



KYAMBOGO UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

MASTER OF SCIENCE IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT

**ENHANCING LABOUR PRODUCTIVITY THROUGH JOB-SITE TRAINING
ON BUILDING SITES IN UGANDA: A CASE OF ARUA CITY**

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20/U/GMET/13131/PE

**A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH
AND GRADUATE TRAINING IN PARTIAL FULFILLMENT OF THE RE-
QUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCI-
ENCE DEGREE IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT
OF KYAMBOGO UNIVERSITY**

SEPTEMBER 2025

DECLARATION

This dissertation entitled “*Enhancing labour productivity through job-site training on building sites in Uganda: A case of Arua City*” is my own work and that, to the best of my knowledge and belief, it neither contains material previously published or written by another person nor material which has been accepted for the award of a degree of any University or other institute of higher learning.

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CERTIFICATION

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ACKNOWLEDGEMENT

This research would not have been feasible without the participation of many different people, each in their own unique way; therefore, my heartfelt gratefulness to the following individuals who never stopped assisting me till my dissertation was completed. Firstly, I thank Jehovah for the wisdom and endurance he has given me throughout my life and especially throughout my dissertation and school life.

It brings me great pleasure to thank my supervisors, Assoc. Prof. Muhwezi Lawrence and Dr. Ssenyondo Vicent for making this research dissertation writing possible through their dedication, mentorship and research direction despite their hectic schedules. I would like to express my special gratitude to my parents, sisters, brothers and the rest of my family members for believing in me, providing unconditional loving support and praying for me; I will eternally be thankful for your love, embrace and covering. I would like to thank Eng. Dr. Morris Oleng and Eng. Mubiru Joel for their helpful thoughts, suggestions and interactions especially at the beginning of this research.

Last but not least, in a special way, I thank my wife, Mrs. Kansiime Enid Econi, workmates and ministry friends for their support throughout this entire period, both by assisting me and by keeping me harmonious in putting different elements of my life, ministry and relationship together. I forever appreciate each of you for the sacrifices and your love. To God be the glory.

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LIST OF ABBREVIATIONS AND ACRONYMS

AII	: Average Importance Index (dimensionless)
CPO	: Construction project organization
CP	: Construction project
CVI	: Content Validity Index
DV	: Dependent variable
EAC	: East African Community
GDP	: Gross domestic product
GPS	: Global positioning system
HRD	: Human resource development
HRM	: Human resource management
IV	: Independent variables
KII	: Key informant interviews
KPIs	: Key performance indicators
LPI	: Labour productivity improvement (%)
LP	: Labour productivity
MSME	: Micro, small and medium enterprise
OJT	: On-the-job training
OSH	: Occupational safety and health
PPE	: Personal protective equipment
RII	: Relative impact index
ROI	: Return on investment
SFP	: Single-factor productivity
SPSS	: Statistical package for the social sciences
TFP	: Total factor productivity
TNA	: Training needs analysis
UNABCEC	: Uganda national association of building and civil engineering contractors

LIST OF SYMBOLS AND MEANINGS

L	:	Total factor productivity
E	:	Equipment
M	:	Material
C	:	Capital
Q	:	Total output
I	:	Input (e.g., actual work hours)
O	:	Output (e.g., installed quantity)
H_a	:	Installed quantity (Output)
Q_i	:	Actual work hours (Input)
N	:	Required sample size
N	:	Total population size
P	:	Estimated proportion of the variable present in the population
Q	:	Complement of p ($q = 1 - p$) representing absence of the variable
Z	:	Standard normal deviate at specified confidence level
E	:	Margin of error between sample mean and population mean
n_o	:	Initial (uncorrected) sample size assuming infinite population
n_i	:	Sample size allocated to stratum i
N_i	:	Population of stratum i
N_T	:	Total population across all strata
Y	:	Interpolated sample size
y_1, y_2	:	Sample sizes at known values x_1 and x_2
X	:	Intermediate value for which interpolation is required
x_1, x_2	:	Known reference values used in interpolation
n_r	:	Number of experts rating the item as relevant
ΣW	:	Sum of weights assigned to factors by respondents
A	:	Maximum possible weight on Likert scale
N	:	Total number of respondents
E	:	Job-site training effectiveness score
β_o	:	Constant term (baseline training effectiveness)
$\beta_1 \dots \beta_s$:	Regression coefficients for factors influencing training
X_i	:	Mean Likert score for factor i ($1 \leq X_i \leq 5$)

- x_i^2 : Squared term of factor i (captures non-linear effects)
- P_a : Productivity after training intervention
- P_b : Baseline productivity before training

ABSTRACT

Labour productivity is a critical determinant of construction project performance directly influencing timelines, cost efficiency and overall quality outcomes. In developing countries like Uganda, the building sites often struggles with low productivity levels due to inadequate workforce skills, inefficient work practices and limited access to structured training programs. In Arua City, evidence from multiple building sites indicate that these challenges manifest in significant delays, substandard workmanship and cost overruns. According to the Uganda Bureau of Statistics (2022) and the Uganda Manufacturers Association (2022) reports, 68% of manufacturing firms in Uganda report difficulties in finding technically skilled workers highlighting a critical skills gap that undermines productivity and efficiency. This study investigates the role of jobsite training in enhancing labour productivity on building sites aiming to identify the most significant factors influencing training effectiveness and workforce performance while proposing strategies to optimize outcomes. A mixed-method approach is adopted, collecting quantitative and qualitative data from 94 workers across fourteen sites and is analyzed using SPSS version 23. Findings reveal a moderate positive correlation between job-site training and labour productivity with training method, recruitment criteria and trainee motivation identified as the most influential factors for training effectiveness while manpower, management and motivation emerge as the primary determinants of labour productivity across worker trades on site. A predictive regression model with R^2 value of 80.2% is developed to design, assess and predict the effectiveness of job-site training on building sites. An on-site training framework is developed and validated demonstrating productivity improvements across all trades including carpenters by 18.06%, non-trade workers by 15.95%, welders by 13.94%, painters by 9.72%, electricians by 6.24%, plumbers by 2.93% and masons by 2.65%. The study recommends that job-site training programs carry out systematic needs assessment to align training content with site-specific requirements. Priority should be given to training methods and manpower management as they have the greatest impact on training effectiveness and worker productivity on building site. The regression model and training framework should be adopted as practical tools for planning and evaluating training programs. Finally, the study recommends apprenticeship and role-playing as the most effective methods for knowledge transfer on building sites.

Keywords: Job-site training, Labour productivity, Building sites, Training framework, Workforce skill

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

In today's corporate environment, training stands out as the primary technique for achieving institutional goals, contributing to the enhancement of both employee and employer performance (Ruttledge and Cathcart, 2019). Recognizing that employees are the most valuable assets shaping an organization's reputation and revenue (Elnaga and Imran, 2013), human resource management plays a fundamental role in training individuals to acquire the information and skills essential for successful task execution. Such human resource management strategies have become common place in firms worldwide (Hughes *et al.*, 2020). In the context of construction, job-site training emerges as a critical factor for improving the competence and efficiency of construction workers, positioning them as the main assets driving productivity success, according to construction companies (Shadare *et al.*, 2009). Organizations with robust on-the-job training systems are believed to outperform others over time, underlining the significance of on-the-job training in any business (Phiona, 2017).

Job-site training and development represent a systematic process aimed at enhancing an individual's performance through the acquisition of knowledge and skills relevant to their work, elevating proficiency, motivation and self-awareness. Job-site training, as a deliberate effort by organizations, aids staff in acquiring behavior and information pertinent to their roles, aligning with the main principles of training and development in an organization (Garavan, 1991). To address the challenges faced by construction sites in adopting efficient employee training and development methods, managers, executives and supervisors must play a significant and positive role in how training is transferred. Training is crucial for enhancing workers' adaptability, flexibility and workforce competency, provided it is delivered sufficiently (Tai, 2006). In the construction sector, job-site training is identified as a key strategy to boost productivity, with numerous studies indicating that training improves company outcomes by increasing productivity, enhancing managerial abilities, reducing production costs, increasing profitability and expanding market reach (Kessy and Temu, 2010).

Recognizing employees as the most valuable assets to a construction firm, the active contribution of workers to the company's success cannot be understated. Despite

substantial studies on construction productivity and training, the same cannot be said for construction workers' training on construction sites, particularly in Arua City, Uganda. This research was conducted to address this gap and shed light on the specific dynamics of job-site training and its impact on construction labour productivity in Arua City.

Uganda's construction sector has experienced significant growth in recent years with 2023 being a landmark year due to the country's increasing population, industrialization, urbanization, government-led infrastructure projects and private sector. The operationalization of new cities such as Arua, Mbarara and Jinja has spurred considerable construction activity across residential, commercial and public sectors. This urbanisation strategy was further supported by the enforcement of the Building Control Act, 2013 and the establishment of the Construction Industry Skills Council to address the skills gap through standardization and training.

Despite these developments, labour productivity on building sites remains particularly low, a trend that has persisted over time (Alinaitwe, 2008). Studies have linked poor productivity to factors such as incompetent supervision, unskilled workers, rework and poor construction methods (Alinaitwe *et al.*, 2010). Addressing these challenges is crucial to achieving the full potential in the construction sector. A study by Alinaitwe (2006) revealed that craftsmen in the Ugandan construction sector spend only about 40 % of their time on productive work and then approximately 33 % devoted to non-value-adding activities. Major inhibitors included lack of skilled supervision, insufficient worker training, poor tools, rework and inadequate management practices. There remains a gap in the current literature addressing the effectiveness of job-site training programs in improving the labour productivity.

1.2 Statement of the problem

The construction industry in Arua City, Uganda currently faces critical challenges that significantly impact labour productivity and the quality of building projects and persistent issues such as poor workmanship, frequent reworks and inefficiency attributed to the presence of unskilled and inadequately trained labourers on site. This situation is compounded by the lack of systematic and tailored job-site training programs on site leaving workers ill-prepared to meet the demands of an evolving construction industry. Construction companies struggle to adopt effective employee training and development methods (Tabassi and Bakar, 2009). This challenge is particularly evident in Arua City where

newly employed workers often lack familiarity with specific site tasks and experienced professionals face difficulties adjusting to new methods on site. These inadequacies in workforce preparedness result in a failure to maximize labour productivity leading to cost and time overruns that further complicated project outcomes.

Reports from national and international sources highlighted a broader mismatch in vocational education and workforce readiness for instance 68% of manufacturing firms in Uganda reported difficulties finding technically skilled workers (Uganda Bureau of Statistics, 2022; Uganda Manufacturers Association, 2022). This disconnect extends to the construction industry where limited training opportunities and sector-specific initiatives fail to comprehensively address the needs of workers on site. Programs like the Mechanical Engineering Training and Advisory Centre (MENTRAC) and corporate-led efforts such as Uganda Baati's artisan training gained recognition for addressing skills gap but these initiatives remain insufficient in both scope and reach.

Although international partnerships and government collaborations have initiated progress, these efforts lack the customization required to address the unique challenges faced by each trade on building sites in Arua City still exist especially with the unskilled and inexperienced workers. Research indicates that labour productivity significantly influences the overall standard of construction and the varying productivity levels among workers affect both the quality and timeliness of projects (Doiphode and Phatak, 2017). Specific categories of workers including inexperienced labourers, newly employed site workers unfamiliar with tasks and experienced professionals trained under different methodologies all require targeted attention to optimize productivity.

The critical importance of consistent and effective training was underscored by incidents such as the collapse of a cantilever at the Arua Hill Stadium and Business Centre building site in 2023. This incident caused by improper removal of the beam component before curing by unskilled labourer which delayed and negatively affected the public image of the construction company involved. Such examples highlight how inadequate job-site training not only impacts project timelines but also endangers worker safety and erodes stakeholder confidence. Research has shown that consistent training leads to significant productivity and performance improvements (McDermott, 2019). The absence of empirical focus on the direct relationship between job-site training and labour productivity in Uganda's construction sector further limits the potential for improvement.

Therefore, this study aims to bridge the existing gaps in job-site training by investigating current practices, identifying factors affecting training effectiveness and assessing the impact of structured programs on productivity. Through the development of practical training framework, this research seeks to empower construction sites, project managers and policymakers to optimize site operations, enhance worker skills and align the workforce for improved labour productivity on building sites in Arua City and beyond.

1.3 Research objectives

1.3.1 Main objective

The main objective of this study is to investigate the role of jobsite training in enhancing labour productivity on building sites, with the aim of identifying the most significant factors influencing both training effectiveness and workforce performance and proposing strategies to optimize outcomes.

1.3.2 Specific objectives

- 1) To determine the factors affecting job-site training on building sites.
- 2) To determine the factors affecting construction labour productivity on building sites.
- 3) To evaluate the impact of job-site training on labour productivity on building sites.
- 4) To establish a developed training framework that maximizes the enhancement of labour productivity on building sites.

1.4 Research questions

- 1) Which factors influence the effectiveness of jobsite training for construction workers on building sites?
- 2) What are the key determinants of labour productivity among construction workers on building sites?
- 3) How does jobsite training relate to and impact labour productivity on building sites?
- 4) What strategies can be employed to optimize labour productivity through effective management of jobsite training practices?

1.5 Justification of the study

Alinaitwe *et al.* (2010) conducted a study focusing on factors affecting the productivity of craftsmen in Uganda. The goal was to develop a strategy for improving productivity by considering the effects on time, cost and quality. Their findings revealed that incompetent supervisors, a lack of skills, rework, a lack of tools/equipment and poor construction methods were the five most important factors influencing labour productivity in Uganda. They concluded that to enhance productivity, UNABCEC, researchers and policymakers should focus on the critical factors that are essential. Their recommendations included providing refresher courses, awarding based on skills and output and structured training for construction workers. Therefore, this study was prompted by the need to highlight job-site training strategies to boost labour productivity on construction sites in alignment with these identified critical factors.

Additionally, despite the practice of training programs on some sites, there is a significant gap in understanding the direct correlation between these programs, their impact and effective implementation of these programs to boost productivity on building sites. The specific training methods that prove most effective in enhancing the skills, knowledge and overall performance of construction workers remain unclear. Furthermore, comprehensive studies assessing how adequately trained workers contribute to reduced errors, improved task completion times and enhanced overall productivity in the construction sector are lacking.

This research aims to address this knowledge gap by investigating the relationship between worker training programs and productivity outcomes on construction sites. By identifying the most effective training strategies and their measurable impact on worker productivity, this study seeks to provide valuable insights for construction industry stakeholders, enabling them to optimize training initiatives and enhance productivity levels within construction projects.

1.6 Significance of the study

The significance of this research is a multi-faceted research topic which holds substantial implications for various stakeholders. Firstly, the research will address the prevalent skills gap issue in Uganda's construction industry, a challenge faced by many countries. By

focusing on job-site training, this study aims to bridge the skills gap, providing workers with the specific skills demanded on building sites. This targeted approach not only addresses the skills shortage but also ensures an increase in worker productivity.

Secondly, the research findings can play a crucial role in informing policy and education. Policymakers can use the evidence-based insights to design initiatives that incentivize sites to invest in employee training. Educational institutions, in turn, can align their curricula with industry needs, ensuring that future workers are adequately prepared to contribute effectively to the construction sector. Lastly, the research contributes to empowering the workforce by providing targeted job-site training. This empowerment equips construction workers with essential skills and knowledge, enhancing their efficiency and effectiveness in tasks. A well-trained workforce not only boosts confidence and job satisfaction but also contributes to timely project completion with high-quality results, minimizing the need for reworks on-site.

1.7 Scope of the study

1.7.1 Content scope

This research examines the effect of jobsite training on labour productivity in building construction sites within Arua City, Uganda. The study focuses on training-related factors and labour productivity factors that mainly affect workers on construction sites obtained from the literature review. These factors are studied and clustered for further analysis. The analysis covers only site working period, training period and the immediate post-training phases ensuring that observed changes directly relate to the implemented training interventions. Worker output is measured for each trade on site namely carpentry, masonry, plumbing, electrical, welding, painting and non-trade labour using productivity records before and after training. Feedback surveys are administered during active site operations to capture worker and supervisor perspectives. Statistical analysis conducted using SPSS to evaluate pre- training and post-training performance differences to ensure consistent and reliable computations across the building sites. The scope excludes macroeconomic factors, large-scale policy changes and sectors outside construction. It also does not extend to industrial or infrastructure projects beyond Arua City. By focusing solely on controllable site-level training and productivity elements the study generates actionable insights for enhancing workforce performance in the local building construction context.

1.7.2 Time scope

The study defines its time scope in line with construction phases where labour productivity for various trades is realistically measurable. For factors affecting job-site training, the focus is on early to mid-stages of the project when recruitment, induction and on-site skill enhancement sessions take place. Data is gathered during the implementation of these training activities to capture real-time effects on-site.

Factors affecting labour productivity are assessed throughout the project with emphasis on peak activity periods when trade outputs are clearly measurable. Masons' productivity is measured in the mid-phase during superstructure works; carpenters in the late structural phase during door installations; painters in the finishing phase through painted surface areas; welders in the mid to late-phase during window frame installations; electricians during first and second fix installations in mid to finishing phases; plumbers in the service installation stages from mid to late-phase; and helpers throughout the project with special focus on material handling tasks.

The impact of job-site training on productivity is measured after training interventions when workers are fully engaged in their tasks. The development of the framework for enhancing productivity spans all construction phases using data from initial training, mid-phase productivity measurements and end-phase performance reflections. These captures both short-term and cumulative effects of job-site training on worker productivity on sites.

1.7.3 Geographical scope

This study is conducted on selected building construction sites within Arua City, Uganda where any form of jobsite training exists, to study its effects and how to improve it. The sites represent a range of urban and peri-urban locations where different trades are actively involved in construction works. The geographical coverage includes projects managed by both private contractors and institutional clients ensuring diversity in work environments, workforce composition and training practices.

This study focuses on selected building sites where job-site training is implemented capturing variations in worker productivity across different locations within Arua city. The building sites have coordinates which are shown in the Figure 1.1 indicating where data were to be collected.

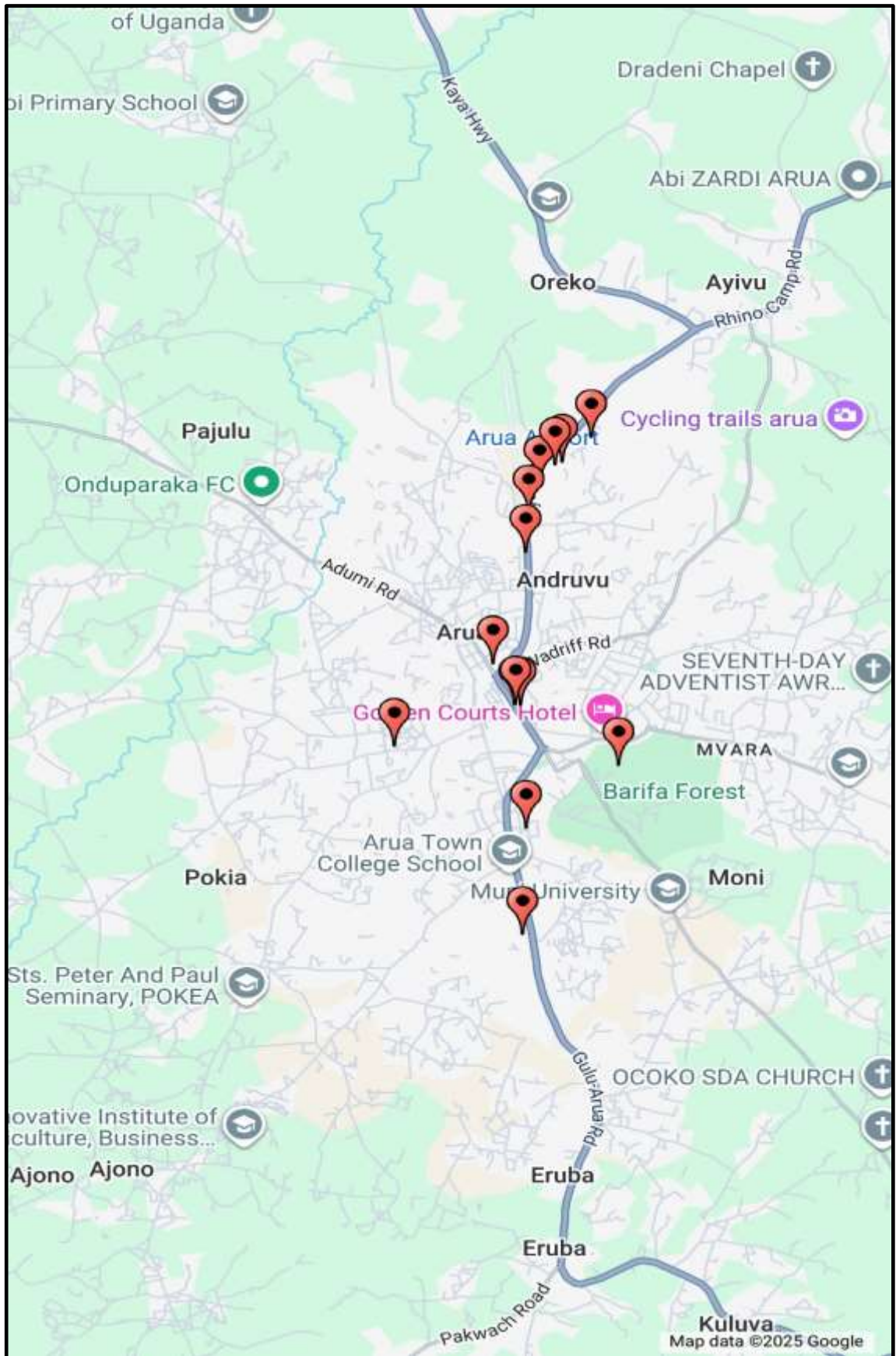


Figure 1.1 Buildings sites

1.8 Layout of the dissertation

This dissertation is written following the traditional format in which the main outcomes are presented in Chapters one, two, three, four and five. The contents of each chapter of this dissertation are described as follows:

Chapter One. Introduction: This chapter sets the foundation for the study presenting the background, problem statement, research objectives, research questions and the significance of the study including the scope of the research and conceptual framework of the study.

Chapter Two. Literature review: This chapter reviewed existing literature, theories and frameworks relevant to labour productivity and job-site training which explores global, regional and local studies while identifying gaps in knowledge that this study addressed. Key factors affecting labour productivity and the role of job-site training in construction were also discussed including the relationship between labour productivity and the job-site training.

Chapter Three. Research methodology: This chapter explains the research design, sampling methods and data collection techniques used in the study including computation equation. It details the tools employed such as questionnaires and interviews and describes the data analysis methods with the ethical considerations of the study area.

Chapter Four. Results and discussions: This chapter presents the findings from the data collected offering an analysis aligned with the study objectives and research questions including statistical interpretations and comprehensive discussion of the findings of results.

Chapter Five. Conclusions and recommendations: This chapter summarizes the key findings of the study while addressing each research objective. Conclusions drawn from the results are presented followed by developed job-site framework and actionable recommendations for policymakers, construction sites and researchers to enhance labour productivity on site.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents literature review on training and development, exploring theoretical approaches to employee training, human resources training needs, levels, categories and approaches to training design. The discussion also encompasses the training evaluation process, methods of training and development and the systematic training cycle. A particular focus is given to labour productivity in the construction industry, factors affecting productivity and examining its implications on training initiatives. Additionally, the chapter addresses the formulation of training plan and process, shedding light on strategies to enhance productivity on building sites. The exploration extends to employee productivity measurement frameworks, emphasizing the interconnectedness between construction worker training and overall productivity. Throughout this chapter, secondary data sources such as textbooks, journals, reports and publications from different authors were cited, showing the depth and credibility of the literature review.

2.2 Overview on employee training

Employee training, synonymous with worker training, holds a crucial role in the success of any organization, serving as a strategic investment to empower individuals with the knowledge and skills essential for excellence in their roles. Recognized as a pivotal component of human resources management, employee training aligns with the broader strategy of human resource development, facilitating the successful execution of organizational objectives and goals (McCourt and Eldridge, 2003).

Various researchers have offered their perspectives on training over the years. Armstrong (2020) defines training as the systematic use of formal processes to assist individuals in acquiring the information and skills required for successful job execution. Wayne (2003) sees it as a structured program aimed at enhancing performance at individual, group and organizational levels. Noe and Hollenbeck (2019) describe training as intentional efforts by an organization to help employees acquire job-related information, skills, abilities and behaviors for application on the job.

Additionally, Gomez-Mejia et al., (2012) defines training as the process of providing employees with specific skills or correcting deficiencies in their performance. Importantly, employee training extends beyond the acquisition of new knowledge and skills.

It encompasses additional benefits such as educating workers on adapting to changes, motivating them to adopt a positive outlook, empowering staff to participate in significant work-related decisions and fostering entrepreneurship. This multifaceted approach underscores the comprehensive impact and importance of Job-site training in the overall development and success of an organization.

2.2.1 Key definitions in this research

The following key terms in this research were defined as follows;

Job-site training in the context of building sites refers to a planned effort which is hands-on and site-specific provided to workers directly on a given construction or building location. This training focuses on equipping workers with new competencies, information, operational knowledge, attitudes and practical skills necessary for their specific roles on a given ongoing site project. Literature refers to job-site training as a more specific term that focuses on training conducted directly at the worksite rather than employee training which encompasses various types of training like technical, managerial or general conducted at any location therefore, this study focuses on job-site training.

Labour productivity on a building sites in this research was defined as the measure of the efficiency of workforce in converting input resources such as time and effort into output which is typically expressed as the quantity of work completed within a specific period.

Worker or Employee is defined as an individual who works for another person or a company in exchange for wages (Kim, 2000). In the context of a building site, labour refers to the workforce engaged in performing physical, skilled, and unskilled tasks essential for construction, maintenance, or renovation. This workforce encompasses all individuals whose efforts contribute, directly or indirectly, to the completion of the project. Labour is generally categorized into three types: skilled, unskilled, and semi-skilled. Skilled labour consists of workers with specialized training or expertise in particular trades, such as masons, carpenters, electricians, plumbers, and welders.

Unskilled labour involves tasks that require no specialized training, including loading and unloading materials, digging, and site cleaning. Semi-skilled labour comprises workers with limited skills or basic technical training, often assisting skilled workers or handling specific tasks requiring minimal expertise. Together, these categories of

labour form the backbone of building site operations.

Building sites refer to plots of ground where structures or groups of buildings are being constructed, renovated, or modified. According to Benator and Thunn (2003), building construction is the technique and industry dedicated to assembling and erecting various structures, including homes, apartments, schools, hospitals, multi-story malls and factories, with the primary goal of providing shelter.

Productivity is quantified as the ratio of output to man-hours worked as indicated by Robles *et al.* (2014). Additionally, Hornbeger (2003) defines labour productivity as an economic measure of output per unit of the input.

These definitions provide a clear foundation for the key terms utilized in the research, ensuring a common understanding of the concepts discussed in the study.

2.3 Theoretical approaches to employee training

The theoretical underpinnings of employee training primarily revolve around two approaches: the human capital approach and the technology-based approach. In the context of construction sites, a common practice is to integrate elements from both approaches, creating comprehensive and effective training programs that cater to specific needs and objectives. By comprehending these theoretical foundations, human resources management and training managers gain the insights needed to formulate training initiatives that not only align with company goals but also foster the continuous professional development of employees. The theoretical approaches to employee training were then discussed as follows;

2.3.1 Human capital approach

The human capital approach, as elucidated by Luo (2000), conceptualizes training as an investment in human capital. This perspective posits that training is undertaken when the financial benefits derived from increased productivity outweigh the costs incurred during the implementation of training programs. Armstrong (2020) defines human capital as encompassing the collective knowledge, skills and talents of individuals within a company. The human capital approach to employee training places emphasis on investing in employees' skills, knowledge and abilities as a means of enhancing organizational performance and productivity. This strategic viewpoint perceives workers as invaluable resources or assets, often referred to as "human capital," whose value can be augmented

through initiatives for training and development.

The concept of human capital has historical roots with economists such as Adam Smith, Gary Becker and Theodore Schultz, although its precise origin and publication in the literature are challenging to pinpoint. Gary Becker, an American economist, played a pivotal role in shaping human capital theory in the 1960s. He proposed the idea that training and education serve as investments in human capital, capable of fostering economic growth and productivity. Consequently, within an organizational context, human capital is deemed essential, as noted by Mathis and Jackson (2016), defining it as the cumulative value of an organization's workforce's abilities, knowledge, skills, life experiences and motivation.

Expanding on the concept, Yimam (2022) introduces intellectual, social and organizational capital as interconnected notions associated with the broader idea of human capital. This multifaceted perspective underscores the significance of recognizing and investing in the diverse dimensions of human capital to foster sustained organizational growth and success.

2.3.2 Technology-based approach

The technology-based approach to employee training, as posited by Yimam (2022), perceives training as a process integral to skill formation. This perspective contends that the increasing prominence of training in the contemporary era is propelled by the rapid evolution of technology and the concurrent restructuring of jobs. Numerous authors and studies in the literature have delved into technology-based approaches to employee training, providing valuable insights into the intersection of technology and learning.

Clark and Mayer (2016) explored the utilization of technology in training and learning contexts. Their work contributes to the understanding of how technology can be effectively integrated into employee training programs. Similarly, Rosenberg (2001) discussed various e-learning strategies and technologies tailored for delivering training and education in the digital age. His insights shed light on the diverse ways in which technology can be harnessed for effective employee training.

Additionally, Ally (2008) delves into the theoretical foundations of online learning in his book, examining the incorporation of technology into education and training. This exploration provides a comprehensive understanding of how various educational

theories can be applied to technology-based training programs. Collectively, these references in the literature serve as a foundational framework for comprehending the intricacies of the technology-based approach to employee training.

2.4 Human resources training needs

Training needs assessment is a strategic process that encompasses various steps, as outlined by Khan and Masrek (2017) and Priyadarshini and Dave (2013). This process involves identifying organizational and industry goals, gathering competencies, analyzing information and determining the gaps between the current situation and the future conditions. In a similar vein, Lussier and Hendon (2020) describe training needs assessment as the critical process of comparing the current state of jobs with the required skills and knowledge, based on the operational and strategic goals of the organization.

At this juncture in the training process, the selection of the appropriate level, type and duration of training becomes crucial, emphasizing the need-oriented nature of training. This phase serves as the diagnostic stage in developing training objectives, wherein the necessity for company training is determined by assessing employee and employer performance issues. It is imperative to broaden the scope of assessment to encompass non-training aspects, including pay structures, work designs, organizational structures and physical work schedules.

A systematic approach to training needs assessment, as advocated by Mondy and Martocchio (2016), centers on aligning with the strategic mission, goals and corporate plans of the company, as well as the outcomes of strategic human resource planning. Sites can ascertain the need for training through this comprehensive assessment process. Notably, several scholars (e.g., Lussier and Hendon, 2020; Mathis and Jackson, 2016; Mondy and Martocchio, 2016; Noe and Hollenbeck, 2019; and Hartoyo and Efendy, 2017) identified three key analyses in training needs assessment as: organizational or company analysis, task/job analysis and person analysis. The organizational analysis examines the overall goals, structure and resource allocation to determine where training can most effectively support productivity improvements. Task or job analysis evaluates specific duties and responsibilities to identify skill gaps and areas where employees require additional instruction. Person analysis focuses on individual workers assessing their current competencies and performance levels to tailor training interventions that address specific needs. These analyses collectively contribute to holistic understanding of training requirements

within an organization.

