USE OF VISUAL COMMUNICATION TOOLS FOR SAFE WORK PRACTICES IN CONSTRUCTION SITES IN BENIN CITY

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DECEMBER, 2025

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BEING A PROJECT SUBMITTED TO THE DEPARTMENT OF QUANTITY SURVEYING, FACULTY OF ENVIRONMENTAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, NIGERIA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OFBACHELOR OF SCIENCE (B.SC.) IN QUANTITY SURVEYING

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DECLARATION

I declare that this project is an original work carried out by me, **Frederick Oshoneh Obemeata** with Matriculation Number **ENV2002811** in the Department of Quantity Surveying, Faculty of Environmental Sciences, University of Benin, Benin City.

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CERTIFICATION

We certify that this project with the title: **Use of Visual Communication Tools for Safe Work Practices in Construction Sites in Benin City** submitted by **FREDERICK OSHONEH OBEMEATA**, with Matriculation Number **ENV2002811** has satisfied the regulations governing the award of Bachelor's Degree in Quantity Surveying from the University of Benin, Benin City, Edo State.

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DEDICATION

This work is dedicated to God Almighty, whose grace, wisdom, and strength made this study possible. I also dedicate it to my beloved family for their unwavering love, prayers, and encouragement throughout the course of this research. To all construction professionals and workers striving daily to maintain safety on sites, this work is for you.

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ABSTRACT

This study examines the use of visual communication tools for safe work practices in construction sites in Benin City. The research explored three objectives; Assessing the level of use of visual communication tools for safe work practices on construction sites, investigating the challenges affecting the use of visual communication tools for safe work practices and examining the effects of visual communication tools on safe work practices in Benin City, Edo State. All three objectives used the mean item score as the method of analysis. The target population for this research comprises stakeholders and participants directly involved in the construction industry within Benin City, Edo State. These include professionals such as architects, engineers, builders, health & safety officers and quantity surveyors. A total of 169 questionnaires were filled from an anticipated sample size of 300. The study revealed that the level of use of visual communication tools varies considerably across construction projects in Benin City. Among the tools assessed, Safety Signs and Symbols (MIS = 4.72) ranked the highest, followed by Colour-Coded Labels (MIS = 4.51) and Floor Markings (MIS = 4.40). The most significant challenge was Limited Budget (MIS = 4.52), followed by Management Indifference (MIS = 4.32) and Lack of Training (MIS = 4.20). The strongest effects of visual communication tools on safe work practices were, Improves Hazard Recognition (MIS = 4.67), Enhances Compliance with Safety Rules (MIS = 4.41), and Reduces Accident Frequency (MIS = 4.29). Generally, the study concludes that visual communication tools play a crucial role in promoting safety culture on construction sites, and their integration especially digital innovations should be strengthened through better funding, management commitment, and worker training.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Construction sites are inherently hazardous environments where workers are frequently exposed to risks such as falls, electrocution, machinery accidents, and structural collapses (Newaz et al., 2025). In Benin City, Nigeria, the construction industry has experienced significant growth due to urbanization and infrastructural development (Idoro, 2011). However, this expansion has also led to an increase in workplace accidents, largely attributed to poor safe work practices, inadequate training, and insufficient communication of safety protocols (Guo et al., 2017).

Safe work practices in construction refer to standardized procedures and actions adopted by workers to mitigate risks, encompassing: consistent use of personal protective equipment (PPE) including hard hats, safety boots, and high-visibility vests. Also included is the proper implementation of fall protection systems such as guardrails and safety harnesses (Tonetto & Saurin, 2021), correct equipment handling techniques and machinery operation protocols (Cheng et al., 2021), and adherence to hazard-specific controls like lockout/tagout procedures for electrical safety (Zhao et al., 2015). Studies have shown that improving these core safe work practices is crucial in reducing accidents and fostering a safety-conscious work culture (Cheng et al., 2021). One of the most effective ways to promote such practices is through visual communication, which includes safety signs demonstrating proper PPE usage, posters illustrating correct equipment handling, digital displays showing real-time hazard alerts (Kim et al., 2021), and infographics detailing fall prevention measures. Visual communication serves as a constant reminder of these critical safety behaviours and reinforces correct work practices, especially in environments where literacy levels may vary (Goodluck & Omorogbe, 2025).

In Benin City, many construction workers have limited formal education, making traditional text-based safety instructions less effective (Okorie & Nwodo, 2022). Visual communication, however, transcends language barriers and can be universally understood, making it a vital tool for training and reinforcing safe work practices (Kim et al., 2021). Research indicates that well-designed visual aids can significantly enhance hazard recognition and compliance with safety procedures, such as proper scaffolding use or electrical safety protocols (Cheng et al., 2021). For instance, the use of pictograms and colour-coded signs has been proven to increase workers' adherence to PPE requirements and hazard zone restrictions (Cheng et al., 2021).

Despite the potential benefits of visual communication, its adoption in the construction industry remains inconsistent. Many construction firms rely heavily on verbal instructions and written manuals, which are often ignored or misunderstood (Cheng et al., 2021). Furthermore, regulatory enforcement of safety standards is weak, leading to non-compliance with established safe work practices (Simeon & Soyingbe, 2023). The Nigerian construction sector, like many developing countries, often prioritizes cost and speed over safety, resulting in inadequate investment in visual communication tools that could improve on-site practices (Simeon & Soyingbe, 2023).

Globally, studies have demonstrated the effectiveness of visual communication in improving safe work practices. For example, studies found that sites using visual safety cues recorded fewer accidents and higher compliance with workplace safety procedures (Abdelkhalek et al., 2019). Similarly, in Ghana, a study by Segbenya & Yeboah, (2022) revealed that construction workers performed safer work practices when instructions were presented visually rather than in text. These findings suggest that visual communication could play a transformative role in the construction safety landscape if properly implemented.

Given the rising accident rates in construction industry, there is an urgent need for innovative interventions to improve safe work practices. Visual communication presents a cost-effective and scalable solution to bridge the gap between safety policies and on-site implementation. By evaluating its effectiveness, this study aims to provide actionable recommendations for enhancing workplace safety practices through targeted visual communication strategies.

1.2 Statement of the Research Problem

The construction industry in Nigeria has witnessed significant expansion due to urbanization and infrastructural development. However, this growth has been accompanied by a rising number of workplace accidents and injuries (Idoro, 2011). Despite existing safety regulations, many construction firms struggle with poor implementation of safe work practices, leading to preventable accidents (Guo et al., 2017). A major contributing factor is the ineffective communication of safety protocols, particularly among workers with low literacy levels (Okorie & Nwodo, 2022). While visual communication – such as safety signs, symbols, posters, and digital displays has been proven to enhance safe work practices on construction sites globally (Kim et al., 2021), its adoption remains inconsistent. Many construction companies still rely on verbal instructions and written manuals, which often fail to effectively communicate proper work practices and are frequently ignored or misunderstood (Cheng et al., 2021). Additionally, weak regulatory enforcement and a lack of investment in safety training further exacerbate the problem (Simeon & Soyingbe, 2023).

Existing research on construction safety in Nigeria has primarily focused on general safety management practices, regulatory frameworks, and workers' attitudes (Simeon & Soyingbe, 2023). However, there is a lack of empirical studies examining the specific impact of visual communication on safe work practices in the construction sector. Key questions remain unanswered about how different visual communication tools influence the actual adoption of

safety procedures on site. Without addressing these gaps, construction firms may continue to implement ineffective safety communication strategies, leading to persistent accidents and injuries. This study seeks to investigate the role of visual communication in shaping safe work practices, identify the most effective visual communication methods, and recommend strategies for improving practical safety implementation in the construction industry of Benin City. By examining these issues, this research aims to contribute to the broader discourse on occupational safety in developing countries, where construction industries often face similar challenges in translating safety knowledge into actual work practices. The findings will provide valuable insights for construction companies, safety trainers, and policymakers seeking to reduce workplace accidents through improved visual communication of safe work procedures. However, there is a paucity of research specifically examining the impact of visual communication on safe work practices in the construction sector of Benin City. Most existing studies focus on general safety management or regulatory frameworks without delving into how visual aids directly influence daily work practices (Park & Kim, 2013). This study seeks to fill that gap by investigating how visual communication shapes safe work practices, identifying the most effective types of visual aids, and assessing the challenges hindering their adoption.

1.3 Research Questions

The study seeks to answer the following research questions:

1. What is the level of use of visual communication tools for safe work practices on construction sites in Benin City?
2. What are the challenges affecting the use of visual communication tools for safe work practices in the study area?

3. What impact do visual communication tools have on safe work practices in the study area?

1.4 Aim and Objectives of the Study

The aim of this study is to evaluate the use of visual communication on safe work practices on construction sites in Benin City, with a view to enhancing workers' hazard recognition and safety consciousness. To achieve this aim, the objectives of the study are to:

1. Assess the level of use of visual communication tools for safe work practices on construction sites in Benin City;
2. Investigate the challenges affecting the use of visual communication tools for safe work practices in the study area; and
3. Examine the effects of visual communication tools on safe work practices in the study area.

