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SCHOOL OF ENGINEERING

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Development of a Behavior-Based Safety Management Framework for the Cement Industry in Uganda

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A DISSERTATION SUBMITTED TO THE DIRECTORATE OF GRADUATE TRAINING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN TECHNOLOGY INNOVATION AND INDUSTRIAL DEVELOPMENT OF MAKERERE UNIVERSITY

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DECLARATION

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DEDICATION

I dedicate this work to my wife Najjuuko Pauline Lutaaya and my son Lule Isaiah, daughter Nakirijja Annet, my uncle Mr. Ssenyonjo Robert and not forgetting all my brothers and sisters Ssemwanga David and Kivumbi John, Nakiganda Harriet, Nakiwala Josephine, Jane and Dorothy for the tireless moral, spiritual and financial support and motivation towards this cause.

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LIST OF ACRONYMS

AGRU	Auditor General of the Republic of Uganda
APAU	Accident Prevention Advisory Unit
BBS	Behavior-Based Safety
BBSI	Behavior-Based Safety Initiative
BBSMS	Behavior-Based Safety Management Systems
FUE	Federation of Uganda Employees
ILO	International Labor Organization
ISO	International Standards Organization
JHA	Job Hazard Analysis
MGLSD	Ministry of Gender, Labor and Social Development
MSDS	Material Safety Data Sheets
OSHA	Occupation Safety and Health Association
OSHE	Occupational Safety, Health and Environment
OSHEM	Occupation Safety Environment Management
OSHEMS	Occupation Safety Environment Management Systems
OSHMS	Occupational Safety and Health Management System
PPE	Personal Protective Equipment
UIA	Uganda Investment Authority
UMA	Uganda Manufacturers Association
UNBS	Uganda National Bureau of Standards
WHO	World Health Organization

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ABSTRACT

OSHE professionals attribute up to 95 percent of workplace accidents to human factors, especially unsafe behaviors such as failure to correctly wear Personal Protective Equipment. In contrast, only 3 percent result from physical factors and 2 percent from natural disasters, showing that engineering controls alone are insufficient for workplace safety. In response to this gap, organizations have increasingly adopted Behavior-Based Safety (BBS) programs as a proactive strategy to identify, monitor, and correct unsafe behaviors and improve overall safety performance. This cross-sectional study evaluated the effectiveness of BBS programs in two cement manufacturing plants in Uganda by examining their influence on workplace safety performance. The study administered a structured closed-ended questionnaire to 450 workers to capture their perceptions of existing BBS practices and conducted checklist-guided workplace inspections to identify prevailing hazards and validate survey responses. Data was analyzed using IBM SPSS Version 20 through univariate, bivariate, and multivariate techniques, including binary logistic regression, to determine key predictors of effective BBS implementation. The findings show that BBS programs contributed to a substantial reduction in workplace incidents by approximately 35 percent in Plant A and 45 percent in Plant B while also improving hazard recognition and risk reporting among workers. The results further demonstrate that plants with stronger leadership engagement in BBS and regular safety observations recorded significantly lower levels of high-risk behaviors. The study recommends integrating BBS programs into the Plan-Do-Check-Act (PDCA) cycle to support continuous safety improvement and suggests that future research should assess how effective BBS implementation influences plant reliability, productivity, profitability, and overall competitiveness to promote sustainable safety and manufacturing practices.

Keywords: Behavior-Based Safety (BBS), Cement Industry, Occupational Safety and Health (OSH), Sustainable Manufacturing, Workplace Incidents

CHAPTER ONE: INTRODUCTION

1.1 Background

The cement industry remains a fundamental driver of global economic development, supporting infrastructure growth and employment creation in both developed and developing economies (Amrina & Vilsi, 2015). Notwithstanding its economic importance, the sector is intrinsically high-risk due to continuous exposure to cement dust, excessive noise, heavy machinery, confined spaces, and elevated working platforms (Thai & Kuˇ, 2021; Rahmani et al., 2018). Prior studies indicate that these hazards contribute to higher rates of occupational injuries and illnesses while also reducing productivity, increasing operational costs, and exposing firms to regulatory penalties and reputational damage (Smallman & John, 2001). Consequently, effective occupational safety management extends beyond regulatory compliance to become a strategic determinant of organizational performance and sustainability.

In Uganda's cement industry, safety management has traditionally prioritized engineering controls, personal protective equipment, and procedural compliance. Although these measures are essential, safety science literature suggests that technical controls alone do not sufficiently prevent accidents, particularly in complex and dynamic industrial environments (Fatima & Shahid, 2017). From a theoretical perspective, Heinrich's Domino Theory posits that most workplace accidents result from unsafe acts rather than purely technical failures, reinforcing the need to address human behavior as a central component of accident prevention. Similarly, Reason's Swiss Cheese Model explains that accidents occur when multiple layers of defense fail simultaneously, often due to human errors, poor safety leadership, and organizational weaknesses rather than isolated technical faults. In Uganda's cement plants, unsafe behaviors, risk normalization, and inconsistent leadership commitment continue to contribute significantly to workplace incidents, demonstrating persistent gaps between formal safety systems and actual worker practices (Smallman & John, 2001). This disconnect highlights a critical limitation in conventional safety management approaches that overemphasize technical safeguards while underestimating behavioral and organizational factors.

Behavior-Based Safety (BBS) has emerged as a widely recognized approach that complements traditional safety systems by systematically targeting unsafe behaviors through observation, feedback, and positive reinforcement (Asamani, 2020). Rooted in behavioral psychology, BBS aligns with modern safety thinking by shifting focus from reactive accident investigation to proactive risk anticipation and prevention (Li et al., 2015). Contemporary BBS frameworks emphasize leadership engagement, peer-to-peer safety observations, data-driven decision-making, and continuous reinforcement, all of which align with Reason's systems-based approach to accident prevention. Evidence from high-risk industries indicates that well-implemented BBS programs can significantly reduce injury rates, strengthen safety culture, and enhance worker participation when integrated within existing safety management systems rather than applied as stand-alone interventions (Fernández-Muñiz et al., 2009). However, BBS effectiveness remains highly context-specific, requiring alignment with organizational culture, workforce diversity, and sectoral risk characteristics. Despite its global recognition, BBS implementation in Uganda's cement industry remains limited and largely unstructured. The absence of a locally adapted BBS framework has hindered systematic adoption, particularly in workplaces characterized by multilingual employees, varying educational backgrounds, and diverse safety perceptions. Prior studies have insufficiently addressed how behavioral safety models can be adapted to such contexts, creating a gap between theory and practice (Fatima & Shahid, 2017). This gap is particularly critical in Uganda, where rapid industrial expansion has outpaced institutional capacity for occupational safety oversight.

In response to these challenges, this study aimed to develop a Behavior-Based Safety management framework specifically tailored to Uganda's cement industry. Grounded in behavioral psychology, Heinrich's accident causation principles, and Reason's Swiss Cheese Model, the proposed framework integrates behavioral risk identification, leadership commitment, worker participation, and continuous feedback mechanisms (Fernández-Muñiz et al., 2009). The study systematically examined existing safety practices, behavioral risk factors, and organizational safety culture to generate practical, context-sensitive interventions aligned with international best practices and local industry realities. By embedding behavioral determinants of safety within a structured management framework, the study responds to growing scholarly calls for more holistic, systems-based, and human-centered approaches to safety management in high-risk industries.

The significance of this study is further underscored by persistent systemic OSHE challenges across Uganda. According to the Auditor General of the Republic of Uganda, widespread deficiencies in OSHE awareness, weak enforcement mechanisms, and poor integration of safety management systems continue to undermine workplace safety (AGRU, 2024). Fewer than 1% of the country's more than one million workplaces are registered with the Ministry of Gender, Labor, and Social Development, while over 20,000 occupational injuries are reported annually, with fatalities widely believed to be underreported. In 2019, authorities threatened to close over 390,000 non-compliant workplaces, and the national inspector-to-worker ratio remains approximately 1:452,000, far below the International Labor Organization's recommended ratio of 1:40,000 for developing countries, reflecting severe regulatory constraints (AGRU, 2024). Within this constrained institutional environment, organization-level interventions such as context-specific BBS frameworks become particularly vital for improving worker safety, enhancing compliance, and promoting sustainable industrial development.