2.4.1 Levels of training needs analysis

Training and development in any given company or firm occurs at three distinct levels, as outlined by Wognum (2001). Firstly, at the strategic level, higher management determines training needs while taking into account the company's strategy, problems, mission and objectives. Secondly, at the tactical level, middle management defines training needs considering advancements in collaboration and coordination between organizational divisions. Lastly, at the operational level, training needs of employees and lower management, such as individual workers and associated departmental performance difficulties, are examined. The cornerstone of effective training and development lies in understanding the requirements of individual workers, departments and the company as a whole.

To align with organizational objectives, the training programs offered by the company have specific goals, guiding the selection of trainees, training materials and schedules (Gerhart *et al.*, 2003). For these programs to have a meaningful impact on employees and contribute to goal achievement, company managers must identify needs that are directly related to the organization's objectives. This ensures that the training and development initiatives are targeted, purposeful and ultimately contribute to the overall success of the company.

2.4.2 Categories of training needs analysis

In a given company or organization, training needs can significantly differ based on the specific requirements, goals and challenges encountered by various departments and job roles. Torrington *et al.* (2005) delineate three distinct areas for identifying training needs. Firstly, there is the aspect of renewing or changing situations, which arises when modifications occur in the organization or company due to strategy adjustments.

Secondly, the focus is on resolving problems, shedding light on worker performances and addressing any difficulties experienced. Lastly, the emphasis is on improving working practices, highlighting project progress more than performance problems. These three areas provide a comprehensive framework for organizations to assess and address their unique training needs ensuring that training programs are tailored to specific situations and challenges within the company.

2.4.3 Approaches of training needs analysis

Training needs analysis (TNA) serves as a systematic process employed by organizations to pinpoint gaps between employees' current skills or knowledge and the skills or knowledge required for effective job performance. Cole (2005) defines a training need as any shortfall in employee knowledge, understanding, skills and attitude relative to what is required by the job or the demands of organizational change. The importance of TNA lies in its role in identifying specific areas where training interventions can enhance employee capabilities. To conduct a TNA, various approaches exist, each employing distinct methods and techniques.

According to Torrington *et al.* (2005), two methodologies stand out for identifying training requirements in a specific work scenario. The first approach is the problem-centered approach, focusing on difficulties experienced in performance. Here, management investigates whether the problems stem from a lack of abilities, aiming to resolve crises and improve overall performance. The second approach is the profile comparison approach, emphasizing the need to align talents or abilities with the job being filled. This applies to both new and existing positions within a specific firm, requiring the development of new or additional skills to meet job demands. Both methodologies contribute to a comprehensive understanding of training needs, allowing organizations to tailor their training programs effectively.

2.5 Training design

The process of training implementation begins with the identification of training needs through a comprehensive assessment, as outlined by Mathis and Jackson (2016). Once these needs are identified, the subsequent step involves the development of a training design that incorporates various training approaches and learning concepts. Training planners are tasked with reporting the main independent factors influencing the training, with training design being a crucial element in this regard (Abeeha and Bariha, 2012).

To ensure the effectiveness of training, a focus on maximizing the transfer of knowledge from the classroom to the work site is essential. According to Mathis and Jackson (2016), effective training design takes into account both the learners and instructional strategies. This implies a thoughtful consideration of factors such as specific skills and knowledge needs of workers, training goals and available organizational resources.

In the realm of designing an effective training program for workers, Mondy and Martocchio (2016), Noe and Hollenbeck (2019), Mathis and Jackson (2016), Lussier and Hendon (2020), and Abu Daqar and Constantinovits (2021) provide a list of examples of training methods. These include instructor-led training, e-learning, case studies, behavior modeling, role-playing, training games, in-basket training, on-the-job training and apprenticeship training. A careful consideration of these methods is crucial in tailoring training programs to the specific needs and dynamics of an organization.

2.6 Training delivery style

Training delivery styles play a pivotal role in shaping the learning experience for employees in the workplace. According to Mathis and Jackson (2016), training delivery can commence as soon as it has been designed. To ensure that the training meets identified needs, it is commonly accepted that it should either be pilot-tested or provided on a trial basis (Yimam, 2022). In the context of rapid technological advancements and evolving educational methodologies, organizations are continually exploring innovative ways to deliver training that is not only engaging but also effective and tailored to the diverse needs of their workforce. The significance of the delivery style lies in how it is expected to bring about a transformation in employees.

The type of training to be facilitated is influenced by the chosen delivery style and various techniques and methods, such as adult learning principles, learning styles and training materials, can be employed for effective delivery (Yimam, 2022). According to Mondy and Martocchio (2016), the overarching goal of corporate training institutions is to instigate organizational change in crucial areas such as employee development, adult learning and company training. Recognizing the pivotal role of training delivery styles is essential, as they significantly contribute to engaging participants, enhancing learning retention and ensuring the overall effectiveness of the training program.

Training delivery style encompasses the structure, format and techniques through which knowledge and skills are imparted aiming to maximize learning effectiveness and engagement. The choice of delivery style can significantly influence how well participants absorb information, retain skills and apply what they have learned to real job tasks performed on sites. Therefore, careful consideration of the delivery style is paramount in the planning and execution of successful training initiatives.

2.7 Training evaluation process

The last stage of the training program is evaluation (Yimam, 2022). Evaluating and monitoring training programs are essential to ensure their effectiveness, identify areas for improvement and measure the impact on the participants and the organization. It is a way to confirm whether program participants are doing the jobs for which they have been trained successfully and whether the program has been successful. According to Balogun (2011), the idea of evaluation is most frequently used to assess how well a program achieves its goals. Additionally, according to Mathis and Jackson (2016), training evaluation compares post-training outcomes to managers', trainers' and trainees' pre-training goals.

Development of human resources is an investment in human capital. The main goal of funding the training program is to enable employees to contribute more effectively to the accomplishment of company goals. Therefore, evaluation serves as a tool for determining the training program's cost and benefits to its company (Yimam, 2022). Though many recommend evaluation of training, very few actually carry it out. The potential metrics for assessing training were outlined by Mondy and Martocchio (2016). These include the opinions of participants, the degree of learning, changes in behavior, the achievement of training goals, the training's return on investment and benchmarking. A comprehensive evaluation process often involves a combination of these metrics, allowing organizations to gather diverse data points for a well-rounded understanding of the training's effectiveness.

The evaluation of training programs is commonly divided into four levels, often referred to as the Kirkpatrick Model, which was developed by Donald L. Kirkpatrick in the 1950s. These four levels provide a structured approach to assessing the effectiveness and impact of training initiatives. According to (Kirkpatrick and Kirkpatrick, 2016; Lussier and Hendon, 2020; Noe and Hollenbeck, 2019; Dessler, 2020; and Kirkpatrick, 2020), evaluation of training can be divided into four levels, namely: behavior, learning, reaction and results. Surveys, feedback forms and participant interviews are the main techniques used under reaction (feelings) to find out how people felt about the training's overall experience, content and delivery. Learning (knowledge) is used to measure the increase in knowledge and skills and the methods used are namely surveys, pre and post-training assessments, quizzes, tests and skills demonstrations. To evaluate changes in behavior and performance on the job, the following techniques are used under behavior

(transfer): observations, supervisor assessments, self-reports and peer feedback.

And lastly, results (impact) are used to assess how the training affects organizational goals and objectives and the methods used are key performance indicators (KPIs), metrics like sales numbers, customer satisfaction ratings, productivity rates and return on investment (ROI) analysis. According to Armstrong (2014), evaluation contrasts the post-training state with the training's predetermined goals. Therefore, training evaluation should be conducted as a must to see the effectiveness of the training program.

2.8 Methods of training and development

Two primary methods of training and development are recognized within the organizational context: on-the-job training and off-the-job training. The selection of training methodologies by sites or organizations is contingent upon a range of factors, including the company's strategy, objectives, current needs and available resources. These methods are not arbitrarily chosen but are tailored to meet the specific training needs of the individuals within the organization or company.

The distinction between on-the-job and off-the-job training is significant, with each method offering unique advantages and addressing different aspects of skill development. Ultimately, the choice between on-the-job and off-the-job training hinges on a thoughtful assessment of the organization's goals and the specific needs of its workforce. By aligning training methods with these factors, sites can optimize their training and development initiatives, fostering the continuous growth and enhancement of their employees' skills and capabilities.

2.8.1 On-the-job training methods

The on-the-job training method is a practical approach that entails instruction or coaching provided by individuals or instructors with greater experience in a specific field. This form of training is typically administered while employees carry out their regular duties within the familiar confines of their workspaces. These methods allow workers to learn directly in the context of their daily tasks, ensuring that training is practical, relevant and immediately applicable. Examples of on-the-job training methods include job rotations, apprenticeships, job transfers and coaching/mentorship programs. The on-the-job training methods are discussed in the following subsections (a) – (c) providing a comprehensive overview of the practical approaches used to in impacting knowledge on worksite.

a) Apprenticeship method of training

The apprenticeship method of training stands as a time-tested and traditional approach to acquiring a specific trade or skill. This structured training program involves individuals, referred to as apprentices, working under the guidance of experienced professionals in a particular field. The essence of the apprenticeship method lies in its combination of practical on-the-job training and classroom instruction, providing learners with a comprehensive educational experience. Rousseau (1762) noted that, hands-on learning, practical experience and individualized instruction are pivotal aspects of this method.

The apprenticeship approach aligns with the idea of preparing workers to meet industry-set criteria for specific jobs. The overarching goal of such programs is to cultivate a sizable pool of skilled workers capable of meeting the evolving needs of the industry while addressing individual career aspirations. According to Dessler (2008), apprenticeship programs allow workers to develop their skills through a blend of long-term formal learning and on-the-job training. This unique system not only offers full-time employment but also serves as a means of education and training, enabling individuals to earn while they learn.

The planning of apprentices' education and training is strategically aligned with the goals of the company or organization. This method finds widespread use in industries, particularly construction sites, that heavily rely on a significant number of skilled tradespeople (Adik, 2014). By integrating practical experience with theoretical knowledge, apprenticeships contribute to the holistic development of individuals, equipping them with the skills needed to excel in their chosen professions.

b) Coaching and mentoring methods

Coaching and mentoring stand out as training methods designed to emphasize individual development and growth. Within these approaches, there is a deliberate cultivation of responsibility and the formation of relationships. In this framework, more experienced and knowledgeable individuals take on the role of mentors or coaches, guiding and supporting those who possess less skill or knowledge (McCourt and Eldridge, 2003; Torrington *et al.*, 2005). Adik (2014) notes that, particularly in the case of newly recruited workers, a coach is assigned, often serving as their immediate supervisor in management

and/or rank. It's crucial to highlight that this form of training is not exclusive to newer employees; older and more seasoned workers should not be overlooked in the coaching and mentoring process. Their continued development and growth are integral aspects of a comprehensive training strategy.

c) Job rotation and transfer method

McCourt and Eldridge (2003) described Job rotation method as one which involved shifting employees from one specific official task to another, thereby expanding their skills and knowledge across various operations within the organization or company. An example of this is the experience gained by working in different branches of an organization. This approach, known as job rotation, proves to be an effective instrument for imparting practical knowledge within an organization.

The process of imparting practical knowledge through job rotation comprises three distinct phases, as outlined by Lu and Yang (2015). Firstly, there is the phase of determining the subjects for practical knowledge transfer. This involves identifying the specific areas or tasks where practical knowledge is crucial for organizational success. The second phase involves the actual transfer of practical knowledge, where employees gain hands-on experience and insights by rotating through different roles. Finally, the third phase focuses on evaluating the performance of practical knowledge transfer. This evaluation ensures that the knowledge acquired through job rotation is effectively integrated into the skill set of employees, contributing to overall organizational development.

2.8.2 Off-the-job training method

Off-the-job training emphasizes long-term education and development by introducing new elements to enhance a worker's technical and problem-solving abilities. According to Adik (2014), workers undergoing training are typically relocated from their regular work areas to engage in off-the-job training sessions, allowing them to concentrate on skill enhancement. The diversity of off-the-job training methods underscores its comprehensive approach.

a) Conference method

The conference method serves as an off-the-job training approach, gathering individuals who share a common interest, often within a specific industry or professional field. This

method involves participants engaging in presentations, discussions, workshops and networking opportunities. As highlighted by Adik (2014), a conference is a training and development strategy where a substantial number of employees receive instruction on a single topic through various presentations and facilitators. Despite the effectiveness of this method, ensuring complete comprehension among all employees can be challenging. Nevertheless, a discernible shift in mindset is observed, leading to a clear distinction in the level of understanding for those who undergo this particular training approach.

b) Role playing method

A role to play, according to Sellers (2002), is a spontaneous, dramatic, creative teaching strategy in which individuals overtly and deliberately assume the roles of others. Furthermore, role play is considered an effective learning strategy, as noted by Billings and Halstead (2005), cited in Cohen *et al.* (2011). This approach requires participants to think about the person whose role they are assuming and is associated with real-life situations, promoting active, personal involvement in the learning process. The method proves particularly effective for training and development, stimulating decision-making situations for trainees.

Rouiller and Goldstein (1993) suggest that role-playing exercises can be implemented in training, with one participant acting as themselves and the other as the trainee. The open communication and "on-the-spot" nature of role-playing contribute to the development of confidence among trainees. Additionally, one of the most successful methods for sharing ideas with clients is through role-playing, aiding employees in better understanding the company or organization system. The optimal setting for using this strategy is one with low tension, as learning is more easily adapted in such an atmosphere. With increased practice, trainers can rectify employee performance during role-playing sessions and provide valuable feedback (Adik, 2014).

To enhance the effectiveness of this kind of training, it is recommended that it be conducted in the actual workplace, creating a more realistic and applicable learning environment. In doing so, employees can better grasp and apply the concepts introduced during role-playing sessions, ultimately improving their performance in the workplace. Off-the-job training therefore benefits from integration with jobsite realities as it bridges the gap between theory and practice. When workers learn in an environment that mirrors their

daily tasks, they develop stronger problem-solving skills and adapt more easily to dynamic site conditions. This process allows them to internalize lessons not only as abstract knowledge but as practical competencies. In addition, exposure to actual equipment and site constraints makes the training more meaningful and reduces the time required for employees to transfer skills from the classroom to the field.

2.8.3 Difference between on-the-job training and off-the-job training methods

On-the-job training (OJT) and off-the-job training represent two distinct approaches to employee training, each possessing unique characteristics and advantages. Tabassi and Baker (2009) highlighted several differences between these methods. Firstly, off-the-job training addresses problems from a curriculum perspective, while on-the-job training deals with issues rooted in a specific workplace setting. Secondly, the ultimate goal of on-the-job training is to develop best practices, whereas off-the-job training focuses on understanding what is done.

Thirdly, on-the-job training typically targets individuals, sites, or groups, whereas off-the-job training primarily focuses on individuals. Fourthly, on-the-job training centers on completing a given task, while off-the-job training revolves around acquiring the basic facts and skills needed by workers. Lastly, during off-the-job training, knowledge gained is general, decontextualized and static, while on-the-job training imparts practice-oriented and dynamic knowledge.

In many instances, a combination of both on-the-job and off-the-job training may be employed to offer a comprehensive learning experience for employees, encompassing both practical skills and theoretical knowledge. The choice between these methods often hinges on the specific needs of the organization, the nature of the work and the learning preferences of the employees.

Research by Rashid *et al.*, (2020) indicates that training received through both on-the-job and off-the-job methods has a positive and significant impact on employee performance. A well-designed training program that integrates both approaches can yield the most comprehensive results in terms of improved employee performance. Consequently, the success of these training methods is influenced by the type and complexity of the tasks involved the particular skills and knowledge that employees need to acquire as well as their individual learning styles and preferences. This plays a critical role in determining

how effectively training is delivered and absorbed on building sites.

2.9 Systematic training cycle

The structured and iterative process known as the systematic training cycle is utilized in the development and implementation of training programs. Its purpose is to guarantee the effectiveness, efficiency and alignment of training initiatives with organizational goals. According to Martyn (1999), the systematic training cycle model holds the utmost significance and widespread usage in the organizational training function. Armstrong (2001) underscored the two most distinguishing aspects of training compared to broader learning approaches, emphasizing its planned and methodical nature and its aim to enhance specific job-related skills. These attributes are mirrored in the systematic training cycle model.

Contrary to being a single, linear, isolated event with a clear start and finish, training is depicted in the model as a continuous process—a circle where the end leads back to the beginning. The systematic training cycle, in its classical form, consists of four stages, as outlined by Armstrong (2001); and Kenney and Reid (1986).

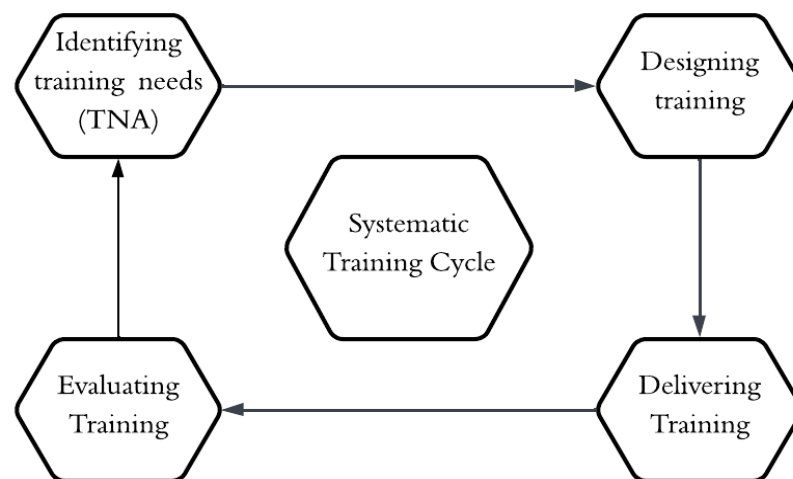


Figure 2.1 The systematic training cycle (Source: Cole, 2005)

Figure 2.1 shows that, systematic training cycle begins with Training Needs Analysis (TNA) which identifies gaps between existing skills and the competencies required to achieve organizational goals. The initial stage provides a foundation for designing effective programs as it ensures that training aligns with actual performance deficiencies rather

than assumed needs. Without this initial analysis, training risks become irrelevant or mis-directed resulting in wasted resources and limited impact on productivity. This step involves pinpointing and detailing the training requisites at either the organizational or job level. The training gap, delineated as the variance between employees' existing knowledge, skills and competence in each job and the required knowledge, skills and competence for effective job performance.

Once needs are clearly defined, the cycle progresses to the design stage where learning objectives, content and delivery methods are determined. At this point, attention is given to matching training methods with the characteristics of the workforce and the conditions of the jobsite which revolves around formulating a training program. The design must balance technical requirements with practical applicability to ensure that workers can directly apply new knowledge to their daily tasks. This entails selecting the appropriate type of training and suitable methods based on the results of the needs analysis alongside the creation of a training schedule.

The implementation stage follows where training activities are delivered in line with the established plan. This phase requires close coordination between trainers, supervisors and employees to ensure effective participation. Practical demonstrations, simulations and on-the-job sessions are often incorporated to strengthen the link between training and workplace realities. Participants undergo a training course constituting the actual training event.

Finally, the evaluation stage assesses the effectiveness of the training program. Feedback is collected to measure whether learning objectives are achieved and whether improvements in performance and productivity are evident on the jobsite. This evaluation not only provides accountability but also creates a feedback loop that informs future TNA and keeps the training cycle continuous and responsive. The assessment of training marks the conclusive and fourth phase of the systematic training cycle.

The systematic training cycle operates as a dynamic process that acknowledges the necessity for continual enhancement and adjustment. Challenges arise in the planning and implementation stages, primarily because management may lack genuine interest in post-training application or fail to follow up. Additionally, many hindrances to post-training learning transfers stem from a breakdown at the initial stage, specifically, the identification of training needs (Sultana, 2015). Failure to identify the gap may render the training

program's objective inappropriate, consequently impeding its achievement upon delivery. Therefore, considerable emphasis should be placed on the pivotal importance of the first stage (TNA) within the systematic training cycle. By methodically progressing through these stages, organizations can ensure that their training endeavors remain adaptable to evolving needs, fostering the continual development of their workforce.

2.10 Training plan and process

A well-structured training plan and process are essential elements for organizations aiming to enhance the knowledge, skills and performance of their workforce as shown in Figure 2.2. According to Kenney and Reid (1986), the goal of training is to increase job performance and scheduled training helps to improve employees' effective performance.

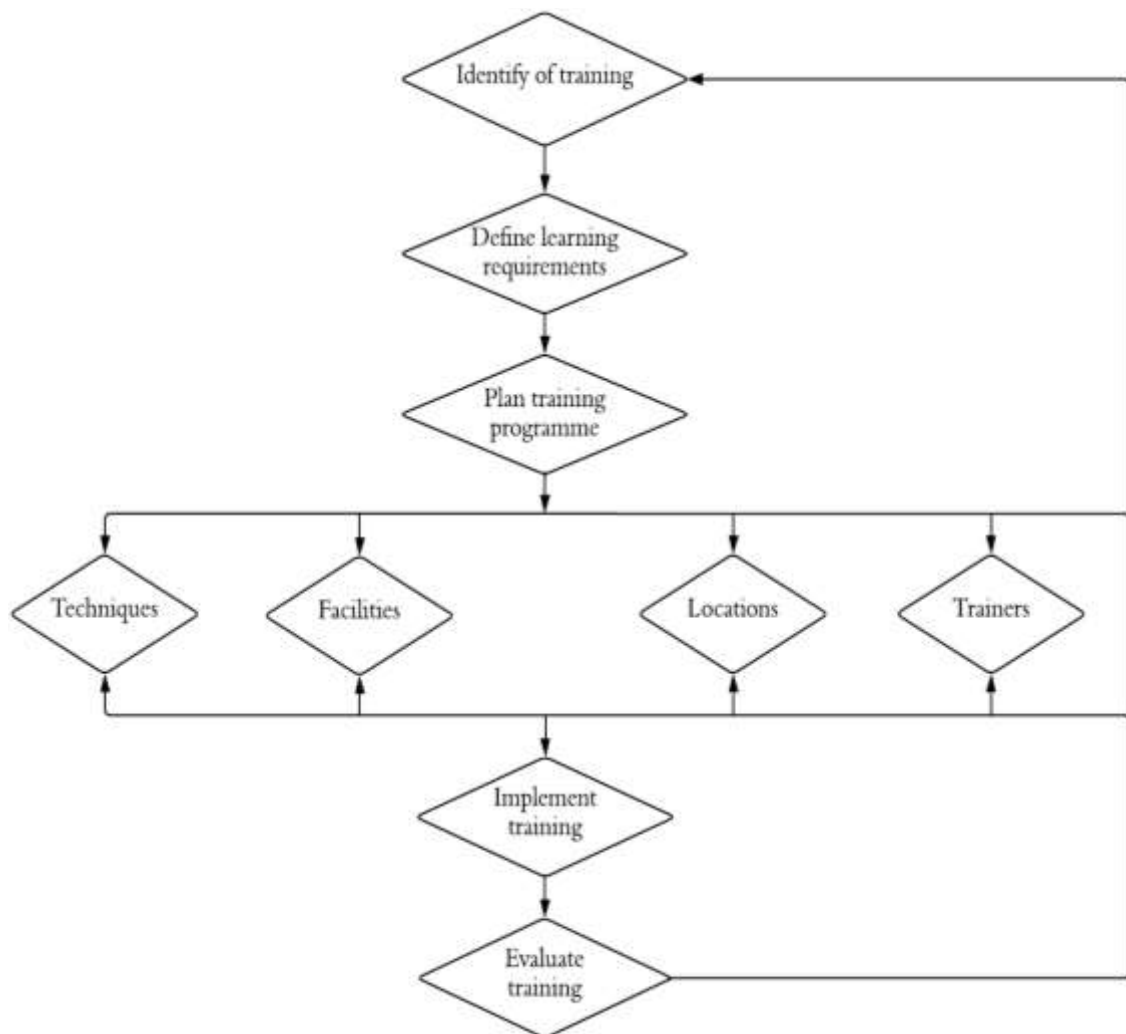


Figure 2.2 The process of planned training (Armstrong, 1995)

Kenney and Reid (1986) outlined a structured approach to planned training, delineating a

series of essential steps. The initial phase involves the identification and definition of training needs, requiring a comprehensive understanding of the skills, information and attitudes that necessitate development or modification. Following this, the learning needs are further elucidated, encompassing the specific types of skills and information required, as well as the attitudes that must undergo change. Subsequently, clear and precise training objectives are established to guide the overall training process.

To ensure the effectiveness of the training program, a judicious mix of training approaches, suitable locations and diverse training programs is recommended, all tailored to meet the predefined goals and objectives. Equally crucial is the careful selection of the individual tasked with conducting the training, ensuring that they possess the necessary expertise. Finally, Kenney and Reid emphasize the importance of post-implementation evaluation, stressing the need to assess the training's effectiveness and make adjustments as necessary.

In conclusion, Kenney and Reid's (1986) structured approach to planned training emphasizes the importance of thorough planning before execution which spells the identification of training needs to the evaluation of outcomes, each step plays a crucial role in ensuring the effectiveness and relevance of training programs. By adhering to this systematic process, organizations can optimize the impact of their training initiatives, contributing to the ongoing development of their workforce

2.11 Productivity on building sites

Productivity on a construction site is a complex concept that incorporates efficiency, resource utilization and effective management. In the construction industry, time is often a critical factor, making the maximization of productivity crucial for project success. The productivity of the construction sector holds significant economic importance, defining a country's wealth and contributing substantially to its overall economic development. In Uganda, the construction industry contributed 2,190.60 billion Ugandan Shillings (approximately 0.5802 Billion US Dollars) in the fourth quarter of 2021 underscoring its significance as a key sector (Uganda Bureau of Statistics, 2021).

Construction being a labour-intensive industry, heavily relies on the capabilities of site workers, especially in developing nations where manual labour is predominant. The workforce in the construction industry holds substantial influence over crucial aspects

such as cost, time and quality of projects, as noted by Han *et al.* (2008). This underscores the significance of labour as a pivotal element in construction processes. According to Nurhendi *et al.* (2022), labour costs account for more than 30% of overall project costs, thus it is critical to monitor the growth of labour productivity in the construction site.

The measurement of the output obtained from a specific amount of input is called productivity, according to Fellows *et al.* (2002). Productivity, as defined by Thomas and Sudhakumar (2014), is the efficient use of resources in the production of goods and services. The overall performance of a building construction company is significantly influenced by productivity, which encompasses various forms such as labour, material and equipment productivity. Identifying factors that impact productivity is the initial step in enhancing construction productivity, as emphasized by Rivas *et al.* (2011). Ultimately, improving productivity not only leads to higher profitability but also results in shorter project timelines, contributing to the overall success of building site projects.

2.11.1 Labour productivity on building site

The role of labour productivity on building sites is paramount in ensuring the successful and timely completion of construction projects. The efficient utilization of human resources not only impacts the project's financial outcome but also significantly influences the overall quality of the constructed structure. Within the global building construction industry, contractors place primary emphasis on labour productivity, as defined by Robles *et al.* (2014) as the proportion of output to man-hours worked. This focus becomes particularly crucial in developing nations like Uganda, where the majority of construction activities still rely on labour-intensive methods (Alinaitwe *et al.*, 2007).

Gundecha (2012) and Robles *et al.* (2014) highlighted that the cost of labour in the building construction industry comprises approximately 33% of the total project cost, indicating its substantial impact on overall expenses. Consequently, the labour force in construction should be regarded as a critical input. Recognizing labour productivity as an indispensable factor, especially on building sites, becomes imperative for the success of construction projects because efficient workers not only contribute to timely project completion but also ensure cost-effectiveness and high-quality project outcomes.

2.11.2 Equipment productivity on building site

The successful completion of any building project is contingent upon the effective utilization of equipment within the dynamic and demanding field of construction, as highlighted by Phiona (2017). Achieving optimal equipment productivity on a building site involves multifaceted approach, strategic planning, technological integration, preventive maintenance and proficient workforce management. To ensure seamless operations, the construction site must strategically deploy, maintain and coordinate machinery. A pivotal factor influencing productivity in the construction sector is the careful selection of appropriate equipment and tools, as emphasized by Phiona (2017).

The deployment of construction machinery goes beyond mere possession of the right equipment; it involves ensuring its efficient and effective use throughout the project lifecycle. Having the right equipment, in the correct size and specifications for the working conditions at a building construction project, can significantly enhance productivity in terms of quality, time and cost (Alinaitwe *et al.*, 2007; Gundecha 2012).

2.11.3 Material productivity on building site

Material productivity on a construction site is a pivotal factor that significantly influences the success and efficiency of a project. Material productivity on building sites depends not only on the quality of the materials procured but also on how effectively they are managed, stored and utilized during the construction process. Poor material handling and inadequate planning often lead to wastage, delays and rework, all of which negatively affect overall labour productivity. Material management stands out as one of the most critical aspects of the construction industry and Phiona (2017) highlights that productivity may suffer if the right choice of materials, proper location and timely delivery to construction sites are not carefully considered before the project commences, emphasizing the importance of a suitable materials management system.

The size of the building site and the location of material storage also wield a substantial influence on productivity, as poorly situated storage areas can lead to increased time spent by labourers in moving necessary materials, thereby reducing overall productivity (Gundecha, 2012). Efficient procurement strategies ensure that materials are delivered on time and in the required quantities, reducing downtime caused by shortages or overstocking. Proper storage facilities and handling practices also preserve the integrity of materials, minimizing losses due to damage or deterioration. In addition, the integration of innovative technologies such as Building Information Modelling (BIM) and digital

inventory systems supports accurate forecasting and real-time monitoring of material usage. These technologies enable site managers to track consumption, identify inefficiencies and adjust procurement plans to align with project demands. Furthermore, material productivity benefits from a workforce that understands the value of resource efficiency. This integrated approach not only improves material management but also contributes significantly to the overall enhancement of labour productivity on building projects hence necessitating a holistic approach.

2.12 Employee productivity measurement in the construction industry

The term "productivity" is defined as the potential output of a production process given its inputs, as outlined by Crawford and Vogl (2006). However, despite the existence of frameworks, there appears to be a lack of consensus among industry researchers on how to evaluate productivity performance in the construction sector. In attempting to assess productivity, two types of approaches are commonly employed based on the number of variables used in the calculation namely: Total Factor Productivity and Single Factor Productivity, as noted by Park (2006). Each approach has its own merits and drawbacks and is deemed suitable for different objectives of a project. The subsequent discussion will delve into the differences of these approaches, shedding light on their application as below;

2.12.1 Total factor productivity (TFP)

The total factor productivity or multi-factor productivity considers labour, equipment, materials and capital as inputs. Total factor productivity is more commonly used in economics studies than in construction (Park, 2006). Total factor productivity is calculated as follows using Eq. (2.1).

$$L = \frac{L + E + M + C}{Q} \quad \text{Eq. (2.1)}$$

Where L is Total factor productivity, E is Equipment, M is Material, C is Capital and Q is Total Output.

Although more commonly used in economics studies than in construction, TFP is crucial for a comprehensive understanding of productivity dynamics. In this approach, multi-factor production functions are estimated to discern the individual contributions of

growth determinants, incorporating measurable inputs like labour and capital as well as intangible inputs such as management, skills and technological advancement. However, this method demands more stringent data and measurement requirements. Despite the potential for a precise analysis, it is acknowledged that this evolving methodology, as suggested by Crawford and Vogl (2006) may not yet offer definitive results.

