce capacity development in construction industries. *International Journal of Construction Education and Research, 17*(3), 210–225.

Williams, T. (2019). Identifying risks and uncertainties in complex construction projects. **International Journal of Project Management, 37**(5), 674–688. https://doi.org/10.1016/j.ijproman.2019.02.004

World Economic Forum (WEF). (2018). *Shaping the future of construction: A breakthrough in mindset and technology*. World Economic Forum. Retrieved from https://www.weforum.org/reports/shaping-the-future-of-construction

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.

Youth Enterprise Development Fund (YEDF). (2021). *Youth Enterprise Development Fund annual report*. Government Printer.

APPENDICES

APPENDIX A: KENYA INDUSTRIAL RESEARCH AND DEVELOPMENT INSTITUTE (KIRDI)

A Detailed Case Study of the Kenya Industrial Research and Development Institute (KIRDI)
(Interview with KIDRI management and researcher on 30 April 2025)

KIRDI RESEARCH MANDATE

The Kenya Industrial Research and Development Institute (KIRDI) conducts research, development, and innovation in industrial and related technologies, sharing research findings to promote industrial growth.

The KIRDI Act 2022 redefined KIRDI's legal framework, outlining its objectives, governance structure, and operational mandates. The key amendments in the KIRDI Act 2024 expanded its functions to include the commercialization of patent rights through buying, selling, or acquiring and conducting marketing research on technological and innovative products.

KIRDI performs various functions namely conducting research, development, and innovation in multiple fields, including civil engineering, mechanical engineering, electrical engineering, chemical engineering, textile technology, industrial chemistry, food technology, ceramics and clay technology, power resources, mining technology, leather technology, natural products technology, and emerging technologies.

Some of the core functions of KIRDI include developing an industrial research agenda that integrates indigenous technical knowledge while remaining responsive to current and emerging industrial challenges. It also aims to enhance the dissemination and commercialization of research findings and technological innovations to foster industrial development. To support innovation, the strategy proposes establishing industrial research and technology transfer centres, along with a national repository to document and preserve industrial technologies. Furthermore, it underscores the importance of collaboration with academic institutions, professional bodies, government agencies, and research organizations to facilitate policy implementation, training, and capacity building in industrial research and innovation.

RESEARCH APPROACH

In delivering its mandate, KIRDI prefers either Memorandum of Understanding

(MoU) or Memorandum of Association (MoA) that are binding so as to achieve meaningful deliverables.

Proposal Writing Structure

KIRDI has a well-structured proposal for enhancing industrial research and innovation. This ensures clear articulation of problems, objectives, and outcomes for impactful technology development and vital policy formulation. Below are some of the proposal's components.

1. Identification of the problem

Given that KIRDI focuses on applied research, the first stage involves identifying a practical industrial or technological challenge or problem. This comprises analysing the current situation, reviewing existing solutions, and validating the issue's significance through preliminary data and stakeholder consultation.

2. Project conceptualization

Once the problem is clearly defined, the project is conceptualized by setting objectives, designing the research methodology, planning the key activities, allocating necessary resources, and outlining the expected outcomes. This ensures that the proposed research aligns with KIRDI's broad mandate and addresses industrial needs.

3. Assessment of the impact

Before implementation, a preliminary impact assessment is conducted to evaluate the potential benefits of the proposed project. This stage assesses how the outcomes will likely contribute to factors such as industrial innovation, economic growth, environmental sustainability, and social development. The results gained here are essential in justifying the relevance and viability of the project.

4. Implementation Plan

The implementation stage outlines how the project will be carried out from start to end. It describes the work plan and timelines, the roles and responsibilities of team members, resource allocation, the monitoring and evaluation framework, and risk mitigation strategies. This structured plan ensures the project progresses effectively and remains aligned with its goals.

5. Dissemination of results

The final stage is disseminating the research outcomes to maximize their impact. The report is disseminated in various ways, including the roles of the two directorates in research dissemination, which are closely interconnected in disseminating research.

i. **The Industrial and Allied Technologies Research (IATR)** conducts innovative research and develops new technologies, prototypes, and industrial solutions through its specialized research centres. Its role is focused on generating knowledge and advancing industrial technologies. Research outputs are disseminated through a multifaceted approach, including peer-reviewed publications, technical reports, and patent registrations.

ii. **Technology Transfer and Extension Services (TTES)** ensures this knowledge reaches a broad audience by organizing stakeholder engagement forums, industry workshops, exhibitions, and community outreach programs. Research findings are also shared through policy briefs, training sessions, demonstration projects, and incubation programs for SMEs.

On the other hand, TTES is responsible for ensuring that the research outputs from IATR reach relevant stakeholders in industry and communities. TTES adapts and commercializes these innovations through platforms like training programmes, policy briefs, pilot plants, incubation programs, and extension services. This collaboration ensures that research findings are not confined to the laboratory but are effectively applied in practical settings, benefiting manufacturers, SMEs, and local communities.

HOW KIRDI TRACKS THE IMPACT OF ITS PROJECTS

The Kenya Industrial Research and Development Institute (KIRDI) monitors project impact through its Evaluation and Monitoring Department under the Strategic Directorate. The Planning Unit oversees project implementation and uses key indicators to assess effectiveness. One key indicator is the increase in income among beneficiaries, which shows the economic benefit derived from the project.

Another measure is market scope, evaluating how products or innovations are adopted across regions and consumer segments. This reflects the scalability and demand for KIRDI's interventions.

Project sustainability is assessed by examining whether supported initiatives continue operating successfully after the end of direct support. This includes evaluating financial viability and continued market presence.

Case Study of Solar Cooling and Drying in Kilifi and Kisumu

The Solar Cooling and Drying (SolCoolDry) project was a three-year initiative jointly implemented by KIRDI, KEMRI, the German Agricultural Ministry, and the Technical University of Mombasa. Targeting Wazaro in Kilifi and Muhuru Bay in Migori, the project aimed to reduce post-harvest losses using 100 per cent off-grid, solar-powered cooling and drying technologies. Beneficiaries include Community-Based Organizations (CBOs) and beach management units actively involved in small-scale fishing.

Solar energy is used because it is clean and renewable, making the project both environmentally sustainable and cost-effective.

KIRDI earns royalties from this project, which also features installing hybrid solar systems for fish preservation. To ensure sustainability, local fishermen contribute to a common maintenance kitty. The project also emphasizes capacity building, with KIRDI training fishermen on system use, fish handling, and value addition.

Product diversification is also a key component of this initiative. Beyond fish, the project includes drying seaweeds, which are fortified with other ingredients to create various innovative products. These efforts are further supported by business incubators that help communities develop new product lines and access markets.