1.2 Problem Statement

Uganda reports over 20,000 workplace injuries annually while likely underreporting fatalities, a problem intensified by weak enforcement and an inspector-to-worker ratio of about 1: 452,000 (AGRU, 2024). Limited regulatory capacity has allowed unsafe practices to persist, contributing to recurring incidents, particularly in the cement industry. In this sector, unsafe worker behaviors, shaped by a highly diverse workforce with varying risk perceptions and safety attitudes, significantly drive accident occurrence. Despite exposure to hazards such as dust, noise, confined spaces, and chemicals, safety management remains largely reactive and focused on compliance and PPE rather than behavioral causes of incidents. The absence of a structured Behavior-Based Safety (BBS) framework has constrained efforts to systematically identify and correct unsafe behaviors before accidents occur. To address this gap, this study developed a context-specific BBS management framework for Uganda's cement industry to reduce incidents, improve compliance under weak enforcement, accommodate workforce diversity, and enhance overall safety performance and operational efficiency.

1.3 Research Objectives

1.3.1 Main objective

The main objective of the study was to develop a BBS management framework for Uganda's cement industry.

1.3.2 Specific objectives

The Specific objectives of the study are:

i. To characterize the occupational hazards encountered in routine cement manufacturing processes in the selected plants.
ii. To assess the risks associated with the hazards encountered in routine cement manufacturing process in the selected plants.
iii. To evaluate the effectiveness of the existing BBS programs on safety performance within the selected cement plants.
iv. To develop a framework for BBS implementation in the cement industry.

1.4 Research Questions

i. What are the commonest hazards encountered in routine cement manufacturing activities in the selected plants?
ii. What are the commonest risks associated with the routine cement manufacturing processes?
iii. What are the overall perceptions and attitudes of cement workers towards the existing BBS programs in the selected plants?
iv. How best can BBS programs be implemented in a cement plant?

1.5 Significance

This study addresses persistent safety challenges in Uganda's cement industry by introducing a Behavior-Based Safety (BBS) management framework that shifts focus from technical controls to behavioral interventions. It aims to reduce workplace incidents, enhance employee well-being, foster a proactive safety culture, improve regulatory compliance, minimize financial losses, and boost productivity, while providing empirical insights that guide policymakers, industry stakeholders, and OSHE researchers.

1.6 Justification

Uganda's cement industry faces recurring workplace incidents because existing safety management approaches largely ignore behavioral factors. Although Behavior Based Safety (BBS) has proven effective in other industries worldwide, it remains underexplored in the cement manufacturing sector. This study addresses this gap by developing a structured BBS framework tailored to the industry's unique challenges, promoting sustainable safety improvements, aligning with global best practices, and advancing regulatory compliance in occupational safety.

1.7 Scope

The study was conducted at two Ugandan cement plants designated as Plant A and Plant B for ethical reasons. The plants were selected due to their combined contribution to cement manufacturing and distribution within the East African region. The researcher focused on understanding the effectiveness of the existing BBS programs and their contribution to overall accident prevention in the study plants. Additionally, the perception and attitudes of employees regarding the effectiveness of the current safety BBS programs were assessed to understand the overall performance levels for sustainable safety management.

1.8 Conceptual Framework

Figure 1 illustrates the conceptual framework for the study and is based on the key variables as derived from the proposed specific objectives. The independent variables comprised of the existing OSHE policies, procedures, and performance gaps within the existing BBS practices. The dependent variables comprise of the existing cement manufacturing process hazards and risks alongside the existing BBS implementation processes. Production pressure and the existing regulatory enforcement efforts formed the mediating variables that cause fluctuations in the effectiveness of the existing BBS programs.

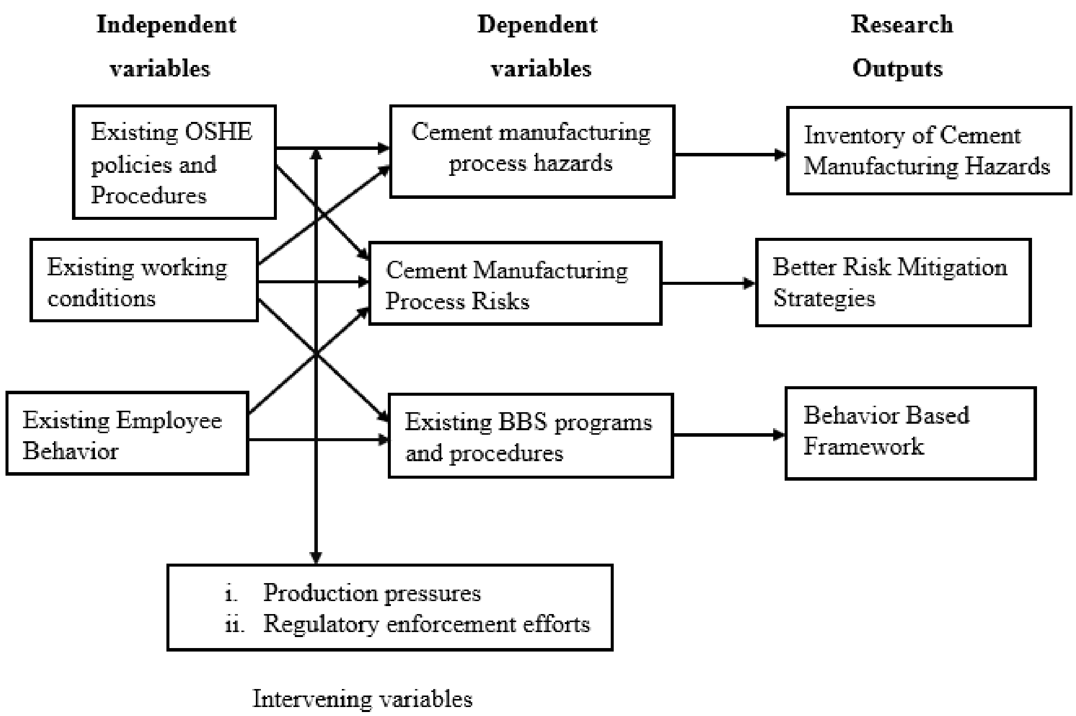

Figure 1: Conceptual Framework

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Uganda's cement manufacturing industry has several players dealing in several brands of cement including, Portland pozzolanic, lime, and terrazzo and Portland cement. The leading players include Tororo, Simba, Kampala, and Hima Cement. Advancements in mechanization have resulted in unsafe work conditions which create occupational health hazards, directly affecting workers (Moradi et al., 2020). Cement plants are faced with inadequate and ineffective OSHE management practices that contribute to high incidents and demotivation rates leading to reductions in; productivity, profitability and competitiveness (Mishra, 2019; Tsalis et al., 2018).

An Occupational Safety and Health Management System (OHSMS) is a coordinated and systematic approach to managing OSHE risks in a workplace (Mohammadfam et al., 2017b). OHSMSs help organizations to continually improve their compliance to different OSHE management standards using the Plan-Do-Check-Act technique so as to meet local, regional and international requirements (Zwetsloot et al., 2013). A Behavior Based Safety Initiative (BBSI) card issuing system was introduced at a cement manufacturing company in Zimbabwe in 2008 to try and curb accident occurrence. A positive correlation between card issuance and incident occurrence was observed in a cement plant in Zimbabwe (Nunu et al., 2018a). It was also noted that the card system positively influenced the mindset of workers towards safe work practices (Nunu et al., 2018; Yeow & Goomas, 2014).

Unsafe working conditions within cement factories undermine workers' morale and motivation as well as their identification with the owners and managers (Yoganandan & Sivasamy, 2015). This can ultimately lead them to leave the firm (employee turnover) hence causing difficulty in finding qualified workers to replace them (Yoganandan & Sivasamy, 2015).