2.12.2 Single factor productivity

Single-factor productivity measurements, chosen as key indicators for policy goals by construction managers or government, are widely used due to their ease of quantification. Defined as a measure that considers only one input in relation to output, single-factor productivity (SFP) is frequently utilized in the construction industry, with labour productivity being a common focus, as highlighted by Woo (1999). This method offers a relatively straightforward assessment of the efficiency of a specific resource or factor within a production process. The formula is used is;

$$LP = \frac{I}{O} = \frac{H_a}{Q_i} \quad \text{Eq. (2.2)}$$

Where;

LP = Labour Productivity, I = Input, O = Output, H_a = Installed Quantity (output) and Q_i = Actual Work Hours (input)

The limitation of single-factor productivity lies in its effectiveness for comparing similar processes or activities rather than assessing the overall efficiency of a construction site. Nonetheless, regularly tracking and analyzing single-factor productivity can reveal trends, assess the impact of changes and guide decisions to improve efficiency in specific areas of the construction process. It is essential to acknowledge the limitations of this approach and recognize that it is more effective in specific contexts. Crawford and Vogl (2006) emphasize that determining labour productivity involves dividing certain output measures, such as gross value added or gross output, by the labour input, expressed in terms of the number of workers or hours.

2.13 Factors influencing construction labour productivity

This section delves into the factors that have shaped labour productivity on building sites over the past five years. The frequency with which issues such as a shortage of skills,

experience and training were highlighted by different authors in literature while examining the principal factors impacting labour productivity in their respective countries. Examining the principal factors impacting labour productivity in their respective countries highlights that productivity is influenced by a combination of technical, managerial and human-related aspects. These factors vary in significance depending on local conditions yet common themes consistently emerge across the construction industry. Understanding and addressing these factors within specific national and organizational contexts is essential for enhancing productivity through targeted jobsite training in Table 2.1 showing the frequency of skills, experience and training gaps highlighted by various authors in literature reflecting a recurring concern about workforce preparedness and capacity development in the construction industry.

Table 2.1 Frequency of skills, experience and training gaps highlighted by authors in literature

Factors influencing labour productivity	Previous findings	Country
Manpower and related factors	Nurhendi <i>et al.</i> (2022)	Nigeria
Poor quality and training of labourers; incompetent site supervisors	Akbar <i>et al.</i> (2021)	Ghana
Labour experience, skill and related factors	Almamlook <i>et al.</i> (2020)	Libya
Lack of training sessions and related factors	Akomah and Roland (2020)	Ghana
Knowledge, salary-related factors and others	Eze <i>et al.</i> (2020)	Nigeria
Worker skill and related factors	Venkatesh and Natarajan (2019)	India
Worker efficiency/skills and related factors	Hamza <i>et al.</i> (2019)	Malaysia
Labourers experience and expertise	Alaghbari <i>et al.</i> (2019)	Yemen
Training and development and related factors	Momade and Hainin (2019)	Qatar
Worker wellbeing on site	Afolabi <i>et al.</i> (2018)	Nigeria
Training and development and related factors	Ohueri <i>et al.</i> (2018)	Malaysia

Inadequate building techniques and related factors	Durdyev and Mbachu (2018)	Cambodia
Employee experience and related factors	Tam (2018)	Vietnam
Worker experience and related factors	Hwang <i>et al.</i> (2017)	Singapore

Table 2.1 *continued*

Factors influencing labour productivity	Previous findings	Country
Lack of skilled labour and related factors	Bekr (2017)	Jordan
Labour experience, skill and related factors	Alaghbari <i>et al.</i> (2017)	Yemen
Shortage of skilled labour, defective workmanship and others	Serdar <i>et al.</i> (2017)	Colombia
Lack of worker skills and related factors	Alinaitwe <i>et al.</i> (2007)	Uganda

2.14 Other factors influencing labour productivity

2.14.1 Knowledge and salary-related factors

The knowledge possessed by workers, derived from their expertise and experience within a particular company, can manifest in both implicit and explicit forms. In the study by Hiyassat *et al.* (2016), education and experience levels are identified as two crucial variables influencing worker productivity. Complementing this, Alinaitwe *et al.* (2007) highlight the substantial impact of timely salary payments and job compensation on labour productivity in the construction sector.

Therefore, the category of 'knowledge and salary-related factors' encompasses considerations such as competitive compensation, punctual payment of salaries and the provision of a robust compensation package. These factors are recognized as essential elements for enhancing productivity within the construction industry.

2.14.2 Site employment security and planning factors

The following are entailed under this factor: a sense of security for job, effective work scheduling, design modifications and bonuses for additional effort, transportation from and to the given site and effective management synchronization of staff, duties and other site activities (Eze *et al.*, 2020). Workers tend to increase their performance, commitment and productivity when they have understanding that their employment is secure and not

subject to abrupt termination because most jobs in the industry of construction are project-based except administrative employees at a given company's office.

One of the most powerful non-financial productivity boosters for skilled and semi-skilled workers was providing free transportation, according to Ameh and Shokumbi (2013). Productivity is affected by an effective bonus and reward system, which corroborates the findings of (Momade and Hainin, 2019; Shan *et al.*, 2016; Dai and Goodrum, 2011). Therefore, strengthening employment security and improving site planning practices are essential strategies for enhancing worker performance and achieving more impact leading to sustained improvements in worker productivity and the successful delivery of construction projects.

2.14.3 Site safety, health and promotion factors

This factor considers various aspects integral to the working environment, including worker safety, health, opportunities for professional growth, the ability to express oneself freely at work, detailed design provisions and positive work relationships between workers and higher management. Studies, such as the one conducted by Ameh and Shokumbi (2013), who highlighted that, among the most significant non-financial productivity boosters for workers are the provision of safety devices and free medical services.

Safety emerges as a key element influencing labour productivity in the construction sector, as emphasized by Dai *et al.* (2009). This acknowledgment underscores the multifaceted nature of factors beyond financial incentives that contribute to enhancing overall productivity and well-being among workers in construction settings.

2.14.4 Working area conditions and overtime payments

This factor encompasses various elements, including overtime compensation, a conducive working environment, a clear job description and the availability of functioning site facilities such as toilets and bathroom spaces. The provision of necessary and desirable working site facilities is highlighted as a specific requirement for projects, as emphasized by Ugulu *et al.* (2020). Having appropriate facilities is crucial for the overall well-being and productivity of construction workers.

Overtime compensation is identified as a significant monetary incentive for enhanced productivity on construction sites (Eze *et al.*, 2020). Recognizing and compensating workers for additional effort through overtime pay not only serves as a form of reward

but also positively influences the productivity of construction workers, acknowledging their dedication and commitment to the job.

Fair overtime compensation motivates workers to extend their efforts beyond regular hours particularly when project deadlines are tight or unexpected delays occur. It reinforces the perception that management values hard work which strengthens loyalty and improves morale. However, excessive reliance on overtime can also have negative consequences. Long working hours without adequate rest reduce physical strength and mental concentration leading to fatigue, errors and even safety risks. In such cases, productivity may decline rather than improve. Therefore, it must be managed carefully without compromising overall efficiency.

2.14.5 Team building and equipment factors

Social gatherings serve as a valuable initiative for team building, fostering a positive working environment and encouraging mutual interaction and communication among employees (Eze *et al.*, 2020). This, in turn, contributes to the overall enhancement of a team's performance and output. In the construction industry, where seamless and continuous work is essential, organizing activities into teams has proven effective in improving and maintaining productivity.

Another crucial factor affecting labour efficiency is the accessibility of necessary tools and equipment. Afolabi *et al.* (2018) highlight that craftsmen often face difficulties due to a lack of equipment and materials, emphasizing the importance of addressing these issues to enhance labour productivity.

2.14.6 Supervision and recognition factors

This factor encompasses several crucial aspects, including the workers' ability to participate in decision-making, effective job supervision, healthy competition among workers and minimizing unplanned breaks. Competent supervision is identified as the cornerstone for successfully completing projects on time, within budget and with high-quality outcomes. The level of education, experience and abilities of the supervisory team plays a pivotal role in ensuring that work aligns with specifications and contracts. As emphasized by Hamza *et al.* (2019), an incompetent supervisor and inadequate planning can significantly impact labour productivity.

Therefore, the competence and proficiency of the supervisory team are essential

elements in achieving project success and maintaining labour productivity. Alinaitwe *et al.* (2007) reported that the supervisors' leadership abilities had an impact on productivity. Similarly, productivity is affected by a lack of labour supervision, as stated by Hickson and Ellis (2014) and Jarkas *et al.* (2015).

2.14.7 Management and teamwork factor

This factor comprises three key elements: strong site leadership and management, collaborative efforts among employees and a sense of commitment and satisfaction with one's work. The successful completion of construction activities and projects hinges on effective teamwork. According to Eze *et al.*, 2020, the leadership and management style adopted by project managers significantly influence the level of cooperation among team members, thereby impacting overall productivity.

Mahamid *et al.* (2013) underscore the significance of proficient site administration and positive labour-management team relationships in mitigating detrimental effects on labour productivity in public construction projects. To enhance production levels, it is imperative to prioritize competent site administration and foster constructive relationships within the labour management team.

2.14.8 Materials and construction methods

Ugulu *et al.* (2020) identified the delay in availing material on site as a significant barrier to labour productivity that needs to be addressed for improved performance. The pace of site activities is directly impacted by the accessibility of materials both on the site and in the nearby market, as emphasized by Alaghbari *et al.* (2019). Additionally, Alaghbari highlight that the adoption of new construction techniques and technology plays a role in influencing overall productivity. This suggests that effective material management and the implementation of advanced construction methods are crucial for ensuring projects are completed on time, within budget and with the required standards, ultimately leading to increased productivity.

2.15 Relationship between job-site training and labour productivity

Training emerges as a pivotal factor with a substantial positive association with employee performance, as asserted by Landa (2018). It serves as a fundamental pillar predicting employees' success by enhancing their talents, capacities, competencies and recognition for their roles and responsibilities, according to Kenny and Nnamdi (2019). The linkage

between training and employee performance is explored by various researchers, such as Luo *et al.* (2021), who assessed the impact of training, supervisory mentoring, work satisfaction and interpersonal aiding on task performance.

Their findings revealed that training and supervisory mentoring significantly influenced work satisfaction and task performance, with job satisfaction positively impacting task performance and interpersonal helping, in conjunction with supervisory mentoring, moderating task performance. Irianto (2001) emphasized the critical role of training in project success, influencing labour productivity, improving output quality through skilled and experienced employees and enhancing adaptability to technical and social changes.

Training workers to operate complex machines and imparting relevant skills fosters improvements in productivity, competitiveness and innovation, positioning training as a crucial instrument for organizational capacity-building (Sasidaran, 2018). Additionally, Landa (2018) underscores the significant positive relationship between training and employee performance, considering it a fundamental tool for organizational capacity building.

Furthermore, studies cited in Afroz (2018) highlight training and development as a strategic instrument for improving employee performance by equipping them with cutting-edge skills, knowledge and the right organizational attitude. Kenny and Nnamdi (2019) reiterate that training is a primary predictor of employee performance, enhancing capabilities, capacities, competencies and recognition for their work. The significance of training for construction workers is paramount, serving as one of the most effective strategies to enhance employee performance and efficiently achieve company objectives and goals (Afroz, 2018).

Supporting this perspective, Kessy and Tesumu (2010) assert that training contributes to improved organizational results by enhancing managerial skills, reducing manufacturing costs, increasing profitability and expanding market reach. These studies collectively emphasize the transformative impact of training on employees, positioning it as a crucial element in enhancing overall performance within the organizational context.

On building sites, jobsite training directly addresses the specific skills and knowledge required to carry out tasks effectively. Unlike general training programs,

jobsite training focuses on the immediate demands of construction work ensuring that workers can apply what they learn directly to their daily activities.

This close link between training content and work requirements makes it a powerful driver of labour productivity under this study. Through job-site training, workers are strengthened in technical competence abilities, receive continuous guidance on safety and efficiency, build teamwork and communication adapting easily to new technologies, materials and construction methods hence spelling out that this relationship is both direct and multidimensional. Organizations that invest in continuous job-site training not only build the capacity of their workforce but also secure long-term gains in efficiency and project success.

2.16 Literature review summary and research gap

Previous studies in the construction sector, exemplified by the works of Hare and Cameron (2011), Odusami *et al.* (2007) and Hassan *et al.* (2005), consistently reveal a significant correlation between productivity and construction site manager training, highlighting the pivotal role of training in optimizing project outcomes. Additionally, the research conducted by Clayton *et al.* (2020), Jafari *et al.* (2014) and Sacks *et al.* (2013) underscores the multifaceted importance of training in the construction sector, emphasizing its influence on both employee performance and safety.

Despite the strategic relevance of competent workers, human resource development (HRD) in developing economies has been insufficiently explored in the literature, as noted by Debrah and Ofori (2006). Consequently, this study aims to illuminate how employee training, a critical aspect of human resource development, can significantly benefit both the company and project success. The imperative nature of conducting this research is emphasized by Garavan *et al.* (2020), who stressed that training is one of the most effective strategies for boosting employee performance and accomplishing company objectives and goals.

Although previous studies such as those by Alinaitwe *et al.* (2010) have explored factors affecting labour productivity in Uganda, there is limited research specifically focusing on the role of jobsite training in enhancing productivity on building sites. In the context of Uganda's construction sector, despite its significance, there is a noticeable gap in the literature and practical implementation of comprehensive job-site training programs

tailored to the needs of workers on building sites. Existing training initiatives may not align with the evolving demands of modern construction practices and technologies. Additionally, empirical research specifically investigating the impact of job-site training on labour productivity in the Ugandan context is lacking. Recognizing these gaps in current training practices and identifying the specific challenges faced by workers on building sites will provide valuable insights for designing and implementing targeted training programs, ultimately enhancing overall productivity in the Ugandan construction sector.

This research will not only bridge the gap between theory and practice but also provide evidence-based recommendations for policymakers, contractors and training institutions. By doing so, it will contribute to building a skilled and adaptable workforce capable of sustaining productivity improvements in a rapidly growing sector.

2.17 Conceptual framework

The research conceptual framework is shown in Figure 2.3 as a diagrammatic representation of the link between the dependent variable, control variables, intermediate variables and independent variables.

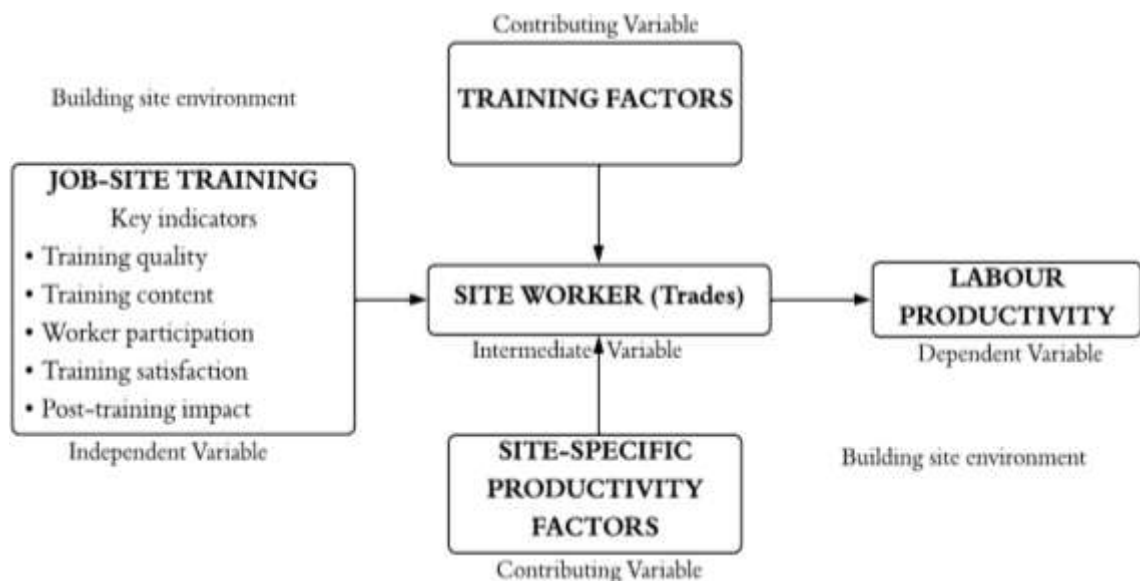


Figure 2.3 Research conceptual framework

2.17.1 Independent variable - Job-site training

Job-site training represents the independent variable of this study and the primary intervention aimed at enhancing workers' skills, knowledge and efficiency on building sites.

It encompasses structured activities, programs and methods designed to improve performance and productivity. The effectiveness of this training drives the outcomes observed in labour productivity on building sites making it the foundational element of the study.

The study measures job-site training through several key indicators.

These include training coverage which assesses the number and proportion of site workers trained in specific trades; training content which evaluates relevance to site needs, safety, technical skills and alignment with project standards; and training quality which reflects the enhancement of knowledge, skills and task performance. Additional indicators include training satisfaction, capturing attendance, engagement and worker perceptions of training relevance and post-training impact assessments on how newly acquired skills translate into improved confidence, competency and eventual labour productivity on site. Collectively, these indicators evaluate how effectively job-site training achieves its intended outcomes.

2.17.2 Contributing and Intermediate variables

The conceptual framework identifies job-site training factors as the primary contributors influencing labour productivity on construction sites. These factors include trainee motivation, training attitude, training method, training aids and materials, recruitment criteria, training content, frequency, language and site complexity. They determine how effectively the training is delivered and applied shaping the skills and efficiency of site trade workers.

Labour productivity factors represent the outcomes influenced by training and other site conditions. They include manpower, management, motivation, availability of tools and equipment, work conditions, external influences and project-specific factors. Site trade workers serve as the intermediate variable linking training to productivity. The effectiveness of job-site training is reflected in the workers' performance demonstrating how training interventions translate into measurable improvements in labour output and efficiency.

2.17.3 Dependent variable - Labour productivity

Labour productivity represents the dependent variable; the outcomes measured in this study capturing the effectiveness of job-site training and its influencing factors. It includes metrics such as task completion rates, error reduction, worker efficiency and overall

trade-specific performance. These measures reflect how well workers apply their skills on site and the impact of training on operational efficiency.

Organizing these variables within the conceptual framework establishes a clear flow from job-site training to labour productivity outcomes. It highlights both direct and indirect relationships, showing how training interventions and contributing factors collectively influence worker performance. The contextual framework is grounded in the understanding that labour productivity of workers on building sites does not depend on a single factor but rather on an interaction of training organizational practices and site-specific conditions which is relevant to the Ugandan construction sector hence guiding both the research process and the formulation of practical recommendations.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter discusses the methodologies employed in this research to achieve the study objectives. It examines the research design, approaches to data collection, sampling strategies, data sources, data analysis and the presentation of results obtained in this study, along with ethical considerations.

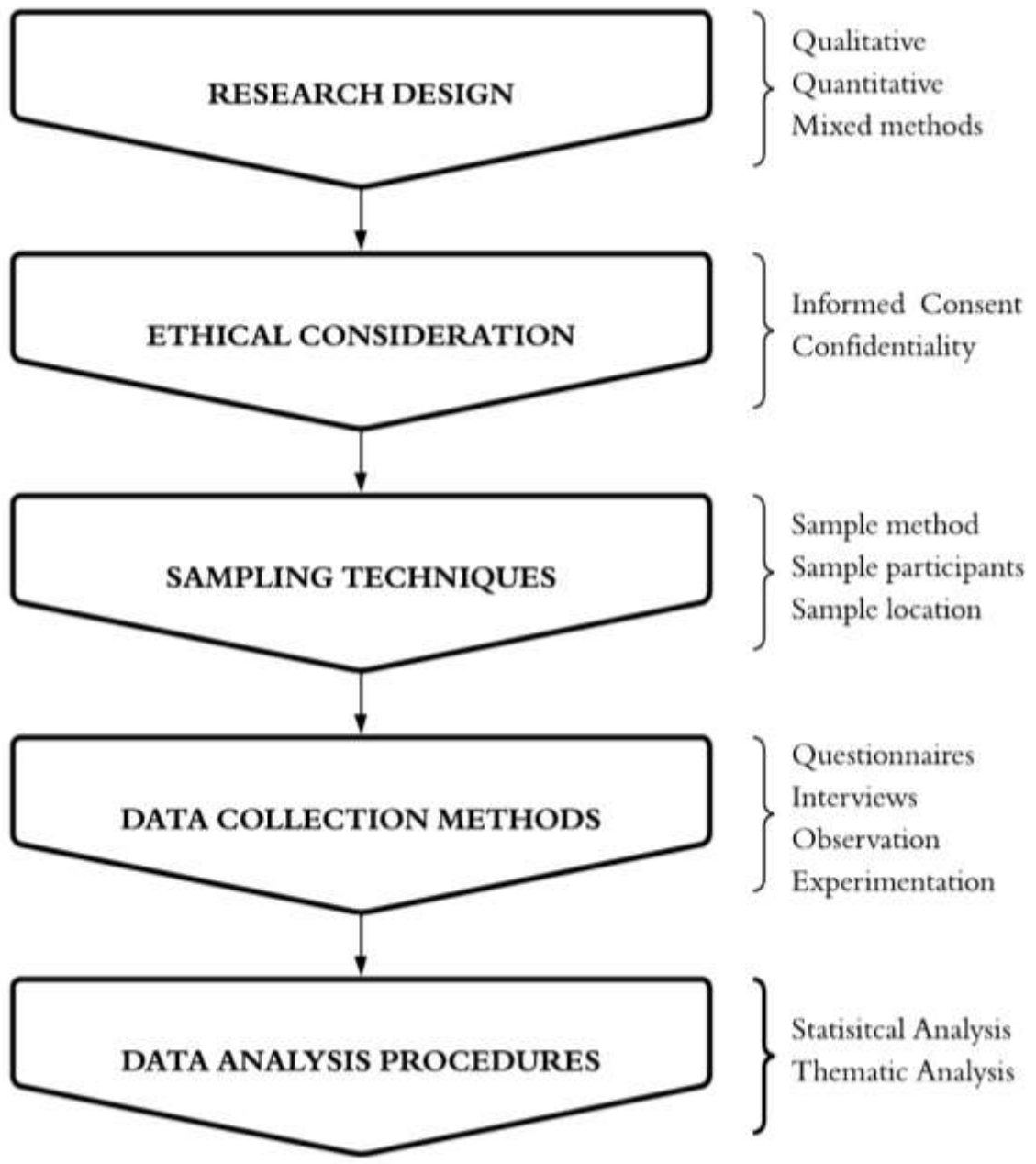


Figure 3.1 Schematic diagram for the research methodology

The schematic diagram in Figure 3.1 provides an overview of the research methodology. The process begins with defining research objectives and reviewing relevant literature followed by the identification and categorization of sites. A research framework is then developed to guide the study. Data are collected, analyzed and used to draw conclusions and recommendations leading to the final report. The data collection specifically examines the status of job-site training and its effect on labour productivity across selected building sites.

The study adopts a mixed-methods design that integrates quantitative and qualitative approaches enabling statistical measurement of productivity improvements alongside contextual insights into training practices. Ethical considerations are observed throughout the study including obtaining informed consent, ensuring confidentiality and minimizing risks to participants.

3.2 Research design and approach

3.2.1 Research design

The research design serves as a structured framework comprising methods and techniques strategically chosen by a researcher to systematically address research questions and draw conclusions (Fellows and Liu, 2008). In this study, a cross-sectional survey design was employed, where data were gathered from various construction workers in a single instance without the need for repetitive visits (Amin, 2005). The rationale behind choosing the cross-sectional survey design stemmed from its efficiency in swiftly collecting data over a concise time period, offering a cost-effective approach, as emphasized by Creswell and Creswell (2018).

This design not only provided a snapshot of the research variables at a specific point in time but also boasted a level of validity comparable to various other data collection methods. In particular, cross-sectional data were recognized for their robust validity, standing at par with other data types, including longitudinal data that entailed repeated observations, as highlighted by Creswell (2009). This aspect enhanced the reliability of findings ensuring that the collected data accurately represented the targeted variables and contributed to a comprehensive understanding of the research phenomenon. It further captures measurable trends and contextual perspectives on the variables of this study.

3.2.2 Research approach

The research approach, as defined by Creswell and Creswell (2018), encompassed a comprehensive plan and methodology that unfolds through a series of steps, progressing from overarching assumptions to the methods of data collection, analysis and interpretation. There were two primary categories of research approach in this study namely; qualitative and quantitative research approach.

a) Quantitative research approach in this study

Quantitative research was defined as a research methodology that sought to quantify data and establish causal relationships between variables through statistical methods, as noted by Singh (2006). This approach was centered on the acquisition of numerical data, employed for constructing graphs and tables, conducting hypothesis testing and drawing empirically sound conclusions from raw data.

In the context of this study, the quantitative approach was employed to summarize and quantify the responses of various participants concerning their bio-data and structured questions related to the respective specific objectives. Some of these objectives included determining the impact of job-site training, establishing the relationship between job-site training and labour productivity on building sites and identifying strategies for enhancing job-site training to boost labour productivity.

During the data analysis phase, statistical methods were employed to transform quantitative data into meaningful information, describing patterns, relationships and connections to inform decision-making. Statistics played a crucial role in summarizing data and identifying statistically significant differences between variables within the datasets.

b) Qualitative research approach in this study

The qualitative research approach represented a scientific method of observation employed to gather information that lacks numerical form, typically consisting of descriptive data (Creswell and Creswell, 2018). The questionnaire was employed with a combination of open and closed-ended questions, applying the qualitative approach to address the details of the specific objectives of the research.

Open-ended questions facilitated the collection of additional information on rec-

ommendations for improving training, description of improvements due to current training on site and type of training on site hence aiding in the achievement of specific objectives and providing an in-depth understanding of the study. On the other hand, closed-ended questions were instrumental in acquiring specific quantitative information on the impact of job-site training on worker productivity, enabling the quantification of the collected data.

3.3 Population and sample

3.3.1 Population

Population sampling referred to the systematic process of selecting a subset of objects or members from a larger population, adhering to specific and well-defined criteria that represented the characteristics of the entire population. The purpose of sampling was to streamline the research process, conserving time, money and effort, while also addressing the impracticality of testing every individual within the population (Cooper and Schindler, 2016). In the context of this study, the targeted population comprised local construction sites situated in Arua City. These sites were specifically chosen due to the alarming statistic of low productivity characterized by increased rework, uncompleted works and poor workmanship due to a shortage of skilled labour.

The decision to narrow the study's scope to construction workers was in consideration of their crucial roles in participating in job-site training on building sites. The local construction sites and the construction workers chosen were through a simple random sampling approach, ensuring an equitable chance for each entity to be included in the study. This methodological choice enhanced fairness and impartiality in the selection process, contributing to the overall robustness of the study's findings.

3.3.2 Sample and sampling strategies

a) Sample size determination

In the conducted study, a sample was carefully selected to actively participate in the research (Marczyk *et al.*, 2015). The primary objective was to ensure the representativeness of the sample in relation to the entire population, thereby facilitating the generalization of findings from the research sample to the population at large.

Moreover, in the specific context of this study, the determination of the sample

size for local construction sites was accomplished through the application of statistical formulas presented in the Equations Eq. (3.1) and Eq. (3.2). Additionally, the research incorporated the use of the Krejcie and Morgan table discussed in

Appendix E, to contribute to the accurate determination of the sample size of respondents involved in the study.

$$n = \frac{N \cdot z^2 \cdot p \cdot q}{e^2(N - 1) + z^2 \cdot p \cdot q} \quad \text{Eq. (3.1)}$$

Where n represents the required sample size, N is the total population size, p denotes the estimated proportion of the variable present in the population and q is defined as $1-p$, representing the absence of the variable in the population. The parameter z corresponds to the standard normal deviate at a specified confidence level, while e denotes the margin of error between the sample mean and the population mean. Consistent with Cochran's (1977) recommendation, this study applies a confidence level of 95 percent for which the z value is 1.96. The values $p = 0.5$ and $q = 0.5$ are adopted to maximize the required sample size thereby ensuring representativeness of the selected sample. The margin of error is set at five percent ($e = 0.05$), a value commonly applied in social science and construction management research.

In line with Cochran's correction for finite populations, the initial sample size (n_0) was adjusted to account for the actual population size. The adjustment is obtained using the formula:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \quad \text{Eq. (3.2)}$$

where n denotes the adjusted sample size, n_0 represents the initial (uncorrected) sample size computed under the assumption of an infinite population and N refers to population size. This correction ensures that the final sample is both statistically valid and practically feasible, thereby reducing time and cost implications associated with large samples (Cochran, 1977; and Marczyk et al., 2015). When determining the sample size, Cochran's formula is often used to calculate an initial sample for large populations. However, when the total population is relatively small or finite, the initial sample size is adjusted using Cochran's correction formula. This correction reduces the sample size proportionally to

the population ensuring that the number of respondents is both manageable and representative.

b) Sampling strategies

Two sampling techniques were employed in this research namely; purposive sampling and stratified sampling techniques.

(i) Stratified sampling

Stratified sampling is a probability sampling technique which divides the entire population into distinct subgroups (Strata). The final samples are then randomly selected in proportion to the different strata (Kothari, 2004). Stratified sampling was used to select building sites from the two main divisions of Arua City, namely *Ayivu* and *Central* Divisions, ensuring that sites from both areas were represented. The building sites of interest were those located within these divisions.

The allocation of the overall sample size to the construction sites was achieved using proportional stratified sampling, expressed as;

$$n_i = \frac{N_i \times n}{N_T} \quad \text{Eq. (3.3)}$$

Where n_i represents the required sample size for stratum i , N_i denotes the population of stratum i , N_T is the total population across all strata and n is the overall sample size previously determined. This ensures that the sampling process remains representative by maintaining the proportional contribution of each group relative to the total population (Cochran, 1977; Marczyk et al., 2015)

To ensure a balanced and unbiased selection of construction (building) sites since Arua City is divided into two major divisions, one category comprised of building sites in *Ayivu* Division and the other in *Central* Division. This categorization aimed to enhance the precision and fairness in the selection process by guaranteeing that both divisions were adequately represented in the study sample. Such stratification minimized the risk of over-representing one area while neglecting the other thereby improving the credibility and generalizability of the findings.

Substituting values in Eq. (3.3) as detailed in

Appendix E, a total of 14 construction sites were obtained and sampled for consideration

in this research. The proportional allocation of sites from each division further strengthened the study by capturing site-specific differences in site management practices, workforce characteristics and jobsite training interventions. In doing so, the research design accounted for potential variations in labour productivity across divisions providing a more accurate and holistic understanding of the phenomenon under investigation.

Table 3.1 Location area and coordinates for building sites in Arua City

S/No	Building sites	Site Coordinates
1	Guest building site	3.00820° N, 30.91312° E
2	Yapi building site	3.02197° N, 30.91260° E
3	Residentail site	3.02204° N, 30.91200° E
4	Tangan Building site	3.04677° N, 30.91442° E
5	Cefford building site	2.99629° N, 30.91280° E
6	GYM and conference rehabilitation site	3.04350° N, 30.91338° E
7	Motel building site	3.01523° N, 30.92200° E
8	Go-down building site	3.02310° N, 30.93212° E
9	Guest House site	3.04919° N, 30.91661° E
10	Springs Secondary School construction site	3.03907° N, 30.91308° E
11	Hunters nest swimming pool construction site	3.04884° N, 30.91593° E
12	Brest building site	3.02663° N, 30.90995° E
13	Alivu building site	3.01736° N, 30.90047° E
14	Awindiri building site	3.05194° N, 30.91939° E

(ii) Purposive sampling

Purposive sampling is a non-random sampling technique where deliberately selected individuals or cases based on specific characteristics or criteria that aligned with the research objectives. In this research, participants in the different worker trades on the building site were consciously and intentionally selected.