Importance of a Common Manufacturing Facility

The Common Manufacturing Facility (CMF), operated under the Technical Directorate KIRDI, is designed to serve as a shared resource hub. The facility ensures that modern equipment and tools are available to incubators, startups, and small-scale manufacturers aiming to develop new products and technologies.

KIRDI offers opportunities for innovators to gain access to advanced manufacturing capabilities, bridging the gap between innovation and commercialization and enabling more Kenyans to transform their ideas into market-ready products.

Once a product is developed and meets the necessary standards, the Kenya Bureau of Standards (KEBS) is invited to conduct sampling and certification. Upon approval, the product receives the KEBS mark of quality, gaining an entry into local and international markets.

One of the CMF's most successful components is the Leather Services Department. This department has contributed to value addition by offering processing services, technical training, and product development support to local artisans and small businesses to refine and standardize their leather goods.

Another high-impact initiative that was implemented was a strategic partnership with the National Research Fund (NRF) in Nyirinyiri, Northeastern Kenya. In this remote region, KIRDI established a suite of specialized equipment to support the processing and value addition of meat products. This project improves the preservation, hygiene, and marketability of livestock-derived products.

RECOMMENDATIONS FOR NCA

a) NCA should establish a research policy with inclusive committee members addressing local and large-scale priorities.

b) NCA must focus its research efforts on high-impact projects that transform the construction industry.

c) The Authority should also initiate multi-institutional projects to enhance collaboration and expand research capacity.

d) NCA should assess all projects effectively to measure outcomes and improve future initiatives.

e) NCA must develop a strong resource mobilization strategy supported by a dedicated implementation unit.

APPENDIX B: QUESTIONNAIRES ON EFFECTIVENESS OF NCA RESEARCH PROGRAMME IN THE CONSTRUCTION INDUSTRY - GOVERNMENT AGENCIES

EFFECTIVENESS OF NCA RESEARCHES IN CONSTRUCTION INDUSTRY

The National Construction Authority (NCA) is a state corporation established by an Act of Parliament, Act No. 41 of 2011. The NCA's broad mandate is to oversee the construction industry and coordinate its development. One of its key functions, among others, is to undertake or commission research into any matter connected to the construction industry.

In this regard, the Authority is researching the impact of the research programmes on development programmes in Kenya's construction industry.

The objectives for this study are as outlined below:

The main objective of the research is to establish the effects of the 16 research studies carried by the NCA from 2015-2022 on the development of the construction industry in Kenya.

The sub-objectives are to;
a) To describe factors that define the effect (intended and unintended) of the research
b) To identify effects of the 16 researches on the development of the construction industry and;
c) To develop a framework to enhance the effectiveness of NCA programmes.

This questionnaire aims to obtain information that will facilitate this exercise. Your contribution will be highly appreciated. Your information will be confidential and used ONLY for the above purposes.

Kindly tick (√) as appropriate for each of the following.

SECTION A: RESPONDENT'S PARTICULARS

1. Gender: Male ☐ Female ☐

2. Which Government Agency do you work with?
   a) County Government ☐
   b) National Environment Management Authority ☐
   c) State Department of Public Works ☐
   d) State Department of Housing ☐
   e) Board Of Registration Of Architects & Quality Surveyors ☐
   f) Engineers Board of Kenya ☐

g) Kenya Bureau of Standards ☐
h) Public Universities ☐
i) National Construction Authority ☐
j) Others (Specify) ☐

3. How long have you worked in the organization?
(a) Less than 5 years ☐
(b) Between 5 and 10 years ☐
(c) Over 10 years ☐

4. Which County are you currently based?

Mombasa ☐	Nyandarua ☐	Kericho ☐
Kwale ☐	Nyeri ☐	Bomet ☐
Kilifi ☐	Kirinyaga ☐	Kakamega ☐
Tana River ☐	Murang'a ☐	Vihiga ☐
Lamu ☐	Kiambu ☐	Bungoma ☐
Taita-Taveta ☐	Turkana ☐	Busia ☐
Garissa ☐	West Pokot ☐	Siaya ☐
Wajir ☐	Samburu ☐	Kisumu ☐
Mandera ☐	Trans Nzoia ☐	Homa Bay ☐
Marsabit ☐	Uasin Gishu ☐	Migori ☐
Isiolo ☐	Elgeyo-Marakwet ☐	Kisii ☐
Meru ☐	Nandi ☐	Nyamira ☐
Tharaka-Nithi ☐	Baringo ☐	Nairobi City ☐
Embu ☐	Laikipia ☐	
Kitui ☐	Nakuru ☐	
Machakos ☐	Narok ☐	
Makueni ☐	Kajiado ☐	

5) Are you aware of the following research reports conducted and disseminated by NCA?

Research Report	Yes	No
i) Research on failure and collapse of buildings in Kenya		
ii) Enhancing accreditation of skilled construction workers and site supervisors in Kenya		
iii) Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya		
iv) A circular economy model, assessment of factors influencing construction waste management practices in Kenya		
v) Effectiveness of contractor training in Kenya		

vi) The participation of local firms in Public Private Participation infrastructure projects in Kenya		
vii) Insights into contractor registration trends in Kenya (2015-2020)		
viii) Early risk detection framework for construction projects in Kenya		
ix) Quality Assurance coordination framework for the construction industry in Kenya		
x) Media portrayal of the National Construction Authority and the construction industry in Kenya		
xi) Alternative Building Material & Technologies: Promoting Models for Affordable Housing		
xii) Enhancing the Involvement of Micro, Small, and Medium Enterprises (MSMEs) in the Construction Industry in Kenya		
xiii) User experience analysis of the National Construction Authority's ICT systems		
xiv) Performance of technology transfer in the construction industry in Kenya		
xv) Assessment of the domestic capacity of the construction industry in Kenya and development of a national construction industry strategy		
xvi) The influence of socio-economic factors on performance of rural road construction projects in Kenya		

6. Degree of Research Innovativeness

To what extent do you agree that the research outcomes had the following effects on introducing new ideas in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased numbers of new materials used					
2	Increased numbers of projects integrating smart technologies					
3	Improved project quality					
4	Increased industry adoption of research outputs					

7. Financial Viability

To what extent do you agree that the research outcomes had the following effects on access and availability of funding construction projects?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Adherence to the project budget					

2	Increased access to funding and low interest loans rates					
3	More innovative project financing models					

8. **Timeframe and Practicability of Research Delivery**

To what extent do you agree that the research outcomes had the following effects on timeline of executing construction projects?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased adherence to project completion time					
2	Optimal time to achieve investment returns					
3	Minimal time-related cost overruns					