2.2 Uganda's Cement Industry

The cement industry in Uganda is composed of various value addition processes which include; mining, limestone breaking/slicing, transportation, processing, packaging and merchandising among others to generate valuable economic activities. In the last three decades, the number of cement plants, cement production, processing and consumption of associated cement products has gradually increased due to a rapidly growing population and regional demand for cement and cement products among others. Government and other cement stakeholders should strongly encourage producers to keep this trend on a positive stride through the implementation of better process and operational technologies coupled with management strategies for increased effectiveness and efficiency. Management commitment, involvement and safety competence form the key aspects in improving the safety culture. Commitment is reflected in the priority, resources, and visibility given to health and safety, while involvement is demonstrated through active participation, co-operation, and open communication.

2.3 Organizations and the OSHE Management Systems

Kaka et al., (2016) suggests that evaluating an organization's management systems involves reviewing it as an open system, considering factors such as (i) the roles of the management system, (ii) the benefits of management systems approach to OSHE and (iii) the Limitations of standards-based OSHE management systems. A systems approach is characterized by inputs, processes, feedback, outputs, a boundary, and an environment. Such a system includes five interrelated sub-assemblies, namely:

a) Goals and values

Depending on the organization, these may include total internal and external customer satisfaction, zero incidents and fatalities throughout the year and effective communication among others.

b) ***Psychosocial***

This sub-assembly focuses on the enhancement of internal customer satisfaction through improved employee motivation, effective labor-management, communication and overall workplace relations.

c) Technical

Under this sub-assembly, emphasis is put on the knowledge, skills and tactics possessed by people enforcing the existing OSHE framework for sustained system effectiveness.

d) Structural

Structural sub-assemblies emphasize the enforcement and reporting criteria in OSHE management at the workplace.

e) Managerial

This sub-assembly usually stipulates the overall execution and management of key OSHE parameters such as training, inspection, audits, accident investigation and compensation.

2.3.1 Role of the management system in the workplace

In order to achieve the overall organizational OSHE goals and targets, management should effectively coordinate and integrate activities in all the subsystems mentioned above through the use of the Plan-Do-Check-Act (Fasanya & Dada, 2016). Continuous improvements can be made for the overall effectiveness of the existing OSHE management system based on the prevailing circumstances and the ever-changing industry requirements and regulations (Amponsah-tawiah & Mensah, 2016).

2.3.2 Key OSHE management system elements

An effective OSHEMS has six core elements that include; management commitment, employee involvement, safety accountability, OSHE training, incidents investigation, and hazard identification and control.

2.3.3 Key OSHE elements from industry commission

According to the United States Industry Commission, (1995) there are seven core characteristics for “best OSHE practice”. These provide benchmarks of organizational superior OSHE performance and include;

i. Recognition of OSHE as part of the core business operations
ii. Effective senior management’s commitment to OSHE
iii. Total employee participation in implementation and improvement activities
iv. Measurement and monitoring of OSHE performance
v. Adoption of the concept of continuous improvement
vi. Training for the provision of knowledge and skills
vii. Promotion of safe and healthy work designs within the working environment.

2.3.4 Quality management principles from ISO

The OSHE best practices reveal core characteristics in line with ISO (2000) quality management principles. These include customer focus, leadership, employee involvement, process and system approach, continuous improvement, and factual decision-making (Harrison & Dawson, 2016).

2.3.5 Potential impacts of OSHE management systems at a workplace

a) Social and Health Effects

Work related injuries cost America 125.1 billion US dollars in 1998 alone which was a little over 1% of the GDP forecast for that year or nearly three times the combined profits of the top fortune five hundred companies (Economist Intelligence Unit, 1999). This highlights the impact on employees' social and physical well-being and underscores the need to standardize data collection and analysis methods in African countries, necessitating further research (Nynäs et al., 2017).

b) Employee Relationships

An adequate and effective OHSMS increases platforms for employees to harness workplace diversification and other social bottlenecks as they get significant opportunities to meet and share work and life challenges (Lajili et al., 2007).

c) Employee Morale and Involvement

Employee morale is the ease with which employees execute their tasks and wish to associate themselves with the firm. Firms with adequate and effective OSHE management systems tend to have highly motivated workers with an increased sense of business ownership.

2.4 Methods for Reviewing OSHE Management Practices in Industrial Workplaces

2.4.1 Perception survey

Perception surveys provide information about employees' attitudes, values and beliefs towards the existing OSHE performance practices within the organization, thereby helping to firms to continually identify and fill performance gaps.

2.4.2 Job Hazard Analysis

Job Hazard Analysis (JHA) is a technique that emphasizes potential risks in specific tasks to identify issues before they arise (Amponsah-tawiah & Mensah, 2016). It emphasizes the direct and indirect relationships between the task, workers, tools, materials and the working environment. Supervisors in various workplaces have found JHAs as a valuable tool to train new employees in the steps required to perform their routine tasks safely. Involving job-specific employees in the JHAs is crucial because their unique understanding of the tasks minimizes oversights and ensures a quality analysis.

2.4.3 Risk Assessment

Risk assessment is the careful examination of what in your work environment could cause harm to people so that you can weigh up whether you have taken enough precautions (Guo et al., 2018). After a careful identification of all the tasks that might require a JHA, it is important that the team prioritizes each task for its degree of risk. Accidents and ill health within the workplace can have both catastrophic legal and socio-economic impacts on both internal and external customers of the business (Argubi-wollesen et al., 2017). Workplace precautions for example physical safeguards, containment of airborne contaminants, safe systems of work, training and personal protective equipment are referred to as risk controls should be put in place for effective risk mitigation (Argubi-wollesen et al., 2017). When proposing risk controls to mitigate a hazard, consideration should be given to the hierarchy of control in the order of elimination from source, substitution with a less hazardous option, use of engineering controls, using of administrative controls and use of Personal Protective Equipment (PPE) as the last line of defense.

2.4.4 Workplace OSHE Inspection and Audit

Routine inspection and periodic audits uncover hidden hazards, unsafe employee behavior, and OSHE system performance gaps for improvement. Cement plants should continually perform OSHE inspections. Workers and their supervisors should conduct these inspections to detect and control hazards before accidents occur.

2.5 Behavior-Based Safety (BBS) Management Systems

There is no universally agreed definition of Behavior-Based Safety (BBS). Guo et al., (2018) describe BBS as a bottom-up approach that seeks to identify and improve unsafe employee behaviors through systematic observation, training, feedback, and goal setting. Many manufacturing organizations implement BBS alongside Safety Incentive Programs (SIPs) to reinforce safe behaviors and improve the performance of their incident learning systems (Yeow & Goomas, 2014). In practice, BBS begins with identifying specific unsafe behaviors for intervention, followed by structured observation and recording until a stable baseline of behavioral frequency is established. Once this baseline is achieved, organizations introduce targeted interventions, such as removing environmental barriers or modifying antecedents and consequences to influence behavior change (Choudhry, 2014; Guo et al., 2018). If implemented effectively, BBS has the potential to reduce workplace incidents by up to 80 percent. A fundamental requirement of BBS is the continuous collection of data on both safe and unsafe behaviors, as well as prevailing workplace conditions.

From a safety science perspective, BBS aligns closely with Heinrich's Domino Theory, which posits that unsafe acts are a primary cause of workplace accidents and that preventing these acts can interrupt the accident sequence. Similarly, BBS complements Reason's Swiss Cheese Model, which emphasizes that accidents result from multiple interacting failures across organizational, supervisory, and individual levels rather than isolated technical faults. By targeting unsafe behaviors while also considering workplace conditions, BBS functions as an additional protective layer within the organization's safety system, helping to close gaps that might otherwise align to produce accidents.