1.5 Scope of the Study

This study focuses on evaluating the use of visual communication tools on safety behaviour within construction sites located in Benin City, Edo State, Nigeria. The research covers both public and private construction projects, targeting construction professionals such as architects, quantity surveyors, civil/structural engineers and builders as primary respondents. The visual communication tools examined include safety signs, colour codes, infographics, and pictorial warnings used on construction sites. Geographically, the study is limited to Benin City due to its rapid urbanization and increasing construction activities, which present relevant case studies for safety communication analysis. The study examines how these visual tools influence workers' hazard recognition, compliance with safety protocols, and overall safety consciousness.

Methodologically, the study employs a mixed-methods approach, combining surveys, interviews, and on-site observations. However, it does not assess the financial cost-effectiveness of implementing visual communication systems, as this would require a separate economic analysis. This scope ensures a targeted investigation into visual safety communication while acknowledging practical constraints in data collection and regional specificity.

1.6 Significance of the Study

This study holds significant value for multiple stakeholders in Benin City's construction industry, including workers, contractors, safety regulators, and policymakers. First, the research will contribute to improving workplace safety by evaluating how visual communication tools such as safety signs, colour codes, and infographics can enhance hazard recognition and compliance among construction workers (Okorie & Nwodo, 2022). Given Benin City's high accident rates (Idoro, 2011), the findings could help reduce injuries and fatalities by promoting more effective safety communication strategies. Second, the study will provide practical insights for construction firms on the most effective types of visual aids for different risk scenarios. Research has shown that well-designed visual communication can bridge literacy gaps and reinforce safe behaviours (Okorie & Nwodo, 2022). By identifying which tools work best, companies can optimise their safety training programmes and reduce costs associated with workplace accidents (Hinze et al., 2013).

Third, the findings will assist government agencies and safety regulators in developing evidence-based policies for construction safety standards. Currently, enforcement of safety regulations in Nigeria remains weak (Umeokafor & Issac, 2016). This study's recommendations could support stronger regulatory frameworks that mandate the use of visual safety communication, aligning Benin City's practices with global standards (Windapo &

Oladapo, 2012). Additionally, the research will contribute to academic literature by addressing gaps in knowledge about visual communication's role in safety behaviour within Nigeria's construction sector. While similar studies exist in developed countries (Breslin et al., 2010), few focus on West African contexts where literacy and resource limitations pose unique challenges (Ankamah-Lomotey, 2025). Ultimately, this study could foster a cultural shift toward proactive safety practices in Benin City's construction industry, benefiting workers' well-being, project efficiency, and overall industry reputation.

1.7 Limitations of the Study

While this study provides valuable insights into the use of visual communication on safety behaviour in Benin City's construction industry, it has several limitations. First, the research is geographically restricted to Benin City, which may limit the generalisability of findings to other regions with different socio-economic and cultural contexts. Construction practices and safety regulations can vary across Nigeria, meaning the results may not fully apply to other states or urban centres. Second, the study relies on self-reported data from construction workers, supervisors, and safety officers, which may introduce response bias. Participants might overstate their compliance with safety measures or under-report unsafe behaviours due to social desirability bias or fear of repercussions from employers.

Third, the research focuses primarily on observable visual communication tools (e.g., signs, colour codes, infographics) and does not extensively examine other influencing factors such as workplace culture, management commitment to safety, or economic constraints that may affect safety behaviour. Finally, the study's cross-sectional design captures data at a single point in time, making it difficult to assess long-term behavioural changes resulting from visual communication interventions. A longitudinal study could provide more robust evidence on sustained safety improvements. Despite these limitations, the findings remain relevant for

improving safety practices in Benin City's construction sector and can serve as a foundation for future research with broader scopes.

1.8 Definition of Terms

Visual communication tools: The instruments and media such as; diagrams, signage, charts, and digital visualizations -used to convey information in a clear and easily interpretable manner, thereby enhancing understanding and reducing ambiguity in workplace settings.

Construction safety: The systematic application of procedures, standards, and protective measures aimed at preventing accidents, injuries, and health risks within construction environments.

Safe work practices: These are established methods and procedural guidelines that workers are expected to follow to ensure that tasks are performed in a manner that minimizes exposure to risks and promotes overall workplace safety.

Hazard recognition: The ability to identify potential sources of harm within the work environment, enabling early detection of unsafe conditions or practices that may lead to incidents if not addressed.

Safety compliance: This denotes the extent to which individuals and organizations adhere to safety regulations, statutory requirements, and internal policies designed to uphold and enforce safe working conditions.

Management commitment: This describes the level of dedication and active involvement demonstrated by organizational leadership in promoting safety, allocating resources, and fostering a culture that prioritizes worker protection.

Digital safety tools: These are technology-based systems such as; mobile applications, monitoring software, data-tracking platforms, and sensor-based devices designed to support safety management by improving hazard monitoring, communication, and documentation.

Construction industry: This encompasses the sector responsible for the planning, development, and execution of building and infrastructure projects, including residential, commercial, industrial, and civil engineering works.

CHAPTER TWO

LITERATURE REVIEW

2.1 Preamble

This chapter undertakes a thorough examination and synthesis of existing literature related to visual communication tools for safe work practices on construction sites. By reviewing theoretical frameworks, empirical studies, and industry reports, this section aims to establish a comprehensive foundation for subsequent chapters. The insights garnered from this literature review will significantly contribute to shaping the research design, guiding the data collection process, and informing subsequent analyses.

2.2 Visual Communication Tools Adopted in the Construction Industry

The implementation of visual communication tools in construction sector remains inconsistent despite their proven efficacy in global construction safety management (Babalola et al., 2023). Recent field observations reveal that only 32% of medium-to-large construction sites utilize standardized safety signs, while small-scale projects show less than 15% adoption rates (Okorie & Nwodo, 2022). The most commonly adopted tools include basic safety signs (78% of adopting sites), colour-coded labels (63%), and floor markings (55%), while advanced tools like AR overlays and digital dashboards are virtually absent (Babalola et al., 2023). This adoption pattern reflects the findings of Cheng et al. (2021) in similar developing contexts, where resource constraints limit technological integration. The construction firms that demonstrate consistent visual communication implementation tend to be multinational companies or local firms with international certifications, suggesting that regulatory pressure and organizational culture significantly influence adoption rates (Kim et al., 2021). This disparity in adoption creates uneven safety standards across projects, with workers moving between sites experiencing confusion about hazard communication protocols (Giri, 2020). The

current state of adoption underscores the need for systematic assessment of implementation gaps and best practices tailored to Benin City's specific construction environment.

Visual communication utilizes various forms of pictorial representation, such as posters, images, and symbols, to convey information and ideas. The use of visual safety signs in workplaces, particularly construction sites, has been a longstanding practice. According to Hughes and Ferrett (2010) and Goetsch (2015), the ISO 38664 safety colours and signs were developed to standardize safety signage globally. Visual safety signs encourage workers to follow safety protocols, even when unsupervised (Goetsch, 2015). For instance, safety signs promoting personal protective equipment (PPE) usage help workers wear the right gear. Research has shown that using cartoons in health and safety training, induction training, and toolbox talks significantly improves site workers' safety behaviours (ILO, 2009; Okorie & Emuze, 2019). The International Labour Organization (ILO) emphasizes that visual safety signs are simple, easy to comprehend, and effective in transferring knowledge (ILO, 2009). Additionally, studies have found that visual safety signs play a crucial role in communicating safety information to workers with diverse nationalities, languages, and literacy levels (Vazquez & Stalnaker, 2004).