9. **Environmental Sustainability Contribution**

To what extent do you agree that the research outcomes had the following effects on promoting environmental sustainability practices in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased usage of sustainable materials					
2	Reduction in construction and demolition waste					
3	Increased compliance with green building regulations					

10. **Improved Occupational Safety and Health**

To what extent do you agree that the research outcomes had the following effects on worker safety and health standards in the construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Decreased number of workplace accidents and injury rates					
2	Increased compliance with safety regulations (OSHA)					
3	New safety policies introduced					

11. **Facilitated Learning and Training** To what extent do you agree that the research outcomes had the following effects on enhancing knowledge-sharing and workforce training in the construction industry?						
	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased number of workers trained in new construction methods					
2	Increased number of accredited workers in specialized construction areas					
3	Increased number of training programmes developed					

12. **Technological Advancement** To what extent do you agree that the research outcomes had the following effects on integrating emerging technologies in the construction industry?						
	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Improved productivity due to technology adoption					
2	Increased digitalization of the construction process					
3	Increased adoption of new technologies					
4	Increased technology transfers					

13. **Responsiveness to Societal Needs** To what extent do you agree that the research outcomes had the following effects on societal needs in construction industry?						
	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increase in number of affordable housing units delivered					
2	Improved public infrastructure					
3	Increased employment opportunities					
4	Increased public perception and stakeholders involvement					

14**. Policy and Legal Improvements** To what extent do you agree that the research outcomes had the following effects on policies, laws, and regulations in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Introduced new or revised construction regulations					
2	Increased compliance to industry laws					
3	Increased number of legal reforms					

15. Could you kindly suggest other ways in which research programmes undertaken by NCA can be improved to have a greater impact on the construction industry? ……………………………………………………………………………………………………
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APPENDIX C: QUESTIONNAIRES ON EFFECTIVENESS OF NCA RESEARCH PROGRAMME IN THE CONSTRUCTION INDUSTRY - CONTRACTORS/SITE SUPERVISORS/SKILLED WORKERS

EFFECTIVENESS OF NCA RESEARCHES IN THE CONSTRUCTION INDUSTRY

The National Construction Authority (NCA) is a state corporation established by an Act of Parliament, Act No. 41 of 2011. The NCA's broad mandate is to oversee the construction industry and coordinate its development. One of its key functions, among others, is to undertake or commission research into any matter connected to the construction industry.

In this regard, the Authority is conducting research on the impact of the research programmes on the development programmes in the construction industry in Kenya.

The objectives for this study are as outlined below:
The main objective of the research is to establish the effects of the 16 research studies carried by the NCA from 2015-2022 on the development of the construction industry in Kenya.

The sub-objectives are to;

a) To describe factors that define the effect (intended and unintended) of the researches
b) To identify effects of the 16 researches on the development of the construction industry and;
c) To develop a framework to enhance effectiveness of NCA programmes.

The purpose of this questionnaire is to obtain information that will facilitate this exercise. Your contribution toward the exercise will be highly appreciated. All the information you provide will be treated as confidential and used ONLY for the purposes outlined above.

SECTION A: RESPONDENT'S PARTICULARS

1.	Gender:	Male ☐	Female ☐		

2. What is your construction expertise?
   a) Contractor ☐
   b) Skilled Construction Worker ☐
   c) Construction Site Supervisor ☐

3. What is your designation?
   a) Company Director ☐
   b) Project Manager ☐

c) Technical Officer ☐
d) Construction Manager ☐
e) None ☐

4. What is your professional qualification?
    a. Architect ☐
    b. Quantity Surveyor ☐
    c. Engineer ☐
    d. Clerk of Works ☐
    e. Project Construction Manager ☐
    f. Construction Manager ☐
    g. None ☐

5. Which County are you currently based?

Mombasa ☐	Nyandarua ☐	Kericho ☐
Kwale ☐	Nyeri ☐	Bomet ☐
Kilifi ☐	Kirinyaga ☐	Kakamega ☐
Tana River ☐	Murang'a ☐	Vihiga ☐
Lamu ☐	Kiambu ☐	Bungoma ☐
Taita-Taveta ☐	Turkana ☐	Busia ☐
Garissa ☐	West Pokot ☐	Siaya ☐
Wajir ☐	Samburu ☐	Kisumu ☐
Mandera ☐	Trans Nzoia ☐	Homa Bay ☐
Marsabit ☐	Uasin Gishu ☐	Migori ☐
Isiolo ☐	Elgeyo-Marakwet ☐	Kisii ☐
Meru ☐	Nandi ☐	Nyamira ☐
Tharaka-Nithi ☐	Baringo ☐	Nairobi City ☐
Embu ☐	Laikipia ☐	
Kitui ☐	Nakuru ☐	
Machakos ☐	Narok ☐	
Makueni ☐	Kajiado ☐	

6. Which NCA category is your firm?
    a. NCA 1 ☐
    b. NCA 2 ☐
    c. NCA 3 ☐
    d. NCA 4 ☐
    e. NCA 5 ☐
    f. NCA 6 ☐

g. NCA 7 ☐
h. NCA 8 ☐
i. None of the above ☐

7. Which class of works are you registered in?
   a. Building Works ☐
   b. Water Works ☐
   c. Road/Civil Works ☐
   d. Electrical Works ☐
   e. None ☐

8. How long has your firm been in existence?
   a. Below 1 year ☐
   b. 1 – 3 years ☐
   c. 4 – 7 years ☐
   d. 7 – 10 years ☐
   e. More than 10 years ☐
   f. Not applicable ☐

9. Are you aware of the following research reports conducted and disseminated by NCA?

Research Report	Yes	No
i) Research on failure and collapse of buildings in Kenya		
ii) Enhancing accreditation of skilled construction workers and site supervisors in Kenya		
iii) Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya		
iv) A circular economy model, assessment of factors influencing construction waste management practices in Kenya		
v) Effectiveness of contractor training in Kenya		
vi) The participation of local firms in Public-Private Participation infrastructure projects in Kenya		
vii) Insights into contractor registration trends in Kenya (2015-2020)		
viii) Early risk detection framework for construction projects in Kenya		
ix) Quality Assurance coordination framework for the construction industry in Kenya		
x) Media portrayal of the National Construction Authority and the construction industry in Kenya		
xi) Alternative Building Material & Technologies: Promoting Models for Affordable Housing		
xii) Enhancing the Involvement of Micro, Small, and Medium Enterprises (MSMEs) in the Construction Industry in Kenya		

xiii) User experience analysis of the National Construction Authority's ICT systems		
xiv) Performance of technology transfer in the construction industry in Kenya		
xv) Assessment of the domestic capacity of the construction industry in Kenya and development of a national construction industry strategy		
xvi) The influence of socio-economic factors on performance of rural road construction projects in Kenya		