Purposive sampling was employed to select specific worker trades on building sites focusing on trades(workers) and activities most relevant to the study's objectives. Additionally, building sites where any form of job-site training was observed was selected based on purposive sampling. This approach allowed the research to target sites and trades that provided valuable insights into the study's focus areas. By deliberately selecting different trades of workers on the building site, a diverse range of perspectives regarding

job-site training was captured. This targeted approach enabled a more in-depth exploration to address the research questions and contribute meaningfully to the overall understanding of training in the construction industry.

To estimate the required number of workers on site (sample size) for the study based on observed productivity improvements, the method of linear interpolation was employed. This approach is appropriate when estimating values within the range of two known data points as shown in

Appendix E. The standard formula used from Burden and Faires, (2010) is;

$$y = y_1 + \frac{(y_2 - y_1) \times (x - x_1)}{(x_2 - x_1)} \quad \text{Eq. (3.4)}$$

Where y is the interpolated sample size, y_1 , y_2 are sample sizes at known values x_1 and x_2 and x is the intermediate value for which the sample size is to be estimated

3.4 Description of research study area

Arua City, located in the West Nile region of northwestern Uganda, is a rapidly expanding urban centre with strategic importance as it shares borders with both South Sudan and the Democratic Republic of the Congo. According to *Population-hub.com*, the city has a population of approximately 70,933 people and attained city status on July 1, 2020 following a parliamentary initiative that elevated seven municipalities to city level. This change stimulated rapid urbanization, attracted foreign investments and accelerated infrastructure development positioning Arua as a growing commercial and construction hub in the region.

Administratively, the city is divided into Central and *Ayivu* Divisions, both experiencing rapid construction growth but heavily dependent on manual labour. With much of the workforce lacking formal training, Arua provides a suitable case for examining how jobsite training can enhance labour productivity and improve construction outcomes.

The city has been the subject of repeated complaints regarding the extensive use of unskilled labour on building sites. Additionally, the city has faced persistent challenges such as slow project progress, incomplete structures and abandoned construction works, many of which have been linked to limited worker skills and poor site-level management practices. These issues highlight the urgent need for systematic interventions that address

workforce capacity and site productivity.

3.5 Data collection

Data collection methods refer to the systematic processes and techniques employed to gather information and data for research or analysis. Different methods were utilized in the collection of data, as Yin (2009) recommends questionnaires, interviews, observations and relevant documents as suitable techniques for case study research. In line with these suggestions, the present study employed these methods for data gathering. This approach to data collection enabled the deduction of high-quality information hence facilitating a rigorous analysis of the specific objectives of this research.

Data collection was done using data collection tools. These tools served as instruments employed for gathering data from all respondents within the computed sample area. The study utilized structured questionnaires, observational methods and interview guides to collect data from respondents. Information pertaining to low productivity was obtained from the building sites that had some sort of job-site training on going presently on the sites and data were mainly collected from construction workers.

3.6 Sources of research data

A data source referred to the collection of research information through direct acquisition for a particular research study. These sources were categorized into primary and secondary data, serving as the foundation on which the study was based, as outlined by Kothari (2004).

3.6.1 Primary data collection methods

Primary research data sources refer to the firsthand or original data that research assistants collected directly from respondents and observations to accomplish the specific objectives of the study.

a) Observation method

This approach was employed to acquire firsthand information by observing ongoing work at specific building sites. This method involved systematically watching and recording the behaviors, activities and interactions of workers within the building sites. Research assistants who were deployed on these sites could directly observe workers engaging in

their tasks, training sessions and collaborative efforts to gain insights into their productivity levels and identify areas for improvement.

By immersing themselves in the work routines and training processes, first-hand information was gathered, real-time data on the challenges faced by workers and the impact of training initiatives on their performance. Valuable qualitative data was collected, providing a nuanced understanding of the dynamics influencing labour productivity and informing strategies for effective training interventions on construction sites. This observational method served as a valuable complement to the data gathered through questionnaires and interview guides in this research.

b) Interview guide

To gather qualitative data on the influence of management skills on labour productivity, an interview guide was employed with study participants. This choice was made because an interview guide allows for the in-depth collection of qualitative data concerning the research topic at hand (Boyce and Neale, 2006). The steps to develop the model were analyzed based on the valid qualitative data collected from the interview guide.

c) Questionnaire survey

In this study, data gathering employed a questionnaire survey utilizing a structured approach, wherein respondents conveyed their opinions in response to the posed questions. The structured questionnaire is a widely adopted research method known for its expediency and effectiveness in collecting and analyzing data from a targeted population (Creswell and Creswell, 2018). The questionnaire design drew upon insights from the literature review on construction management skills and underwent validation by three expert respondents familiar with questionnaires in the field.

(i) Questionnaire design

The questionnaire comprised five (5) sections, each tailored to collect specific data necessary for achieving the study's objectives (in *Appendix B*). Section A, serving as a general introduction, aimed to gather information about respondents' profiles. Questions in this section sought details on respondents' bio-data which included trade, age, experience, qualifications and other relevant information particularly workers involved in various tasks within the building sites.

Moving on to Section-B, respondents were asked to express their opinions on the factors affecting job-site training on building sites. This section employed closed-ended questions, utilizing a five-point Likert scale (1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; and 5-Strongly Agree) for easy statistical analysis. The categorization of the factors of job-site training was based on the literature review conducted and open-ended questions were also used in this section.

Proceeding to Section-C, participants were tasked with sharing their perspectives on the factors affecting labour productivity on building sites. This segment featured closed-ended questions, employing a three-point Likert scale (1-Disagree; 2-Neutral; 3-Agree) to facilitate straightforward statistical analysis. The classification of the labour productivity factors was drawn from an in-depth literature review conducted.

Finally, Section-D aimed to gather information on the impact of job-site training on the productivity of construction workers at building sites, along with recommendations from the respondents. This section incorporated both open-ended and closed-ended questions in its design.

(ii) Validity of questionnaire

Validity pertains to the degree to which discrepancies identified using a measuring instrument genuinely represent authentic distinctions among those under examination (Kothari, 2004; Creswell and Creswell, 2018). To establish the validity of the questionnaire, a pilot study was conducted involving the participation of four expert respondents (foremen) who were purposefully selected based on their expertise and familiarity on working on several building sites with all worker trades. They were well positioned to provide constructive feedback on the design and content of the questionnaire. These respondents did not participate in the final survey to maintain the integrity and independence of the data collection process.

The feedback from the pilot study participants was instrumental in refining the questionnaire and these insights guided the final modifications and adjustments to enhance its clarity, relevance and overall effectiveness of the tool. This iterative process led to the validation of the tool ensuring it was suitable for achieving the objectives of this research. Following the validation process, the revised questionnaire was distributed to the 94 respondents in the field forming the basis for data collection in this study.

This systematic approach ensured that the data collection tool was both accurate and well-aligned with the study's goals. In the interpretation of CVI results, a high CVI value near 1 signifies strong consensus among experts regarding the relevance of surveyed items, indicating effective representation of the intended content domain. A CVI between 0.5 and 1 reflects moderate to high agreement among experts and a CVI value below 0.5 indicates lower agreement among experts and may signal potential issues with the relevance of certain items. In the process of assessing the content validity of questionnaire, a panel of four experts was engaged. Each expert was tasked with providing ratings on a scale of 1 to 4, where 1 indicated "Not Relevant", 2 denoted "Somewhat Relevant", 3 denoted "Quite Relevant" and 4 denoted "Very Relevant."

To ensure the validity of the data collection instrument, the Content Validity Index (CVI) was computed following the method described by Bandalos (2018). The CVI assesses the proportion of subject matter experts who agree that each item is relevant to the construct being measured.

$$CVI = \frac{n_r}{n} \quad \text{Eq. (3.5)}$$

Where *CVI* is Content Validity Index, n_r if the number of experts rating the item as "relevant" (usually rating 3 or 4 on a 4-point scale) and n = Total number of experts participating in the evaluation. An item is generally considered valid when the CVI is ≥ 0.78 for panels of 6 or more experts (Polit and Beck, 2006). The Content Validity Index (CVI) for this questionnaire is approximately 0.875 or 87.5%. This indicates a high level of content validity based on the expert ratings, with higher values suggesting better content validity. Therefore, since the CVI of this questionnaire is approaching 1, it is indicative of high content validity, signifying a substantial consensus among experts regarding the relevance of the evaluated items which suggested that the items in the questionnaire effectively captured the intended construct or objective.

(iii) Reliability of questionnaire

According to Cooper and Schindler (2016), the degree to which an experiment or measuring technique produces consistent results after multiple tries is known as reliability. In this research, the reliability and internal consistency of the survey instruments were determined using Cronbach's alpha statistics through SPSS software. The reliability of data

is deemed weak when Cronbach's α is less than 0.3, moderate when it is between 0.3 and 0.7 and strong when it is more than 0.7, it indicates a high level of internal consistency of the instrument and is deemed appropriate for research purposes (Creswell and Creswell, 2018). Cronbach's α reliability correlation coefficient ranges from 0 to 1.

The cumulative reliability for all variables, indicated as "Overall," was calculated to be 0.856. This overall reliability score suggested that, collectively, the survey instruments used in the research exhibit a robust internal consistency across all variables, contributing to the credibility and dependability of the data collected.

3.6.2 Secondary data collection methods

The collection of secondary data involved employing several techniques.

a) Desk literature review sources

Systematic study was done to enhance comprehension of job-site training, construction management, workforce training and productivity improvement on construction sites, relevant topics, themes and previously published information from journals and textbooks by various scholars.

b) Global positioning system (GPS) readings

For the specified construction sites in Arua City, coordinates were obtained using a GPS device so as to avoid mixing up sampling sites or wrong locations. This facilitated the gathering of global positioning system location coordinates of the building sites during the field data collection. To ensure accuracy, the GPS device was employed to precisely determine the geographical positions of each construction site, contributing to the overall reliability of the spatial data acquired. The utilization of this technology not only prevented confusion in identifying sampling locations but also enhanced the precision of the collected data, thus fortifying the validity of the study's findings.

c) Review of construction project documents

The data collection strategy employed in this study involved conducting site visits to various building sites. During these visits, comprehensive data were accessed, covering a wide range of information related to the nature of work, types of workers present, working hours, overtime hours, training records, contractor method statements, construction

schedules and labour productivity assessed through admeasurements. This approach facilitated a detailed and holistic study enhancing our understanding of the factors influencing construction worker job-site training and productivity on building sites. Consequently, it contributed to the reliability of the study's data collection process.

3.7 Data analysis tools

The data analysis process played a pivotal role as a crucial cornerstone in extracting meaningful insights. By employing a combination of quantitative tools and qualitative methods, such as content analysis of interviews and surveys, a comprehensive exploration of the multifaceted aspects influencing labour productivity was achieved. Systematic data analysis revealed patterns that illuminated the effectiveness of training on building sites and its impact on worker productivity. The application of data analysis techniques not only successfully met the research objectives but also paved the way for evidence-based recommendations.

The following were the data analysis methods employed in this research namely, chi-square test, regression analysis, average importance index (AII), relative importance index (RII), Pearson's correlation analysis and Microsoft excel analysis and are discussed below.

3.7.1 Relative Importance Index (RII)

The Relative Importance Index (RII) is a tool used to rank and prioritize factors based on the relative importance as perceived respondents. In this study, RII was proven to be valuable in assessing, prioritizing and quantifying the significance of factors essential for enhancing labour productivity and also factors affecting labour productivity on building sites in this study.

By assigning weights to each factor based on workers' perspectives, the RII facilitated a comprehensive understanding of the relative importance of the factors affecting training and labour productivity on building sites. This dissertation employed a mixed-methods approach, combining surveys and interviews to collect data from construction workers for RII calculations. The findings aimed to provide evidence-based insights that could inform targeted training and labour productivity interventions ultimately optimizing labour productivity on building sites. Through the application of the Relative Importance Index (RII), the study identifies and ranks the key factors affecting performance

ensuring that the most influential challenges are given priority. This approach not only highlights critical areas for improvement but also supports the development of focused training strategies that directly address workforce needs thereby enhancing efficiency and the overall success of construction projects.

3.7.2 Regression analysis

Regression analysis is a statistical method used for analyzing the relationships between variable. In this study, regression analysis was used as a powerful statistical tool to explore and quantify the relationships between job-site training effectiveness and the factors affecting job-site training on the building sites. The Statistical Package for the Social Sciences (SPSS) Version 23 software was used for regression analysis because of its user-friendly interface.

Regression model was generated to assess the impact of factors affecting job-site training on job-site training effectiveness on the building sites. Additionally, the regression analysis facilitated the identification of potential confounding variables and helped establish a predictive model offering valuable insights for optimizing job-site training strategies and ultimately enhancing overall labour productivity on the site.

3.7.3 Pearson correlation analysis

Pearson's correlation analysis tool is measuring the relationship between two variables expressed as a correlation coefficient ranging from -1 to +1 which measures the strength and direction of the relationship. In this research, Pearson correlation analysis served as a crucial statistical tool for evaluating the relationships between job-site training and labour productivity on building site.

This research employed Pearson correlation to assess the strength and direction of associations between different training components and the resulting impact on worker productivity. Statistical Package for the Social Sciences (SPSS) Version 23 software was used to perform Pearson correlation analysis by entering their data sets and specifying the variables of interest. By systematically analyzing the correlation coefficients, the relationship was established to identify how training was linked to productivity of worker hence enabling the formulation of targeted and evidence-based recommendations for optimizing job-site training programs on sites.

3.7.4 Chi-square tests analysis

Chi-square test is a statistical test to determine whether there is a significant association between categorical variables. In this research, chi-square tests served as an analytical tool for investigating categorical associations and dependencies within the dataset of this research. The SPSS version 23 software was used for chi-square test analysis. By employing Chi-square tests, the study identified statistically significant factors of training factors and labour productivity factors on sites.

3.7.5 Microsoft excel analysis

Microsoft Excel is a tool widely used in research across disciplines due to its flexibility, accessibility and ability to handle data entry, analysis and presentation (data visualization) hence good analyzing of trends, comparisons and relationships. Utilizing Excel's spreadsheet functionalities, diverse datasets related to labour productivity and job-site training initiatives were managed, cleaned and analyzed. The software played a crucial role in facilitating the generation of graphical representations.

Data obtained from questionnaires were analyzed and presented on bar graphs and pie charts. These visual aids were then interpreted and discussed using simple statistical tools namely percentages and frequencies focusing on labour productivity and job-site training aspects on building sites. Through the utilization of Excel's functions and tools, meaningful insights that significantly contributed to the understanding of the impact of job-site training on labour productivity within the context of building sites were derived.

3.7.6 Average Importance Index (RII)

The Average Importance Index (AII) provides a method to quantify the relative significance of job-site training factors as perceived by construction workers. In this research, the AII allows for the identification of which training factors most strongly influence labour productivity enabling a clear prioritization of areas requiring intervention. It facilitates the evaluation of multiple variables simultaneously revealing patterns in worker perceptions that might not be evident through simple observation or descriptive statistics. By applying the AII, the study ensures that recommendations and resource allocations focus on the most impactful training elements thereby directly supporting the objective of enhancing labour productivity on building sites.

The AII also provides a standardized approach to compare responses across different sites and trades ensuring consistency in the interpretation of results. It highlights

discrepancies between perceived and actual training effectiveness allowing this study to address gaps in training design. Through ranking, the AII informs decision-makers about which factors require immediate attention and which can be considered secondary. The tool strengthens the reliability of findings by reducing subjectivity in analyzing questionnaire responses. Finally, the AII supports the integration of worker feedback into the development of a more targeted and practical job-site training framework.

3.8 Achievement of specific objectives

Achieving specific objectives provided a narrative that shaped the coherence and depth of the study propelling it toward a comprehensive and meaningful contribution to the academic discourse. Each objective was methodically addressed using tailored data collection and analytical approaches with a focus on all construction worker trades at building sites. Below is a breakdown of how each specific objective was achieved. Quantitative data from surveys and structured questionnaires were complemented by qualitative insights from interviews to capture a comprehensive view of training practices and productivity outcomes. This combination ensured that the objectives were achieved with accuracy allowing the study to draw practical conclusions on enhancing labour productivity.

3.8.1 Factors affecting job-site training on building sites

The relevant factors influencing job-site training were identified from previous researches through extensive literature review. Research assistants were deployed on the different building sites with the questionnaires and interview tools. This objective was addressed through Section-B of the questionnaire to workers on site. Data was collected via both open-ended and closed-ended questions administered to construction workers. The questions aimed to capture the key factors influencing job-site training, drawing insights from the literature review. The data was coded and analyzed using Statistical Package for the Social Sciences (SPSS) Version 23 software.

After data collection the dataset was cleaned, classified and entered into SPSS. The analysis involved; Chi-square tests to identify statistically significant factors and relative Importance Index (RII) analysis to rank the factors, revealing the most critical components influencing training effectiveness on-site and Average Importance Index (AII) used to rank or prioritize variables based on respondents' perceptions. These methods facilitated a structured prioritization of job-site training challenges and helped identify

actionable areas for improvement on building sites. Once the factors of job-site training are identified, the factors affecting labour productivity are examined to provide a holistic understanding as discussed in the next objective.

3.8.2 Factors affecting construction labour productivity on building sites

Literature review was done and factors that influence labour productivity on building sites from past studies were identified. Objective 2 was achieved through Section C of the questionnaire which focused on understanding how labour productivity factors influenced construction labour productivity. Closed-ended questions were developed based on a three-point Likert scale (1 - Disagree, 2 - Neutral, 3 - Agree) derived from the literature. The collected data underwent cleaning, coding and classification process in the Statistical Package for the Social Sciences (SPSS) Version 23 software.

The analysis use of chi-square tests to determine statistically significant factors, RII analysis to rank the factors by importance and Average Importance Index (AII) used to rank or prioritize variables based on respondents' perceptions. The outcome provided a clear hierarchy of factors that negatively or positively influenced labour productivity on sites. These insights are critical for workflow optimization on building sites yielding greatest improvements that ensure efficient use of resources and the overall project performance.

3.8.3 Impact of job-site training on construction labour productivity

Literature review was explored on links between training and productivity in existing researches and this led to guiding the framing of Section-D of the questionnaire which focused on how job-site training influences worker productivity and their relationship. Both open-ended and close-ended questions facilitated uniform responses and simplified the comparative analysis.

Data was cleaned, coded and entered into Statistical Package for the Social Sciences (SPSS) Version 23 software. Pearson's correlation analysis was used to measure the relationship between job-site training and labour productivity on site expressed as a correlation coefficient ranging from -1 to +1. Therefore, understanding the sign and magnitude of the correlation coefficient helped to identify the positive or negative influence

and degree of impact on labour productivity when job-site training is implemented. Ultimately, this statistical approach supports data-driven decision-making for optimizing training strategies and highlights whether training interventions on building sites are effective in improving worker productivity.

3.8.4 Regression model and framework to improve labour productivity through effective job-site training on building sites

The study began with a literature review to explore best practices and strategies from previous research related to job-site training and productivity improvement and based on these insights, Part-D of the questionnaire was designed incorporating both open-ended and closed-ended questions to collect qualitative data from workers. During data collection, detailed feedback was gathered from workers across all trades on potential strategies for enhancing training and job-site conditions. The collected responses underwent data cleaning and thematic classification where similar ideas were grouped into meaningful categories. Statistical tools such as frequencies and percentages were used to analyze the data in Microsoft Excel and the findings were presented using bar charts and pie charts to enhance visual interpretation.

The need for making informed decisions and workforce planning is key. While multiple software options like SPSS, R-Studio, SAS, and Excel can be used for such modeling (Chakkappan and Das, 2016), SPSS was selected for this study due to its reliability in handling regression analysis. To examine the impact of the factors of job-site training on the effectiveness of training on site, a regression model was developed using Statistical Package for the Social Sciences (SPSS) Version 23 software. The assumptions underlying regression analysis were applied to validate the model which provided predictive insights into how adjustments in training programs could impact training effectiveness.

Finally, the study culminated in the development of an on-site training framework for construction workers that integrated findings from all research objectives. This framework, illustrated using Microsoft Word diagrams highlights the relationships between various training factors and productivity outcomes hence offering a practical guide for implementing effective job-site training strategies on building sites. A reliability test was to be done involving all worker trades on site applicability of the framework.

3.8.5 Ethical consideration in this research

In the pursuit of ethical research practices, it is imperative to establish guidelines that prioritize the well-being of human subjects and ensure that investigations align with the interests of individuals, groups and society as a whole. Ethics, defined by Kumar (2011), are the principles of conduct derived from moral judgments distinguishing between what is deemed good and bad. In the context of this study, several key elements of research ethics were conscientiously addressed.

Firstly, the commitment to truthfulness was adhered to, fraudulent practices, data fabrication, plagiarism and data trimming were avoided. Secondly, official permission was sought from site or company's head. Furthermore, confidentiality, a fundamental aspect of research ethics, was maintained. And lastly, participants were afforded the flexibility to withdraw from the study at any point, emphasizing the recognition of individual autonomy.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents, analyses and discusses the results obtained from the data collection process which targeted the four specific objectives of the study. Data from both interviews and questionnaires are systematically analysed using statistical tools such as the chi-square test, regression analysis, Average Importance Index (AII), Relative Importance Index (RII), Pearsons correlation analysis and Microsoft Excel computations. The findings on factors influencing job-site training and labour productivity are examined in relation to the study objectives and discussed alongside relevant previous studies.

4.2 Background information about respondents

The results begin with a demographic analysis of construction workers (bio-data) drawn from various building sites in Arua City. This section outlines key characteristics of the respondents, providing a basis for understanding workforce composition and interpreting subsequent analyses.

4.2.1 Type of construction workers on the site

This section analyses the distribution of skilled and non-skilled trades across 14 building sites in Arua City. Understanding this composition informs targeted workforce development and productivity improvement strategies. Construction workers on these building sites consist of both trade and non-trade categories each playing a vital role in project delivery. Non-trade workers provide general labour support such as site clearing, excavation, material handling and assisting skilled workers with basic tasks. Masons are responsible for brickwork, blockwork, plastering and concrete works forming the structural fabric of buildings. Carpenters construct formwork, scaffolding, doors, windows and other wooden or structural elements needed during construction. Painters carry out surface preparation, painting and finishing works. Electricians install wiring, lighting systems and electrical fixtures to provide safe and reliable power supply. Plumbers handle water supply systems, drainage, and sanitation installations essential for functionality. Welders fabricate and join metal components such as reinforcement bars, gates and frames to strengthen structures. Together, these categories of workers form the backbone of construction projects, each contributing specialized skills that directly affect labour productivity and overall project outcomes.

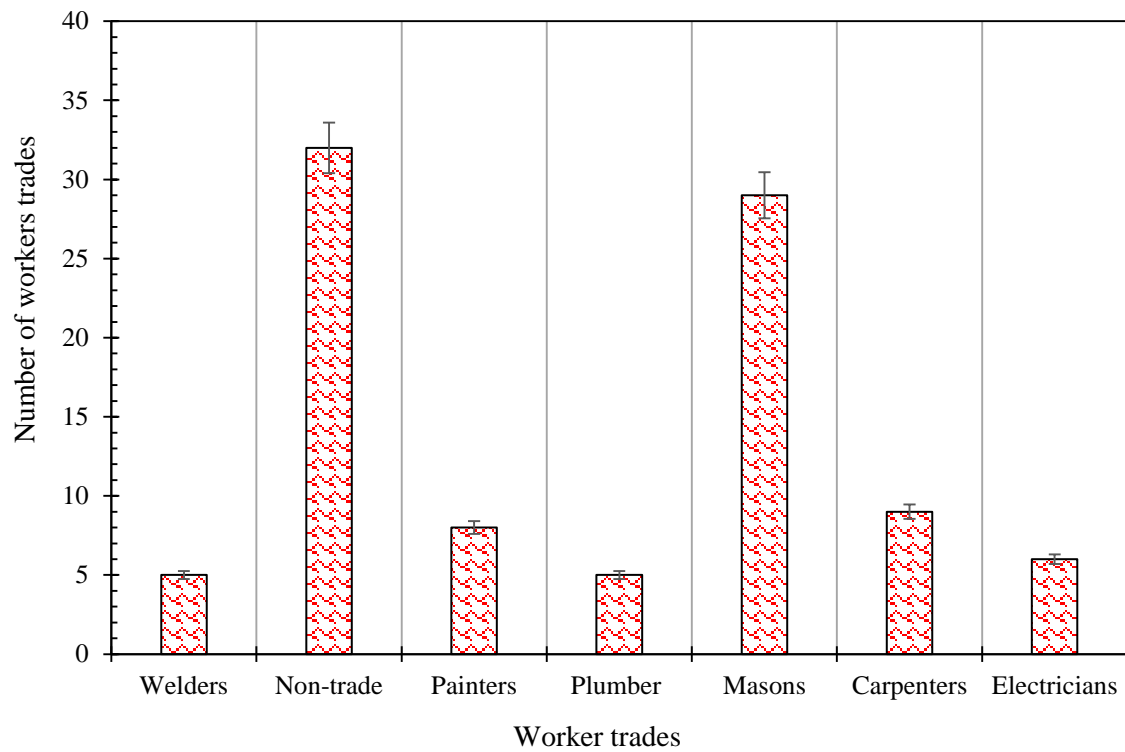


Figure 4.1 Worker trades on building sites

Figure 4.1 shows that non-trade workers form the largest proportion (34.04%), Masons account for 30.85% of the workforce followed by carpenters (9.57%), painters (8.51%), electricians (6.38%), plumbers (5.32%) and welders (5.32%). The predominance of non-trade workers highlights their essential role in physical labour, material handling and supporting skilled trades on building sites. This aligns with Durdyev and Mbachu (2018) who reported that unskilled labour is vital to maintaining construction workflow despite limited specialised skills. Targeted training in safety, efficiency and basic technical competencies could therefore enhance their productivity.

The significant representation of masons reflects their involvement in multiple project phases from foundations to finishing, which is consistent with the findings of Baloi and Price's (2003) that masonry trades dominate workforce composition due to their cross-phase applicability. Advanced training in construction techniques and quality control could improve output and workmanship for them. Specialised trades such as carpenters, painters, electricians, plumbers and welders appear in smaller proportions suggesting engagement in specific project stages. Although fewer in number, their contributions are critical to completion and operational quality. Continuous professional development and cross-trade training could improve adaptability and collaborative efficiency.

4.2.2 Age of workers on building sites

This section examines the age distribution of construction workers across various building sites in Arua City on building sites. Understanding these demographics provides insight into workforce composition and guides strategies for productivity, training and sustainable labour management. The age distribution of workers influences labour productivity by balancing physical capability and practical knowledge on site.

Younger workers often demonstrate higher energy levels, physical strength and stamina which allows them to complete physically demanding tasks quickly and efficiently. The older workers, on the other hand, bring years of experience, technical know-how and precision that improves the quality of work and reduce errors. Therefore, a mix of younger and older workers creates a complementary workforce where energy is combined with expertise leading to improved overall labour productivity on building sites.

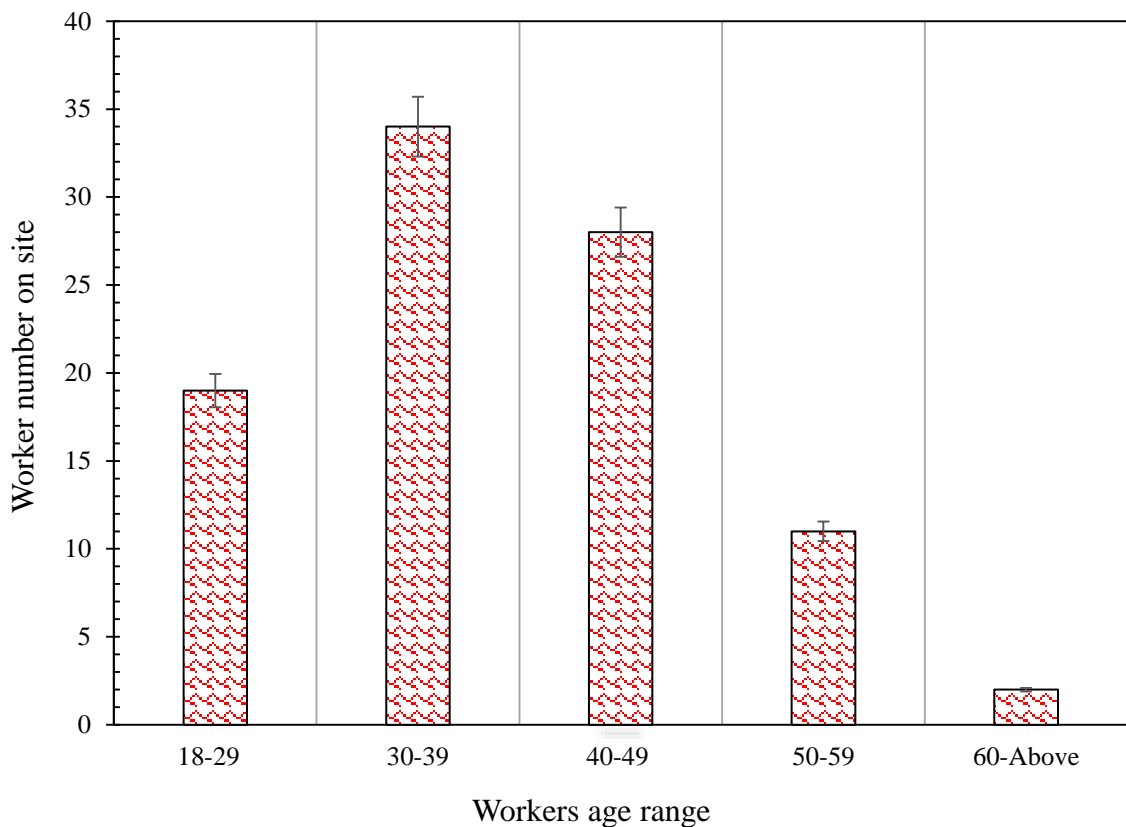


Figure 4.2 Age of workers

Figure 4.2 shows that 19 respondents are aged 18–29 years (20.21%), 34 respondents are aged 30–39 years (36.17%), 28 respondents are aged 40–49 years (29.79%), 11 respondents are aged 50–59 years (11.70%) and 2 respondents are above 60 years (2.13%). The

largest proportion of workers falls in the 30–39 age group followed by 40–49 years, with fewer respondents in the younger and older extremes.

The predominance of the 30–39 age group suggests a workforce in its prime productive years, often possessing both physical capability and relevant experience (Koch *et al.*, 2018). The notable representation of 18–29 year olds indicates a significant entry of younger workers which can introduce innovation and adaptability but may require targeted skill development (Gurmu and Aibinu, 2019). The smaller proportions in older age groups, particularly above 60 years aligns with Heizer and Render's (1993) observation that ageing can reduce physical performance, speed and agility thereby impacting productivity on sites.

The age spread across all groups highlights the need for age-sensitive training approaches. Programs for the dominant 30–39 segment should focus on enhancing efficiency and leadership while younger workers (18–29) may benefit from hands-on mentorship and structured skill-building.