TABLE 2.1 Existing Literatures on Visual Communication Tools

S/N	Visual Communication Tool	Description	References
1	Safety Signs & Symbols	Standardized pictograms (e.g., danger, warning)	Haslam et al. (2005); Ouyang et al. (2020)
2	Colour-Coded Labels	Red (danger), yellow (caution), green (safe)	Gao et al., 2019
3	Infographics & Posters	Step-by-step safety instructions	Bust et al (2010)
4	Digital Dashboards	Real-time safety alerts on screens	Ghosh et al. (2024)
5	Floor Markings	Hazard zone demarcations	Uche (2026)
6	Directional Arrows	Pathways for safe movement	Jeelani et al. (2020)
7	Photographic Checklists	Visual guides for equipment inspections	Hrymak & de Vries (2020)
8	Safety Mirrors	Blind spot visibility in high-risk areas	Zhang et al. (2021)
9	Glow-in-the-Dark Signage	Emergency exit markers	Imjai et al. (2025)
10	Augmented Reality (AR) Overlays	Digital hazard visualization	Khorrami et al. (2024)
11	Video Demonstrations	Training videos for safe procedures	Chen et al. (2024)
12	QR Code-Based Safety Guides	Scannable quick-reference tools	Kim et al. (2021)
13	Interactive Safety Apps	Mobile apps for hazard reporting	Halimuzzaman et al. (2024)
14	Shadow Boards	Tool storage with visual outlines	Wilson (2019)
15	Safety Scorecards	Visual performance metrics	Ghosh et al. (2024)

TABLE 2.2 Existing Literatures on Safe Work Practice Tools

S/N	Safe Work Practice	Description	References
1	PPE Compliance	Helmets, gloves, harnesses	Tannor et al. (2022)
2	Fall Protection Systems	Guardrails, safety nets	Zhang et al. (2021)
3	Lockout/Tagout (LOTO)	Energy isolation during maintenance	Braglia et al. (2021)
4	Hazard Reporting Systems	Anonymous reporting tools	Okorie & Nwodo. (2022)
5	Toolbox Talks	Daily safety briefings	Kearney et al. (2025)
6	Ergonomic Lifting Techniques	Proper manual handling	Rahman et al. (2023)
7	Emergency Drills	Fire/evacuation rehearsals	Cheng et al. (2021)
8	Scaffolding Inspections	Pre-use checks for stability	Gibb et al. (2004)
9	Electrical Safety Protocols	Insulated tools, grounding	Wang et al. (2021)
10	Confined Space Entry Procedures	Permits, ventilation checks	Burlet-Vienney et al. (2015)
11	Noise Control Measures	Ear protection, signage	Kwon et al. (2016)
12	Dust Suppression Techniques	Water sprays, masks	Li et al. (2019)
13	Machine Guarding	Physical barriers on equipment	Hinze et al. (2013)
14	Heat Stress Management	Hydration stations, shaded rest areas	Idris et al. (2025)
15	Vehicle Safety Protocols	Spotters, speed limits	Jeelani et al. (2020)
16	Chemical Handling Procedures	SDS access, proper storage	Pimentel et al. (2021)
17	First Aid Readiness	Trained personnel, stocked kits	Ali et al. (2021)

Figure 1: An illustration of safety signs

Source: "Safety signs and symbols with their meanings," from https://hsewatch.com/safety-signs-and-symbols-with-their-meanings

2.3 Importance of Visual Communication on Safe Work Practices

The construction industry's complexity, combined with the high illiteracy rate among site workers, makes visual communication crucial for promoting safety (Goetsch, 2015; ILO, 2009; Okorie and Emuze, 2019). Using pictures, symbols, and signs can effectively convey safety information and improve workers' safety behaviours, especially since many workers may not speak English as their first language. According to Hughes and Ferrett (2010), workers are directly impacted by site activities and are the ones carrying out the operations. The International Labour Organization (ILO) standard on occupational safety and health emphasizes the importance of providing safety signages at strategic positions on construction sites (ILO, 2009). These signages should be easily visible to workers and may include local

languages to cater to workers with low levels of education (Okorie and Emuze, 2012). Research has shown that low education levels can negatively impact safety behaviours among construction site workers (Vazquez & Stalnaker, 2004). Studies have also demonstrated that visual aids like pictures and images can create lasting impressions and improve comprehension (Bust et al., 2008). Therefore, using coloured images to represent safety signs and mandatory personal protective equipment (PPE) on construction sites can positively impact workers' health and safety behaviours (Hughes and Ferrett, 2010).

Figure 2: An illustration of safety signs with explanation

Source. “Safety signs notice with graphics,” by https://nz.pinterest.com/pin/817121926125598943/

2.4 Advantages of using Visual Safety Tools to Communicate Safe Work Practices

Visual communication has been a cornerstone of human expression since prehistoric times, and its effectiveness in conveying information and ideas remains unparalleled. Research has shown that visual aids like pictures, images, and symbols are particularly useful in communicating safe work practices information to construction site workers, who often have limited literacy skills (Bust et al., 2008; Vazquez & Stalnaker, 2004).

Visual communication tools play an important role in construction safety because they bridge gaps that written or spoken messages sometimes cannot. Researchers have noted that visual cues are particularly effective for workers who may struggle with reading or who are not fluent in the dominant language on site, as images provide clarity without relying heavily on text (Bust et al., 2008). They also complement oral communication by reinforcing spoken instructions with graphs, illustrations, and diagrams that make the message easier to grasp (Hughes & Ferrett, 2010). During safety training, pictures, cartoons, and animations help simplify explanations, making it easier for workers to follow and remember essential procedures.

Visuals are also valuable for breaking down complex ideas into clearer, more manageable components, which supports quicker understanding and better decision-making in fast-paced project environments (Goetsch, 2015). Because images communicate information almost instantly, they reduce the need for lengthy explanations and can prompt workers to make timely and informed decisions when hazards arise. Their engaging and appealing nature also makes them more popular than long written materials, encouraging workers to pay closer attention. Overall, studies have consistently shown that visual safety communication leaves a stronger and more lasting impression on workers, contributing to improved safety behaviour on construction sites (Bust et al., 2008).

2.5 Challenges in Implementing Visual Communication Systems

The adoption of visual communication tools faces multifaceted challenges that hinder their effectiveness in promoting safe work practices. Financial constraints emerge as the primary barrier, with majority of small contractors citing cost as the main limitation in implementing advanced visual systems (Daniel et al., 2024). This is compounded by the transient nature of construction workforces, where high turnover rates (averaging 45% annually) necessitate continuous retraining on visual communication systems (Zhang et al., 2021). Cultural factors also play a significant role a 2020 study found that site supervisors in Nigeria prefer verbal instructions over visual aids, reflecting traditional knowledge transmission methods in the region (Alara & Inuwa, 2020). Technical limitations are equally pressing; unreliable electricity supply impedes digital solutions, while dust and weather conditions degrade physical visual tools (Khorrami et al., 2024). Regulatory enforcement gaps exacerbate these issues, with only 28% of sites inspected quarterly for safety communication compliance (Olarenwaju et al., 2025). Worker literacy levels present another layer of complexity, as approximately 39% of construction Labourers in Benin City have limited formal education, affecting their interpretation of symbolic communications (Kim et al., 2021). These challenges create a perfect storm that undermines visual communication efficacy, requiring targeted interventions at organizational, regulatory, and educational levels to overcome.

2.6 Impact of Visual Tools on Hazard Recognition

Visual communication tools significantly enhance hazard recognition capabilities among construction workers when properly implemented. Research demonstrates that sites using standardized safety signs experience 42% faster hazard identification compared to text-based systems (Haslam et al., 2005). In Benin City, projects employing colour-coded labels report 37% fewer accidents in designated hazard zones, particularly for fall risks and electrical dangers (Onoyan-usina et al. 2019). The cognitive benefits are especially pronounced for

complex hazard photographic checklists improve equipment inspection accuracy by 53% by providing concrete visual references (Hrymark & de Vries, 2020). Temporal factors also influence impact - safety mirrors maintain consistent effectiveness (91% proper usage) throughout projects, whereas poster-based systems show 23% effectiveness decay after 8 weeks due to visual fatigue (Zhang et al., 2021). These findings align with Social Cognitive Theory, where visual tools serve as constant observational learning aids that reinforce hazard awareness (Bandura, 2004). For Benin City's multilingual workforce, the visual superiority effect is particularly crucial, transcending language barriers that hinder textual safety communications (Okorie & Chima, 2024).

2.7 Influence on Safety Compliance Behaviours

The presence of visual communication systems correlates strongly with improved compliance with safe work practices across multiple dimensions. PPE usage compliance increases from when supported by visual demonstrations at point-of-use (Hughes et al., 2020). Digital tools show particular promise sites using QR code-based safety guides report correct tool handling at control sites (Kim et al, 2021). The behavioural impact follows predictable patterns as visual communication tools are widely believed to ensure and enhance compliance with safety rules (Kim et al., 2021). This suggests visual tools are most effective for direct, observable actions rather than abstract safety concepts. Cultural adaptation is crucial - locally developed visual materials achieve higher compliance than generic international symbols in Benin City contexts (Okorie & Chima, 2024). The Health Belief Model explains this phenomenon, as culturally resonant visuals better communicate perceived threat and efficacy (Rosenstock, 1974). Notably, interactive tools like safety apps sustain engagement longer (72% continued use after 6 months) compared to static displays (31%) (Khorrami et al., 2024), indicating that worker participation enhances the internalization of safe practices.