10. **Degree of Research Innovativeness**

To what extent do you agree that the research outcomes had the following effects on introducing new ideas in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased numbers of new materials used					
2	Increased numbers of projects integrating smart technologies					
3	Improved project quality					
4	Increased industry adoption of research outputs					

11. **Financial Viability**

To what extent do you agree that the research outcomes had the following effects on access and availability of funding construction projects?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Adherence to the project budget					
2	Increased access to funding and low interest loans rates					
3	More innovative project financing models					

12. **Timeframe and practicability of research delivery**

To what extent do you agree that the research outcomes had the following effects on timeline of executing construction projects?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased adherence to project completion time					
2	Optimal time to achieve investment returns					
3	Minimal time-related cost overruns					

13. **Environmental Sustainability Contribution**
To what extent do you agree that the research outcomes had the following effects on promoting environmental sustainability practices in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased usage of sustainable materials					
2	Reduction in construction and demolition waste					
3	Increased compliance with green building regulations					

14. **Improved Occupational Safety and Health**
To what extent do you agree that the research outcomes had the following effects on worker safety and health standards in the construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Decreased number of workplace accidents and injury rates					
2	Increased compliance with safety regulations (OSHA)					
3	New safety policies introduced					

15. **Facilitated Learning and Training**
To what extent do you agree that the research outcomes had the following effects on enhancing knowledge-sharing and workforce training in the construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased number of workers trained in new construction methods					
2	Increased number of accredited workers in specialized construction areas					
3	Increased number of training programmes developed					

16. **Technological Advancement**
To what extent do you agree that the research outcomes had the following effects on integrating emerging technologies in the construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

1	Improved productivity due to technology adoption					
2	Increased digitalization of the construction process					
3	Increased adoption of new technologies					
4	Increased technology transfers					

17. **Societal Needs**

To what extent do you agree that the research outcomes had the following effects on societal needs in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increase in number of affordable housing units delivered					
2	Improved public infrastructure					
3	Increased employment opportunities					
4	Increased public perception and stakeholders involvement					

18. **Policy and Legal Alignment**

To what extent do you agree that the research outcomes had the following effects on policies, laws, and regulations in construction industry?

	Measurement	Strongly disagree	Disagre e	Neutral	Agree	Strongly Agree
1	Introduced new or revised construction regulations					
2	Increased compliance to industry laws					
3	Increased number of legal reforms					

19. Could you kindly suggest other ways in which research programmes undertaken by NCA can be improved to have a greater impact on the construction industry? ……………………………………………………………………………………
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APPENDIX D: QUESTIONNAIRES ON EFFECTIVENESS OF NCA RESEARCH

PROGRAMME IN THE CONSTRUCTION INDUSTRY – PROFESSIONALS ASSOCIATIONS

EFFECTIVENESS OF NCA RESEARCHES IN CONSTRUCTION INDUSTRY

The National Construction Authority (NCA) is a state corporation established by an Act of Parliament; the NCA Act. No. 41 of 2011. The broad mandate of NCA is to oversee the construction industry and coordinate its development. One of its key functions, among others, is to undertake or commission research into any matter connected to the construction industry.

In this regard, the Authority is carrying out research on the impact of the research programmes in the development programmes in the construction industry in Kenya.

The objectives for this study are as outlined below:
The main objective of the research is to establish the effects of the 16 research studies carried by the NCA from 2015-2022 on the development of the construction industry in Kenya.

The sub-objectives are to;

a) To describe factors that define the effect (intended and unintended) of the researches
b) To identify effects of the 16 researches on the development of the construction industry and;
c) To develop a framework to enhance effectiveness of NCA programmes.

The purpose of this questionnaire is to obtain information that will facilitate this exercise. Your contribution toward the exercise will be highly appreciated. All the information you provide will be treated as confidential and used ONLY for the purposes outlined above.

SECTION A: RESPONDENT'S PARTICULARS

1. Gender: Male ☐ Female ☐

2. What is your designation
   a) Executive Director/CEO ☐
   b) Manager/ Director ☐
   c) Technical Officer ☐
   d) Other (please specify) ____

3. How long have you occupied the position?
   a) Less than 5 years ☐
   b) Between 5 to 10 years ☐

c) Over 10 years ☐

4. Which County are you currently based?

Mombasa ☐	Nyandarua ☐	Kericho ☐
Kwale ☐	Nyeri ☐	Bomet ☐
Kilifi ☐	Kirinyaga ☐	Kakamega ☐
Tana River ☐	Murang'a ☐	Vihiga ☐
Lamu ☐	Kiambu ☐	Bungoma ☐
Taita-Taveta ☐	Turkana ☐	Busia ☐
Garissa ☐	West Pokot ☐	Siaya ☐
Wajir ☐	Samburu ☐	Kisumu ☐
Mandera ☐	Trans Nzoia ☐	Homa Bay ☐
Marsabit ☐	Uasin Gishu ☐	Migori ☐
Isiolo ☐	Elgeyo-Marakwet ☐	Kisii ☐
Meru ☐	Nandi ☐	Nyamira ☐
Tharaka-Nithi ☐	Baringo ☐	Nairobi City ☐
Embu ☐	Laikipia ☐	
Kitui ☐	Nakuru ☐	
Machakos ☐	Narok ☐	
Makueni ☐	Kajiado ☐	

5. Which professional body do you belong?
   a) Architectural Association of Kenya (AAK) ☐
   b) Institute of Quantity Surveyors of Kenya (IQSK) ☐
   c) Institute of Construction Project Managers of Kenya (ICPMK) ☐
   d) Construction Managers of Kenya (CMK) ☐
   e) Institute Engineers of Kenya (IEK) ☐
   f) Institute of Planners of Kenya (IPK) ☐
   g) Kenya Association of Building and Civil Engineering Contractors (KABCEC) ☐
   h) Kenya Property Developers Association (KPDA) ☐
   i) Institution of Surveyors of Kenya (ISK) ☐
   j) Other (please specify) ________________________________

6. How long have you been a member?
   a) Below 1 year ☐
   b) 1 – 3 years ☐
   c) 4 – 7 years ☐
   d) 7 – 10 years ☐
   e) Above 10 years ☐