The Hawthorne effect further illustrates the behavioral dimension of safety, as workers tend to modify their actions when they know they are being observed. For example, when a safety manager appears on site, workers often immediately don their Personal Protective Equipment, meaning planned safety observations may not always reflect everyday work practices (Yeow & Goomas, 2014). Consequently, effective BBS implementation requires a strong emphasis on meaningful observations, constructive feedback, and worker self-awareness regarding how their behavior influences safety performance. Ultimately, BBS establishes a continuous feedback loop that reinforces safe practices over time. Published work demonstrates that well-designed BBS programs can contribute to hazard reduction and improved safety performance in cement plants (Nunu et al., 2018; Bhatnagar et al., 2017; Moradi et al., 2020). However, BBS management systems vary across organizations (Choudhry, 2014), and research consistently highlights the importance of systematic goal setting, reliable measurement, constructive feedback, and visible management commitment for successful outcomes (Zhang et al., 2019; Guo et al., 2018; Choudhry, 2014). Moradi et al., (2020) found that effective BBS interventions almost always lead to significant reductions in unsafe behaviors and corresponding improvements in safety performance, while Amrina et al., (2015) and Moradi et al., (2020) emphasize the necessity of continuous observation, detection, and feedback.

A central strength of BBS lies in its explicit recognition of the human dimension of safety. Even when organizations rigorously apply the hierarchy of controls, human behavior remains a decisive factor in safety performance. By clearly defining safe and unsafe behaviors, BBS enables organizations to manage this human element rather than ignoring it. Specifically, BBS provides a structured system for defining behavioral expectations, engaging employees in safety decision-making, promoting desirable behaviors through shared understanding, and formally recognizing positive actions. These practices enhance consistency, reduce uncertainty for workers, and strengthen employee engagement. BBS also facilitates collaboration between management and workers to identify, assess, and correct unsafe behaviors before they result in harm, thereby supporting a safer work environment. Organizations implementing BBS can achieve lower accident-related costs, fewer operational disruptions, improved productivity, and more stable production processes. However, BBS must operate in conjunction with broader Environmental, Health, and Safety (EHS) management systems rather than as a standalone solution.

Replacing existing safety programs with BBS alone can alienate workers and undermine safety performance. While BBS acknowledges the role of employee behavior, it cannot serve as the primary line of defense for worker protection, nor can it replace the established hierarchy of controls. Instead, BBS should complement existing safety systems by identifying weaknesses, reinforcing strengths, incorporating worker feedback, promoting self-awareness, and fostering active participation in daily safety practices.

When organizations implement BBS poorly or treat it as a procedural formality, its effectiveness diminishes. Observations may devolve into superficial checklist exercises that add little value to safety performance. Moreover, misapplied BBS can shift responsibility disproportionately onto individual workers while neglecting systemic and organizational factors, thereby generating resistance rather than genuine compliance.

Ultimately, BBS should function as a reinforcing component of an organization’s safety culture rather than its foundation. Consistent with modern BBS frameworks and systems-based safety thinking, its primary objective is to promote, demonstrate, and reinforce safe behaviors while cultivating a shared belief that safe practices represent the first layer of worker protection (Fang & Mohamed, 2007). For BBS observations to be valid and effective, they must satisfy key criteria: the behavior must be observable or audible, consistently interpreted by both labor and management, described in positive terms, and within the worker's control.

2.6.1 BBS Feedback

As earlier mentioned, BBS not solely about observing and noting behaviors. Feedback is equally as important as the observation itself (Choudhry, 2014). For BBS to succeed in any organization, feedback should exist in a loop where by it flows as two-way traffic between workers and management (Guo et al., 2018). As always, BBS implementers should remember that workers understand their jobs better than the person observing them. If an employee consistently uses a specific would be unsafe behavior to accomplish a task, then it is important for one to realize that there is a logical reason for the behavior (Choudhry, 2014). An effective feedback loop ensures that BBS observers get that reason and create room for discussion before making the necessary changes (Akram, 2015).

2.6 BBS Feedback

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2.6.1 How a feedback loop works in practice

In a situation where an entire team of workers in particular workplace consistently fails to wear their safety gloves. The implementer will remind them that gloves are essential for company safety rules, regulations and work procedures, related local and regional regulatory compliance (Depasquale & Geller, 1999). In addition, it has to be cited to them that the gloves also protect their hands from injuries (Guo et al., 2018). Failure to put this feedback in a loop leaves it hanging and makes change difficult to achieve both parties will fail to understand the reasoning behind the unsafe behavior (Zhang et al., 2019). Employees will communicate if the gloves don't fit or if their usage under certain circumstances gets in their way of work by restricting movement and reaction time. A feedback loop can be as simple as running daily and weekly toolbox talks and safety stand downs based on the data and trends gathered from your safety program (Guo et al., 2018). One could then run a toolbox talk based on his or her observations and generate feedback during the talk hence creating a focused feedback loop.

2.6.2 Tips for providing BBS feedback

Although anyone can give feedback, successful BBS implementation requires corrective and specific feedback (Krause et al., 1999). Some of the core tips for providing BBS feedback include; (i) the observer should stay on one topic and person or team. The 'here and now' is what's important for the feedback loop. (ii) Keep the feedback focused on behaviors**.** i.e., the observer should focus on correcting the behavior, not the person, and (iv) Avoid tying discipline directly onto feedback when possible. i.e., there could be scenarios where discipline is the most prudent choice for the behavior (Guo et al., 2018).

2.7 Key Safety Signs and Signals

According to the OSH Act of Uganda 2006, Safety signs and signals are part of the mandatory and minimum requirements in a given work environment. The signs aim at helping employers to meet their legal safety requirements. Employers have an obligation as stipulated in the OSH Act of 2006 to provide such signs as it may be required at the workplace and must administer accountability measures in case of violation of such signs by their workers.

2.8 Summary of the Literature Review

This section distills key insights from the literature review that inform effective OSHE management in the cement industry.

1. Most existing studies have concentrated on primary production hazards such as dust and noise, often neglecting risks tied to essential activities like transportation, equipment repair, and routine maintenance. To fill this gap, the current study evaluated hazards across the entire cement production chain, from raw material handling to final product storage, ensuring comprehensive risk assessment.
2. A few studies have explored the contribution of Behavior-Based Safety programs in enhancing overall safety management system performance within the cement industry. This study addressed that oversight by examining how BBS practices influence safety performance, particularly in high-risk industrial environments.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This section presents the research approach, the methods, data collection tools, and analysis techniques that were used to conduct the study. Additionally, the section includes the sampling techniques that were used to select the respective study respondents.

3.2 Research Design

The study adopted a positivist paradigm and used a mixed methods approach (qualitative and quantitative) to achieve the study objectives. Both qualitative and quantitative methods were employed to collect and analyze data obtained through perception surveys and observation methods.

3.3 Study Population

The study population comprised cement workers at various levels within each of the selected plants. This included all personnel involved in cement processing and support activities, such as maintenance, as indicated in Table 1.

3.4 Sampling

The study employed random sampling to select participants from two cement manufacturing plants with contrasting operational characteristics, while ensuring sampling adequacy and consistency across sites. Plant A was a large-scale, highly mechanized facility with the highest installed production capacity, whereas Plant B was a smaller-scale, labor-intensive operation. These plants were deliberately selected to capture variations in operational scale, technology use, and organizational structure, thereby strengthening the representativeness and comparative value of the sample. To enhance consistency across plants, the perception survey applied the same sampling criteria, survey instrument, and data collection procedures at both sites. Participants were drawn from multiple departments, job categories, and work shifts to ensure adequate coverage of the workforce and to minimize sampling bias. This approach ensured that differences observed in safety perceptions and practices reflected true contextual variations rather than inconsistencies in sampling design. Table 1 presents the comparative installed production capacities of the two plants.

Table 1: Table 1: Target Population, sample size and Sampling techniques

	Functional managers	Line supervisors	Frontline workers	Target Population	Sample	Surveys used for analysis
Plant A	35	28	187	250	233	223
Plant B	28	20	155	200	186	186
Sampling Technique	Convenience sampling	Convenience sampling	Purposive sampling	450	419	
Total						409

3.5 Risk Assessment Matrix

A qualitative risk assessment was done to determine risk ratings of the most common hazards encountered by cement workers in their routine tasks before the development of possible mitigation strategies. To produce distinct risk ratings for each identified and prioritized hazard, a 6x6 matrix, as presented in Table 2, was used. Qualitative risk assessment was conducted, based on the likelihood of risk occurrence, and the associated severity of consequences.