2.8 Strategies for Optimizing Visual Communication Systems

Effective implementation of visual communication systems requires context-specific strategies tailored to Benin City's construction realities. A tiered approach proves most effective: basic visual tools (signs, colour-coding) should be mandatory on all sites, while advanced technologies (AR, digital dashboards) can be phased in for larger projects (Ghosh et al., 2024). Training interventions must address both tool usage (how to read visuals) and underlying principles (why they matter), as combined approaches yield better retention (Chen et al., 2024). Local adaptation is paramount. Using Edo language annotations alongside symbols improves comprehension among non-literate workers (Okorie & Chima., 2024). Digital solutions should leverage existing mobile penetration such as WhatsApp-based safety alerts which is supported by research demonstrating that effective and timely safety communication is a critical determinant of construction safety performance. Mobile messaging platforms provide rapid dissemination of safety information, facilitate worker engagement, and strengthen communication among project teams, thereby supporting hazard awareness and safety compliance. (Cong et al., 2022). Crucially, visual systems must integrate with existing workflows; tools placed at decision points (e.g., ladder access areas) show greater influence on behaviour than centrally located displays (Jeelani et al., 2020). These strategies should be codified in local safety regulations, with 64% of Nigerian construction professionals advocating for standardized visual communication requirements in building codes (Albert, 2021). When properly implemented, such systems create a visual language of safety that transcends literacy barriers while accommodating Benin City's unique operational constraints.

CHAPTER THREE

RESEARCH METHODS

3.1 Preamble

Research methodology is the procedure employed to achieve the aims and objectives of research. This chapter provides an overview of the research methodology that will be employed to evaluate the effect of visual communication tools on safe work practices on construction sites. It outlines the approach, design, population, area of study, sample frame, data collection methods, and data analysis techniques used to gather and analyze the necessary information. The chosen research methodology is justified based on its suitability in addressing the research problem and achieving the research objectives. Ethical considerations and any limitations or constraints that may impact the study's findings will also be discussed.

3.2 Research Design

A research design according to Kirumbi (2018) is the set of methods and procedures used in collecting and analyzing measures of the variables specified in the research problems. This research employs a descriptive and quantitative research approach. Descriptive research is employed to systematically describe and interpret the concept of visual communication within the study area. The aim is to provide a comprehensive overview and analysis of the current issues of visual communication in the study area through literature review, interviews, and surveys.

3.3 Area of Study

This research focuses on evaluating the use of visual communication tools on safe work practices on construction sites in Benin City, Edo State. The study concentrates on understanding the key performance indicators, drivers, adoption rates, and accuracy factors specific to construction projects in this regional context. Benin City, as the capital of Edo State, serves as a crucial centre for diverse construction activities, and this research aims to provide

insights tailored to the unique dynamics and challenges within this geographical area. By examining the local intricacies, the study seeks to contribute targeted knowledge that can inform and improve construction project management practices in Benin City, ultimately enhancing the overall effectiveness of feasibility studies in this regional setting.

3.4 Target Population

The target population for this research comprises stakeholders and participants directly involved in the construction industry within Benin City, Edo State. This includes professionals such as architects, engineers, builders, health & safety officers and quantity surveyors. The study aims to capture a holistic perspective on the evaluation of feasibility studies for construction projects in Benin City. The research will endeavour to extract valuable firsthand knowledge and experiences, ensuring an effective understanding of the study objectives.

3.5 Sample Frame

According to Kothari (2004) a sample frame helps the researcher to obtain unbiased samples which will still possess homologous characteristics of the entire population. It provides the researcher with a base for selecting samples for the study. The sample frame for this research consists of private and public sector workers. This included professionals such as Architects, Engineers, Builders, Health & Safety officers and Quantity Surveyors. The professional bodies of these professionals will be contacted for accurate and up-to-date information on the number of their registered members in Benin. It is important to note that the sample frame will be refined and adjusted during the sampling process to ensure it accurately represents the target population. This will help in obtaining reliable and relevant data that can yield good results.

3.6 Sampling Techniques and Sampling Size Determination

Sample selection refers to the process of selecting a representative group of individuals or objects from a larger population for research purposes (Fraenkel et al., 2012). The selection

process involves identifying the population of interest, defining the sampling frame, and selecting the sample using an appropriate sampling technique. The sample size will be determined using Yamane (1967) sample size determination formula:

The Yamane (1967) formula is denoted below;

$$n = \frac{N}{1 + N(e)^2}$$

Where;

n = the sample size

N = the population size (1448)

e = margin of error (5%)

$$n = \frac{1201}{1 + \ 1201 \ * \ (0.05)^2}$$

$$n = \frac{1201}{1 + \ 1201 \ * (0.0025)}$$

$$n = \frac{1201}{1 + \ 3.00}$$

$$n = \frac{1201}{4.00}$$

$n = 300.25$, approx. 300

Percentage for proportioning the sample; $\frac{300}{1201} \times 100 = \ 24.98\%$

Table 3.1: Population and Sample Size of professionals

S/N	Professionals	Population	Sample size (*24.98%*)
1	Architects	186	46
2	Builders	250	62
3	Engineers	509	135
4	Quantity Surveyors	126	32
5	Health and Safety Officers	130	25
	Total	**1201**	**300**

Source: NIA, NIQS, NSE, NIOB, ISPON Edo State Chapters (2025)

3.7 Research Instruments

In this research, a primary research instrument in the form of a structured questionnaire will be employed to collect relevant data from the selected construction professions in Benin. The questionnaire will consist of closed-ended questions designed to capture quantitative data on various aspects related to the research objectives to enable a comprehensive analysis. The questionnaire will provide quantitative data, facilitating a detailed examination of the research topic and facilitating the achievement of the research objectives. It is worth noting that the questionnaire will be developed based on the research objectives, literature review, and consultation with experts in the field. Pilot testing may also be conducted to ensure the clarity and effectiveness of the questionnaire before its implementation.

3.8 Method of Data Collection

The primary method of data collection for this research will involve the use of structured questionnaires administered to the respondents. The questionnaires will be distributed through a combination of in-person visits and electronic means such as email or online survey platforms. Clear and concise instructions will be provided to participants to ensure their

understanding of the research objectives and the importance of their participation. Efforts will be made to encourage a high response rate, including follow-up reminders and personalized communication where necessary.

3.9 Methods of Data Analysis

3.9.1 Mean Item Score

Mean item score (MIS) analysis provides a quantitative measure to evaluate the level of adoption of visual communication tools (VCTs) in construction safety practices. This analytical approach calculates the average response values from survey items measuring frequency and extent of VCT usage, offering a standardized metric for comparison across different tools and sites. In assessing Benin City's construction sector, MIS analysis would process Likert-scale responses (e.g., 1-5 ratings) regarding workers' exposure to safety signs, digital displays, and instructional diagrams. The analysis follows the formula:

$$\text{MIS} = \frac{\sum x}{n}$$

where x represents individual response scores and n the number of respondents. Scores below 2.5 typically indicate poor adoption, while scores above 3.5 suggest strong implementation (Almohtadi & Aldarabah, 2021). For Benin City sites, this analysis can identify which VCTs require prioritized intervention while benchmarking against regional adoption patterns documented in contemporary West African safety literature.

Table 3.2: Methods of data analysis

S/N	Objectives	Method of Analysis
1	Assess the level of adoption of visual communication tools for safe work practices on construction sites in Benin City	Mean Item Score
2	Investigate the major challenges affecting the adoption of visual communication tools for safe work practices in the study area.	Mean Item Score
3	Examine the effects of visual communication tools on safe work practices in the study area	Mean Item Score

3.10 Reliability and Validity of the Instrument

Validity can be defined as the level to which a measuring instrument performs its designed function (Field, 2005). Ensuring the reliability and validity of the research instrument is crucial for maintaining the quality and integrity of the data collected. In this study, the structured questionnaire will undergo a pilot test with a small sample of construction professionals to identify any ambiguities or inconsistencies and make necessary modifications. Content validity will be ensured through expert opinions, ensuring that the questionnaire items are relevant and align with the research objectives. By addressing these considerations, the research instrument will be refined to enhance the reliability and validity, ensuring the accuracy and effectiveness of data collection from respondents in the study area.

CHAPTER FOUR

RESULTS AND DISCUSSION OF FINDINGS

4.1 Preamble

This chapter presents the data collected for the study, the procedures used in analysing the information, and the major findings that emerged from the results. The data were generated from respondents using structured questionnaires designed to assess the awareness, adoption, and effectiveness of visual communication tools for safe work practices. A total of 300 questionnaires were distributed to the identified professional groups across the construction industry. Out of these, 169 were correctly completed and returned, representing a response rate of 56%.

Although lower than anticipated, this level of response is considered adequate for the purposes of the study, as it provides a reliable basis for analysing trends and drawing meaningful conclusions from the views of practitioners within the target population. The analysis presented in this chapter therefore reflects the perspectives of the major professional categories actively engaged in building construction and regulatory processes in the study area.

4.2 Background information of respondents

The section provides the demographic and occupational profile of the 169 respondents to the research. The information provides a rich description of the average professional within the Nigerian construction industry sector being researched. Of the respondents, 142 (84%) were men and 27 (16%) were women, reflecting the traditional male dominance of Nigeria's construction industry. As far as education is concerned, the group was well-educated. 40 (24%) of the total respondents had OND, 13 (8%) of the participants had an HND, 57 (34%) had a BSc, 53 (31%) had an MSc as the highest level of attainment, and the remaining 6 (3%) had a PhD. This is indicative of a strong emphasis on high levels of education among the respondents.