7. Are you aware of the following research reports conducted and disseminated by NCA?

Research Report	Yes	No
i) Research on failure and collapse of buildings in Kenya		
ii) Enhancing accreditation of skilled construction workers and site supervisors in Kenya		
iii) Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya		
iv) A circular economy model, assessment of factors influencing construction waste management practices in Kenya		
v) Effectiveness of contractor training in Kenya		
vi) The participation of local firms in Public Private Participation infrastructure projects in Kenya		
vii) Insights into contractor registration trends in Kenya (2015-2020)		
viii) Early risk detection framework for construction projects in Kenya		
ix) Quality Assurance coordination framework for the construction industry in Kenya		
x) Media portrayal of the National Construction Authority and the construction industry in Kenya		
xi) Alternative Building Material & Technologies: Promoting Models for Affordable Housing		
xii) Enhancing the Involvement of Micro, Small, and Medium Enterprises (MSMEs) in the Construction Industry in Kenya		
xiii) User experience analysis of the National Construction Authority's ICT systems		
xiv) Performance of technology transfer in the construction industry in Kenya		
xv) Assessment of the domestic capacity of the construction industry in Kenya and development of a national construction industry strategy		
xvi) The influence of socio-economic factors on performance of rural road construction projects in Kenya		

8. **Degree of Research Innovativeness**

To what extent do you agree that the research outcomes had the following effects on introducing new ideas in construction industry?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Increased numbers of new materials used					
2	Increased numbers of projects integrating smart technologies					
3	Improved project quality					

4	Increased industry adoption of research outputs					

9. **Financial Viability**
To what extent do you agree that the research outcomes had the following effects on access and availability of funding construction projects?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Adherence to the project budget					
2	Increased access to funding and low interest loans rates					
3	More innovative project financing models					

10. **Timeframe and Practicability of Research Delivery**
To what extent do you agree that the research outcomes had the following effects on timeline of executing construction projects?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Increased adherence to project completion time					
2	Optimal time to achieve investment returns					
3	Minimal time-related cost overruns					

11.**Environmental Sustainability Contribution**
To what extent do you agree that the research outcomes had the following effects on promoting environmental sustainability practices in construction industry?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Increased usage of sustainable materials					
2	Reduction in construction and demolition waste					
3	Increased compliance with green building regulations					

12. **Occupational Safety and Health Contribution**
To what extent do you agree that the research outcomes had the following effects on worker safety and health standards in the construction industry?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**

1	Decreased number of workplace accidents and injury rates					
2	Increased compliance with safety regulations (OSHA)					
3	New safety policies introduced					

13. **Enhancement of Workforce Capacity**
To what extent do you agree that the research outcomes had the following effects on enhancing knowledge-sharing and workforce training in the construction industry?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Increased number of workers trained in new construction methods					
2	Increased number of accredited workers in specialized construction areas					
3	Increased number of training programmes developed					

14. **Technological Advancement**
To what extent do you agree that the research outcomes had the following effects on integrating emerging technologies in the construction industry?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Improved productivity due to technology adoption					
2	Increased digitalization of the construction process					
3	Increased adoption of new technologies					
4	Increased technology transfers					

15. **Societal Needs**
To what extent do you agree that the research outcomes had the following effects on societal needs in the construction industry?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Increase in number of affordable housing units delivered					
2	Improved public infrastructure					
3	Increased employment					

	opportunities					
4	Increased public perception and stakeholders involvement					

16**. Policy and Legal Alignment**
To what extent do you agree that the research outcomes had the following effects on policies, laws, and regulations in the construction industry?

	Measurement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Introduced new or revised construction regulations					
2	Increased compliance to industry laws					
3	Increased number of legal reforms					

17. Could you kindly suggest other ways in which research programmes undertaken by NCA can be improved to have a greater impact on the construction industry? ……………………………………………………………………………………………
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APPENDIX E: NCA QUESTIONNAIRE ON IMPROVEMENT OF NCA RESEARCH PROGRAMMES - NCA MANAGEMENT

EFFECTIVENESS OF NCA RESEARCH IN THE CONSTRUCTION INDUSTRY

The National Construction Authority (NCA) is mandated under section 5 (2) (c) of the Act to undertake or commission research into any matter relating to the construction industry. Consequently, the Authority published 16 research studies in the following broad thematic areas: risk and safety, Construction economics, Legal and regulatory framework, Capacity development, Construction management, Construction technology and materials, and Environmental issues.

The Authority has disseminated the research's findings and recommendations through workshops, conferences, and other media channels. However, the impact of these initiatives on the construction industry has not been assessed.

NCA has, therefore, commissioned **Waaki Associates**, a consultant, to undertake countrywide research to establish the effectiveness of this research in developing the construction industry.

The study will help the Authority identify gaps in executing the research programmes and thereafter develop a framework to enhance their effectiveness.

This questionnaire aims to obtain information that will facilitate this exercise. Your contribution will be highly appreciated. All your information will be treated as confidential and used ONLY for the above purposes.

Kindly tick (√) as appropriate for each of the following.

SECTION A: RESPONDENT'S PARTICULARS

1.Gender: Male ☐ Female ☐

2.What is your designation?

a) Board Member ☐
b) Executive Director ☐
c) Manager ☐
d) Corporate Secretary ☐
e) Technical Officer ☐
f) If other, (please specify) ……………………………………

3. Which County are you currently based?

Mombasa ☐	Nyandarua ☐	Kericho ☐
Kwale ☐	Nyeri ☐	Bomet ☐

Kilifi ☐	Kirinyaga ☐	Kakamega ☐
Tana River ☐	Murang'a ☐	Vihiga ☐
Lamu ☐	Kiambu ☐	Bungoma ☐
Taita-Taveta ☐	Turkana ☐	Busia ☐
Garissa ☐	West Pokot ☐	Siaya ☐
Wajir ☐	Samburu ☐	Kisumu ☐
Mandera ☐	Trans Nzoia ☐	Homa Bay ☐
Marsabit ☐	Uasin Gishu ☐	Migori ☐
Isiolo ☐	Elgeyo-Marakwet ☐	Kisii ☐
Meru ☐	Nandi ☐	Nyamira ☐
Tharaka-Nithi ☐	Baringo ☐	Nairobi City ☐
Embu ☐	Laikipia ☐	
Kitui ☐	Nakuru ☐	
Machakos ☐	Narok ☐	
Makueni ☐	Kajiado ☐	

4. How long have you worked at NCA?
   a) Below 1 year ☐
   b) 1-3 years ☐
   c) 4-7 years ☐
   d) 7-10 years ☐
   e) Above 10 years ☐