Table 2: Risk assessment matrix

Likelihood of Occurrence		**Severity of Consequences**					
		Minor	**Moderate**	**Serious**	**Very Serious**	**Catastrophic**	**Disastrous**
		1	2	3	4	5	6
	6	6	12	18	24	30	36
	5	5	10	15	20	25	30
	4	4	8	12	16	20	24
	3	3	6	9	12	15	18
	2	2	4	6	8	10	12
	1	1	2	3	4	5	6
Legend		(green)	Risk Level 3	(amber)	Risk Level 2	(red)	Risk Level 1

3.6 Desk Research

This study employed desk research to develop a Behavior-Based Safety (BBS) framework for the cement industry. The method involved reviewing documented safety practices, industry reports, and regulatory guidelines to compare existing BBS approaches with recognized best practices. Performance evidence from previous studies was analyzed to identify gaps and effective interventions, which informed the development of a performance-driven and context-appropriate BBS framework for cement manufacturing operations.

3.7 Data Collection Methods

During the study, multiple data collection methods were employed to address the stated objectives. To achieve objective (i), the researcher administered a structured perception survey questionnaire (Appendix 1) and conducted workplace inspections to identify and validate hazards commonly encountered in workers' daily tasks. The study assumed that workers could accurately recognize and report hazards in their work environment, justified by their direct and continuous exposure to these conditions. For objective (ii), a 6 x 6 risk assessment matrix was employed to assess and compare the likelihood and severity of each identified hazard, generating standardized risk ratings. This approach assumed that expert judgment and documented incident trends provided a reasonable basis for estimating risk levels.

To achieve objective (iii), a self-administered perception survey targeting managers, supervisors, and frontline employees was employed to capture their attitudes toward existing Behavior-Based Safety (BBS) practices. The study assumed that respondents would provide honest and reflective responses about their safety experiences and behaviors. While recognizing potential self-reporting bias, this assumption was justified by ensuring anonymity, voluntary participation, and a structured questionnaire designed to minimize socially desirable responses. The researcher also acknowledged the possibility of observation bias during inspections, as workers might alter their behavior when being observed. To mitigate this, observations were conducted over multiple shifts and work settings rather than relying on single, one-time assessments.

For objective (iv), relevant academic literature was systematically reviewed alongside industry reports to identify internationally recognized best practices in BBS implementation. These findings were then compared with existing practices in the selected cement plants to develop an improved, context-sensitive BBS framework. The study assumed that insights from these two plants could provide meaningful lessons for Uganda's cement industry more broadly. This case study generalization was justified on the basis that the selected plants share similar production processes, hazard profiles, workforce characteristics, and regulatory environments with other cement facilities in the country.

3.8 Reliability and Validity of Instruments

3.8.1 Reliability of Instruments

To ensure the reliability of the data collection tool, Cronbach's alpha was computed to confirm that the tool met the minimum reliability requirements. For the tool to be considered reliable, the researcher ensured that Cronbach's alpha was greater than 0.7.

3.8.2 Validity of Instruments

Internal and external validity of the instruments were conducted to measure and analyze dependable data. Pre-testing of the perception survey questionnaire was conducted to ascertain its accuracy in measuring the intended variables.

3.9 Data Analysis

Descriptive statistical techniques for analysis were used with the help of SPSS and Microsoft Excel tools to plot different graphs. Data processing occurred sequentially on a firm-by-firm basis at univariate, bivariate, and multivariate levels. A risk assessment was conducted to generate risk ratings by comparing the likelihood of risk occurrence with the severity of consequences, using a 6x6 matrix.

3.10 Ethical Consideration

The researcher obtained a letter of introduction from his supervisors to seek permission from the individual plant management to collect data from participants within the selected plants. The letter requested participants' consent for the study to prevent unethical conduct, such as falsifying information, during the research. It also aimed to avoid coercing respondents into providing data and information against their will or contrary to their company policies. The researcher ensured that personal prejudices and opinions did not override the goals of the study.

3.11 Methodological Limitations

The study faced several methodological limitations that may influence interpretation of the findings. The cross-sectional design restricted the ability to establish clear causal relationships between BBS implementation and reductions in workplace incidents because the study captured data at only one point in time rather than tracking changes longitudinally. The study relied partly on self-reported survey data from workers, which may have introduced social desirability and recall bias as respondents could overstate safe behaviors or underreport unsafe practices. Checklist-guided workplace inspections depended on the researcher's judgments, which may have introduced observer bias despite efforts to standardize assessments, and workers may have altered their behavior during observations due to the Hawthorne effect. The focus on only two cement plants in Uganda limited the generalizability of the findings to other plants or industries with different organizational and safety contexts. Finally, the study could not fully control for external factors such as management changes, production pressures, or parallel safety initiatives that may have also influenced incident reductions.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter present and analyzes the results from the study. It interprets the findings in relation to the research objectives and situates them within the broader context of Occupational Safety, Health, and Environment (OSHE) management literature. This discussion highlights patterns, relationships, and key insights derived from the data while critically examining their implications for BBS theory, practice, and policy. In doing so, the chapter not only reports what the study uncovered but also explains how these findings contribute to understanding safety performance and management in the cement manufacturing sector.

4.2 Respondents Demographics

4.2.1 Age and gender distribution

The workforce in both plants was predominantly composed of individuals aged 30-35 years, representing 46.19% in plant A and 48.83% in plant B. This age group, typically considered experienced yet adaptable, forms a strategic target for safety behavior modelling. Younger employee (18-25 years) constituted a small proportion of the workforce in both plants, indicating limited representation of early-career workers, who often require more structured safety orientation. Male employees dominated both sites, representing 82.96% in plant A and 79.34% in plant B, a trend consistent with heavy industrial sectors. Female employees accounted for only 17.04% in Plant A and 20.66% in Plant B, a representation that may influence the design of inclusive safety initiatives.

4.2.2 Educational background

Most employees in both plants possessed formal tertiary education. A majority at plant A held bachelor's degrees (61.43%), while plant B showed greater diversity with more diploma (23.00%) and certificate holders (18.78%). Notably, master's degree holders were present only in plant A (4.48%). These educational disparities suggest a need for differential safety communication strategies that consider varying levels of technical comprehension and learning preferences.

4.2.3 Religious affiliation

Catholicism was the most prevalent religion in both plants (40.36% in plant A and 41.78% in plant B), followed by Anglicanism and Islam. Although religious affiliation may not directly influence workplace safety behavior, understanding dominant values can guide the tone and framing of the safety messaging and employee engagement.

4.2.4 Plant sections and departmental distribution

Packaging had the highest representation of workers in Plant A (14.80%), while plant B showed a more even distribution of workers across clinker storage (10.80%), quarry (7.04%), and cement grinding (7.04%). These variations imply different exposure risks and underscore the need to tailor safety protocols to the specific hazards of each section.

4.2.5 Work shifts

The 8:00 am – 4:00 pm shift had the highest presence of workers across both plants, representing 77.58% in plant A and 71.83% in plant B. Plant B recorded the highest frequency of workers in the 4:00 pm – 12:00 am shift (23.94% compared to 14.80% in Plant A). These shift patterns indicate that most safety interventions and observations should focus on daytime operations, while the substantial presence of second-shift employees in plant B highlights the need for additional support during evening hours.

4.2.6 Job roles

Most employees identified their roles as “other” (63.23% in plant A; 59.15% in plant B), likely encompassing non-managerial technical and support positions. Team leaders and Technicians each constituted nearly 9% in plant B. underlining their potential as change agents in behavior-based safety programs. Managers and Assistant Managers were fewer in number but critical for policy endorsement.

The demographic and operational profiles of the workforce present strategic insights for developing a behavior-based safety management framework tailored to Uganda’s cement industry. The predominance of mid-career, male and moderate to highly educated employees suggest a workforce capable of engaging with cognitively rich safety content, provided that it is practically oriented and contextually relevant.