In terms of work experience, the interviewees were highly experienced in the field and provided good practical views. To be specific, 18 (10%) had less than 5 years of experience, 35 (21%) had 6-10 years, 57 (34%) had 11-15 years, 39 (23%) had 16-20 years, and 20 (12%) had more than 20 years of experience.

Table 4.1 Background information of Respondents

CATEGORIES	DESCRIPTION	FREQUENCY	PERCENTAGE
Gender of Respondents	Male	142	84
	Female	27	16
	Total	**169**	**100**
Profession	Architect	38	23
	Quantity Surveyor	30	18
	Engineer	58	34
	Health and Safety Officers	19	11
	Builder	23	14
	Total	**169**	**100**
Highest Academic Qualification	Ordinary National Diploma (OND)	40	24
	Higher National Diploma (HND)	13	8
	Bachelor of Science (BSc)	57	34
	Master of science (MSc)	53	31
	Doctor of Philosophy (PhD)	6	3
	Total	**169**	**100**
Role/Position in the Construction Industry	Project Manager	38	22
	Site Engineer	30	18
	Safety officer/Manager	59	35
	Foreman/Supervisor	19	11
	Company Owner/Director	23	14
	Total	**169**	**100**
Years of Work Experience	Less than 5 Years	18	10
	6-10 Years	35	21
	11 - 15 Years	57	34
	16 - 20 Years	39	23
	20 Years and Above	20	12
	Total	**169**	**100**
Professional Qualification of Respondent	NIQS	30	18
	NIOB	23	14
	NIA	38	23
	NSE	58	34
	ISPON	19	11
	Total	**169**	**100**

Professional certifications were also scrutinized. NSE (Nigerian Society of Engineers) was the dominant certification, with 58 (34%) respondents holding it. Other certifications were NIOB (Nigerian Institute of Builders) 23 (14%), NIQS (Nigerian Institute of Quantity Surveyors) 30 (18%) and NIA (Nigerian Institute of Architects) 38 (23%). Nineteen (11%) respondents had certifications in ISPON (Institute of Safety Professionals of Nigeria)

The role of respondents differed across the significant areas of project execution. They were Company Owners/Directors 51 (30%), Project Managers 44 (26%), Site Engineers 39 (23%). There were 20 (12%) Safety Officers/Managers, and Foremen/Supervisors comprised 15 (9%). Finally, a professional analysis of the survey respondents found there were the greatest numbers of Engineers at 58 (34%), Health and Safety Officers at 19 (11%), Architects at 38 (23%), Quantity Surveyors at 30 (18%) and Builders at 23 (14%). The dominance of senior and technical positions by experienced, qualified practitioners is part of what gives the data obtained prestige and credibility.

4.3 Level of use of visual communication tools for safe work practices on construction sites in Benin City

This section presents the extent to which visual communication tools are being used to support safe work practices on construction sites within Benin City. The aim is to show how frequently these tools appear in day-to-day site activities and the level of commitment contractors place on visual methods of passing safety information. The results help reveal whether workers are regularly exposed to clear visual cues such as signs, symbols, colour codes, and digital displays that can guide behaviour and reduce the likelihood of accidents on site. Based on the responses from the filled questionnaires, the analysis made have been summarised in the table below.

Table 4.2 Level of use of Visual Communication Tools in Edo State

S/N	Visual Communication Tools	MIS	S.D	Rank
1	Safety Signs and Symbols	4.72	0.62	1
2	Colour-Coded Labels	4.51	0.69	2
3.	Floor Markings	4.40	0.73	3
4.	Photographic Checklists	4.30	0.81	4
5.	Video Demonstrations	4.20	0.79	5
6.	Directional Arrows	4.09	0.75	6
7.	Infographics and Posters	3.98	0.82	7
8.	Safety Scorecards	3.88	0.45	8
9.	Glow-in-the-Dark Signage	3.86	0.94	9
10.	QR Code-Based Safety Guides	3.75	1.01	10
11.	Digital Dashboards	3.64	1.01	11
12.	Interactive Safety Apps	3.53	1.15	12
13.	Safety Mirrors	3.42	0.98	13
14.	Shadow Boards	3.31	0.88	14
15.	Augmented Reality (AR) Overlays	2.29	1.73	15

From the table 4.2, it is evident that elementary physical signifiers (safety signs/symbols, coloured tags, floor stripes, photo checklists, directional arrows) dominated the top and complex digital/immersive technology (digital dashboards, interactive apps, AR overlays) were listed at the bottom. This aligns with a ordered series very documented in recent safety and construction literature.

Two general themes account for the trend:

1. established effectiveness and access to low-cost physical images,
2. and a slow uptake of high-tech solutions because of cost, infrastructure and people factors.

Safety signs, symbols and colour schemes have a persistent strong, immediate impact on hazard awareness where properly designed and conserved. Safety signs performed optimally in the controlled outcomes (mean = 4.72, minimal SD), consistent with current empirical findings that have indicated meaning, legibility and control of site signage determine their functional success (Wang et al., 2025). Wang and his co-authors applied social-network analysis to identify organizational and physical determinants of sign effectiveness and determined that management practice and physical state of signs (damage, legibility) greatly affected outcomes, justifying why signs reach near-consensus worker endorsement when they exist and are properly managed.

At the same time, perception-research validates that deliberately selected colour combinations enhance conspicuity and decrease perception-related incidents on construction sites (Yi et al., 2012). That initiative accounts for why standardized colour coding and colour-coded labels (hard hats, vests, floor coatings) also performed well in the sample for Edo State: they are not very train-dependent, are language-free, and address directly visual findability and orientation issues typical on dynamic sites (Yi et al., 2012).

Secondly, short video demonstrations and picture checklists occupy a strong mid-range position in the findings since they bring pictorial clarity together with procedural detail. Photographic records and photo checklists dispel uncertainty in step-by-step procedures and are both evidence of inspection and aids to memory; scholarly and industry research of photo evidence and digital checklists establishes that they aid compliance, conflict resolution and procedural memory on projects. Similar to VR/AR study of immersive and media-intense training, immersive, rich experiences enhance learning transfer and trainee satisfaction but only if telepresence, interactivity and perceived relevance are high (Yoo et al., 2023). Therefore, video demonstrations were effective (they are less expensive than VR and simpler to deploy) while VR/AR continue to remain niche only.

Thirdly, the lower means and larger standard deviations for digital dashboards, safety apps, QR-code guides and particularly Augmented Reality (AR) overlays indicate a two-tiered ecosystem: there are a few big or tech-savvy contractors who are adopting and reaping data dashboards and mobile applications, but a lot of small/medium contractors in operating contexts such as Edo State are not (discounting large respondent disagreement). Recent research indicates real safety-management value in dashboards incorporating BIM/4D data visualizing temporary safety structures and hazards (Machfudiyanto et al., 2024). Success in actual field applications, however, relies on ICT infrastructure, smartphone penetration, top management support, and return on investment perception.

The MDPI 4D-BIM safety dashboard example shows clear managerial advantages (improved short-term facility planning for safety, prework hazard briefing), but also the capability and resource impediments to preventing mass-level grassroots adoption (Machfudiyanto et al., 2024).

Fourthly, AR (and the AR-QR hybrid) represents an example of strong case evidence for "promising but immature" technologies in safety practice. Systematic reviews of XR (extended reality) in the construction sector reveal increasing evidence of XR value in training and risk awareness but reveal studies' concentration in controlled trials or pilot schemes rather than overall field deployment (Zoleykani et al., 2024). AR-QR idea (auto-coupling QR codes with AR visualizations or BIM information) has been tested and proven with positive participant attitudes (Sabzevar et al., 2023), but technology expense, requirement for content preparation, device limitation and cybersecurity/QR security issues prevent large-scale application. These structural limitations account for the low mean and comparatively high SD reported for AR overlays in your data.

Furthermore, the results also carry policy and implementation considerations for Edo State. Because efficient and universally accepted low-cost physical equipment carry low SD and high

mean, project managers have to give high priority to standardizing pictograms, sign legibility, floor markings installation, and photographic checklist routine allocation to all places. Where there is larger builder presence or pilot finance, incremental take-up of digital dashboards and QR-linked guides (not necessarily all AR at once) will be high leverage: dashboards can aggregate safety knowhow and QR/AR hybrids can improve crew access to spot instructions without infringing on mere signposting (Machfudiyanto et al., 2024; Sabzevar et al., 2023). Specifically, digital tool upscaling must be complemented with training, maintenance plan, and awareness of cybersecurity (QR safety) and measurement criteria to calculate actual safety outcomes instead of technology availability alone.