5. Are you aware of the following research reports conducted and disseminated by NCA?

Research Report	**Yes**	**No**
i) Research on failure and collapse of buildings in Kenya		
ii) Enhancing accreditation of skilled construction workers and site supervisors in Kenya		
iii) Building resilience among the contractors in the face of business disruptions: Case of COVID-19 in Kenya		
iv) A circular economy model, assessment of factors influencing construction waste management practices in Kenya		
v) Effectiveness of contractor training in Kenya		
vi) The participation of local firms in Public Private Participation infrastructure projects in Kenya		
vii) Insights into contractor registration trends in Kenya (2015-2020)		
viii) Early risk detection framework for construction projects in Kenya		
ix) Quality Assurance coordination framework for the		

construction industry in Kenya		
x) Media portrayal of the National Construction Authority and the construction industry in Kenya		
xi) Alternative Building Material & Technologies: Promoting Models for Affordable Housing		
xii) Enhancing the Involvement of Micro, Small, and Medium Enterprises (MSMEs) in the Construction Industry in Kenya		
xiii) User experience analysis of the National Construction Authority's ICT systems		
xiv) Performance of technology transfer in the construction industry in Kenya		
xv) Assessment of the domestic capacity of the construction industry in Kenya and development of a national construction industry strategy		
xvi) The influence of socio-economic factors on performance of rural road construction projects in Kenya		

6**. Capacity Building in the NCA Research Department**
To what extent do you agree that the following factors define research programme at NCA?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Adequate funding for research programs					
2	Workforce of the department were adequately trained					
3	Appropriate research technology was provided					
4	Adequate infrastructure for research was in place					
5	Strong partnerships and collaboration with academia					

7. **Planning and Conducting of Research**
To what extent do you agree that the following factors define research programme at NCA?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Addressed real problems of the construction industry					
2	Comply with new construction regulations and policies					
3	Aligned to the local and international research standards					

4	Involved stakeholders in design and implementation of research program					
5	Prioritized research on emerging issues					
6	Fostered strong partnership between academia, research institutions and construction firms					

8. **Implementation of Research Outcomes**
To what extent do you agree that the following actions were effective in implementing research outcomes?

	Measurement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Dissemination to targeted audience					
2	Research utilized appropriate dissemination channels					
3	Developed pathways for commercialization of research outcomes					
4	Created effective feedback mechanisms for different stakeholders					
5	Had strategies for protecting Intellectual Property (IP) of new research products					

9. Could you kindly suggest other ways in which research programmes undertaken by NCA can be improved to have a greater impact on the construction industry? ……………………………………………………………………………………………
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APPENDIX F: EFFECTIVENESS OF NCA RESEARCH PROGRAMMES

FGD GUIDE

Introduction

The National Construction Authority (NCA) is a state corporation established by an Act of Parliament, Act No. 41 of 2011. NCA's broad mandate is to oversee the construction industry and coordinate its development. One of its key functions, among others, is to undertake or commission research into any matter connected to the construction industry.

In this regard, the Authority is researching the impact of the research programmes on development programmes in Kenya's construction industry. The main objective of the research is to establish the effects of the 16 research studies carried out by the NCA from 2015 to 2022 on the development of the construction industry in Kenya and to develop a framework to enhance the effectiveness of NCA programmes.

We want to ask you some questions that will contribute to this research. The information you give will be used solely for the study. Please feel free to share your point of view, even if it differs from what others have said.

Name of Interviewer	

Group Information

Name of Group		
County		
Membership	**Male (No.)**	**Female (No.)**
Age Bracket		
18 - 35 years		
36 - 60 years		
61 Years and above		
Total		

Focus Group Discussion

(a) Awareness of the research reports: Are you aware of the following research publications by the National Construction Authority?

i. Alternative Building Material and Technologies (ABMT)

ii. Coordination framework for inter-agency quality assurance processes for the construction industry in Kenya

iii. Participation of local construction firms in Public Private Participation (PPP) infrastructure projects in Kenya
iv. Accreditation dynamics for skilled construction workers and construction supervisors in Kenya
v. Contractor registration dynamics
vi. The Involvement of Micro, Small and Medium Enterprises (MSMEs) in the construction industry in Kenya
vii. The effects of the COVID-19 pandemic on the business resilience of contractors in Kenya
viii. Construction and demolition waste management practices in Kenya
ix. Early Risk Detection System for the Construction Industry in Kenya
x. Research report on building failures
xi. The role of socio-economic factors on the performance of rural road construction projects in Kenya
xii. Performance of technology transfer in the construction industry of Kenya by NCA
xiii. Capacity building programs on the effectiveness of the construction sector: A case of contractors in Kenya
xiv. Assessment of the domestic capacity of the construction industry and development of a national construction capacity strategy
xv. Media portrayal of the NCA and the construction industry in Kenya
xvi. Influence of ICT system on its regulatory performance

(b) NCA Research Capacity: What is your assessment of NCA Research Capacity along the following parameters;
i Capacity building in the NCA Research Department
ii Planning and Conducting Research
iii Implementation of research outcomes

(c) How has NCA research contributed to the effectiveness of NCA Research Programmes
i. Innovation e.g. new materials and construction technologies
ii. Access and availability of funding for construction projects
iii. Timeframe and practability of research delivery
iv. Environmental sustainability
v. Safety and health
vi. Learning and training
vii. Technological advancement
viii. Societal needs
ix. Policy and legal improvements

(d) What are your recommendations on how NCA can enhance the effectiveness of research programmes?

(e) In your opinion, what would comprise a framework that would enhance the effectiveness of NCA research programmes for optimum impact?

FGD Targeted Stakeholders – 20

Stakeholder	Numbers
NCA	3
Professional Bodies (KIP, AAK, IEK, IQSK, BORAQS)	5
Contractors	3
Government Agencies	5
Academia	2
Total	20

Key Informant Interviews

(a) NCA Manager
(b) Kenya Association of Building and Civil Engineering Contractors (KABCEC)
(c) Chairman or a Council Member – AAK & IQSK
(d) Chairman BORAQS/
(e) Academia –
(f) Representatives of case studies – KIPPRA, KIRDI, KBRC & KEFRI