Variations in departmental distribution emphasize the need for section-specific behavior observation checklists, as hazard types and risk exposure levels differ significantly across the production units. For instance, workers in the Clinker Storage or Rotary Kiln sections may face unique thermal and mechanical risks that differ markedly from those in Packaging or Maintenance. Thus, safety behavior must be observed and reinforced with granularity.

The dominance of the day shift underscores the strategic advantage of embedding safety leadership behaviors during standard working hours, although attention to second-shift operations especially in plant B is crucial to ensure equitable implementation. Shift supervisors and team leaders, given their presence and peer influence, represent optimal focal points for training in positive reinforcement and behavior modelling techniques.

The educational background of workers supports a dual-pronged communication approach: one that leverages visual aids and practical demonstrations for employees with vocational training and another that utilizes analytical content and procedural detail for those with higher education. The educational segment could significantly improve message retention and behavior adherence.

Finally, the apparent cultural homogeneity in religious affiliation presents an opportunity to leverage shared values such as community, responsibility and stewardship in shaping collective safety norms. Messaging that resonates with such values may enhance receptivity and internalization of safe behaviors. These results align with findings by Kim et al., (2021) and Maqsoom et al., (2020), who emphasized that workforce diversity significantly enhances organizational performance. Additionally, Choudhry, (2014) noted that workforce diversity significantly contributes to unsafe behaviors, which in turn affects safety accountability and performance.

Logistical hazards during materials procurement and transportation were linked to inadequate planning, high clinker costs, and a bureaucratic customs union. Logistical hazards have the potential to elevate all other hazards within the study plants as they usually enhance production pressure which in turn causes deviation from OSHE performance. Mechanical hazards, encountered in repair, maintenance, and engineering activities, were associated with limited supervision, inadequate PPE use, and unsafe employee behaviors.

Table 3: Demographics characteristics of the study respondents

		Plant A		Plant B	
Variable	Category	Frequency	Percentage	Frequency	Percentage
Age	18-25	5	2.24	8	3.76
	25-30	35	15.70	43	20.19
	30-35	103	46.19	104	48.83
	40-45	52	23.32	40	18.78
	45-50	20	8.97	10	4.69
	50-55	7	3.14	7	3.29
	55-60	1	0.45	1	0.47
Gender	Female	38	17.04	44	20.66
	Male	185	82.96	169	79.34
Level of education	A-Level	5	2.24	11	5.16
	Apprentice	7	3.14	12	5.63
	Certificate	25	11.21	40	18.78
	Degree	135	61.43	88	41.31
	Diploma	35	15.70	49	23.00
	Masters	10	4.48	0	0.00
	O-Level	4	1.79	7	3.29
Religion	Adventist	18	8.07	10	4.69
	Anglican	82	36.77	68	31.92
	Catholic	90	40.36	89	41.78
	Islam	21	9.42	30	14.08
	Others	12	5.38	13	6.10
	Traditionalist	0	0	3	1.41
Section of the plant	Blending	12	5.38	14	6.57
	Cement Grinding	11	4.93	15	7.04
	Cement Silos	20	8.97	14	6.57
	Clinker Storage	13	5.83	23	10.80
	Cooler Section	15	6.73	18	8.45
	Crushing	13	5.83	12	5.63

		Plant A		Plant B	
	Category	Frequency	Percentage	Frequency	Percentage
	Maintenance	28	12.56	23	10.80
	Packaging	33	14.80	17	7.98
	Pre-Homogenization	2	0.90	5	2.35
	Pre-Heating	10	4.48	6	2.82
	Quarry	8	3.59	15	7.04
	Rotary Kiln	16	7.17	14	6.57
	Storage	19	8.52	16	7.51
	Transportation	18	8.07	14	6.57
Work shift	12:00am-8:00am	17	7.62	9	4.23
	4:00pm-12am	33	14.80	51	23.94
	8:00am-4pm	173	77.58	153	71.83
Position at work	Assistant Manager	6	2.69	6	2.82
	Driver	8	3.59	13	6.10
	Foreman	2	0.90	4	1.88
	Manager	11	4.93	5	2.35
	Mechanic	18	8.07	13	6.10
	Other	141	63.23	126	59.15
	Shift Supervisor	8	3.59	8	3.76
	Team Leader	14	6.28	19	8.92
	Technician	15	6.73	19	8.92

4.3 Hazard Identification Using a Perception Survey within the Study Plants

Figure 2 illustrates the hazards that cement workers frequently reported encountering during routine activities in various sections of the study plants, based on survey data. As expected, noise, dust, mechanical hazards and confined spaces, dominated the list, as revealed in related studies. Noise was one of the most common hazards reported present in the study plants at levels in excess of 80 decibels (dB). Workers most affected by this noise were those performing routine activities in sections such as crushing and raw mill.

Chemical hazards were encountered during various activities, including repair, maintenance, and chemical mixing, while dust was primarily found in sections such as the quarry, raw material crusher, and packaging. These hazards were linked to the limited provision of adequate and correct PPE, insufficient OSHE awareness about chemical and dust safety among the workers, and inadequate use of Material Safety Data Sheets (MSDSs) within the study plants.

Confined spaces and caught in between hazards were noted to be encountered in activities such as repair in cement silos and transportation of cement materials between sections. These hazards were primarily associated with activities performed by contractors, who face substantial constraints in adhering to OSHE standards and requirements, leading to higher incident rates. Dust hazards were mainly experienced by workers in sections such as quarrying and packaging. Inhaling high levels of dust may occur during activities such as quarrying and packaging of cement, such exposure irritates the nose and throat and causes choking and difficulty during breathing, exposing workers to several health risks.

Hazards associated with the unsafe behaviors of cement workers were also reported to be rampant in routine cement manufacturing tasks, with potential to elevate incident rates in the study plants. These hazards were associated to the high degree of workforce diversification in the study plants. Workers unsafe behaviors may include but not limited to failure to properly wear and care for PPEs, dodging toolbox talks and risk assessments and failure to follow safe working protocols. Unsafe behavior hazards have a significant potential to impact all sections of the plant. In the study plants, hazards involving workers being squeezed, caught, crushed, pinched, or compressed between objects frequently occurred during activities such as quarrying, crushing, and grinding. Workers involved in transportation and maintenance tasks, particularly in silos, were severely exposed to these dangers.

Traffic and mobile equipment hazard primarily affected workers operating near mobile plant equipment, increasing the risk of serious injury or fatal accidents. These hazards included rollovers, machine injuries, and excavation collapses caused by uncontrolled worker movements, simultaneous operation of multiple vehicles, uneven surfaces, and unsafe use of equipment. Such risks were most common in the crushing, rotary kiln, cement grinding, silos, and transport sections. Slips and trips hazards occurred in all sections involving human movement. Presence of conditions such as uneven surfaces, obstacles, trailing cables, wet or slippery areas, and changes in levels led to injuries such as fractures, dislocations, or even fatalities within the study plants. Proper housekeeping practices coupled with the effective management of work areas and access routes, including stairwells, corridors, footpaths, and site cabins, are potential strategies for reducing the risks associated with these hazards.

Workers responsible for loading and offloading of materials, as well as those handling the final cement product, face significant lifting hazards due to improper techniques and heavy loads. In various sections of the plants such as the quarry, crushing, grinding, maintenance, and transportation it was observed that manual lifting is often done incorrectly, leading to musculoskeletal disorders, injuries, and accidents. The frequent use of poor lifting methods, lack of training and inadequate supervision contributes to the risk of these incidents.

In sections like quarrying, crushing, rotary kilns, and grinding, workers face hazards from pollutant gases emitted by cement plants. These emissions, including CO, NOx, and SOx, pose serious health risks by reducing oxygen delivery to organs and tissues, potentially damaging the cardiovascular and central nervous systems. Workers with health conditions such as asthma or bronchitis are particularly vulnerable to these pollutants. Fire hazards with the potential to cause explosions, severe property damage, and worker injuries were identified in key activities like quarrying, grinding, and kiln burning. Additionally, operations involving coal pulverizing, bag filters, electrostatic precipitators, chemical handling, and power plant boilers also presented significant fire and explosion risks. Furthermore, conditions such as the use poorly maintained electrical tools, poor ventilation, improper storage of lubricants, and poor waste management can potentially increase fire risks within the study plants.