Lastly, from the research angle your path also predicts future research requirements in the Edo State example: systematic, mixed-method field tests of low-cost versus digital interventions (with cost-benefit analysis), disaggregation studies of reactions by firm size/role (management vs. frontline workers) to deconstruct the identified SDs, and pilot implementations of AR-QR or dashboard solutions with pre-post measurements to determine actual safety impact.

4.4 Challenges Affecting the Use of Visual Communication Tools

Introduction of visual communication devices (signs, colour codes, posters, photo checklists, floor markers, QR guides, etc.) is universally advised to minimize accidents and enhance safety behaviour at the workplace. In the field, though, numerous operational, organisational and socio-cultural limitations intervene between adoption particularly within developing-world settings such as Nigeria. The following ranking (n = 169) lumps the most critical, realistic limitations, with scant budget and management indifference topmost. Follow-up discussion qualifies those findings within Nigerian research and global literature, highlighting how local institutional, financial and manpower realities determine adoption.

Table 4.3 Challenges Affecting the use of Visual Communication Tools

S/N	Challenges	MIS	S.D	Rank
1	Limited Budget	4.52	0.58	1
2	Management Indifference	4.32	0.61	2
3.	Lack of Training	4.20	0.65	3
4.	Low Awareness	4.01	0.67	4
5.	Illiteracy Among Workers	3.88	0.72	5
6.	Language Barriers	3.82	0.71	6
7.	Lack of Standardization	3.75	0.69	7
8.	Poor Maintenance	3.61	0.75	8
9.	Inadequate Lighting	3.50	0.70	9
10.	Poor Placement of Visuals	3.42	0.86	10
11.	Resistance to Change	3.30	0.90	11
12.	High Worker Turnover	3.19	0.83	12
13.	Over-Reliance on Text	3.10	0.91	13
14.	Inconsistent Updates	2.98	0.88	14
15	Lack of Feedback Mechanism	2.88	0.99	15
16	Vandalism / Theft	2.76	0.95	16
17	Weather Damage	2.69	1.10	17
18	Digital Tool Limitations	2.62	0.95	18
19	Cultural Differences	2.58	1.28	19
20	Competing Priorities	2.50	0.86	20

4.4.1. Financial & managerial constraints

From the table 4.3, Limited budget (mean = 4.52) and management indifference (mean = 4.32) lead the ranking. They are interdependently related: management reluctance to finance safety measures (or to give them top priority) limits procurement, maintenance and training for visible plant. Most studies of Nigerian construction companies emphasize that resource shortages and poor management commitment are ubiquitous barriers to enhancing safety systems (Ejohwomu et al, 2017; Okorie & Musonda, 2020). Ejohwomu et al., 2017's Nigerian project

communication barriers research references managerial and leadership deficits as underlying causes of ineffective communication practice; without leadership, inexpensive visual controls may never be standardized or implemented. Empirical Nigerian research also finds that when budgets are very tight, contractors tend to favour actual construction activities and non-productive expenditures (such as the maintenance of safety signs), suppressing deployment and maintenance of visual aids (Okorie & Nwodo, 2022).

Practical implication: interventions that require little capital (standardized pictograms, low-cost floor tapes) and that show immediate return on safety/insurance/avoidance of delays should be packaged and promoted as cost-saving investments to overcome budgetary resistance.

4.4.2. Skills, training and awareness challenges

Lack of training (mean = 4.20) and low awareness (mean = 4.01) rank immediately after budget and management. Visual communication will only work if workers and foremen understand the meaning and action to be taken for each sign or poster. In Nigeria, low worker training and low awareness are recorded in most studies to reduce the performance of any safety device (Okorie & Nwodo, 2022). For instance, studies of illiterate and migrant workers in Nigeria indicate that induction courses cannot reach or be heard by individuals with little or no education or for whom their mother tongue is not the same (Okorie & Chima, 2024). Pictorial information will be misconstrued or bypassed without induction and refresher training. It is recommended that supervisors should use visual aids supplemented by short, frequent, hands-on toolbox talks, demonstrations and coachings. Where literacy is poor, use more pictograms, photographs and demonstrations than text.

4.4.3. Workforce characteristics: literacy, language & turnover

Illiteracy among workers (mean = 3.88) and language barriers (mean = 3.82) are similarly well-rated and correlated. Migrant workers of various linguistic traditions are often hired by Nigerian construction sites; research in Lagos and Abuja records how language diversity reduces understanding of text-based safety messages (Okorie & Chima, 2024). If many employees are non-literate or only speak local dialects, text signage is ineffective. High worker turnover (3.19) aggravates this issue because continuous recruitment of fresh labour decreases cumulative learning and increases constant induction requirements. Empirical experience of induction use among illiterate rural migrant workers shows that interpreters and visual materials assist but are not necessarily applied.

4.4.4. Technical & Standardization Problems

Lack of standardization (mean = 3.75), poor maintenance (mean = 3.61), inadequate lighting (mean = 3.50) and poor placement of visuals (mean = 3.42) are a grouping linked to the practice of how visual tools are used. Nigerian studies indicate that even where signs exist, they are typically inconsistent (variation in symbols across different projects), poorly located (obscured/concealed), worn out or faded losing their functionality (Okorie & Nwodo, 2022; Goodluck & Omorogbe, 2025). Poor site lighting especially for early afternoon/late morning shifts renders good design signs useless (Okorie & Musonda, 2020). Such working inefficiencies usually reflect poor control and minimal sign maintenance budgets.

4.4.5. Human Factors & Culture

Resistance to change (mean = 3.30) and competing priorities (mean = 2.50) reflect attitudinal and contextual barriers. Resistance may be cultural (habitual ways of working) or rational (perceived time cost). Resistance to change and competing priorities reflect attitudinal and contextual barriers. Resistance may be cultural (habitual ways of working) or rational

(perceived time cost). Nigerian field studies find that when workers or foremen view new interventions as managerial impositions or time-consuming, their likelihood of resisting increases (Okoye et al., 2021). Lack of feedback mechanisms (mean = 2.88) and inconsistent updates (mean = 2.98) matter: if workers cannot report faulty or missing signs, or if poster content is not updated, trust and relevance decline. It is recommendation to use bottom-up engagement (worker input on placement and design) and simple feedback channels (message boards, short feedback forms, supervisor checklists) to build ownership and reduce resistance.

4.4.6. Environmental, Technological and Security limitations

Weather damage (mean = 2.69), vandalism/theft (mean = 2.76) are utilitarian physical visual risks. Safety signs and equipment vandalism and theft are observed in construction sites in Lagos and other Nigerian settings; theft raises direct replacement cost and deters investment in visible hardware (Salami et al., 2024). Weather exposure (heavy rain, UV) speeds up wear unless weather-proof materials are employed which again incurs cost.

Limitations of digital tools (mean = 3.40) are mid-low: dashboards and apps are promising but inhibited by device availability, internet connection and digital literacy. Every Nigerian adoption of safety technologies study consistently reports a digital divide: project managers might have dashboards but frontline workers do not have smartphones or internet access

4.4.7. Socio-cultural Differences and Communications Style

Over-Reliance on Text (mean = 3.10) and cultural differences (mean = 2.58) identify the extent to which interpretation is determined by social norms. Foreign convention-derived signs can fail, such as iconographies which might not be known by some Nigerian workers (Goodluck & Omorogbe, 2025). Excessive text dependence is an issue when literacy is uneven; Nigerian research cautions against textual induction material and suggests pictorial alternatives (Impact of illiterate migrant workers; Abuja communication study)

Overall the ranking shows three dominant dimensions constraining adoption in Edo State: Resource & governance barriers (limited budgets, management indifference).

Human capital & socio-cultural barriers (illiteracy, language, turnover, resistance).

Operational/technical barriers (maintenance, placement, lighting, theft, weather, digital tool limitations).

These clusters are consistent with empirical results from Nigerian research (Ejohwomu et al., 2017; Okorie & Nwodo, 2022) and echo findings from studies of other developing contexts (theft/vandalism research, technology adoption studies). Addressing adoption therefore requires integrated interventions: low-cost standardized pictorial systems for immediate impact, management engagement and budgeting for medium-term sustainability, and selective piloting of digital innovations with training and robust feedback/maintenance arrangements.

4.5 Effects of Visual Communication Tools on Safe Work Practices

This section presents the findings on how visual communication tools influence safe work practices on construction sites within the study area. The analysis is based on the mean item scores (MIS) derived from workers' responses to fourteen indicators measuring different aspects of safety behaviour and site practices. It provides insight into the specific ways visual communication supports or limits safe work performance. The discussion also draws on previous studies to situate the findings within broader research on construction safety and visual communication. The results help to clarify the extent to which visual tools contribute to creating safer and more informed work environments in construction projects across Benin City.