APPENDIX G: RESPONSES FROM EXTERNAL AND INTERNAL STAKEHOLDERS

Government Agencies

1) Enhance media visibility on print, social and mainstream media on the importance of construction regulations.
2) Share black list of consultants with the board (BORAQS) for architects who cannot handle many projects rubber stamping projects/oversee projects they can't handle 2) recommend that such architect be given disciplinary action of 6 months not practicing and 3 years under supervision of the board (BORAQS) 3) encourage the NCA to share reports with the board (BORAQS) on their portal for more knowledge to members same report to be shared by AAK on their portal for more knowledge to members 4- give NCA power to bite by prosecuting contractors who go against said rules , laws ,policies.
3) Dissemination is lacking.
4) Deliberate effort to present research findings during professional conference. If you need help in this. I will be pleased to support.
5) Build synergy with institutions of higher learning i.e. for masters and PhD students participating or taking topics from real time construction projects.
6) Official presentation of the reports to stake holders and sharing of this information in maybe newsletter or media pressers or print media.
7) Proper public awareness before researches commence and involving related government agencies like KEBS.
8) Adopt of sustainable technologies with usage of locally available materials.
9) It will be good to also include webinars in the research programmes undertaken to reach more audience.
10) N/A
11) Conduct regular needs assessments with contractors, consultants, developers, and regulators to ensure the research addresses real challenges on the ground (e.g., building code compliance, construction waste management, labor productivity, etc.).
12) Research should be based on needs of different geographical regions in Kenya tailored to the techniques used in construction of each area. For instance, construction in the Lamu archipelago is way different from Mombasa and the coastal region which is way different to Nairobi County. NCA should adopt regional technological framework and policies rather than a blanket national policy. A quick example is the use of mangrove poles on floor slabs in Lamu as the resource is locally available rather than implementation of reinforced concrete.
13) Increase publication outlets especially social media platforms.
14) NCA should involve engineers in the private sector in this policy improvements or training. This can be done through IEK or EBK The private sector also plays a huge role in construction and these policies would be more effective.

15) Engage with stakeholders such state department of public works, like the case of affordable housing the material used that's the precast should be tested at the material testing and research for it to be of quality assurance rather than just allowing placement of those panel blocks, another one is to have someone from material testing lab in all the ongoing construction this is to curb poor workmanship.
16) A) Conducting individual governmental agency awareness sessions for the research studies/reports.
    B). IEK, EBK among other professional bodies have a good platform for the dissemination of these research reports to their registered professionals. Increasing the number of collaborations, workshops, and webinars with them will certainly go a long way in achieving awareness of these reports.
17) Collecting data on ongoing projects and workers on-site.
18) Public sensitization and worker training.
19) Increase the study sample to cover all stakeholders.
20) Technological training and adoption, like AI, 3D printing in the construction industry.
21) Involve all stakeholders in the construction industry and create vigorous awareness to ensure this information is disseminated everywhere. Also consider Electrical and Mechanical Engineers to be part of the construction approval process not only Architects and Structural Engineers.
22) Improve public awareness.
23) It is unfortunate I have not seen the said research reports. Kindly ensure effective dissemination in the future.
24) Deepen the involvement of professional societies in all the processes.
25) Good job done.
26) They should carry out realistic reports.
27) Organize webinars and seminars with all stakeholders in the relevant field.
28) NCA should endeavor to closely partner with relevant authorities/organizations in whose areas of operations research is being conducted.
29) Digitize most of the process to avoid shortcuts, which promotes impunity and corruption.
30) The topics are very relevant and interesting with great potential for impact but there is little to no public awareness on these. Create more awareness. Speak in engineering conferences and webinars, talk to industry specialists, have awareness meetings with relevant civil servants and state departments, construction industry stakeholders, use social media, websites TV, newspaper, government newspaper etc. to create more awareness. Adopt some government pilot projects where implementation of the studies can be done and the results and positive impacts published, advertised and used as case studies.
31) Not at the moment.
32) Underutilization of Skilled Professionals in the Construction Industry: one of the major challenges currently facing the construction industry is the

widespread underutilization of skilled and professionally trained personnel, particularly in projects involving complex or specialized structural designs. It has become increasingly common for clients to bypass the essential services of qualified structural engineers during both the design and implementation stages of construction. Instead, many rely on semi-skilled or unskilled laborers, such as masons, to carry out critical structural work. This trend poses serious risks to structural safety and project quality. The absence of professional oversight often results in design flaws, poor workmanship, and, in extreme cases, structural failures that endanger lives and require costly repairs. Beyond compromising safety standards, this practice significantly undermines the role of engineering professionals and the relevance of formal education in the construction sector. Moreover, the continued preference for cheaper, unqualified labor over trained graduates exacerbates the problem of unemployment among engineering professionals. Despite possessing the necessary technical skills and theoretical knowledge, many qualified individuals struggle to find opportunities within an industry that does not fully recognize or utilize their expertise. This situation reflects a systemic failure in the alignment between construction practices and professional standards. To address this issue, there is an urgent need for stronger regulatory frameworks, public awareness campaigns, and strict enforcement of professional requirements in construction projects. Promoting the engagement of licensed engineers and trained professionals is essential for ensuring structural integrity, enhancing project outcomes, and fostering economic growth through the productive employment of skilled graduates.

33) Linkages between the industry and research institutions to mainstream contemporary technologies.
34) NCA can incorporate more stakeholders into their research. They may also engage the youth; explore challenges affecting them and possible solutions.

NCA Management

1) Involve relevant professionals to give their professional opinions on matters of construction.
2) Training for contractors/site supervisors/skilled workers through partnership with other stakeholders like academia.
3) Beyond dissemination, there should be demonstrable uptake of the provided solutions and measurement of the same to deem the research studies a success.
4) N/A.
5) Develop innovative research methods. Explore new approaches to data collection and data analysis including machine learning and artificial intelligence.
6) Incentives to the best researcher to motivate them.

7) Sharing thematic topics with universities for students to research through NCA funding.
8) Partner more closely with the construction industry and tertiary institutions to enhance applicability of research outputs.
9) N/A
10) Inform the sector of this research paper and how they can help their businesses or the sector (more advertising about the sector).
11) Stronger partnerships and increased visibility of programmes with academic and industry players.
12) The need for increased partnership with academia and state agencies.
13) Tie research themes to national goals like affordable housing, infrastructure development, or climate-resilient construction. -Offer training for industry professionals based on research outcomes. -Track how research influences practice, policy, or productivity over time.
14) N/A
15) By collaborating hand in hand with all construction players in the field and able to heard their views and compile them so as to come with best results.
16) Focus on impactful research with a keen interest in evidence-based research that is scientifically proven for instance making use of the mobile testing labs to carry out investigations for collapsed buildings. Collate information from contractors at the point of renewal or during CPDs to address their research needs. Work on bankable research that can be commercialized to benefit NCA, contractors and the construction industry. Instead of commissioning brand new research, the existing data the authority has starting from TIC Reports and Inquiries reports into collapsed buildings should form an important starting point where research can be used to understand the underlying factor leading to collapse of buildings, the recommendations of which should be used to formulate policy.
17) Civil education.
18) N/A
19) Through more training and awareness.
20) By sensitization training and team building.
21) Real time monitoring of any recommendations to assess their level of implementation would be greatly useful.
22) Encourage multi-disciplinary approach to research. Recognize efforts of staff participation in research.
23) Involve people outside of the authority in finding new technologies in building and doing regular documentaries on your findings. No one is interested in reading docs in the portal people want visual representation of your findings.
24) NCA staffs in the regions should be incorporated in the research programme.
25) Establishing clear pathways for knowledge transfer and promoting collaborations between academia and industry are crucial for translating research into tangible benefits.