4.2.3 Gender of workers on site

This section presents the gender distribution of construction workers across building sites in Arua City. Understanding this composition is critical for identifying potential disparities addressing inclusivity and designing effective jobsite training programs that enhance productivity for the entire workforce.

The gender distribution on sites has implications for labour productivity as diverse teams bring different strengths, men often contributing physical capacity while women bring attention to detail, precision and organizational skills. Encouraging more gender inclusivity in construction can therefore help balance the workforce and enhance overall productivity. Although construction has historically been male-dominated, increasing female participation introduces complementary skills that improve quality, efficiency and team collaboration. Gender is important in construction because it directly influences the balance, efficiency and sustainability of the workforce on sites hence achieving better outcomes in terms of speed, quality and overall efficiency.



Figure 4.3 Gender on building sites

The findings in Figure 4.3 show a marked gender imbalance, with 71 male respondents (75.53%) and 23 female respondents (24.47%). Males therefore constitute over three-quarters of the workforce, indicating a substantial dominance in site participation.

The predominance of male workers reflects a pattern common in the construction sector where physically demanding tasks and societal perceptions often limit female participation. This finding is consistent with Agapiou *et al.* (1995) who observed that cultural norms and perceptions of construction as a male-oriented field contribute to gender disparity. Similarly, Dainty *et al.* (2000) reported that female representation in construction remains low globally with work environments and recruitment practices often skewed towards male participation.

Given the male dominance, training programs derived from the study's findings may naturally align more with male workers' needs and work styles. However, to enhance productivity across the entire workforce, training content should also address the unique challenges faced by female workers including workplace integration, safety considerations and equitable task allocation. Designing inclusive training modules can help foster diversity and ensure that both genders benefit equally from productivity-enhancing initiatives.

4.2.4 Educational background of construction workers

This section presents the educational qualifications of construction workers on building sites in Arua City. Understanding these qualifications informs the design of effective training programs to enhance skills and productivity.

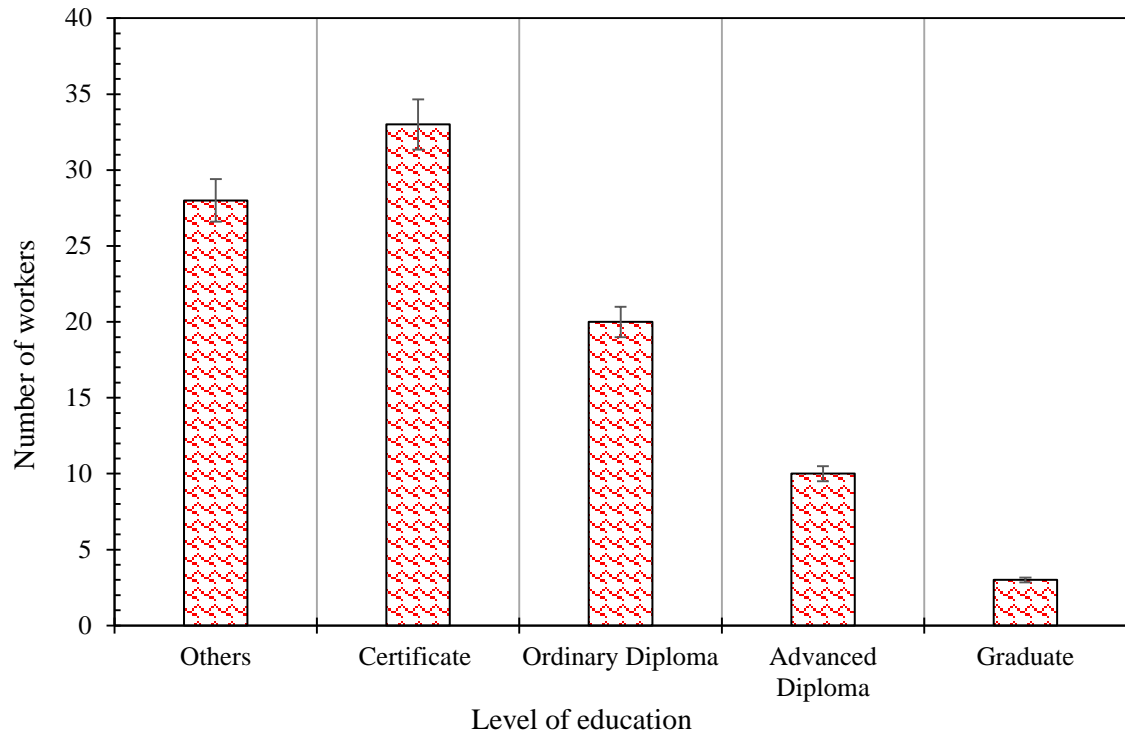


Figure 4.4 Workers' education level

Figure 4.4 shows that 28 workers (29.79%) have no formal education, 33 (35.11%) hold certificate-level qualifications, 20 (21.28%) possess an ordinary diploma, and 10 (10.64%) have an advanced diploma. Only 3 workers (3.19%) hold higher-level qualifications.

The high proportion of workers without formal education indicates a gap in basic skills consistent with Durdyev and Mbachu's (2018) findings which showed that low educational attainment can limit productivity in construction. The diversity of qualification levels suggests a heterogeneous workforce consistent with Gibb (1994) who noted that varying educational backgrounds on construction sites require adaptable and inclusive training approaches. To improve productivity, training programs should target foundational skill gaps for those without formal education while offering advanced trade-specific training for workers on site.

4.2.5 Workers' period of employment on site

This section presents the duration of employment for construction workers on various building sites in Arua City. Understanding work tenure helps in assessing experience levels and designing targeted training strategies to improve productivity and retention.

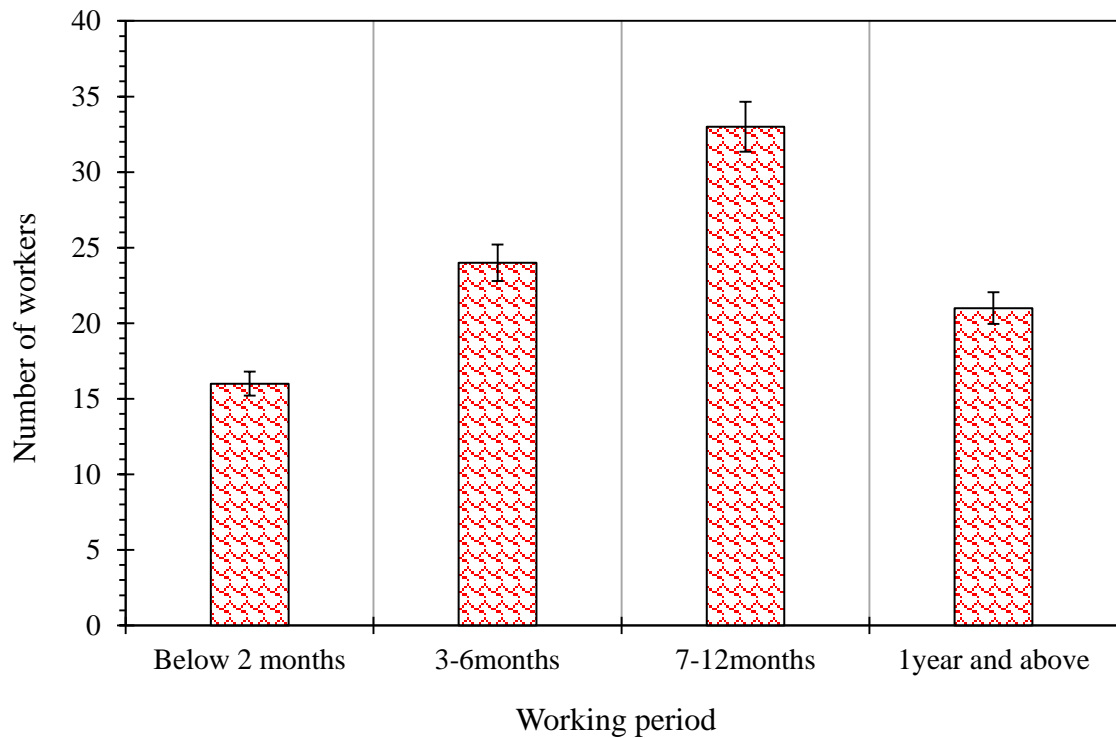


Figure 4.5 Workers' period of working on the given site

The Figure 4.5 shows that 24 workers (25.53%) have been on site for 3–6 months, 33 workers (35.11%) for 7–12 months, 16 workers (17.02%) for less than 2 months and 21 workers (22.34%) for over a year. Most respondents therefore have at least 3 months of site experience.

The predominance of workers with 3–12 months of tenure suggests a workforce familiar with site-specific conditions and challenges making them suitable for evaluating jobsite training effectiveness. This aligns with Durdyev and Mbachu (2018) who noted that worker experience positively influences productivity due to improved task familiarity. The notable proportion of long-term workers (over 1 year) offers valuable insights into the evolution of training practices and their sustained impact. This result is consistent with Jarkas and Bitar (2012) who stated that ongoing training for both newer and long-term employees can enhance performance and maintain engagement hence supporting workforce stability.

4.2.6 Work experience on construction site

This section presents the work experience of construction workers on building sites in Arua City. Understanding experience levels supports the design of training interventions tailored to both new and experienced workers to enhance productivity.

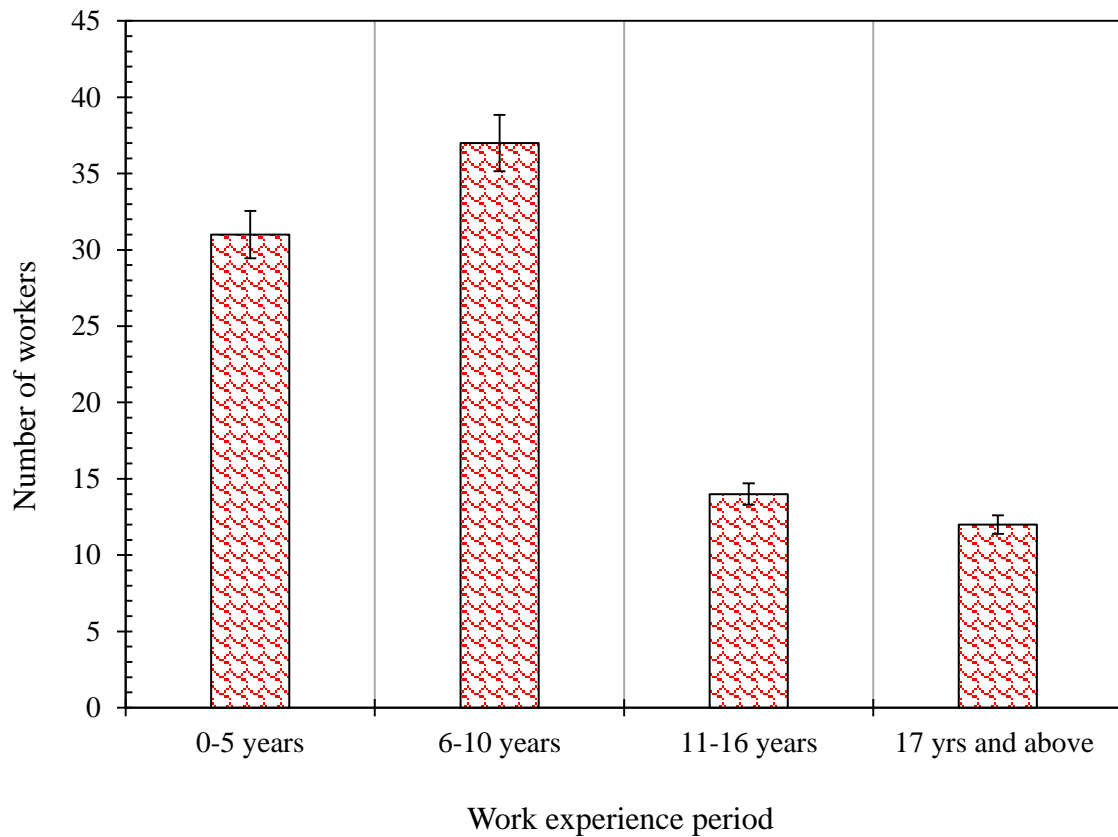


Figure 4.6 Worker experience on building sites

Figure 4.6 shows that 37 workers (39.36%) have 6–10 years of experience, 31 workers (32.98%) have 0–5 years, 14 workers (14.89%) have 11–16 years and 12 workers (12.77%) have more than 17 years of experience.

The majority of workers have less than 10 years of experience, indicating a strong need for jobsite training to improve skills and productivity. This aligns with Jarkas and Bitar (2012), who note that targeted training for less experienced workers can yield significant productivity improvements. The large proportion with 6–10 years of experience suggests that intermediate-level training could have widespread benefits. Similarly, the sizable group with 0–5 years of experience requires foundational skill-building consistent with Durdyev and Mbachu’s (2018) findings that early-career training enhances long-term workforce performance.

4.2.7 Types of training on site in Arua City

This section presents the types of training provided to construction workers on sites in Arua City. Understanding these methods informs strategies to enhance labour productivity, safety and worker well-being.

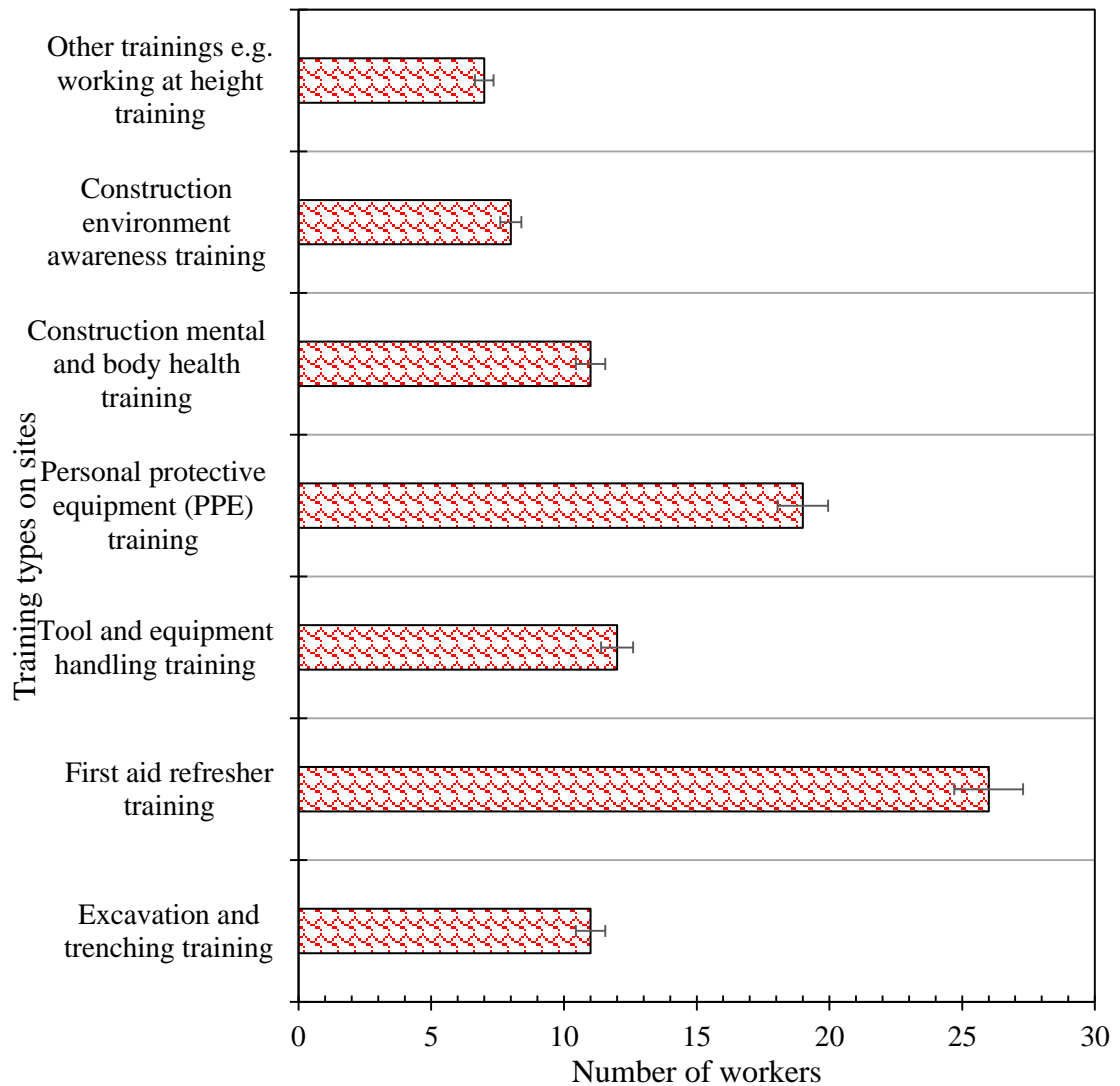


Figure 4.7 Types of trainings on building sites

The Figure 4.7 shows that among 94 respondents, multiple training types were reported. First aid refresher training is the most common, with 26 workers (27.66%) reporting participation, followed by personal protective equipment (PPE) training attended by 19 workers (20.21%). Tool and equipment handling training was received by 12 workers (12.77%) while excavation and trenching training and construction mental and body

health training were each reported by 11 workers forming 11.70%. Construction environment awareness training was less frequent with 8 workers (8.51%) receiving it and other specialized trainings such as working at height were reported by 7 workers (7.45%).

The prevalence of safety-focused training such as First aid and PPE reflect an emphasis on reducing accidents and improving worker well-being which is consistent with Lingard and Rowlinson (2005), who highlighted safety training as critical for construction productivity. Skills-oriented training such as excavation, tool handling and working at height are carried out to ensure workers perform tasks efficiently and safely supporting the findings of Mohammed *et al.* (2017) who found that technical training directly enhances site performance.

The relatively lower frequency of environmental awareness and specialized trainings suggests opportunities to expand these areas so as to create a more holistic training program. A balanced approach integrating safety, technical and specialized training improves the overall productivity and fosters a skilled and healthy workforce on construction sites.

4.2.8 Method of job site training methods

This section presents the methods used to train construction workers on building sites in Arua City. Understanding these methods is essential for evaluating current practices and identifying opportunities to improve skill transfer and labour productivity. The justification for the use of these methods is outlined as follows; Mentorship training is used because it provides direct guidance from experienced supervisors helping less skilled workers build confidence and learn quickly. Apprenticeship training is applied to ensure workers gain both theoretical knowledge and practical skills in specific trades. Site instruction technique training is used to provide immediate, task-specific guidance that improves accuracy and compliance with project requirements.

Jobsite rotation training is adopted to expose workers to different roles within the same trade for multiple tasking purposes. Case-study training is used to strengthen workers' problem-solving and decision-making abilities by applying real or simulated challenges. Finally, informal training is used because it naturally occurs on sites through observation, trial and error, or casual interactions allowing workers to gradually acquire skills without formal structures. Therefore, these training methods are checked for their

effectiveness in addressing skill gaps, improving efficiency and enhancing overall labour productivity on building sites.

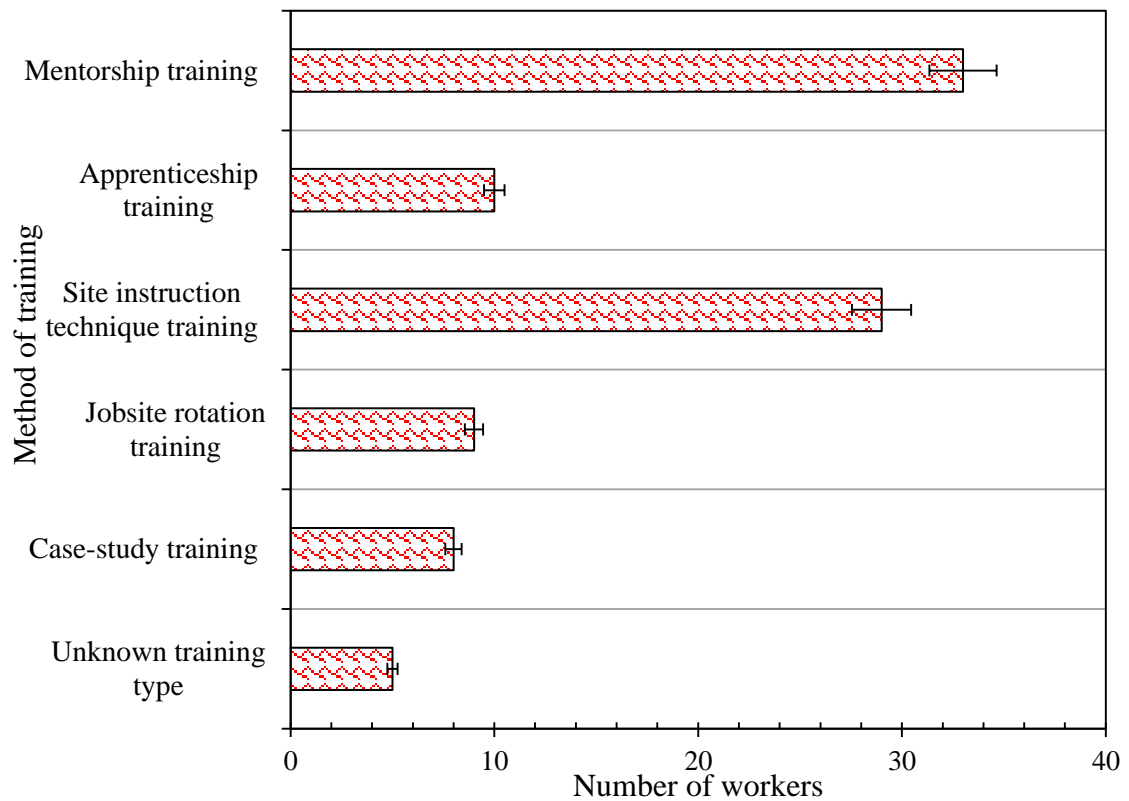


Figure 4.8 Method of job-site training provided on site

Figure 4.8 shows that mentorship is the most frequently used training method with 33 workers (35.11%) reporting participation. Site instructional techniques are also common reported by 29 workers (30.85%). Apprenticeship training is used by 10 workers (10.64%) while job rotation involves 9 workers (9.57%). Case-study training is reported by 8 workers (8.51%) and 5 workers (5.32%) indicated exposure to undescribed or unspecified training methods.

The predominance of mentorship and site instructional techniques highlights the emphasis on hands-on and on-site learning which is consistent with Enshassi *et al.* (2007) who noted that mentoring and direct instruction are effective for skill development in construction settings. However, limited interaction time due to tight project schedules may constrain effective skill transfer as cited by Ogunlana *et al.* (2003) who reported that short fragmented training sessions reduce the efficiency of learning on construction sites. These results suggest a need to explore complementary training methods and approaches to enhance labour productivity and ensure comprehensive skill acquisition.

4.2.9 Recruitment criteria for job site training

This section examines the criteria used by construction sites in Arua City to select workers for job-site training. Understanding these recruitment methods is essential for evaluating how training opportunities are allocated and their alignment with workforce skill development and productivity goals.

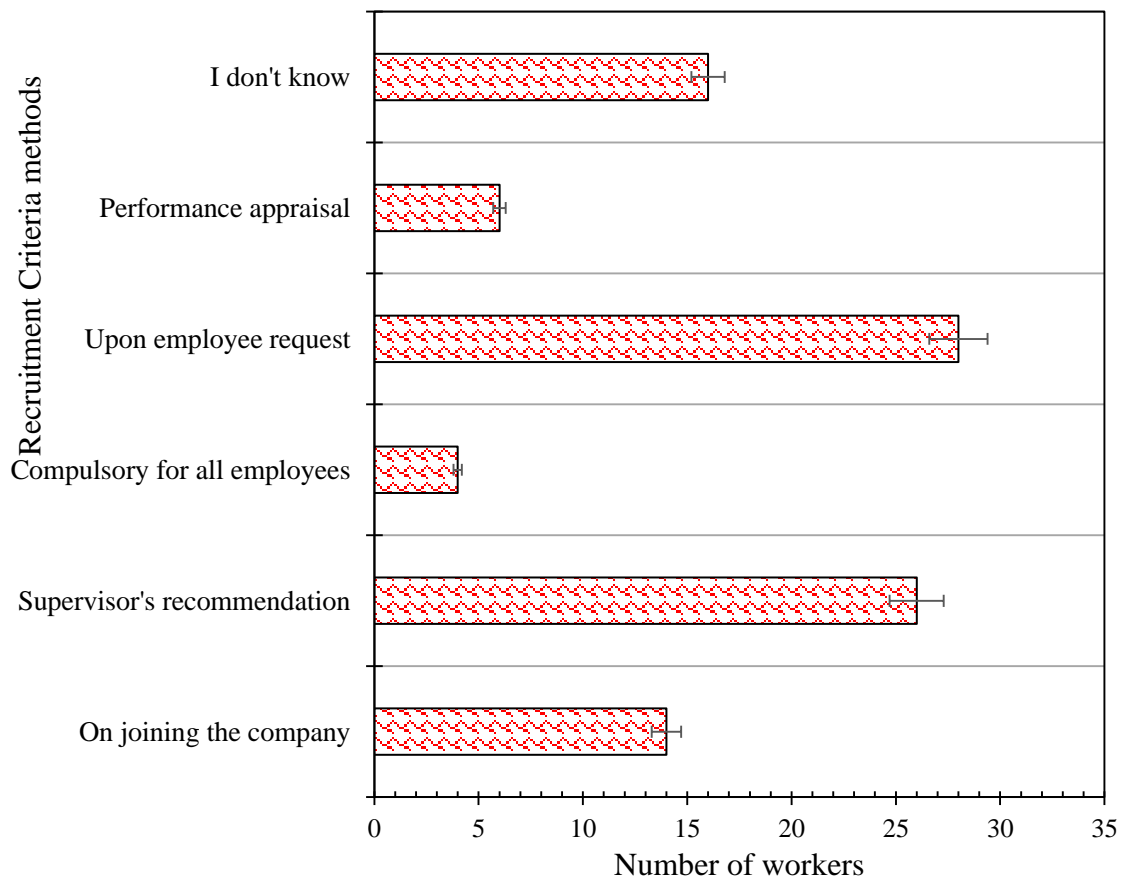


Figure 4.9 Recruitment criteria used for job site training

Figure 4.9 shows that 28 workers (29.79%) are selected based on employee request, 26 (27.66%) through supervisor recommendation, 14 (14.89%) upon joining the company and 6 (6.38%) based on performance appraisal evaluations. Additionally, 4 workers (4.26%) are selected as a compulsory requirement for all employees while 16 (17.02%) reported being unaware of any training recruitment criteria.

The findings indicate a mix of formal and informal selection approaches with emphasis on employee initiative and supervisor recommendation. This supports the observations of Enshassi *et al.* (2007) who noted that supervisor-led selection helps identify workers' skill gaps effectively.

However, the fact that 17% of workers are unaware of recruitment criteria highlights issues of communication and transparency echoing Lingard and Rowlinson (2005) findings who noted that clear systematic selection processes enhance training participation and effectiveness. Implementing structured, performance-based recruitment criteria can ensure that training addresses specific skill needs and improves overall workforce productivity.

4.2.10 Worker satisfaction with job-site training

This section presents the level of satisfaction among construction workers regarding the effectiveness of job-site training on building sites in Arua City. Assessing worker satisfaction provides insight into the strengths and weaknesses of the current training program and its impact on labour productivity.

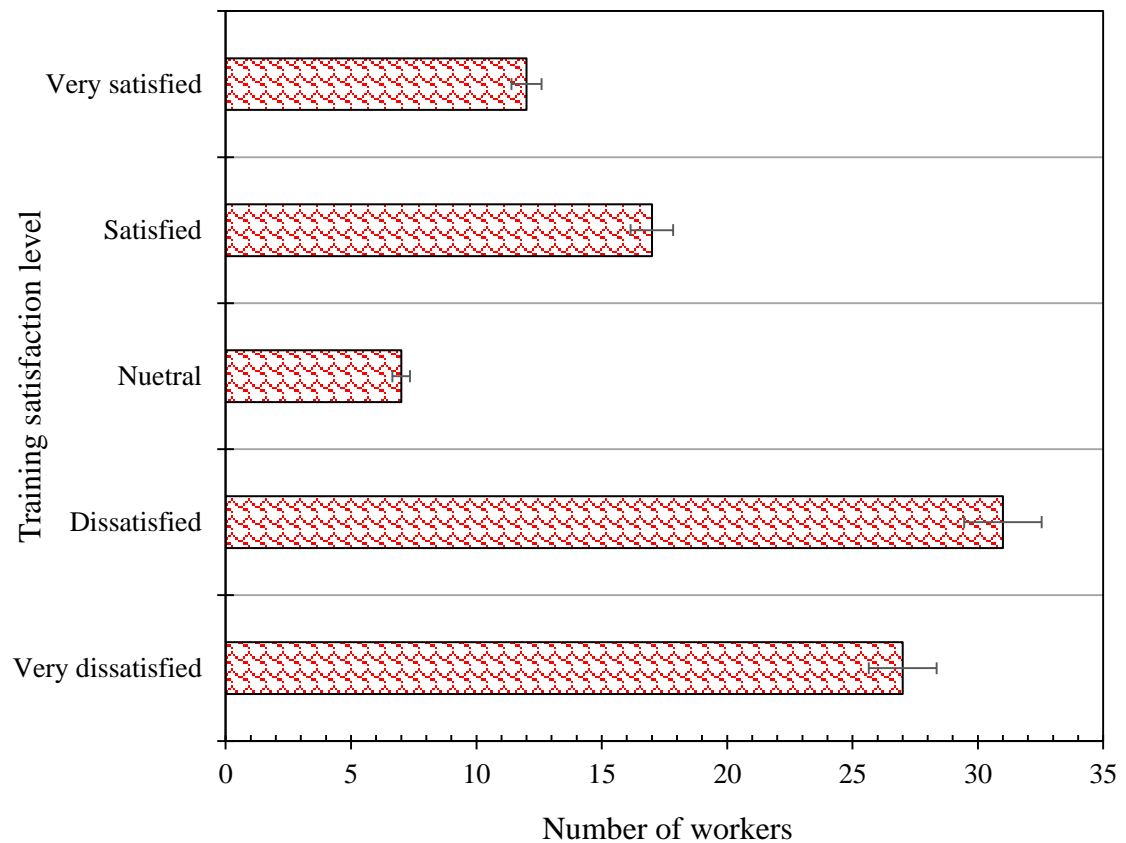


Figure 4.10 Level of satisfaction on effectiveness of the training program

Figure 4.10 shows that 12.77% of respondents are "Very satisfied," 18.09% are "Satisfied," 7.45% are neutral, 32.98% are "Dissatisfied," and 28.72% are "Very dissatisfied." The combined dissatisfaction rate of 61.7% indicates significant concern regarding the perceived effectiveness of the training program.

The results indicate that the majority of workers are dissatisfied with current training methods, suggesting that the programs do not adequately equip workers with the necessary skills for optimal productivity. This aligns with Saadah (2018) who found that ineffective training reduces employee engagement and motivation of workers in the construction sector. Similarly, Al Balkhi (2019) emphasizes that training and motivation are positively correlated with improved performance in construction companies.

Additionally, Lingard *et al.* (2013) emphasized that worker dissatisfaction often arises when training does not address practical skill gaps or workplace needs. The high dissatisfaction rate in this study highlights the need to review and enhance training content, delivery methods and engagement strategies to improve both satisfaction and workforce productivity on building sites.