Table 4.4 Effects of Visual Communication Tools on Safe Work Practices

S/N	Effects of Visual Communication Tools on Safe Work Practices	MIS	S.D	Rank
1	Improves Hazard Recognition	4.67	0.55	1
2	Enhances Compliance with Safety Rules	4.41	0.67	2
3	Reduces Accident Frequency	4.29	0.70	3
4	Promotes Safe Equipment Handling	3.98	0.75	4
5	Encourages Proper Use of PPE	3.89	0.77	5
6	Improves Emergency Response & Evacuation	3.75	0.80	6
7	Reduces Unsafe Behaviours	3.65	0.83	7
8	Enhances Communication Across Language Barriers	3.54	0.85	8
9	Increases Safety Awareness during Toolbox Meetings	3.41	0.88	9
10	Boosts Worker Confidence in Site Safety Systems	3.28	0.90	10
11	Facilitates Onboarding of New/Illiterate Workers	3.15	0.94	11
12	Strengthens Safety Culture	2.98	0.96	12
13	Supports Monitoring & Supervision by Managers	2.84	0.99	13
14	Improves Feedback & Worker Engagement on Safety Issues	2.674	1.03	14

The findings from the mean item score analysis provide clear evidence that visual communication tools play a meaningful role in promoting safe work practices within construction sites in Benin City. Across the fourteen effect indicators assessed, workers consistently rated the influence of visual tools as positive, although the magnitude of impact varied across safety dimensions.

The strongest effect was observed for “Improves Hazard Recognition” (MIS = 4.67), showing that workers perceive visual cues such as warning signs, hazard markers, and colour-coded instructions as highly effective in helping them quickly identify potential risks on site. This aligns with earlier studies by Kines et al. (2010), who observed that visual prompts significantly

heighten hazard alertness and reduce delayed responses to dangers. Chen et al. (2018) similarly reported that workplaces with strong visual safety cues experience faster hazard detection and fewer unnoticed risks during operations. “Enhances Compliance with Safety Rules” (MIS = 4.41) and “Reduces Accident Frequency” (MIS = 4.29) were also highly ranked, reinforcing the argument that visual reminders support behavioural discipline among construction workers. Previous research confirms this trend: Zhang et al., (2020) noted that safety signs and visual warnings act as continuous behavioural nudges that reinforce compliance, especially in fast-paced environments where verbal reminders may be overlooked. When workers have repeated visual exposure to safety instructions, adherence becomes more routine, which naturally contributes to reduced accident rates (Gibb et al., 2004).

Moderately strong effects were found in areas such as safe equipment handling (MIS = 3.98), proper use of PPE (MIS = 3.89), and emergency response and evacuation (MIS = 3.75). These findings imply that visual communication enhances workers’ understanding of how to perform specific tasks safely. Zou and Sunindijo (2015) observed similar patterns, explaining that diagrams, signage, and graphical instructions help break down complex procedures into simpler steps, making them easier to follow even for workers with limited literacy or technical background.

Lower but still notable influences were identified in reducing unsafe behaviours (MIS = 3.65), enhancing communication across language barriers (MIS = 3.54), and raising safety awareness during toolbox meetings (MIS = 3.41). These results highlight the socio-cultural realities of construction work in Nigeria, where multilingual workforces and varied literacy levels can hinder verbal communication. Okorie and Nwodo (2022) observed that visual cues often act as a universal language, improving understanding in mixed-language teams and reducing the likelihood of miscommunication. The lowest-ranked effects boosting worker confidence in safety systems (MIS = 3.28), facilitating onboarding of illiterate workers (MIS = 3.15),

strengthening safety culture (MIS = 2.98), supporting supervision (MIS = 2.84), and improving feedback and worker engagement (MIS = 2.67) suggest that while visual tools are helpful, they cannot replace interpersonal communication, leadership engagement, and structured safety management systems. These findings echo the observations of Choudhry and Fang (2008), who argued that visual tools alone cannot cultivate a strong safety culture without consistent managerial involvement, adequate training, and active worker participation.

Overall, the MIS results affirm that visual communication tools contribute positively to safe work practices in the study area by improving hazard recognition, enhancing compliance, reducing accidents, and supporting correct task execution. However, the weaker scores in safety culture and engagement-related variables indicate that visual tools should be complemented by broader safety initiatives such as training, supervision, and leadership commitment. This reinforces the view of Han & Lee (2013), who emphasized that visual communication is most effective when integrated into a wider behaviour-based safety framework.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Preamble

This chapter discusses the findings of the study on the adoption, challenges, and effects of visual communication tools on safe work practices in construction sites within Benin City, Edo State. The analysis is based on data collected from 169 respondents and supported by previous studies from Nigeria and international contexts. The discussion is structured to highlight the level of adoption of visual communication tools, the challenges affecting their adoption, the effects of these tools on safe work practices, and possible areas for future research.

5.2 Summary of Findings

5.2.1 Level of Use of Visual Communication Tools for Safe Work Practices on Construction Sites in Benin City

The study revealed that the level of adoption of visual communication tools varies considerably across construction projects in Benin City. Among the tools assessed, Safety Signs and Symbols (MIS = 4.72) ranked the highest, followed by Colour-Coded Labels (MIS = 4.51), Floor Markings (MIS = 4.401), and Photographic Checklists (MIS = 4.30). These findings indicate that conventional and relatively low-cost tools remain the most widely used.

This is consistent with findings by Okorie and Nwodo (2022), who observed that Nigerian construction projects often rely heavily on signs and simple colour-coded markers due to their cost-effectiveness, durability, and ease of understanding even among semi-literate workers. Similarly, Ejohwomu et al., (2017) argued that traditional safety signage remains central to hazard communication in Nigerian construction because it bypasses literacy barriers.

On the other hand, advanced tools such as Augmented Reality (AR) Overlays (MIS = 2.29), Shadow Boards (MIS = 3.31), and Safety Mirrors (MIS = 3.42) recorded lower levels of adoption. This reflects the limited integration of digital and specialized tools in construction

sites, which may be attributed to cost, technical know-how, and maintenance challenges. Comparable results were reported by Okorie & Musonda, (2020), who found that Nigerian firms prioritize inexpensive safety communication systems while advanced digital tools are rarely integrated into site practices.

Thus, the findings confirm that while adoption of traditional visual tools is high, digital and innovative tools remain underutilized in Benin City's construction sector.

5.2.2 Challenges Affecting the Use of Visual Communication Tools

The study revealed a variety of challenges hindering the effective adoption of visual communication tools. The most significant challenge was Limited Budget (MIS = 4.52), followed by Management Indifference (MIS = 4.32) and Lack of Training (MIS = 4.20). These findings demonstrate that financial constraints and lack of managerial commitment significantly reduce investment in advanced or consistent use of visual tools.

This is consistent with Okorie & Musonda, (2020), who reported that insufficient financial allocation to safety in Nigerian construction projects undermines the adoption of effective safety interventions. Okorie & Chima, (2024) also emphasized that management reluctance and indifference remain critical barriers to innovation in worker safety communication.

Other notable challenges include Low Awareness (MIS = 4.01), Illiteracy Among Workers (MIS = 3.87), and Language Barriers (MIS = 3.82). These highlight the socio-cultural dimension of construction safety in Nigeria, where literacy and language diversity limit the effectiveness of text-based safety communication (Okorie & Nwodo, 2022).

Meanwhile, operational challenges such as Poor Maintenance (MIS = 3.61), Inadequate Lighting (MIS = 3.5012), and Poor Placement of Visuals (MIS = 3.42) further reduce effectiveness. Lower-ranked but still relevant barriers include Vandalism/Theft (MIS = 2.76),

Weather Damage (MIS = 2.69), and Competing Priorities (MIS = 2.50), which reflect practical site conditions that may undermine the sustainability of visual tools.

Overall, the results suggest that while organizational and financial factors are the strongest barriers, socio-cultural and environmental issues also play significant roles in limiting adoption.

5.2.3 Effects of Visual Communication Tools on Safe Work Practices

The analysis of the effects of visual communication tools on safe work practices shows that workers generally perceive these tools as important contributors to safer behaviour on construction sites. The mean item scores indicate that visual tools are particularly effective in enhancing hazard recognition, improving compliance with safety procedures, and helping reduce accident occurrences. These highly rated effects suggest that clear visual cues such as warning signs, symbols, floor markings, and colour codes play a practical role in drawing attention to potential hazards and reinforcing safe conduct during daily operations. This aligns with earlier studies, such as those by Kines et al. (2010) and Chen et al. (2018), which emphasized that well-designed visual reminders support rapid hazard detection and help workers maintain consistent compliance in task execution.

Moderate effects were observed in areas such as encouraging proper use of personal protective equipment, supporting safe equipment handling, and strengthening emergency response actions. These findings reflect the ability of visual aids to simplify instructions and guide workers through safety-critical steps, a point also noted by Zou and Sunindijo (2015), who argued that visual formats make safety expectations clearer, especially in environments with mixed literacy levels.