26) More workshops for the staff.
27) N/A.
28) Ensuring that the research results are economically feasible, such that they can be adopted by the contractors when it comes to operational costs, initial investment and the potential benefits.
29) My thought is about the dissemination of research findings. Sometimes research is published in journals that industry professionals do not read. So maybe translating findings into more accessible formats, like guidelines, case studies, or workshops. Practical training sessions could help in transferring knowledge.
30) Sensitization of regional staff and stakeholders outside Nairobi on the research programs being conducted or before they are initiated perhaps on social media posts and emails. A more personalized touch as opposed to the NCA website and select media press.
31) N/A
32) More dissemination workshops needed.
33) N/A
34) More counties should be included when coming up with venues for training contractors, site supervisors and skilled workers. Contractors in Baringo county have been requesting even if it is only once in a financial year.
35) Build capacity in terms of human resource, funds and technology for the department.
36) The Authority should procure research data analysis software's to be used in data analysis.
37) Make the researches more applied as opposed to academic.
38) Incorporate research to campus and college levels in the whole world.
39) By adding more personnel with technical skills.
40) Research collaboration with Local and International research organization's
41) N/A
42) Massive sharing of the research findings.
43) Focus on practical and scalable solutions i.e., emphasize applied research over purely theoretical work.
44) N/A
45) Empowering in future research and program improvements.
46) The research department should include a blend of professional. A statistician should be hired to support the department.
47) -By having more two-way communication research that includes the common *mwananchi* by having public surveys/polls that entail a demand-driven research agenda. Develop user friendly guide to disseminate research findings to target audience through variety of channels mostly public like visual ads/programs/documentaries on television, billboards etc. As most people don't know what NCA actually does, they think we just mark red X'es on

buildings and don't even know why. Common *wanjiku* needs severe sensitization.

48) Regular research presentations on innovations by members of NCA family.
49) Stronger partnerships with Manufacturers & Service providers in the construction industry.
50) Focusing on real-world problems, actively engaging with industry stakeholders, and ensuring that research outcomes are readily accessible and usable.
51) More training.

Professionals

1. Implementing some new mandatory changes. For example, concrete manufacture is still based on codes from 1956, whereas codes for the same material were published in 2024. Research programmes could focus on implementation and its barriers.
2. More transparency, equitable access to resources for all, and the availability of staff to respond to inquiries.
3. Dissemination of the outcomes through county forums, all the way to the sub-chief. Use of MPS to disseminate. Presenting the outcomes in Nairobi and on YouTube is not a practical approach.
4. Make them more practical, i.e. applied rather than academic.
5. Involvement and basic civic education of the public regarding the building construction industry.
6. More studies and surveys to be conducted. Should be inclusive and include all stakeholders. Case studies of how to solve this problem form other countries to be considered which suits our needs and similar to our context.
7. More dissemination, collaboration, funding and capacity building of research resources.
8. Develop and integrate affordable training programs that can be easily accessed by the new generation of the built environment. Strong emphasis on the importance of Planners at the micro scale in the built environment.
9. Sensitize stakeholders of your studies through social media and collaborative activities. Publicize research results widely and wildly for all and sundry to know. For instance, make known the register of skilled persons in building works, such as painters, plumbers, and masons, along with their fee charges as regulated by the NCA.
10. Routine inspections must be undertaken.
11. Having more public meetings on research outcomes.
12. NCA should foster innovation by partnering with construction research institutions (like KEBS & MTRD), universities, and private sector stakeholders.

Contractors/Site Supervisors/Skilled Workers

1) N/A
2) Buy involving more stakeholders, and ensuring that developers are more compliant.
3) Yes, in my opinion, I can suggest that NCA should strictly enforce a policy that no one will be allowed to work on site without NCA training. This is due to my ten years in construction, a very low percentage have NCA accreditation. The NCA should employ more staff to ensure all sites in Kenya are regulated, especially in Parklands and Eastleigh, where a site has not even a single NCA-trained personnel, and a site has no safety officer.
4) Offer relevant training to each engineering specialty i.e., mostly, training are for civil engineering not considering that there are other specialists.
5) The NCA focus on more youths and come up with a strategy on how to involve them more actively in building industry.
6) The training should be done under local authorities and chief *barasa*.
7) To use more digital platforms.
8) Sina maoni.
9) Stakeholder engagement and affordable CPD training. Adopt free clinic. Public illumination. Power to prosecute and enforcement of rules and regulations.
10) Weeding out of rogue, corrupt, untrained and cartel like contracts.
11) Curry time depending on the type of sand. Every area has a different sand.
12) Following up to make sure payments are made, and have a zero pending bills which has brought many companies down.
13) NCA should enhance compliance on all constructions and approvals, NOT county governments.
14) Have more mentorship programmes.
15) By involving learning institutions to undertake research that related to construction activities.
16) Safety matter.
17) N/A.
18) By placing students who have graduated from technical institutes on national projects country wide to gain skills so that in future we don't depend on China for labour.
19) Plan more research programs in remote areas. Reduce the registration charges for more and young contractors to participate in such surveys.
20) Increase number of project managers.
21) A) Carry out public participation at NCA offices in counties. B). Questionnaires to be originated by contractors on ground. C). Waiver of penalties to be done at the end of every financial year. D). Encourage NCA trainings in counties. E). Encourage/motivate skilled workers who don't have certificates (minor works).
22) I have no idea, but am okay with what you are doing.
23) By NCA reducing training fees to a more affordable rate and increasing the number of trainings.

24) Increased NCA field follow ups in the construction to confirm that projects awarded are done.
25) NCA should, inform contractors when the surveys are done, also link with universities & TVET institutions by helping bridge the gap btw training and the construction industry since most graduates are not aware of what happen in the construction site, they can also do research and help tailor make the curriculum for effective training and seamless transition to the industry.
26) Sensitization of the public on the new technologies and importance to them.
27) Offer free trainings on research findings. This means that NCA should ensure the research findings is disseminated to the beneficiaries.
28) Thanks again.
29) Enhance online programmes to reach more construction workers.
30) Carry out training on site.
31) Research programmes be conducted at the County level.
32) Try reaching out to people on social media. People spend a reasonable amount of their free times on mobile phones and social media. If you can try tap that energy it will be more effective, I imagine in your comfort zone looking at the phone and getting training from NCA that would be great.
33) N/A.