4.2.11 Workers preferred job-site training methods

This section examines the most effective job-site training methods as identified by construction workers on building sites in Arua City. Understanding worker preferences provides insight into practical approaches for enhancing labour productivity and skills transfer in the construction sector.

During the data collection process, workers provide valuable suggestions on how job-site training can be made more effective and responsive to their needs. Their preferences highlight the need for training programs that are practical, inclusive and tailored to the diverse backgrounds of construction workers. Aligning training methods with these needs not only ensures greater engagement but also enhances effectiveness and long-term impact on labour productivity. Overall, workers emphasize job-site training methods that are practical, accessible and skill-oriented directly improving their performance on site. In particular, they prefer hands-on practical trainings from experienced workers and refresher sessions on core technical tasks. They also identify safety-focused training such as first aid and emergency drills as critical for workplace wellbeing. Furthermore, workers stress the importance of improving efficiency and collaboration on site.

Figure 4.11 shows that 42.55% of respondents prefer apprenticeship training, 28.72% favor role-playing, 14.89% recommend case study training, 7.45% endorse mentorship training and 6.38% suggest technology-based training.

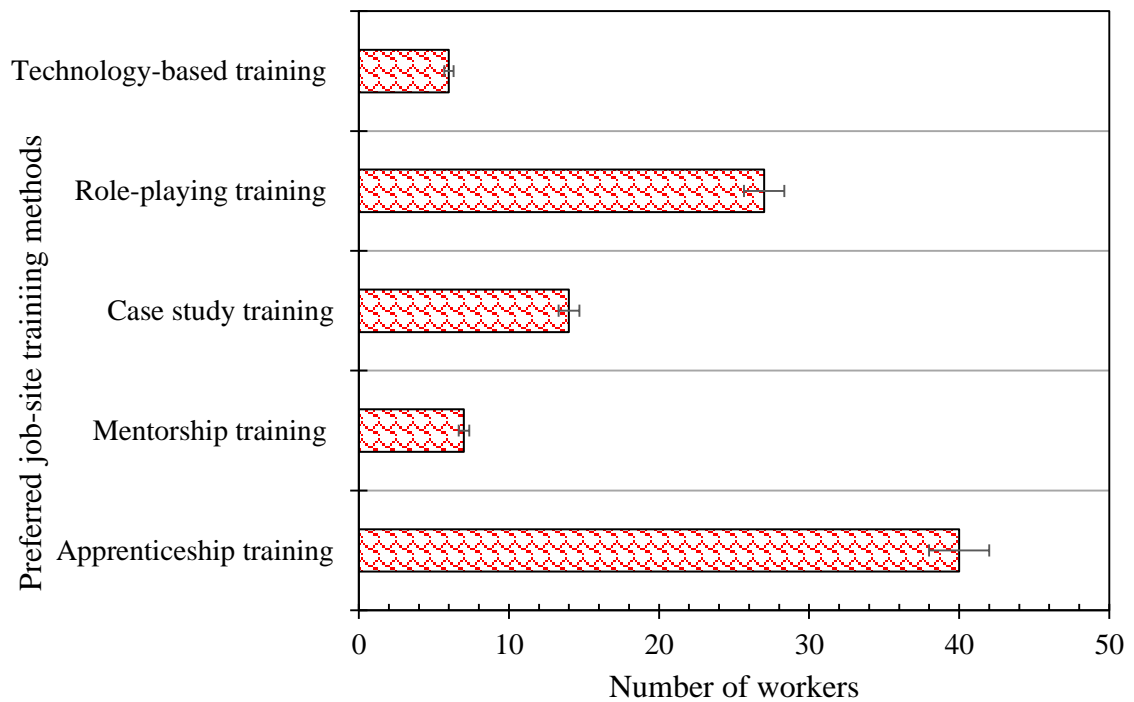


Figure 4.11 Worker preference on training methods on building sites

The findings indicate a strong preference for apprenticeship training reflecting its effectiveness in providing hands-on skills directly applicable to construction tasks. Role-playing training also ranks highly because it is valued for simulating real-world scenarios and fostering problem-solving and decision-making skills. Mentorship training received the least endorsement (7.45%), likely due to limited interaction time between supervisors and trainees given that sites are busy which constrains knowledge transfer sessions.

These results align with Daniel *et al.* (2020) who emphasizes that apprenticeship programs equip trainees with broad-based skills, addressing skill gaps in construction sectors. Similarly, Bhattacharjee and Ghosh (2013) highlighted that role-playing strategies enhance practical skill acquisition and knowledge retention in complex environments like construction. Overall, workers consider apprenticeship and role-playing as the most effective methods for skill development and productivity improvement on building sites.

4.2.12 Measurement methods of labour productivity on site

The study examines the methods used to measure labour productivity per workday on building sites in Arua City. Understanding how workers assess productivity provides valuable insights for the design and implementation of effective training programs.

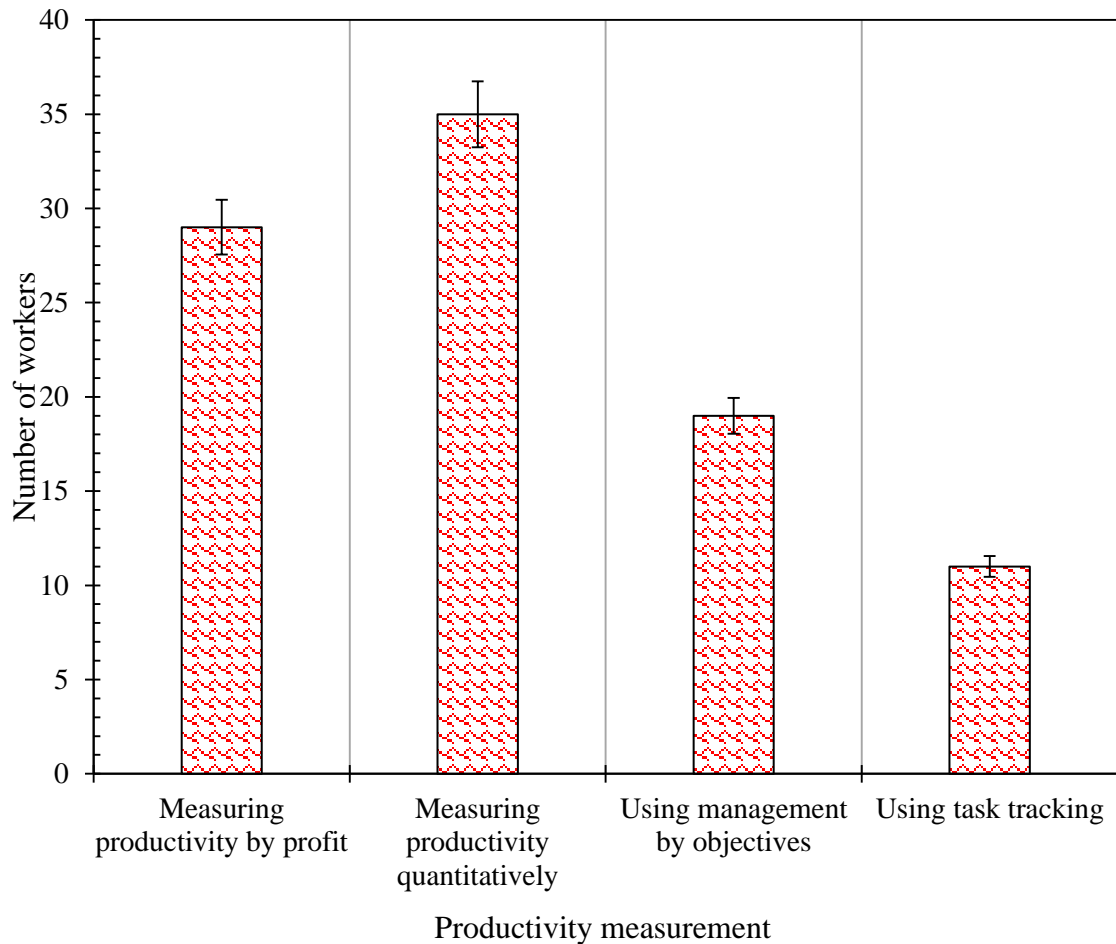


Figure 4.12 Measurement methods of worker productivity on sites

Figure 4. shows that workers employ several methods to measure productivity on building sites in Arua City. The majority of workers (37.23%) use quantitative measurement focusing primarily on tangible and numerical outcomes. A significant portion of workers (30.85%) assess productivity based on financial outcomes reflecting the importance of profit considerations in evaluating performance.

Additionally, 20.21% of workers adopt Management by Objectives (MBO) indicating the use of structured goal-setting approaches to track productivity. A smaller proportion of workers (11.70%) rely on task tracking monitoring and recording the daily progress and completion of individual tasks on site. These findings provide insight into how workers perceive and measure productivity which has implications for designing targeted and effective job-site training programs.

The study demonstrates that understanding the preferred productivity measurement methods is essential for designing effective training programs. Quantitative and

profit-based approaches dominate indicating that workers value tangible, outcome-focused methods. This supports Hallowell and Gambatese (2010) and Alinaitwe *et al.* (2007) who emphasize that productivity improves when workers engage with measurable outputs and understand the financial impact of their work.

The results suggest that training programs should be tailored to the specific productivity measurement methods used by supervisors and workers on site. Customizing training to these preferences ensures relevance, engagement and improved labour productivity on sites. Integrating RII and AII metrics allows project managers to rank and prioritize training factors systematically ensuring interventions target areas with the highest.

4.2.13 Categorization of open-ended survey responses from construction sites

This section presents the findings of the survey questionnaire conducted to assess the relevance of job-site training to the tasks they perform on site. The survey included both structured and open-ended questions targeting workers across various construction sites. Responses to the open-ended questions were diverse reflecting workers' practical experiences, technical knowledge gaps and the challenges they face on-site. The category "Other responses (varied, less frequent)" was further organized into five main themes to better capture the workforce's priority responses. The results are presented quantitatively using frequency and percentage distributions followed by a discussion that situates these findings within the existing literature on construction management and productivity.

Appendix F shows that construction workers identify five main categories of training needs: safety and health, technical skills, modern and eco practices, project and site management and mentorship and soft skills. These categories capture the key areas where workers believe job-site training has the greatest potential to improve their performance. The results presented in Figure 4. reflect responses from workers based on a survey questionnaire administered across fourteen building sites in Arua City. These responses provide suggestions on how to enhance the relevance of job-site training in relation to the specific trade tasks on the respective building sites.

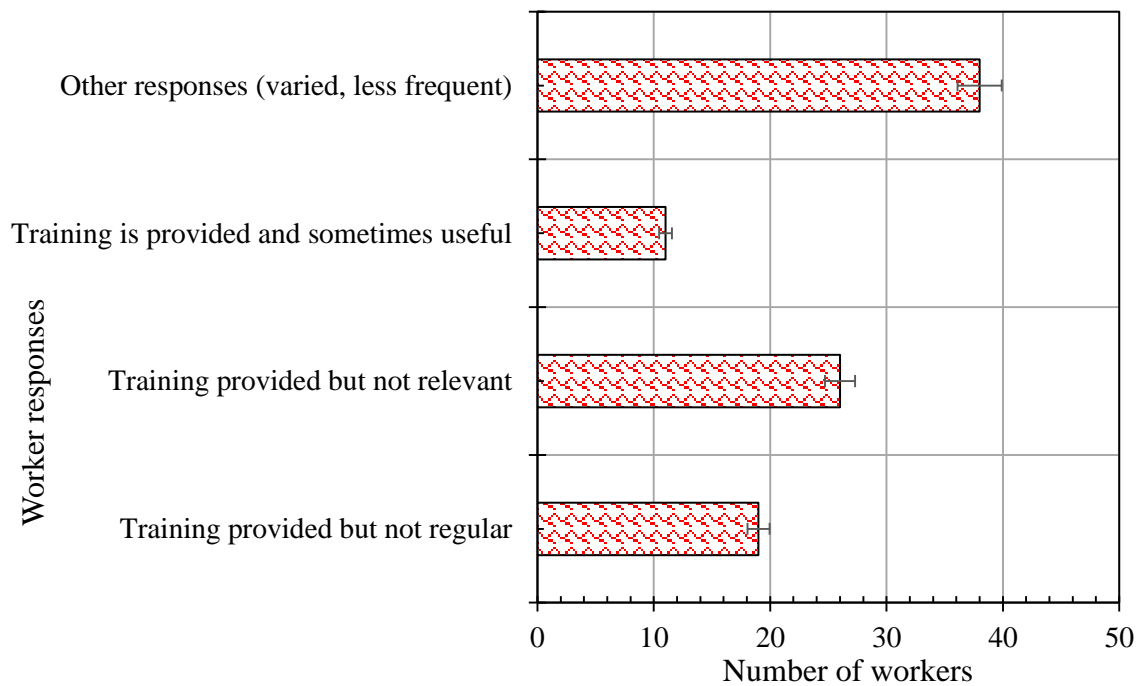


Figure 4.13 Categorized responses from workers on sites

Figure 4. shows variability in jobsite training impact among workers on site. 19 respondents (20.21%) report that training is provided but irregularly on sites while 26 (27.66%) reported that training is not always relevant to their work or task. 11 workers (11.70%) find that the training sometimes is useful during performance of their respective tasks. The largest group, 38 respondents (40.43%) provided varied suggestions including safety training, technical skills, mentorship and soft skills suggestions. These results indicate that while training exists improvements in frequency, relevance and comprehensiveness are needed to enhance labour productivity.

The results indicate that while a significant portion of training is irregular or not fully relevant, there is evidence of a wide range of learning opportunities that impact productivity indirectly. 20.21% of workers reported that training is provided but not regularly suggesting gaps in structured skill development programs. This finding aligns with the study by Hallowell and Gambatese (2010) which emphasizes that irregular training reduces the effectiveness of skill acquisition on construction sites.

Furthermore, 27.66% of workers stated that training provided is not relevant to their daily tasks. This supports the findings of Mohammed *et al.* (2017) who observed that misaligned training content leads to low worker engagement and limited productivity gains.

About 11.70% of the workers report that training provided is only occasionally useful in carrying out their respective tasks. This suggests that although training is available, its content and delivery did not align with the day-to-day practical requirements of workers echoing findings by Agumba and Haupt (2018) who noted that training effectiveness depends on its relevance to specific job functions for workers.

The “other responses” category (30.8%) highlights the diversity of training needs and practices on building sites. The thematic analysis reveals that safety and compliance remain a core component of on-site training consistent with Lingard and Rowlinson (2005) who highlights that safety training is critical to reducing accidents and ensuring continuity of work.

Technical skill development also emerges prominently indicating that workers value hands-on, practical instruction on modern construction methods, machinery operation and quality control. These observations are consistent with Agapiou *et al.* (1995) and Durdyev and Mbachu (2018) who argue that technical training directly enhances worker productivity by reducing errors and improving work quality. Soft skills and teamwork are also emphasized reflecting the importance of communication, coordination and time management in improving labour efficiency. As noted by Lingard *et al.* (2013), training in these areas improves site coordination, reduces downtime and fosters collaborative work culture.

Mentorship and on-the-job learning are cited as crucial by workers particularly for juniors and the less experienced workers. This aligns with Daniel *et al.* (2020) who found that structured mentorship programs and role-playing exercises enhance skill acquisition and knowledge retention. Finally, exposure to technology and innovation was mentioned by workers including training on software tools suggesting adjustments in construction techniques so that workers adapt to technological advancements. This is supported by Mohammed *et al.* (2017) who highlights that adoption of innovative techniques improves productivity and overall project performance in the construction sector.

Overall, the results suggest that job-site training positively influences labour productivity, but its impact is maximized when training is regular, relevant and aligned skill requirements.

4.3 Factors affecting job-site training on building sites

The first objective of this study is to examine the factors influencing construction worker job-site training on building sites in Arua City. Data was collected through questionnaires and interviews administered to construction workers. The responses were analyzed using the Chi-square test, Relative Importance Index (RII) and Average Item Index (AII) to identify key trends and relationships. This section presents the results in a structured manner and discusses them in relation to findings from previous studies.

4.3.1 Chi-Square tests for the factors affecting job-site training

This section examines the relationship between job-site training and various influencing factors in building sites within Arua City. The Chi-square test is applied to determine the statistical association between training outcomes and selected factors. The analysis focuses on these factors which are chosen to capture the core dynamics shaping job-site training effectiveness and by extension labour productivity on construction sites.

By applying this test, the study evaluates whether these factors significantly affect access to and effectiveness of training on building sites. The results provide evidence on which factors play a critical role in shaping training outcomes thereby informing strategies for enhancing labour productivity. This statistical approach ensures that conclusions are not based on assumptions but on objective evidence derived from the data.

Table 4.1 Chi-Square Tests for the factors affecting job-site training on building sites

Statistics	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.455 ^a	2	0.001
Likelihood ratio	10.180	2	0.006
Linear-by-Linear association	0.279	1	0.597
N of valid cases	94		

*a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.49 (Significant factors; ***training method, training language, training attitude and trainee motivation***)*

The Chi-square analysis Table 4.1 reveals a Pearson Chi-Square value of 9.455 (df = 2, p = 0.001), a Likelihood Ratio of 10.180 (df = 2, p = 0.006) and a Linear-by-Linear association value of 0.279 (df = 1, p = 0.597). The minimum expected count is 5.49 and significance levels indicate that training recruitment criteria, training language, training aids

and materials, training method, trainee motivation, training attitude, training content, trainers' frequency and site complexity have a statistically significant relationship with job-site training effectiveness ($p < 0.05$). These factors emerge as the most influential in shaping training success on building sites in Arua City.

4.3.2 Relative Importance Index (RII) and Average Item Index (AII) analysis

Job-site training on building sites plays a pivotal role in bridging the gap between theoretical knowledge and practical skills, ensuring adaptability and productivity among workers. Evaluating the factors influencing the effectiveness of such training is crucial for optimizing training programs and achieving better outcomes. This study employs the Relative Importance Index (RII) and Average Item Index (AII) to quantify and prioritize factors affecting job-site training on building sites. These tools offer a systematic approach to ranking variables based on their perceived significance among construction workers.

4.3.3 Relative Importance Index (RII) for factors affecting job-site training

According to Hossen *et al.* (2015), the Relative Importance Index (RII) is a statistical technique used to rank factors in a study. In this research, the RII measures and ranks factors influencing job-site training. The questionnaire uses a Likert scale to collect responses on these factors enabling a structured evaluation and ranking. The RII provides a statistical framework for determining the relative significance of each factor affecting job-site training.

The RII scores are essential in interpreting the findings. A higher score indicates greater significance while a lower score shows lesser impact. Analysing the RII scores identifies the most and least influential factors on job-site training. The table presents a Likert scale used to capture respondents' opinions on factors influencing job-site training. Each response category is assigned a weight from 1 to 5, where 1 represents "Strongly Disagree" (Very Uninfluential) and 5 represents "Strongly Agree" (Very Influential). This weighting allows quantitative analysis of subjective perceptions enabling the identification and ranking of the most and least influential factors.

Table 4.2 Likert scale adopted for training factor analysis

Respondent opinion	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Weight	1	2	3	4	5
Result Interpretation	Very Uninfluential	Uninfluential	Un-known	Influential	Very Influential

Table 4.2 outlines the weight system used in the RII computation: “Strongly Disagree” (1), “Disagree” (2), “Neither” (3), “Agree” (4), and “Strongly Agree” (5). These weights are applied to determine the RII values. The results are summarised to rank the factors in order of influence based on respondents’ assessments adding a quantitative dimension to the evaluation of factors affecting job-site training on building sites. The frequency values are derived from the corresponding frequency tables outputted by SPSS software. The equation below for RII is used.

$$RII = \frac{\sum W}{(A \times N)} \quad \text{Eq. (4.1)}$$

Where **RII** is the Relative Importance Index (dimensionless), $\sum W$ is the sum of the weights given to a factor by respondents, **A** is the maximum possible weight in the scale in a Likert 1–5 scale and **N** is the total number of respondents.

4.3.4 Average Item Index (AII) for factors affecting job-site training

The Average Item Index (AII) serves as a quantitative metric to assess and rank the significance of job-site training factors on building sites. In this study, the AII facilitates comparison of multiple factors to identify priority areas for intervention enabling targeted allocation of resources to address the most impactful challenges.

It is calculated by assigning numerical weights to response categories ranging from “strongly disagree” (1) to “strongly agree” (5) as presented in Table 4.2. The weighted responses for each factor are summed and divided by the total number of respondents producing an average score that reflects the degree of impact or importance of the factor. A higher AII indicates a more influential factor while a lower AII suggests lesser importance. The calculation follows the formula below which is applied to determine the index for each factor affecting job-site training.

$$AII = \frac{\Sigma W}{N} \quad \text{Eq. (4.2)}$$

Where *AII* is the Average Importance Index (dimensionless), ΣW is Weighted total (i.e., sum of scores or ratings given by respondents), *A* is the maximum possible weight in the scale in a Likert 1–5 scale and *N* is the total number of respondents (workers).

4.3.5 RII and AII Results and discussion of factors influencing job-site training

This section presents and discusses the factors influencing job-site training on building sites in Arua City based on the Relative Importance Index (RII) and Average Item Index (AII) analyses. The use of the Relative Importance Index (RII) and Average Item Index (AII) is important in assessing the factors that influence job-site training because they provide both ranking and quantitative measures of significance. RII highlights which factors workers consider most critical while AII offers insights into the extent of their impact on training effectiveness.

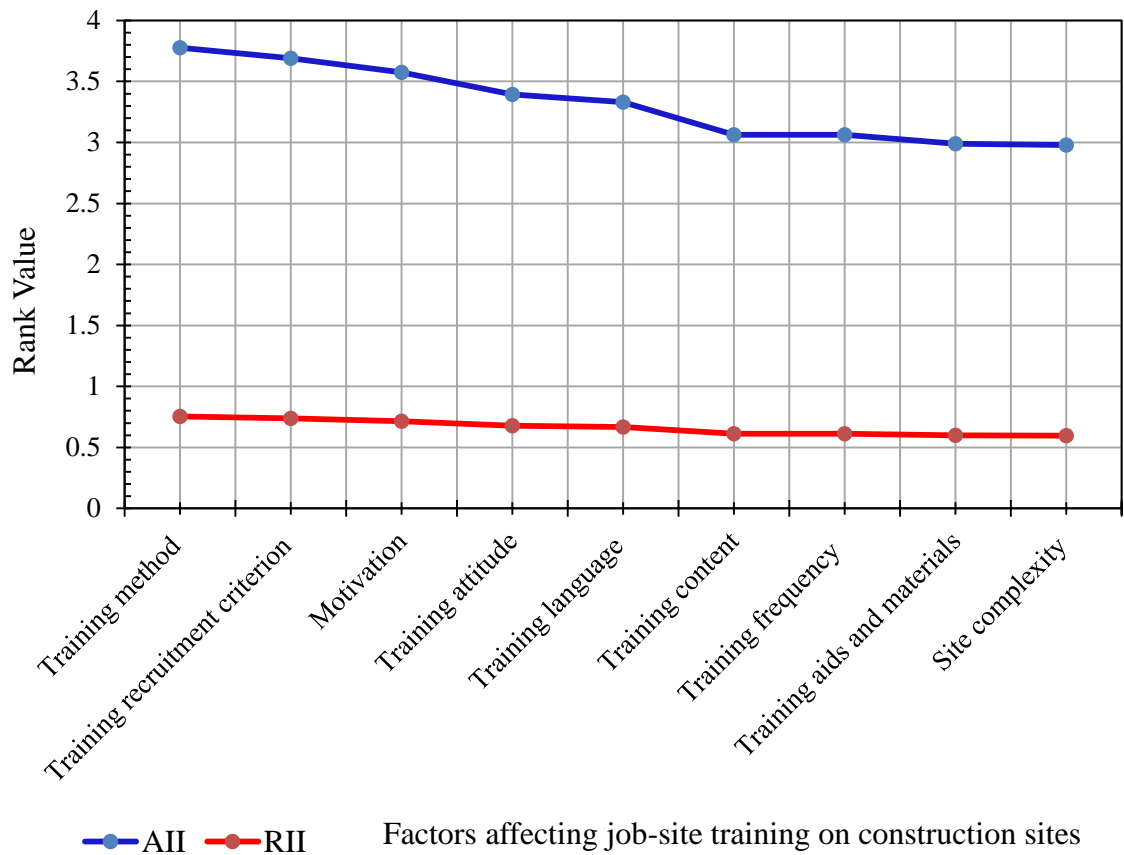


Figure 4.14 RII and AII values the factors affecting job-site training on sites

(a) Training method

Figure 4.14 shows Training method ranks first with an RII of 0.755 and an AII of 3.776 indicating the highest influence on job-site training effectiveness. This finding highlights that workers perceive the approach used to deliver training as the most critical factor in acquiring skills and knowledge relevant to their tasks.

Effective training methods strongly determine the success of job-site training and are most impactful when aligned with clearly defined recruitment criteria. The choice of method also influences worker motivation and engagement as hands-on and interactive approaches foster active participation and skill retention (Saadah, 2018). Furthermore, selecting appropriate training methods ensures efficient use of resources and addresses the specific learning needs of the workforce minimizing skill gaps and improving overall productivity on building sites (Yimam, 2022).

(b) Recruitment criteria

Figure 4.14 shows that recruitment criteria rank second with an RII of 0.738 and an AII of 3.691. This highlights that the process used to select workers for training is critical in determining how well training programs achieve their objectives on building sites.

Lack of awareness of selection processes may limit access to training and reduce program relevance. Time constraints and resource limitations often lead to informal mentorship methods which can reduce interaction and learning quality. These findings align with Yimam (2022) who stresses the need for clear objectives relevant content and appropriate trainer selection for effective training outcomes. Structured recruitment criteria also allow supervisors to identify skill gaps and assign training that addresses specific needs, optimizing workforce capability and labor productivity (Kinicki and Kreitner, 2007). Therefore, clear and structured recruitment criteria is essential for ensuring that job-site training translates into practical skills and improved labour productivity on building sites.

(c) Trainee motivation

Figure 4.14 shows that Trainee motivation ranks third with an RII of 0.715 and an AII of 3.574. The main issues include lack of incentives, absence of recognition during training and limited understanding due to language barriers hence leading to no or low motivation during training implementation.

Motivated workers engage more actively in training and retain skills better. A lack of rewards or procedural awareness may discourage participation affecting labour productivity. These findings support Kinicki and Kreitner (2007) and Landy (1985) who linked motivation and job satisfaction to higher performance and retention. Addressing incentives and communication barriers becomes critical to sustaining motivation on sites.

(d) Training attitude

Training attitude ranks fourth with an RII of 0.679 and an AII of 3.393. Dissatisfaction levels are high with 32.98% “dissatisfied” and 28.72% “very dissatisfied” as seen in Figure 4.14. Contributing factors include poor communication of training benefits and delivery including the unclear recruitment methods on building sites.

Negative attitudes reduce learning engagement. Some workers perceive training as a break from work rather than a skill-building opportunity. This is consistent with Emeti (2015) who reports similar attitudes in Nigeria and Nassazi (2013) who finds that training effectiveness depends on improving knowledge, skills and attitudes simultaneously.

(e) Training language

Training language ranks fifth with an RII of 0.666 and an AII of 3.330. The challenge stems from migrant workers from the Democratic Republic of the Congo and South Sudan as well as local workers, many of whom have no formal education as shown in Figure 4.14. This situation creates communication barriers during the implementation of training on building sites. Language barriers limit understanding and engagement in training sessions. Donaghy (2009) notes that migrant workers with limited language proficiency often do not fully benefit from training. Similarly, Wang *et al.* (2019) links education and skill levels to training participation willingness. A clear training language enhances engagement and allows workers to ask questions and clarify doubts which strengthens learning outcomes therefore should be considered critically during training implementation.

Overall, the combined RII and AII results identify training method, recruitment criteria and motivation as the most critical areas for intervention. Addressing these alongside attitude and language barriers allows targeted resource allocation to improve worker productivity.

4.4 Factors affecting construction labour productivity on sites

The second specific objective of this study examines the factors influencing construction labour productivity on building sites in Arua City. Data are collected through questionnaires and interviews with construction workers. The responses are analyzed to generate meaningful insights. The findings are presented using the Chi-square test, Relative Importance Index (RII), Average Item Index (AII) and detailed discussion. By combining quantitative and qualitative data the study highlights the key factors affecting labour productivity and provides valuable insights for improving job-site performance.

4.4.1 Chi-Square tests on factors affecting construction labour productivity on building site

The investigation employs a Chi-square test to determine the correlation between labour productivity and factors affecting construction worker performance on building sites. The study examines critical factors namely motivation factors, work condition factors, manpower factors, management factors, tools and equipment, project factors and external factors. These factors are selected to provide a comprehensive understanding of the dynamics influencing labour productivity on site.

The Chi-square test functions as a statistical tool to assess the interaction between these factors and worker productivity highlighting their potential impact and offering insights for enhancing labour productivity through job-site training.

Table 4.3 Chi-Square tests for factors affecting construction labour productivity on site

Statistics	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.455 ^a	2	0.002
Likelihood Ratio	11.200	2	0.023
Linear-by-Linear Association	0.386	1	0.461
N of Valid Cases	94		

*a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.65 (Significant factors; *** manpower factors, management factors and motivation factors ***)*

Table 4.3 presents the Chi-square test results including Pearson Chi-Square (7.455, 2 degrees of freedom, $p = 0.002$), Likelihood Ratio (11.200, 2 degrees of freedom, $p = 0.023$)

and Linear-by-Linear association (0.386, 1 degree of freedom, $p = 0.461$). The results indicate a statistically significant association between these factors and worker productivity as shown by the p -values less than 0.05. Tailored interventions focusing on these critical factors will improve the labour productivity and overall project performance of building sites.

4.4.2 Relative Importance Index (RII) and Average Item Index (AII) analysis for factors affecting construction worker productivity

The productivity of construction workers on site determines project success by influencing timelines, costs, and overall quality. Labour productivity depends on multiple factors making it essential to identify and prioritize these factors to enhance worker performance. This study uses the Relative Importance Index (RII) and Average Item Index (AII) to evaluate and rank the factors affecting construction labour productivity on building sites. These methods identify key productivity drivers by assessing their relative significance based on workers' input providing a basis for targeted interventions that improve efficiency and project outcomes including training effectiveness.

4.4.3 Relative Importance Index (RII) for factors affecting construction worker productivity

Hossen *et al.* (2015) describes the Relative Importance Index (RII) as a statistical method used to rank factors in a study. In this study, the RII evaluates and ranks factors that are affecting construction worker productivity on building sites. The questionnaire collects responses using a Likert scale allowing a structured assessment and ranking of these factors. The RII provides a systematic framework for determining the relative importance of each factor. A higher score indicates greater importance while a lower score reflects lesser influence. Analysing the RII scores highlights the most and least significant factors affecting job-site training.

Table 4.4 captured respondent's opinion scale where individuals were asked to express their views on a given statement by choosing from three options namely; Disagree (assigned a weight of 1), Neutral (assigned a weight of 2) and Agree (assigned a weight of 3). The weights reflect the degree of influence or agreement associated with each option.

Table 4.4 Likert scale adopted for labour productivity factor analysis

	Disagree	Neutral	Agree
Weight	1	2	3
Result Interpretation	Uninfluential	Unknown	Influential

This scale provides a structured way to gauge respondent opinions and allows a clear interpretation of the perceived impact or influence of each factor enabling a quick and meaningful analysis of collective viewpoints. The frequency values are extracted from the relevant frequency tables generated by SPSS version 23. Eq. (4.1) is used for the computations.