Entanglement hazards were faced by workers wearing loose clothing and moving near rotating machines, along slippery surfaces, or in narrow walkways. These hazards were associated to inadequate supervision of certain tasks and inadequate adherence to rules related to proper PPE usage within the study plants. Workers performing tasks like welding and grinding in the study plants encountered hazards and risks associated with flying objects. These hazards resulted from inadequate use of PPE, such as safety goggles, poor supervision, and failure to follow safety measures like barricading. Procurement and replenishment delays in material supplies create production pressures within the study plants. These pressures push workers to speed up tasks, often compromising safety standards. As a result, incidents become inevitable, leading to potential financial losses and increased turnover among experienced staff. The results collaborate the findings of Adeyanju & Okeke, (2019) and Fresenbet et al., (2022) who observed that the inherently hazardous nature of cement manufacturing tasks undermines worker's safety compliance and performance, thereby weakening the overall safety culture.

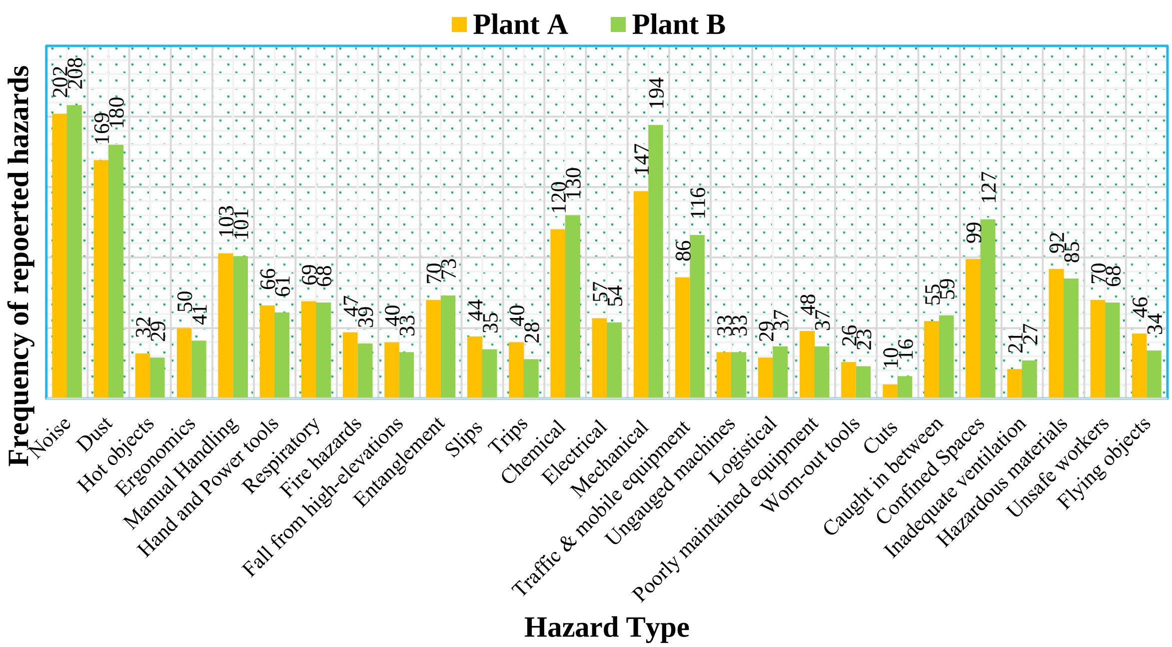

Figure 2: Most common hazards encountered in routine cement manufacturing processes

4.4 Hazard Identification Using Inspection Method

The most prevalent hazards associated with routine cement manufacturing tasks in both Plant A and Plant B as shown in Table 7 were obtained from the use of a structured observational checklist. High-impact hazards such as hot objects, noise, dust, mechanical hazards, and confined spaces were consistently observed across both plants, with variations influenced by plant-specific operational dynamics.

In Plant A, thermal hazards were concentrated around maintenance and clinker cooling operations, while Plant B showed elevated risks during kiln activities and fuel storage, both reporting cases of heat stress, burns, and fire-related injuries. Mechanical hazards, confined space risks, and electrical risks were widespread, driven by insufficient lockout/tag-out procedures, poor supervision, and differed equipment maintenance.

Plant B exhibited greater and behavioral and environmental hazards, particularly dust, noise, and unsafe acts, largely due to limited PPE adherence and limited safety awareness. Meanwhile, Plant A faced elevated mechanical and logistical risks, including traffic related incidents and exposure to unguarded machinery, attributed to poor inspection practices and ineffective task planning. Both plants experienced severe outcomes from fires, electrical hazards, and falls from heights, frequently linked to overloaded circuits, deficient maintenance regimes, and inadequate fall protection measures.

These findings reveal systemic deficiencies in safety practices across both plants, characterized by persistent failures in hazard-specific control measures. The recurring issues of inadequate PPE, insufficient training, and a weak safety culture underscore an urgent need for targeted behavioral-based safety interventions and robust engineering controls. In Plant B, the prevalence of environmental exposures and unsafe behaviors necessitates improved supervision, enhanced hazard communication, and greater worker engagement. Conversely, Plant A's elevated exposure to equipment-related and logistical risks demands reinforced maintenance protocols, redesigned traffic systems, and upgraded physical safety infrastructure The current study supports findings by Amiri et al., (2022), Thai & Kuˇ, (2021) and Leela et al., (2022) confirming that cement manufacturing involves high-risk operations that demand targeted safety interventions, especially under conditions of production pressure.

The observed failures in hazard controls, training, and cultural enforcement necessitates plant-specific operational reforms. For plant B, interventions should focus on environmental controls, behavior-based safety training, and stringer supervisory oversight. Plant A requires upgrades in equipment safety infrastructure, preventive maintenance systems, and traffic management protocols. These insights confirm the need for adaptive, data-driven hazard management strategies that align with real-time operational conditions. The findings of this study alongside gaps in existing OSHE practices, align with Kumar et al., (2021) and Aghelpour et al., (2023), demonstrating that integrating intelligent predictive tools such as BCO-ANFIS and ACO-ANFIS into routine OSHE assessments, in volatile environments, enables precise mitigation, optimized resource deployment, and improved safety performance cross high-risk industrial sectors.

Table 4: Most common hazards encountered in routine cement manufacturing tasks

S/N	Hazard type/Cause	Activity within the plant		Risk or impact
		Plant A	**Plant B**	
1	Hot objects	Maintenance and clinker cooling, and cyclone towers	Quarrying, use of hand tools, kiln and preheating, tasks and fuel storage	Heat stress, burns, and fire
	Cause	Absence of heat resistant PPE, Inadequate ventilation	Limited worker training and inadequate ventilation and poorly maintained equipment	
2	Noise	Quarrying, blasting and raw mill	Quarrying, air compressors, maintenance and clinker cooling	Noise Induced Hearing Loss (NIHL), stress and communication challenges
	Cause	Absence of enclosures, and absence of dampers	Inadequate PPE Usage,	
3	Dust	Grinding, cement packing, and drying	Raw materials handling, waste handling, and alternative fuel handling	Skin irritations, respiratory and eye problems
	Cause	Inadequate ventilation, and inadequate use of filters	Inadequate use of PPE and inadequate use of dust suppressants	
4	Mechanical hazards	Maintenance activities, cement grinding, kiln operations, and transportation	Crushing, materials handling, quarrying, and cement packing	Entanglement, crushing and mechanical injuries
	Cause	Poor machine guarding, inadequate maintenance planning, and insufficient training on Lock-Out/Tag-out	Inadequate use of PPE and training	