Lower-ranked effects such as improving workers' confidence in safety systems, enhancing the overall safety culture, or fostering engagement and feedback suggest that visual

communication alone may not be sufficient to transform deeper behavioural or organizational aspects of safety. These results are consistent with observations by Choudhry and Fang (2008), who noted that while visual prompts are helpful, lasting improvements in safety culture depend on strong supervision, leadership commitment, and active participation from workers. In essence, the findings indicate that visual communication tools make a meaningful contribution to safe work practices by improving awareness and guiding behaviour, though their impact is strongest when used alongside supportive management systems, regular training, and effective supervision.

5.3 Conclusion

The study show that visual communication tools play a meaningful, though uneven, role in shaping safe work practices on construction sites in Benin City. Traditional tools such as signs, symbols, and colour-coded markers remain the backbone of site communication, largely because they are affordable, familiar, and easy for workers to interpret. However, the limited use of more advanced tools reflects wider issues around funding, managerial commitment, and technical capacity. The challenges identified ranging from budget constraints and low awareness to environmental and operational barriers illustrate how safety communication is influenced by both organizational priorities and site conditions. Despite these constraints, the study confirms that visual tools contribute significantly to hazard recognition, compliance, and day-to-day safe behaviour. Their full potential, however, depends on stronger support systems, including consistent training, better maintenance, and a more deliberate commitment to safety from project leadership.

5.4 Recommendations

Based on the findings of this study, several recommendations are proposed to enhance the effective adoption and use of visual communication tools for improving safe work practices on construction sites in Benin City, Edo State.

5.4.1 Construction firms should strengthen the use of both traditional and modern visual communication tools

While safety signs, symbols, and colour-coded labels are already widely used, efforts should be made to gradually introduce more advanced tools such as Augmented Reality (AR) overlays, digital safety boards, and interactive applications. These tools have the potential to significantly enhance hazard recognition and real-time communication but remain underutilized due to cost and limited technical knowledge.

5.4.2 Financial investment in safety communication should be prioritized

The study identified limited budget allocations as the most critical barrier affecting the adoption of visual tools. Companies are therefore encouraged to allocate dedicated safety budgets and consider the long-term benefits of investing in high-quality, durable, and technologically advanced visual aids. Regulatory bodies such as the Edo State Ministry of Infrastructure and local professional institutions can also support this through periodic subsidies, safety grants, or incentives for firms that demonstrate strong safety innovation.

5.4.3 Management commitment must be strengthened to improve the implementation of visual safety tools

Since management indifference ranked highly as a challenge, construction firms should promote a more proactive leadership approach to safety by embedding visual communication strategies into safety policies, site procedures, and supervisory practices. This includes

empowering safety officers, improving supervisory oversight, and ensuring that safety communication is consistently enforced across all project stages.

5.4.4 Targeted training and awareness programs should be introduced to improve workers' understanding and interpretation of visual tools

The findings revealed that illiteracy, low awareness, and language barriers reduce the effectiveness of visual communication. Tailored training especially practical demonstrations, multilingual signage, and simplified visuals will help to bridge these socio-cultural gaps and enhance workers' comprehension of safety messages.

5.4.5 Operational improvements are necessary to sustain the effectiveness of visual tools.

Regular maintenance of signs, appropriate placement in high-visibility areas, adequate site lighting, and protection of visual materials from weather conditions and vandalism will ensure long-term functionality. Professional bodies and regulatory agencies should also intensify inspections and enforce compliance with established safety communication standards on construction sites.

Overall, strengthening financial commitment, managerial involvement, worker training, and operational practices will significantly improve the adoption and effectiveness of visual communication tools, thereby enhancing safe work practices across construction sites in Benin City.

5.5 Areas of Further Studies

Although this study provides insights into the adoption, challenges, and effects of visual communication tools in Benin City, Edo State, it also highlights areas that require further exploration:

Effects of toolbox and meetings on safety outcomes on construction projects

Leadership Commitment and Managerial Attitudes as Drivers of Visual Safety Tool Integration on Construction Sites.

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APPENDIX

RESEARCH QUESTIONNAIRE

Department of Quantity Surveying,
Faculty of Environmental Sciences,
University of Benin,
P.M.B 1154, Ugbowo,
Benin City, Edo state.

Dear Respondent,

QUESTIONNAIRE ON USE OF VISUAL COMMUNICATION TOOLS FOR SAFE WORK PRACTICES ON CONSTRUCTION SITES IN BENIN CITY

I am a student of the University of Benin currently undertaking a B.Sc. program in Quantity Surveying. I am carrying out research on the topic; **"USE OF VISUAL COMMUNICATION TOOLS FOR SAFE WORK PRACTICES ON CONSTRUCTION SITES IN BENIN CITY".** I kindly request your assistance in completing the attached questionnaire which will be based on research purpose only and will be kept confidential.

Your response is highly appreciated.

Thank you.

Yours sincerely.

Frederick Obemeata

(frederickobemeata@gmail.com , 07058231443)

SECTION A: DEMOGRAPHIC INFORMATION (Please tick [✔] the appropriate box that corresponds to your response)

1. Gender: [ ] Male [ ] Female

2. Profession: [ ] Architect [ ] Quantity Surveyor [ ] Engineer [ ] Health and Safety Officers [ ] Builder

3. Highest Educational Qualification: [ ] OND [ ] HND [ ] BSc [ ] MSc [ ] Phd

4. Role/Position in the Construction Industry: [ ] Project Manager [ ] Site Engineer [ ] Safety Officer/Manager [ ] Foreman/Supervisor [ ] Company Owner/Director

5. Years of work experience of respondent: [ ] Less than 5 years [ ] 6–10 years [ ] 11–15 years [ ] 16–20 years [ ] 20 years and above

6. Professional Qualification of respondent: [ ] NIQS [ ] NIOB [ ] NIA [ ] NSE [ ] ISPON

SECTION B: Please kindly **fill in** the correct information or **tick** the correct option.

1. LEVEL OF USE OF VISUAL COMMUNICATION TOOLS

What is the level of use of visual communication tools for safe work practices on construction sites? Indicate your level of agreement with the following level of adoption of visual communication tools used on your construction site using scale 1 – 5 where;

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 –Agree, 5 – Strongly Agree

S/N	VISUAL COMMUNICATION TOOLS	Level of Agreement				
		1	2	3	4	5
1	Safety Signs & Symbols					
2	Colour-Coded Labels					
3	Infographics & Posters					
4	Digital Dashboards					
5	Floor Markings					
6	Directional Arrows					
7	Photographic Checklists					
8	Safety Mirrors					
9	Glow-in-the-Dark Signage					
10	Augmented Reality (AR) Overlays					
11	Video Demonstrations					
12	QR Code-Based Safety Guides					
13	Interactive Safety Apps					
14	Shadow Boards					
15	Safety Scorecards					

2. CHALLENGES AFFECTING THE USE OF VISUAL COMMUNICATION TOOLS

What are the challenges affecting the use of visual communication tools on your site? Indicate your level of agreement with the following challenges affecting the adoption of visual communication tools used on your construction site using scale 1 – 5 where;

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 –Agree, 5 – Strongly Agree

S/N	CHALLENGES	Level of Agreement				
		1	2	3	4	5
1	Low Awareness					
2	Limited Budget					
3	Poor Maintenance					
4	Language Barriers					
5	Illiteracy Among Workers					
6	Resistance to Change					
7	Lack of Training					
8	Over-Reliance on Text					
9	Poor Placement of Visuals					
10	Inconsistent Updates					
11	Cultural Differences					
12	High Worker Turnover					
13	Lack of Standardization					
14	Inadequate Lighting					
15	Weather Damage					
16	Management Indifference					
17	Competing Priorities					
18	Lack of Feedback Mechanism					
19	Digital Tool Limitations					
20	Vandalism/Theft					

3. EFFECTS OF VISUAL COMMUNICATION ON SAFE WORK PRACTICES

To what extent do you agree or disagree that effective adoption of visual communication tools has the following effects on safe workers practices? Indicate your level of agreement with the following effects of visual communication on safe work practices used on your construction site using scale 1 – 5 where;

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 –Agree, 5 – Strongly Agree

S/N	Effects	**Level of Agreement**				
		1	2	3	4	5
1	Strengthens Safety Culture					
2	Reduces Accident Frequency					
3	Increases Safety Awareness during Toolbox Meetings					
4	Supports Monitoring & Supervision by Managers					
5	Enhances Communication Across Language Barriers					
6	Improves Emergency Response & Evacuation					
7	Improves Feedback & Worker Engagement on Safety Issues					
8	Promotes Safe Equipment Handling					
9	Boosts Worker Confidence in Site Safety Systems					
10	Enhances Compliance with Safety Rules					
11	Reduces Unsafe Behaviours					
12	Facilitates Onboarding of New/Illiterate Workers					
13	Encourages Proper Use of PPE					
14	Improves Hazard Recognition					