4.4.4 Average Item Index (AII) for the factors affecting construction worker productivity

The Average Item Index (AII) measures and ranks the significance of factors affecting construction labour productivity on building sites. It assigns numerical weights to responses: “Disagree” (1), “Neutral” (2), and “Agree” (3) as shown in Table 4.4. The weighted responses for each factor are summed and divided by the total number of respondents to produce an average score representing the factor’s importance. Factors with higher AII scores are more significant while lower scores indicate less importance. This approach allows comparison of multiple factors and helps prioritize interventions and allocate resources effectively. Eq. (4.2) is used for the computations.

4.4.5 RII and AII Results and discussion of factors influencing labour productivity on building sites

This section presents the Relative Importance Index (RII) and Average Item Index (AII) results for the factors influencing labour productivity on building sites in Arua City. The results rank these factors in order of importance followed by a discussion comparing them with findings from previous studies. RII and AII results and discussion are important as combined because they provide a comprehensive view of the influence of job-site training factors on workers on building sites. Combining these indices ensures that both the perceived importance and quantitative impact of training factors are considered leading to the accuracy and relevance of the findings of this study. This provides both practical insights for both academic research and industry application.

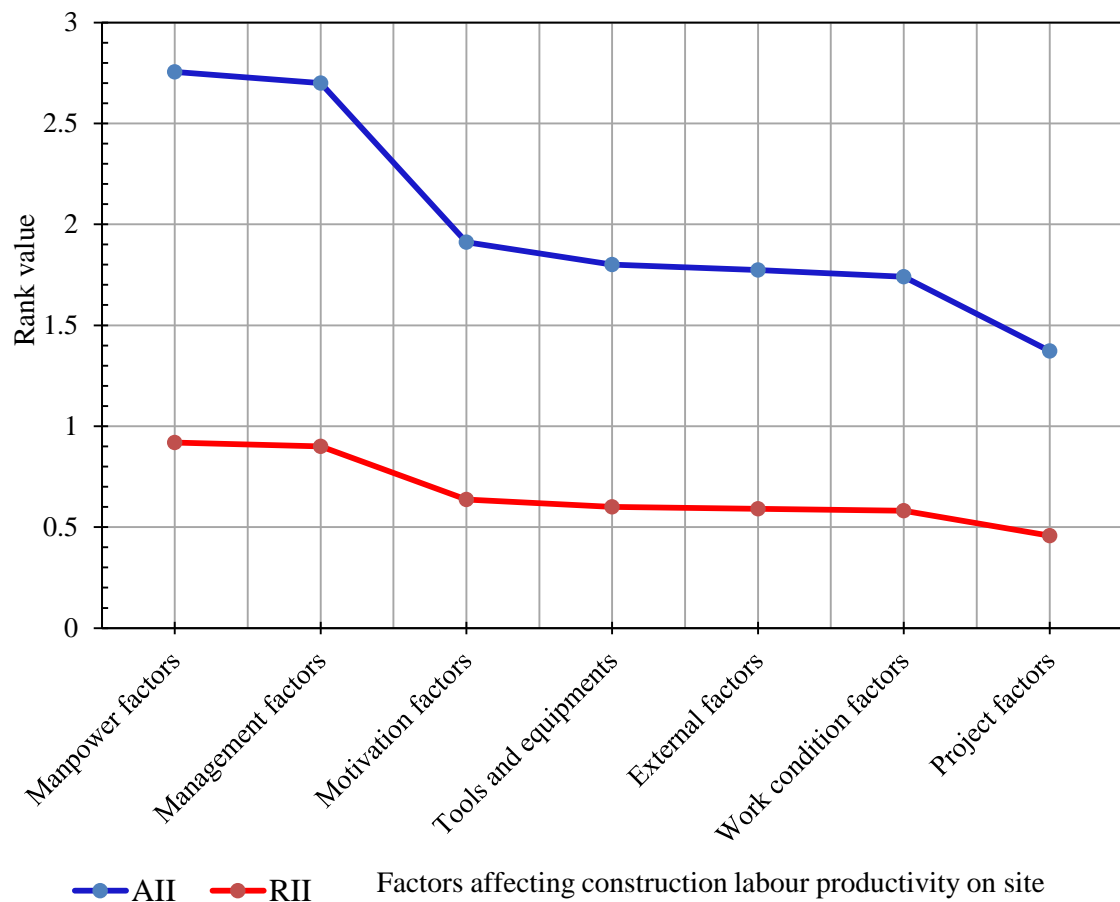


Figure 4.15 RII and AII values for factors affecting construction labour productivity

The observation is that parallel trends in RII and AII highlight manpower, management and motivation factors as the top priorities for interventions aimed at enhancing productivity. Secondary factors including tools and equipment, external conditions and site-specific aspects are also relevant areas for improvement as shown in Figure 4.15.

(a) Manpower factors

The results indicate that manpower factors hold the strongest influence on productivity. The top RII (0.919) and AII (2.755) confirm their critical role as shown in Figure 4.15. Workforce composition, skill levels, availability and efficiency directly shape project outcomes. This aligns with Ahn and Lee (2013) who noted that labour absence reduces productivity and Gundecha (2013) who identified lack of labour experience as a major cause of inefficiency on construction sites. These findings imply that training programs should prioritise skill enhancement, workforce planning and strategies to improve worker deployment.

(b) Management factors

Figure 4.15 shows that Management factors hold the second position (RII: 0.900, AII: 2.699) indicating their pivotal role in labour productivity optimisation. Effective supervision, communication, planning and resource allocation contribute to improved site performance. This is consistent with Alinaitwe *et al.* (2007) and Hiyassat *et al.* (2016) reports which mentioned that inadequate supervision and monitoring reduce labour productivity on construction sites.

Sanders and Thomas (1991) further highlights that management must equip workers with the necessary skills and tools aligned with project requirements. These findings suggest that supervisors and managers should be empowered to strengthen leadership and operational efficiency during implementation of job-site training on sites.

(c) Motivation factors

Figure 4.15 shows that Motivation ranks third (RII: 0.637, AII: 1.911) reflecting its significant though moderate influence. Delayed payments, lack of recognition, job insecurity and absence of development opportunities hinder labour productivity. Similar conclusions were drawn by Nurhendi *et al.* (2022) and DeCenzo and Holoviak (1990) who identifies motivation as a key driver of construction labour performance.

Balogun (2011) notes that linking training to motivation enhances job satisfaction and execution ability. The findings imply that training should incorporate both technical skills and motivation strategies to maintain workforce engagement. These factors not only boost morale but also enhance workers' focus, efficiency and overall performance. Strengthening motivation through well-structured training programs and supportive site policies ensures sustained productivity improvements and long-term project success.

4.5 Impact of job site training on labour productivity on sites

The third specific objective investigates the impact of independent variables on the dependent variable. Job-site training serves as the independent variable while worker productivity is the dependent variable. Pearson correlation analysis and regression analysis determine the relationship between these variables. The findings provide a clear understanding of how job-site training influences worker productivity within the building site environment.

4.5.1 Pearson correlation analysis of the dependent and independent variables

This section presents the results of the correlation analysis between job-site training and worker productivity. The objective is to determine the strength, direction and significance of the relationship between these two variables using Pearson correlation analysis. Pearson correlation analysis assesses associations between variables measured on a continuous scale. A coefficient close to +1 shows a strong positive linear relationship while a coefficient close to -1 shows a strong negative linear relationship. A coefficient near 0 shows little or no linear relationship.

Table 4.5 Correlation between job site training and workers' productivity

Control variables		Job-site Training	Worker productivity
Job-site training	Correlation	1.000	0.395
	Significance (2-tailed)	.	0.003
	Df	0	94
Worker productivity	Correlation	0.395	1.000
	Significance (2-tailed)	0.003	.
	Df	94	0

*. *At the 0.05 level, correlation is significant (2-tailed)*

Table 4.5 presents the correlation analysis between job-site training and worker productivity. The correlation coefficient is 0.395 indicating a moderate positive correlation. This means that as job-site training increases worker productivity also tends to increase. The associated significance level (p-value) is 0.003 which is less than the 0.05 threshold indicating that the relationship is statistically significant. This implies that the observed correlation is unlikely to occur by chance. The same coefficient of 0.395 is observed in the reverse relationship as correlation is a symmetric measure with the same p-value of 0.003. This reinforces the statistical significance of the relationship between job-site training and worker productivity.

The results show that job-site training positively and significantly influences worker productivity. This suggests that improving training initiatives on-site is likely to result in higher labour productivity levels. These findings are consistent with Kumar *et al.*, 2019 who reported that job-site training provides employees with practical knowledge and an understanding of co-worker's roles thereby improving performance. Similarly, Colombo and Stanca (2014) found a positive and significant effect of training on labour

productivity. The agreement between this study and prior literature strengthens the conclusion that job-site training is an effective means of enhancing worker productivity in construction settings.

4.5.2 Regression analysis

This section presents the results of the regression analysis conducted to evaluate the influence of various factors on job-site training effectiveness on building sites. The model estimates how the independent variables contribute to changes in training effectiveness which in turn impacts labour productivity of workers on site.

Regression analysis is a powerful statistical technique employed to examine and quantify the relationship between job-site training effectiveness and the various influencing factors. To ensure the reliability and validity of the results, several key conditions are made. First, the selected sample population is the representative of the broader workforce on building sites providing a sound basis for generalizing the findings of this study. Secondly, when all other variables are held constant, each estimated coefficient reflects the expected change in job-site training effectiveness corresponding to a one-unit change in the respective predictor variable. These foundational conditions enabled a meaningful interpretation of the regression results allowing the study to identify the impact of individual factors on the effectiveness of job-site training.

Table 4.6 Model summary table

Model	R Square	Adjusted R Square	Std. Error of the Estimate	Significance (p-value)
Regression	0.802	0.785	2.050	0.001

Predictors: (Constant), training recruitment criterion, trainee motivation, training attitude, language barrier, training content, frequency of training, training aids and materials and site complexity

Table 4.6 shows that the regression model produces an R^2 value of 0.802 indicating that 80.2% of the variance in job-site training effectiveness is explained by the independent variables. This shows that the selected predictors provide a strong representation of the factors influencing training outcomes. The p-value of 0.001 confirms that the overall model is statistically significant.

Table 4.7 Regression coefficients table

Variable	Unstandardized coefficient (β)	Standard error	P-value	Standardized coefficient
Constant (β_0)	2.10	0.30	0.01	—
Training method (β_1)	0.90	0.20	0.001	0.25
Training recruitment criterion (β_2)	0.75	0.18	0.005	0.22
Trainee motivation (β_3)	0.60	0.17	0.015	0.20
Training attitude (β_4)	0.50	0.16	0.02	0.18
Training language (β_5)	0.45	0.15	0.025	0.17
Training content (β_6)	0.40	0.14	0.03	0.16
Frequency of training (β_7)	0.35	0.13	0.04	0.14
Training aids and materials (β_8)	0.30	0.12	0.05	0.13
Site complexity (β_9)	0.25	0.11	0.06	0.12

Dependent variable: Job-site training effectiveness

Table 4.7 shows that the regression analysis results reveal three levels of predictor influence on job-site training effectiveness. Training method (β_0) and Training recruitment criterion (β_1) emerge as highly significant factors ($p < 0.01$) highlighting their critical role in shaping the success of training interventions. Moderately significant predictors ($0.01 \leq p < 0.05$) include Trainee motivation (β_3), Training attitude (β_4), Training language (β_5) and Training content (β_6) which play an important role in influencing outcomes though to a lesser degree. Marginally significant predictors ($p > 0.05$) are Frequency of training (β_7), Site complexity (β_9), Training aids and materials (β_8) have weaker influence suggesting they may not directly determine training effectiveness but could still contribute when combined with stronger factors. This hierarchy is useful in prioritizing improvement strategies as attention should first be directed toward highly significant predictors before addressing those of moderate and marginal importance. Table 4.7 presents the detailed regression results with job-site training effectiveness (E) expressed in the regression equation below.

Job-site training effectiveness (E) is expressed as;

$$E = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \beta_6x_6 + \beta_7x_7^2 + \beta_8x_8 + \beta_9x_9^2 + \epsilon \quad \text{Eq. (4.3)}$$

Where E is the Job-site training effectiveness score (units), β_0 of a value 2.10 is the constant term (baseline training effectiveness) on sites, $\beta_1, \beta_2, \dots, \beta_9$ are regression, x_i mean Likert score for factor i ($1 \leq x_i \leq 5$) and x_i^2 is the squared term to capture non-linear effects of some of the training factors.

$$E = 2.10 + 0.90x_1 + 0.75x_2 + 0.60x_3 + 0.50x_4 + 0.45x_5 + 0.40x_6 + 0.35x_7^2 + 0.30x_8 + 0.25x_9^2 + \epsilon \quad \text{Eq. (4.4)}$$

Discussions

The constant (2.10) is the baseline training effectiveness when all predictors are absent, coefficients represent the change in training effectiveness score for a one-unit change in the predictor holding other factors constant and error term (ϵ) captures unmeasured factors and random variation.

The findings of this study indicate that the most influential factor in enhancing training effectiveness is the training method ($\beta_1 = 0.90$) which is consistent with Clarke (2006) and Durdyev and Mbachu (2011) who argues that structured and well-designed training programs directly improve site productivity. Secondary predictors such as trainee selection ($\beta_2 = 0.75$) and motivation ($\beta_3 = 0.60$) also align with previous research of Ng *et al.* (2004) emphasizing the importance of matching workers' skills with training opportunities and Ryan and Deci (2000) highlights how motivation fosters sustained performance gains.

Moderate predictors including communication language, worker attitudes and training content ($\beta_4, \beta_5, \beta_6$) are in line with Burke (2015) and Ling and Loo (2015) who stress that effective communication, positive dispositions and relevant material are essential for meaningful learning on site. Although factors such as frequency of training, availability of training aids and site complexity (β_7, β_8 and β_9) show weaker effects, these findings remain consistent with Olomolaiye *et al.* (1998) and Loosemore *et al.* (2003) who recognize that contextual and material support contribute to reducing inefficiencies and enhancing long-term training outcomes. Overall, these results demonstrate strong

alignment with established literature thereby validating the argument that effective, worker-centered jobsite training strategies improves labour productivity on sites.

4.5.3 Weights for quantification of regression equation

In this study, the regression equation is quantified by assigning weights to the predictor variables based on their standardized coefficients (β -values). Each β coefficient represents the relative strength and direction of the relationship between the independent variables and the dependent outcome which in this case is worker productivity as influenced by jobsite training.

The use of quantification in regression analysis provides a structured way to prioritize training interventions. This ranking system transforms abstract data into practical guidelines that can be applied directly on site and improves decision-making in site planning. During the preparation of training programs, managers can use the regression weights to forecast how different approaches will influence worker productivity outcomes. The quantified equation serves as a predictive tool that allows stakeholders to anticipate the effect of their training investments.

The method should be used at different stages of training planning. At the initial stage, it helps identify the priority areas that require investment such as most influential factors. During implementation, it guides supervisors on where to focus monitoring and evaluation. At the post-training stage, the quantified regression results provide a basis for measuring whether productivity improvements align with predicted outcomes.

In practice, regression quantification becomes a management tool that supports both short-term and long-term site productivity goals. In the short term, it informs the daily allocation of resources for worker training. In the long term, it builds a knowledge base that construction companies can use to refine their training policies across multiple projects. By applying this approach consistently, construction managers enhance worker productivity ensuring that training addresses factors influencing worker site performance.

Grace-Martin (2008) highlights that Likert-scale items such as values ranging from 0–3 can be used as predictor variables in regression models when treated as continuous data. Setting a maximum weight of three (3) in this study ensures that predictors remain interpretable and balanced preventing any single factor from disproportionately

influencing the model. This approach supports model stability and meaningful interpretation.

Table 4.8 Weights for quantification of regression equation

Explanation	Suggested quantification
Training method (β_1) (Measured in units)	3=Suitable training method Apprenticeship, role playing) 1= Not suitable method 0= No method applied coz no training on site
Training recruitment criterion (β_2) (Measured in units)	3= Selection method based on clear qualifications (e.g., for specific skills) 1= Selection not based on clear qualifications 0= No recruitment because no training on site
Trainee motivation (β_3) (Measured in units)	3= Highly motivated for the training 2= Moderately motivated for the training 1= Low motivation for the training 0= Not motivated
Training attitude (β_4) (Measured in units)	3= Very positive (eager to learn) 2= Neutral (indifferent attitude) 1= Negative (resistant to training) 0= No attitude noted coz no training on site
Language barrier (β_5) (Measured in units)	3= Language understood well 1= Language not easily understood 0= Language barrier
Training content (β_6) (Measured in units)	3= Highly relevant and well-prepared materials. 2= Moderately relevant 1= Not relevant content provided 0= No content provided
Frequency of training (β_7) (Measured in units)	3= Weekly 2= Monthly 1= Training done when need arises 0= No training
Training aids and materials (β_8) (Measured in units)	3= Aids and materials available and right materials 1= Few/not enough materials 0= Aids and materials not available

Site complexity (β_9)	3= Not complex
Reflects construction environment including project scale, technical requirements, logistics and environmental conditions.	1= Moderately complex
(Measured in units)	0= Complex

Using the weights in Table 4.8, managers can calculate expected training effectiveness. Substituting the maximum value (3) in Eq. (4.4) yields an optimal training effectiveness score of 19.2 units. This model can be applied for prediction, sensitivity analysis and resource allocation. Prioritizing β_1, β_2 and β_3 in planning training programs will yield the greatest productivity gains.

Worker productivity outcomes are categorized as low (≤ 10 units), moderate (> 10 to ≤ 17 units) and high (> 17 units) to facilitate interpretation of regression results and guide training interventions. This approach reflects the principle of segmented regression which estimates distinct relationships within defined intervals of the predictor variable (Muggeo, 2003). In the context of worker productivity, segmentation allows observation of how jobsite training effectiveness changes across levels of output. Productivity scores ≤ 10 units indicate poor training outcomes requiring immediate intervention, scores between > 10 and ≤ 17 units reflect moderate effectiveness with room for improvement and scores > 17 units indicate strong performance resulting from well-aligned training practices that should be maintained. Studies show that dividing data into intervals increases interpretability and enhances model accuracy when underlying relationships differ across ranges (Hastie *et al.*, 2009).

The significance of the training method aligns with Sal and Raja (2016) who found that training outcomes are strongly influenced by the approach used with varied methods improving both individual and organizational performance. Structured selection criteria, encompassing qualifications, experience and interpersonal skills are pivotal in forming competent construction teams. This is consistent with the findings of Zhang (2022) who indicates that systematic selection processes significantly influence team effectiveness and collaborative dynamics on construction projects. Similarly, motivation plays a critical role in the success of training programs within the construction industry. This aligns with

the conclusions of Smith and Johnson (2021) who demonstrate that implementing strategies that recognize and reward employee efforts can significantly enhance morale and sustain motivation. Collectively, these factors namely careful participant selection, effective motivational strategies and appropriate training methods ensure that training programs on building sites are both relevant and impactful. Ultimately, contributing to improved worker productivity and efficient resource allocations on building sites especially concerning training implementation.

4.6 Framework for implementing job-site training to enhance labour productivity on building sites

The fourth specific objective of the research work centered on gathering insights from construction workers through a combination of questionnaires and interviews. The primary focus was on finding information regarding approaches to enhance job-site training on building sites.

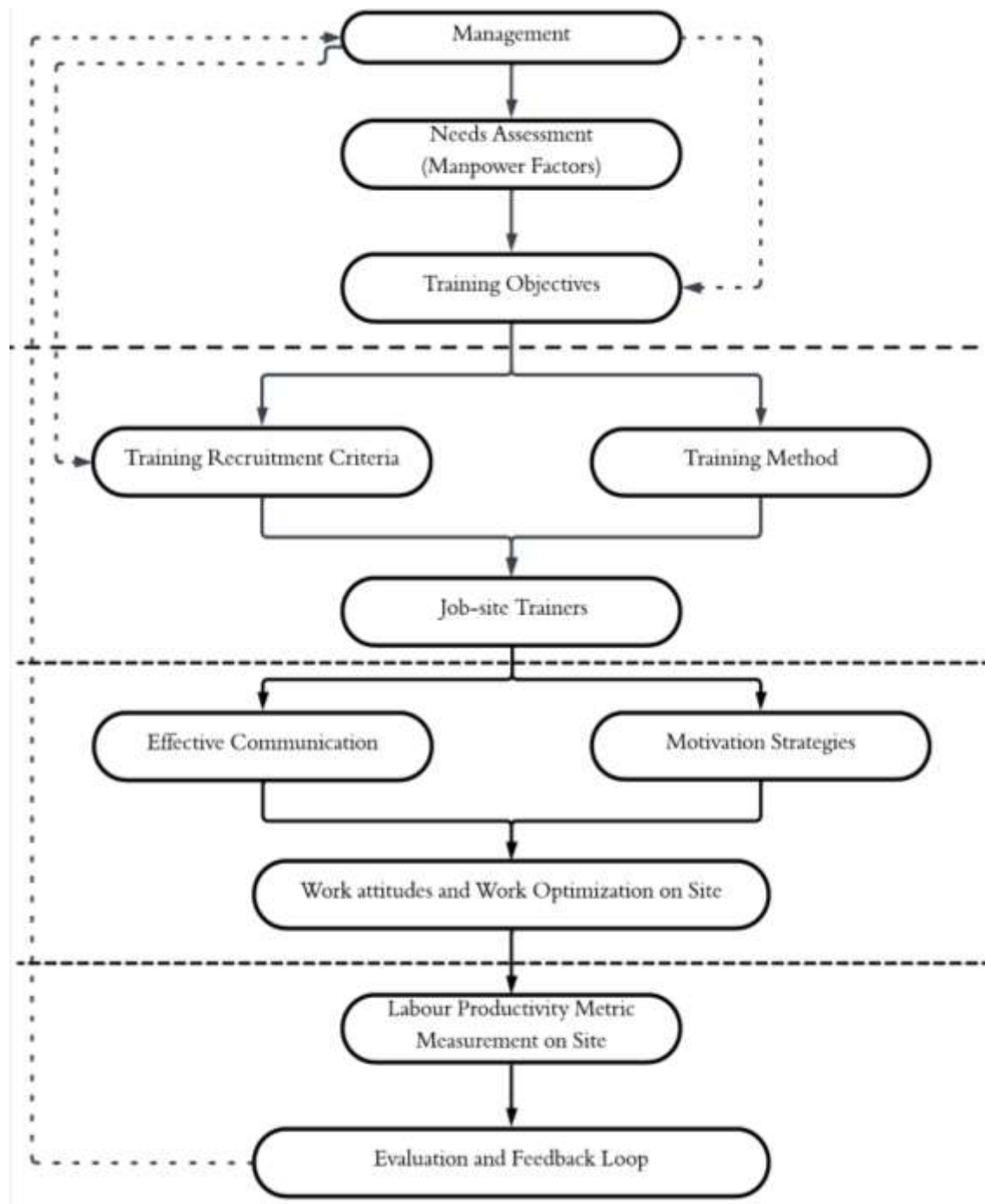


Figure 4.16 On-site training framework for construction workers

Figure 4.16 shows a practical framework tailored specifically for implementing job-site training on building **sites** linked to the various trades (carpenter, equipment operator, painter, electrician, mason, plumber, welder and non-trade workers) as discussed below;

Stage 1: Planning stage of training

This planning stage starts with a Training Needs Analysis (TNA) which identifies the gap

between existing skills and the competencies required to achieve organizational objectives. This stage forms the foundation for program design by ensuring that training addresses actual worker performance deficiencies rather than assumed needs. Without it, training risks becoming irrelevant or misdirected, leading to wasted resources and limited improvement in productivity. This stage sets the foundation for developing an effective training intervention on site and it involves high-level strategic inputs from management and a structured assessment of the current workforce capacity and needs as regards the projects.

Management → Needs assessment [manpower factors]

Management plays a central role in recognizing the need for workforce development on given sites authorizing the assessment of current manpower capacity. Inputs - Management or site prioritizing training, availing resources, strategic goals and scheduling of trainings on sites and Outputs - Commissioning of manpower needs assessment to identify skills gaps including worker role mismatching.

Needs assessment (manpower factors) → Training objectives

The assessment provides evidence-based insights that guide the setting of realistic, measurable and targeted training goals on the site. Once needs are established, the framework progresses to program design. Inputs - Data from workforce evaluation, performance basis, worker absenteeism rates, safety incident records and evaluation of site productivity trends checked per trade and Outputs - Defined training objectives tailored to close performance gaps observed and align with project demands.

Stage 2: Design of the training program

Once objectives are set, this phase defines the structure of the training program leading to the selection of appropriate methods, trainers and recruitment criteria for both workers and trainees. At this stage, learning objectives, training content and delivery methods are specified. Care is taken to align training methods with the characteristics of construction workers and the realities of the jobsite. The design balances technical requirements with practical application ensuring that acquired knowledge and skills can be directly transferred to daily work activities.

Training objectives → Training recruitment criteria

Creating objectives inform the kind of workers best suited for the training program to maximize impact. Inputs - Target workers and job task responsibilities are outlined in the objectives for selection process and Outputs - Clear criteria for selecting workers to participate in the training for example skill level, experience, language proficiency, job tasks etc. in line with project requirements.

Training objectives → Training methods

The training objectives determine the most effective delivery formats that can transfer skills efficiently to workers. Inputs - Nature of construction tasks, literacy levels, and preferred learning styles and Outputs - Selection of appropriate delivery methods and this study recommends apprenticeship and role-play methods among others as workers selected these methods as preferred.

Training methods → Job-site trainer

The mode of delivery dictates the competencies a trainer possesses and impact of training on workers. Inputs - Choice of methods for training content delivery such as hands-on technical demonstration or multilingual delivery and Outputs - Identification or hiring of trainers with specific capabilities aligned to chosen methods and worker trades on site.

Training recruitment criteria → Job-site trainer

A trainer must adapt training content and delivery based on the profile of the selected worker trades on site. Inputs - Workers characteristics and background investigation with respect to qualification for training and Outputs - Trainer's preparedness and instructional strategies to suit learner(workers) needs.

Stage 3: Training delivery stage

The delivery stage involves the actual delivery of training in accordance with the established plan. Effective coordination between trainers, supervisors and workers is critical to encourage active participation. Practical methods such as apprenticeship and role-playing methods which was identified by workers as the most suitable for knowledge transfer than the existing methods are applied to strengthen the link between training and workplace realities. This phase focuses on the active facilitation of job-site training and the in-session elements that impact knowledge transfer on site.

Job-site trainer → Motivation strategies

Trainers influence worker motivation by building trust, using reinforcement, and maintaining enthusiasm during sessions. Inputs - Trainer's engagement techniques, recognition of learner (worker) achievements and emotional intelligence during training and Outputs - Increased attentiveness of workers, willingness to learn and persistence in training among workers.

Job-site trainer → Effective communication

A trainer's communication ability ensures that knowledge is accurately transmitted and understood across diverse trainees (workers) on site. Inputs – Good communication skills with clarity in instructions, feedback loops and use of interpreters or visual aids in case of language barrier and Outputs - Enhanced understanding, reduced ambiguity to workers and better retention of skills.

Motivation during training → Work attitudes and work optimization

Motivated workers are more likely to apply new knowledge effectively reducing inefficiencies and errors on site. Inputs - Intrinsic drive, empowerment and confidence gained during job-site training implementation and Outputs - Better task execution, time management and teamwork improvements.

Effective communication → Work attitudes and work optimization

When communication is clear workers are more engaged and aligned with site goals hence exhibiting a positive attitude towards work. Inputs - Clarity in understanding roles and clear problem-solving procedures and Outputs - Positive disposition, accountability and proactive behavior of workers on site.

Stage 4: Training Evaluation stage

Finally, during the evaluation stage, the framework incorporates an evaluation mechanism to measure training effectiveness. Feedback is collected to determine whether learning objectives are achieved and whether measurable improvements in performance and productivity occur on the job-site. The results of evaluation not only ensure accountability but also create a feedback loop that informs future needs analysis done by management hence keeping the training cycle continuous and adaptive.

This final element ensures the training cycle remains responsive to ongoing site

challenges. This feedback reinforces the narrative that on-site training leads to tangible productivity outcomes. This stage examines the impact of training on-site performance and productivity through observable changes in worker behavior and output on sites.

Work attitudes and work optimization → Labour productivity

Optimized work practices directly feed into the broader outcome of productivity improvement and the positive worker attitude are often a precursor to sustainable labour productivity growth on site. Input - Enhanced performance in work tasks and worker coordination with positive mindset and commitment at work and Output - Measurable productivity gains (faster task completion, reduced rework, increased compliance, better overall site efficiency etc.).

Evaluation and feedback → Management

A feedback mechanism helps align future training interventions with evolving project and workforce needs creating a continuous improvement cycle. Input - Post-training performance data, site observations, worker feedback and trainer reports are to be provided and Output - Revision or reaffirmation of training objectives for future cycles based on each worker trade on site.

The integration of management-led needs assessment, targeted recruitment and method selection ensures that training interventions are both relevant and effective. The cyclical nature of the framework with its feedback mechanism reflects the continuous improvement model suggested by Kumar *et al.* (2019) where aligning training objectives with project requirements sustains productivity gains.

The strong emphasis on communication and motivation supports Colombo and Stanca's (2014) findings that well-delivered training fosters not only skill acquisition but also a positive work attitude which are critical for long-term labour productivity enhancement. In conclusion, this framework demonstrates a structured, hierarchical and feedback-driven model for on-site training of construction workers ensuring that every stage from planning to delivery and evaluation feeds into the next with clear output-input dependency. This framework ensures effectiveness implementation job-site training on construction sites.

4.6.1 Reliability of training framework

The reliability of the developed jobsite training framework is evaluated through a structured process. Labour productivity metrics for the respective trades are recorded on seven selected sites both before and after training. The data undergoes statistical analysis to ensure consistency in productivity computation across all sites. The framework is validated when consistent productivity improvements are observed across all sites confirming its reliability and adaptability for application.

(a) Training administration on building site

The jobsite training is systematically planned and implemented beginning with needs assessment of workers. Site supervisors participate in the process and feedback is collected from both supervisors and workers to identify operational challenges on each site. Based on these insights, the training content is tailored to address specific needs of the respective site. The delivery method emphasises hands-on practice, enabling workers to apply concepts directly to live projects under supervision.

Timely evaluations are conducted to monitor the progress of trained workers, and productivity metrics are regularly reviewed and computed. Continuous monitoring and feedback mechanisms are established to guide further improvement in both training delivery and on-site productivity.

4.6.2 Selecting seven building sites for testing framework

Seven building sites are carefully selected to test the reliability of the training framework. The selection is based on representativeness ensuring that sites vary in size, complexity and type of construction including residential, commercial and institutional projects. This diversity ensures that the framework can be tested under a wide range of conditions. Sites are also chosen based on access to both skilled and unskilled labour allowing the effectiveness of the job-site training to be evaluated across different skill levels. Geographic distribution is another key factor with sites located in within Arua to ensure broad applicability of the training framework.

The reliability tests for labour productivity across all construction trades are conducted on the following sites; Pajulu site located at 3.01667° N, 30.85000° E; Central site with coordinates 3.01944° N, 30.91250° E; Mvara site at 3.03028° N, 30.90710° E; Anyafio site situated at 3.02800° N, 30.91000° E; Osu site at 3.06472° N, 30.93806° E; Muni site at 2.9925° N, 30.9264° E; and Barifa site with coordinates 3.01020° N, 30.92740° E.

These locations are strategically selected to ensure comprehensive and reliable data collection across various construction trades.

Cooperative site managers were prioritized to facilitate smoother implementation of the job-site training program. Comparative labour productivity records are analyzed on pre- and post-training levels. This approach allows a clear evaluation of the impact of job-site training on worker productivity and ensures that the framework's reliability is tested under practical conditions.

4.6.3 Computations for labour productivity improvements

The following equations were used to compute labour productivity and labour productivity improvements for all the worker trades on the various building sites as shown below;

The formula is used is:

$$LP = \frac{I}{O} = \frac{H_a}{Q_i} \quad \text{Eq. (4.5)}$$

Where P = Labour Productivity, I = Input, O = Output, H_a = Installed Quantity (output) and Q_i = Actual Work Hours (input). This formula is widely used to monitor performance across different trades and project sites.

The labour productivity equation measures the efficiency of construction workers in completing a given task. The output refers to the total quantity of work completed by each worker trade on site measured in respective units while input refers to the total man-hours consumed which is the cumulative amount of time (in hours) that workers spent on the specific task. By dividing the total output by the total man-hours, this formula yielded a productivity rate (units/hour). Higher values indicate better labour efficiency while lower values suggested inefficiency possibly due to poor training or poor planning etc.

$$LPI = \frac{P_a - P_b}{P_b} \times 100 \quad \text{Eq. (4.6)}$$

Where the labour productivity improvement (LPI) represents the percentage (%) change in productivity following the training intervention. P_b is the baseline productivity before training while P_a is the productivity after training on building site. The difference ($P_a - P_b$) shows the gain or loss in worker output. Dividing by the baseline productivity P_b normalises the change and multiplying by 100 expresses it as a percentage.

4.6.4 Reliability test of labour productivity across trades

This section presents the reliability test results of labour productivity across different worker trades. The tests are carried out on selected sites to evaluate consistency of the proposed framework. Labour productivity (LP) is computed using Eq. (4.5) and LP improvement (%) is determined using Eq. (4.6). Results are shown in Figure 4.17, Figure 4.18 and Figure 4.19 for better visualization. Labour productivity measurements are influenced by task complexity, worker expertise, site-specific conditions particularly the number of workers available on each site and the ongoing activities on the respective site.

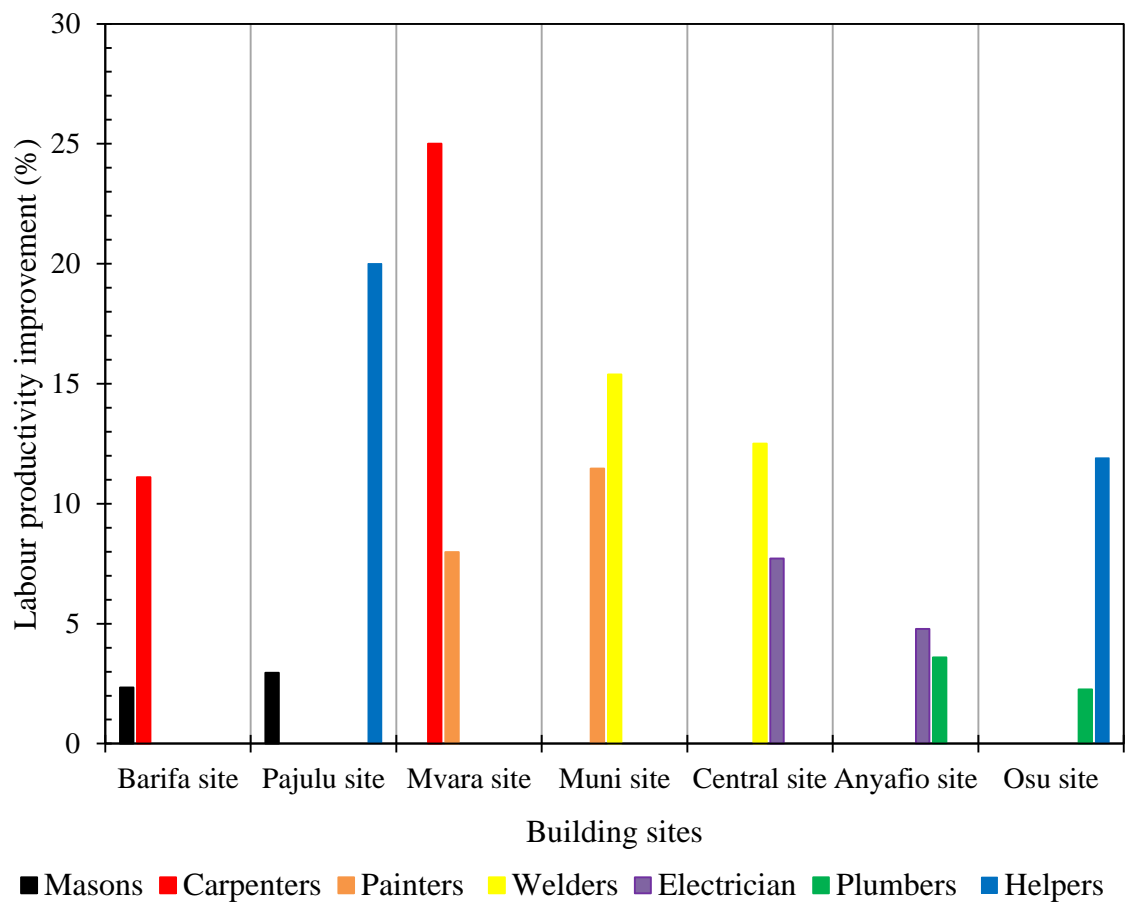


Figure 4.17 Labour productivity of worker trades on building sites

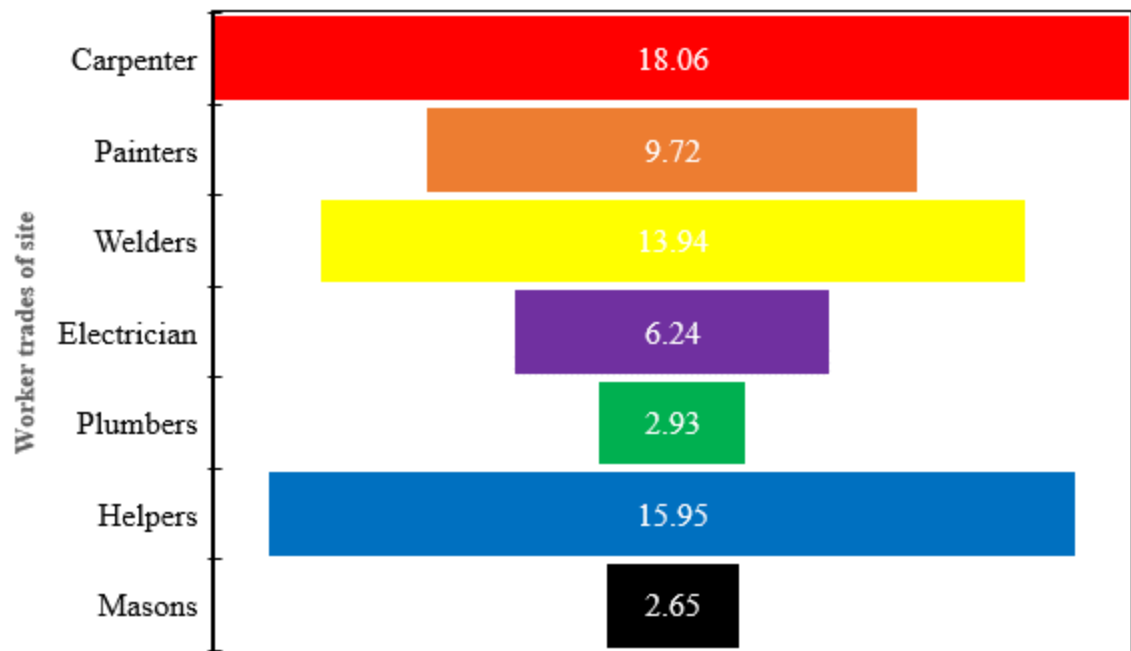


Figure 4.18 Average labour productivity improvement of worker trades on site

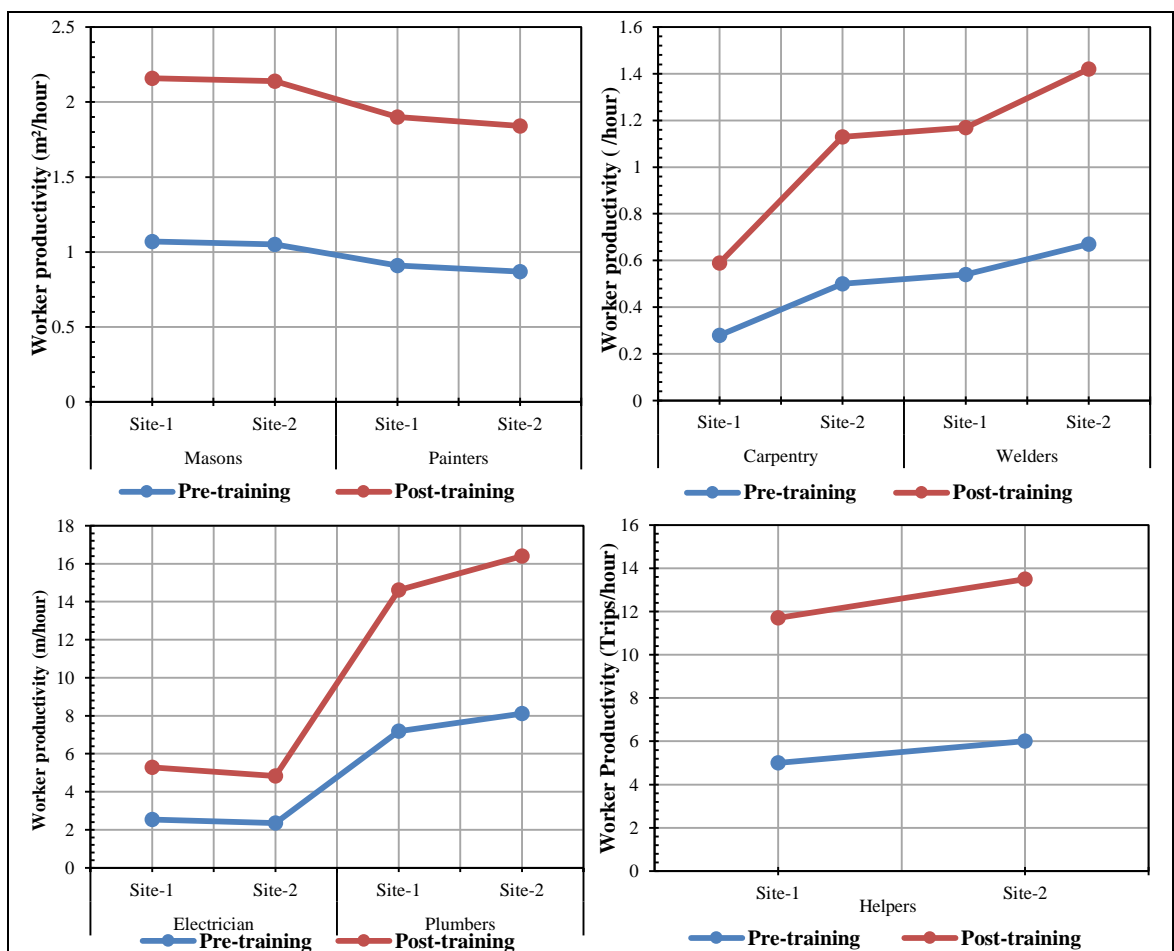


Figure 4.19 Pre- and Post-training worker productivity outcomes on building sites

(a) Carpenters productivity measurement on building sites

Carpenters' productivity is tested on Mvara and Barifa sites through the installation of mahogany panel doors (0.9×2.1 meters). Activities include door frame preparation, hinge fixing, alignment and installation of door. The labour productivity of carpenters is measured by the number of doors installed per carpenter-hour. The training content delivered to carpenters at the Mvara and Barifa sites emphasizes task sequencing, process optimization and communication guided by needs assessments carried out from developed framework. Figure 4.19 shows the effects of job-site training on worker productivity of carpenters before and after implementation at the two respective sites.

Figure 4.17 shows Barifa site records 11.11% labour productivity improvement while Mvara site achieves 25.00%. Higher labour productivity at Mvara is attributed to well-prepared door frames unlike Barifa where uneven adjustments slowed installations. Post training emphasizes is on task sequencing, process optimization and communication. Carpenters achieve an average productivity improvement of 18.06% as illustrated in Figure 4.18.

(b) Painters productivity measurement on building sites

Reliability tests for painters are conducted on Muni and Mvara sites with main activity as painting of wall. Activities involve preparing the wall, sanding, priming and painting. The labour productivity of the painters is measured as painted area (m^2) per painter-hour. At both the Muni and Mvara, painters receive training that concentrates on workflow organization, material handling and team coordination based on needs assessments drawn from the developed framework. Figure 4.19 illustrates changes in worker productivity of painters before and after job-site training across the two respective sites.

Figure 4.17 indicates Muni site records 7.99% labour productivity improvement while Mvara achieves 11.46%. The higher labour productivity at Mvara is due to the use of paint sprayers unlike Muni where textured surfaces reduced efficiency. The average increase in productivity for painters is 9.72% as shown in Figure 4.18.

(c) Welders productivity measurement on building sites

Tests are carried out at Muni and Central sites on metallic window frame installation

which is the main activity with tasks that include positioning, welding, sealing and alignment checks. The labour productivity of the welders is measured by number of windows installed per welder-hour. The training program for carpenters at Muni and Central sites highlights systematic material preparation, alignment and task sequencing all informed by needs assessments derived from the framework. The effects of job-site training on worker productivity of welders both before and after implementation on the two sites are presented in Figure 4.19.

Figure 4.17 shows Central site records 12.50% labour productivity improvement while Muni achieves 15.39%. The productivity improvement is lower at Central due to poorly prepared openings that required adjustments. As depicted in Figure 4.18, welders experience a mean productivity enhancement of 13.94%.

(d) Electricians

Tests are conducted on Central and Anyafio sites with concealed PVC conduit wiring as the main activity with activities include planning, cutting, embedding and securing conduits. The labour productivity of the electricians is measured as meters of conduit installed per electrician-hour. Training provided to carpenters at the Central and Anyafio sites emphasizes sequencing, pre-planning and communication with content tailored through needs assessments informed by the developed framework. Figure 4.19 depicts the worker productivity levels of electricians before and after the introduction of job-site training at the two respective sites.

Figure 4.17 shows Anyafio site records 4.78% labour productivity improvement while Central achieves 7.71%. The lower improvement value at Anyafio result from extensive chiseling and preparation work on site. Figure 4.18 highlights that the average productivity improvement among electricians is 6.24%.

(e) Plumbers productivity measurement on building sites

Tests are conducted at Osu and Anyafio sites on installation of ½-inch PPR pipes for hot and cold-water systems as the main activity with activities that include layout planning, cutting, jointing and embedding pipes on walls. The labour productivity of plumbers is measured as meters of pipe installed per plumber-hour. The Plumbers at both Osu and Anyafio sites undergo training that focuses on efficient cutting, jointing and workflow

organization obtained on the basis of needs assessments carried out under the framework developed. Shown in Figure 4.19 are the comparative effects of before and after of job-site training on worker productivity of plumbers at the two respective sites.

Figure 4.17 indicates Osu site records 2.26% labour productivity improvement while Anyafio achieves 3.60%. The improvement value at Osu site are linked to complex layouts requiring numerous bends and fittings compared to the Anyafio site. The findings show that Plumbers achieve an average productivity increase of 2.93% as illustrated in Figure 4.18.

(f) Helpers (Non-Trade) productivity measurement on building sites

Tests are carried out at Osu and Pajulu sites. Helpers manually transport bricks of size $230 \times 110 \times 75$ mm using wheelbarrows to needed areas on site in the absence of mechanical lifting equipment. The labour productivity of the helpers is measured as trips completed per helper-hour. Training interventions for helpers at Osu and Pajulu sites address teamwork, task sequencing and communication signals with content shaped by needs assessments undertaken from the developed framework. Figure 4.19 demonstrates how job-site training influenced worker productivity of helpers before and after its application at the two respective sites.

Figure 4.17 shows that Pajulu site records 20.00% labour productivity improvement while Osu site achieves 11.90%, averaging 15.95%. Higher improvement values at Pajulu result from use of two helpers per wheelbarrow on upper floors compared to the Osu sites. The findings show that carpenters achieve an average productivity increase of 15.95%, as illustrated in Figure 4.18. Helpers play a vital role in the overall productivity of building sites by supporting skilled workers and ensuring that construction activities proceed efficiently with benefits from smoother coordination, faster task completion and reduced project delays thereby contributing to overall labour productivity on site.

(g) Masons productivity measurement on building sites

The reliability test for masons is conducted at Barifa and Pajulu sites with Masons constructing exterior and partition walls using stretcher bond clay bricks ($230 \times 115 \times 75$ mm) with 10–12 mm mortar joints as the main activity. The stretcher bond method places bricks lengthwise outward creating a horizontal pattern suitable for load-bearing and non-load-bearing walls. The labour productivity of the masons is measured as wall surface

area (m²) per mason-hour. The training administered to masons at both Barifa and Pajulu sites centers on optimizing task sequencing to reduce errors and delays, better communication between masons, helpers and supervisors which are identified through needs assessments embedded in the developed framework. The variations in the worker productivity of masons resulting from job-site training are highlighted in Figure 4.19 comparing pre- and post-training outcomes on the two respective sites.

Figure 4.17 shows that Barifa site achieves 2.34% labour productivity improvement while Pajulu site records 2.96%. Higher productivity at Pajulu site is linked to simpler wall designs, better scaffolding and available block cutting tools as compared to Barifa site. Masons register an average improvement in labour productivity of 2.65% as shown in Figure 4.18.

Discussion of framework reliability testing

The findings indicate that carpenters and helpers have higher labour improvements from the job-site training. This is because their tasks depend heavily on clear sequencing and role clarification which training can improve instantly. Welders and painters also record notable gains due to skill-focused demonstrations. On the other hand, masons and plumbers have lower productivity improvements because of their work processes which are less responsive to short-term training and require longer practice however an improvement is still recorded.

These results align with Thomas and Sudhakumar (2013) who reports that productivity improvement depends on the extent to which training addresses task-specific challenges. Similarly, Zakeri *et al.* (1996) notes that labour productivity varies across trades and effective training has a stronger impact on activities with higher levels of task interdependence and supervision. The results therefore confirm that job-site training enhances productivity across trades but its effectiveness depends on the nature of tasks and the degree of supervision. The results across all trades confirms the reliability of the framework.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study concludes that the effectiveness of jobsite training is primarily influenced by training methods, recruitment criteria and worker motivation. Structured, practical approaches such as apprenticeship and role-playing emerged as the most effective methods for skill transfer and knowledge retention. Additional factors such as training language and trainer attitude also positively contribute to training outcomes. These findings indicate that careful planning and management of these factors are critical to delivering successful training interventions on building sites.

The findings indicate that manpower, management and motivational factors are the most critical determinants of worker productivity on building sites. Improvements in these areas not only create an enabling environment for effective training but also directly enhance the efficiency and performance of workers. The study also found that improvements in site-specific conditions, workforce allocation, and motivational strategies significantly boost productivity across trades.

The study revealed a moderate positive correlation between jobsite training and labour productivity. Effective training interventions especially when structured and aligned with workers' skill gaps lead to measurable performance improvements across different trades. The implementation of the developed on-site training framework resulted in measurable productivity gains across multiple trades with the highest improvements recorded among carpenters (18.06%), non-trade workers (15.95%) and welders (13.94%). Additionally, painters (9.72%), electricians (6.24%), plumbers (2.93%) and masons (2.65%) are observed to have improved productivity confirming the applicability of the framework in diverse construction contexts and trades.

Lastly, maximizing labour productivity requires implementing a structured training framework that begins with a needs assessment to ensure alignment with site-specific requirements. Consistent monitoring and evaluation of training effectiveness guided by the predictive regression model developed in the study. The developed regression model on training effectiveness (E) = $2.10 + 0.90x_1 + 0.75x_2 + 0.60x_3 + 0.50x_4 + 0.45x_5 + 0.40x_6 + 0.35x_7^2 + 0.30x_8 + 0.25x_9^2 + \epsilon$ can reliably be used to design, assess and predict the effectiveness of training on building sites.

5.2 Recommendations for further studies

Future research should examine how jobsite training impacts labour productivity over extended periods. This includes assessing whether skills acquired during training are retained and applied consistently on the construction site. Studies should also evaluate in worker behaviour resulting from continuous training. Understanding these long-term effects will help organizations design training programs that sustain performance improvements and reduce the need for repeated interventions.

Examine the interaction between training methods and site complexity. Research can investigate how different training methods perform under varying levels of site complexity. High-variation construction environments present unique challenges, including diverse trades, multiple workflows and fluctuating resources. Identifying which training strategies are most effective under complex conditions enables managers to tailor programs to specific project requirements which ensures that training remains practical, efficient and responsive to the real demands of construction sites.

Future research studies should be on the adaptability of framework in dynamic site conditions, project types, cultural contexts and varying management approaches to ensure that the framework remains relevant and applicable across diverse construction settings. Furthermore, this investigation aims to provide empirical evidence on whether the framework delivers measurable improvements in worker productivity when applied on these building sites.

Future studies should quantify the economic impact (cost-benefit analysis) of implementing jobsite training programs. This involves comparing the costs of training initiatives with productivity gains, reductions in errors and improvements in quality outcomes. Evaluating the financial benefits helps justify resource allocation and informs management decisions on scaling training programs across projects. Such analysis ensures that investments in workforce development produces measurable returns for construction organizations hence encouraging implementation.

5.3 Recommendations for application

Construction companies should adopt the developed on-site training framework to enhance workforce productivity. Training programs should be tailored to meet the specific needs of workers through detailed needs assessments and aligned recruitment processes. Tiered and trade-based training systems should be implemented to accommodate varying

skill levels.

Apprenticeship and role-playing methods should be emphasized for effective knowledge transfer and practical skill development. Management should utilize the regression model as a planning tool to prioritize resources and focus on factors with the greatest impact on labour productivity on site. Lastly, integrating structured training into routine site operations ensures continuous skill development, improved efficiency and sustained performance improvements across all trades.

The developed regression equation provides a quantitative basis for understanding the impact of job-site training factors on site. It is recommended that site managers and contractors apply weighted quantifications in Table 4.8 when using the equation to prioritize training interventions. By assigning appropriate weights to the factors, the most influential variables are identified, resources are allocated effectively and informed decisions are supported.

During the implementation of the developed framework in Figure 4., it is recommended that all job-site training programs commence with a systematic training needs assessment. This process identifies worker needs and project requirements enabling contractors and site managers to enhance both the relevance and effectiveness of training thereby achieving sustainable improvements in labour productivity on site.

Finally, the findings reveal that jobsite training is often inconsistent, occasionally irrelevant and frequently lacks structured content. To address these challenges, the framework recommends that training content aligns directly with workers' trade-specific tasks and project requirements. Structured modules of technical skills should be prepared based on needs assessments of workers. Furthermore, management should apply the framework to standardize training schedules, maintain relevance and integrate worker feedback into program design.

5.4 Limitations of the study

The study experiences some limitations. Variations in training quality and duration make it difficult to standardize certain findings although measures are taken to improve consistency and comparability. External factors such as adverse weather conditions, material availability and unforeseen project delays which influence worker productivity remain outside the scope of this study recognized as a limitation. Time constraints also limit the

scope resulting in exclusion of pre-construction trainings. Furthermore, worker productivity is assessed using specific trade-related indicators which may not fully capture broader outcomes such as adaptability and long-term skill retention and this is recognized as a limitation.

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APPENDICES

Appendix A Cover letter



COVER LETTER

Dear respondent,

I am ECONI KENNETH YIKII, a student at Kyambogo University pursuing a Master of Science in Construction Technology and Management. I am conducting a research project titled “Evaluating the impact of job-site training on labour productivity on building sites in Uganda - A case of Arua City”. My research project endeavors to develop a comprehensive framework showing the relationship between job-site training and labour productivity on building sites in Arua City.

I thus respectfully request that you take the time to complete the questionnaire by checking and filling in the answers inside the box and area provided. It should be noted that participation in this survey is voluntary, all responses to the questions shall be treated as anonymous and confidential and all responses shall be used **ONLY** for academic purposes.

Thank you for your time, co-operation and contribution to my study

Yours faithfully,

Econi Kenneth

Appendix B Survey Questionnaire

SURVEY QUESTIONNAIRE FOR CONSTRUCTION WORKERS

SECTION -A

This section entails the demographic information about the respondents' personal information (Bio-Data)

To be completed by filling or ticking in the most appropriate option provided.

1. What is your trade?

- a) Carpenter b) Non-trade workers c) Painter
 d) Electrician e) Mason f) Plumber
 g) Welder

If others, specify _____

2. In what age (years) bracket do you fall?

- a) 18-29 b) 30-39 c) 40-49 d) 50-59 e) 60-Above

3. What is your Gender?

- a) Male b) Female

4. What is your highest level of education?

- a) Informal b) Certificate c) Ordinary Diploma
 d) Advanced Diploma f) Graduate

If others, specify _____

5. How long you have worked on this constructions site?

- a) Below 2 months b) 3-6 months c) 7-12 months
 d) 1yr - above

6. What is your work experience on construction sites?

- a) 0 – 5 yrs b) 6 – 10 yrs c) 11 – 16 yrs
 d) 17 - above yrs

SECTION -B

This section will seek to determine the factors affecting job-site training on building sites.

7. Does your company or site provide job-site training to workers?

- a) Yes b) No

8. If yes, what is the method employed on your site for job-site training?

- a) Case-study training b) Mentorship training
 c) Site instruction technique training d) Job-site rotation training
 e) Apprenticeship training f) Unknown training type

9. What criteria is used for selecting construction workers for job-site training on your site or in your company?

- a) On joining the company b) Supervisor's recommendation
 c) Upon employee request d) Compulsory for all employees

- e) Performance appraisal f) Don't know
10. What types of training do you receive on your site or in this company?

11. How satisfied are you with the effectiveness of the training programs in enhancing your skills and knowledge?
- a) Very satisfied b) Satisfied
- c) Neutral d) Dissatisfied
- e) Very dissatisfied

12. The following factors affect job-site training on your site. Kindly rate the following statements by ticking(✓) the appropriate option.
- 1 - Strongly Disagree, 2 - Disagree, 3 - Neither Disagree nor Agree, 4 – Agree, 5 – Strongly Agree

S/No	Statements	1	2	3	4	5
a)	Trainee motivation					
b)	Training attitude					
c)	Training language					
d)	Training method					
e)	Management support					
f)	Training recruitment criteria					
g)	Training content					
h)	Trainers frequency					
i)	Site complexity					

If others, specify

SECTION - C

This section seeks to determine the factors affecting productivity of construction workers on building sites.

13. The following are the factors believed to affect construction labour productivity on your site. Kindly tick(✓) an option from the following statements provided below.

S/No	Factors affecting construction labour productivity on site	Options		
		Agree	Neutral	Disagree
	Categories			
	Manpower factors			
a.	Workers absence or late coming on site			
b.	Workers experience and skills			
c.	Workers discipline on site			
	Management factors			
d.	Understandable construction drawings and schedule			
e.	Good communication between management and workers (timely instruction and decisions)			

f.	Experienced and competent site managers in supervision			
Motivation factors				
g.	Overtime work payment to workers			
h.	Workers motivation, recognition and reward for uniqueness			
i.	Workers timely salary payments			
Work condition factors				
j.	Healthy and safe work environment			
k.	Work security on site			
l.	Workers safety wears given on site			
Project factors				
m.	Abrupt changes in design			
n.	Prevailing economic conditions			
o.	Understandable construction drawings and schedules			
External factors				
p.	Changing weather conditions			
q.	Legal site operation according to laws and regulations			
r.	Social culture around the project site			
Tools and equipment factors				
s.	Available tools and equipments for workers on site			
t.	Routine maintenance and repair of tools and equipments			
u.	Good condition and rightly positioned tools and equipments on site			

14. How do you measure your productivity on a given work day on your site?

- a) Measuring productivity by profit
- b) Measuring productivity quantitatively
- c) Management by objectives
- d) Task tracking
- e) Daily catch-ups

If others, specify _____

SECTION - D

This section seeks to determine the impact of job-site training on construction labour productivity on building sites in Arua

15. Do you think job-site training has improved your labour productivity on your site?

- a) Yes
- b) No

16. If yes, please describe some specific improvements or changes observed?

17. Would you recommend any specific training methods or topics or improvements that you believe would be beneficial to further enhance the impact of training programs on worker productivity?

Thank you for your cooperation

Appendix C Validity of questionnaire

Expert	Expert-1	Expert-2	Expert-3	Expert-4	CVI
Status of training on site	3	4	3	4	1
Job-site factors	4	3	2	4	0.75
Productivity factors	3	4	4	3	1
Impact and strategies	2	3	4	3	0.75
Overall					0.875

Appendix D Reliability of questionnaire

Variables	No. of questions	Cronbach's alpha
Status of training on site	20	0.864
Job-site factors	10	0.841
Productivity factors	26	0.862
Impact and strategies	4	0.857
Overall		0.856

Appendix E Krejcie and Morgan (1970) table for determining sample size for a given population

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note. *N* is population size.
S is sample size.

Appendix F Categorised open-ended survey responses from construction sites termed under “Other responses (varied, less frequent)”

Category	Responses from construction workers
Safety and health	<ul style="list-style-type: none"> - Training on proper use and maintenance of Personal Protective Equipment (PPE) - Guidance on safe lifting and handling of heavy loads to prevent injuries - Training on hazard identification and accident reporting - First aid training using available materials - Instructions on handling hazardous materials safely - Fire safety and first aid training for emergencies - Awareness on working safely at heights (scaffolds and ladders)
Technical skills	<ul style="list-style-type: none"> - Training on formwork installation and dismantling techniques - Lessons on proper curing methods to improve concrete quality - Skills training on roof installation and waterproofing techniques - Guidance on installing doors, windows and ceiling works - Welding and fabrication training for doors, windows and roof structures - Electrical wiring and plumbing training to meet safety codes - Masonry skills to improve quality of block/brick laying
Modern and eco practices	<ul style="list-style-type: none"> - Training on solar panel installation - Lessons on water harvesting and site water management - Awareness sessions on reducing site waste through recycling and reuse - Training on eco-friendly materials like compressed earth blocks - Sessions on safe disposal of construction waste to protect the environment
Task and site management	<ul style="list-style-type: none"> - Training on supervising small teams and assigning tasks effectively - Guidance on trade work planning of materials and cost control on site - Lessons on site record-keeping and reporting progress - Workshops on risk management and avoiding delays - Training on how to schedule activities and time management to meet task deadlines on site - Training on proper storage and handling of materials to minimize losses
Mentorship and soft skills	<ul style="list-style-type: none"> - Training on leadership skills for foremen and gang leaders - Mentorship on work ethics and professionalism in construction - Sessions on conflict resolution and problem-solving on site - Encouragement of peer-to-peer knowledge transfer - Record keeping skills - Communication skills training for effective teamwork - Motivation and attitude training to improve productivity