S/N	Hazard type/Cause	Plant A	Plant B	Risk/Impact
5	Confined spaces	Silos, underground tunnels, kiln, and dust collection, bag,	Conveyor pits, silos, and rotary kilns	Exposure to toxic gases, heat stress, asphyxiation and engulfment
	Cause	Inadequate ventilation, poor task planning and limited use of work permits	Inadequate supervision, absence of gas monitoring and limited use PPEs	
6	Respiratory hazards	Quarrying, crushing, raw material grinding, and dust collection	Baghouse area, waste and fuel handling areas, clinker cooling	Lung infections, airway irritations, silicosis and chronic respiratory disorders
	Cause			
7	Cuts and lacerations	Maintenance and repair, conveyor belts, material handling,	Electrical installations, quarrying and crushing, and conveyor belts	Deep tissue damage, lifetime injuries, serious infections
	Causes	Inadequate use of PPEs and inadequate training on hand and power tools	Absence of effective machine guarding in some sections, limited training and poor storage of tools	
8	Chemical hazards	Maintenance, cleaning, quality control testing, waste handling, and raw materials handling	Kiln operations, fuel handling, cement packing, clinker cooling, and storage	Skin burns, chemical poisoning, and respiratory problems
	Causes	Inadequate ventilation and limited use of Material Safety Data Sheets (MSDS).	Limited chemical safety training, inadequate PPE usage and limited use of toxic gas sensors in key areas	
9	Unguarded machines	Quarrying and kiln, maintenance, conveyor systems, and cement packing	Quarrying, cement grinding, preheater tower, and raw material grinding	Fatalities, amputations, and Serious injuries
	Causes	Limited training on Lock-out and Tag-out and ineffective inspections	Limited training, and absence of effective supervision	

S/N	Hazard type/Cause	Plant A	Plant B	S/N
10	Traffic and mobile equipment	Quarrying, material transportation, dispatch, and material handling	Cement packing and dispatch, and clinker transportation	Fatalities, Operational disruptions and severe injuries
	Causes	Crowded pathways, and inadequate use of spotters and signage	Limited use of seatbelt and related signage, and inadequate traffic management	
11	Worn-out tools	Electrical and mechanical workshops, and clinker cooling	Quarrying, electrical and mechanical workshops, and roller press maintenance	Reduced productivity, serious, and fatal injuries
	Causes	Inadequate regular inspection and storage of tools	Proper storage of hand tools and poor use of hand and power tools	
12	Fire Leaking fuel tank Overloaded electrical circuits	Kiln operations, alternative fuel storage, and conveyor belts.	Preheater and kiln, maintenance areas, electrical installations, and chemical handling	Severe equipment damage, plant shutdown and work injuries
	Causes	Absence of regular equipment inspections, poor duct control measures	Unsafe fuel handling and inadequate dust control measures	
13	Falls from high elevations	Electrical maintenance and conveyor belt systems	Maintenance activities, clinker cooler, and construction works	Fatal falls, fractures and head injuries, severe burns, falls into hot kiln areas, broken bones, and spinal injuries
	Causes	Inadequate fall protection measures and inadequately secured scaffolds	Limited training on fall protection, inadequate use of signage and poor housekeeping	
14	Slips	Quarrying, crushing, grinding, and storage areas	Quarrying, conveyor belt walkways, loading zones and storage areas	Serious injuries, lost work time, fractures, entanglement, falls into hot surfaces, and muscle strains
	Causes	Poor housekeeping and inadequate use of advanced PPEs.	Ineffective control of chemical and material spills and limited use of warning signs	

S/N	Hazard type/Cause	Plant A	Plant B	Risk/Impact
15	Trips	Stairways, electrical rooms, cement packing, crushing and grinding operations	Kiln and clinker cooling tasks, quarrying and crushing, and conveyor belt walkways.	Serious injuries, broken limbs, electric shocks and head injuries
	Causes	Neglected cables, uneven grounds, material spills and poorly lit areas	Misaligned pallets, stacked materials and oil spills, unsecured electric cables and wet floors	
16	Electrical hazards	Control rooms, crushing, grinding, administrative areas, and pumping stations	Mobile equipment maintenance, loading operations, maintenance activities.	Severe burns, electrocutions, electric shock, equipment breakdowns, and electric fires
	Causes	Inadequate electrical inspections and ineffective LOTO procedures.	Use of substandard components, limited training on electrical safety coupled with ineffective inspections	
17	Hazardous materials	Raw materials handling, crushing and grinding activities	Blending, quality control, waste water treatment and chemical storage	Skin irritation, skin burns, respiratory issues, inhalation of toxic chemicals, and fire explosions
	Causes	Clinker dust, inadequate use of PPEs, and limited awareness of hazardous materials	Inadequate ventilation, limited air quality monitoring, and limited training about hazardous chemicals	
18	Flying objects	Blasting, kiln and clinker cooling, equipment maintenance and repair.	Bagging activities, mobile equipment operations, materials handling, and packing,	Eye injuries, severe burns, severe hand and finger injuries and concussions
	Causes	Limited use of correct PPEs such as anti-slip boots, absence of sufficient machine guarding and equipment inspection	Lack of observation of safe distances, limited supervision and limited safety training	

S/N	Hazard type/Cause	Plant A	Plant B	Risk/Impact
19	Logistical hazards	Raw materials handling, material transportation to crushers, and movement of hot clinker.	Maintenance and repair, storage management and mobile equipment movements	Injury strains, vehicle collisions, slips, trips and falls,
	Causes	Inadequate task planning, poor traffic management, and limited safety training	Absence of clear communication, poor planning, and limited use of high visibility PPEs	
20	Poorly maintained equipment	Crushing, kiln burning, clinker transportation, blending and laboratory testing	Quality control, silos, storage, electrical and transportation between sections	Unpredictable malfunctions, equipment over heating, material spills, crush injuries, power surges and explosions
	Causes	Absence of regular inspections and inadequate use of correct tools	Inadequate adherence to safety protocols, and limited use of correct PPEs	
21	Unsafe behaviors	Materials handling, maintenance, and heavy equipment operations	Working at heights, maintenance, quarrying operations, and handling of hazardous materials and quarrying and inadequate use of correct PPEs	Environmental contamination, serious injuries, entrapment, falls, repetitive strains, eye injuries and electrocutions
	Causes	Absence of continuous safety training, limited vigilance, and presence of weak BBS programs	Presence of weak BBS programs, ineffective safety reward programs,	

4.5 Risk Assessment Results of the Most Common Hazards

The qualitative risk ratings as shown in Figure 3 were obtained based on the likelihood of risk occurrence and the associated severity of consequences within the study plants. Risk assessment was done by comparing the likelihood of risk occurrence and the severity of consequences for each identified hazard within the respective plants.

The study assessed the most common workplace hazards in two cement Plants-Plant A and Plant B-and evaluated their respective risk ratings to inform the development of a Behavior Based Safety (BBS) management framework tailored to the Uganda context. The data reveals a clear convergence in hazard prevalence and severity across both facilities, though with nuanced variations in risk perception and exposure intensity.

Among all hazards, “caught in between” incidents involving mobile equipment recorded the highest risk rating in both plants, with plant A at 38 and plant B at 30. These results highlight the urgent need for strict behavioral controls, situational awareness, and operator training in mobile equipment zones. Similarly, “slips and trips” and “unsafe behaviors” were rated consistently high, each scoring 36 in both plants. These findings justify integrating BBS principles to address human error and complacency.

Traffic-related, manual handling of tools, and logistic hazards also registered high scores (30-36), illustrating the operational complexity and exposure associated with cement production logistics. In plant A, traffic and mobile equipment risk was rated at 30, while in plant B, it was 36-possibly reflecting higher movement density or differences in enforcement of traffic safety protocols between the two sites.

Contrastingly, hazards such as chemical exposure, lifting hazards and fire risks were rated lower, especially in plant B, where lifting hazards received the lowest score of 4, and fire hazards rated at 10 in plant A and 12 in plant B. This suggests that existing control measures in these domains reduce the frequency of hazards, but severe incidents can occur in the absence of sustained vigilance.

Noise hazards were rated 30 in plant A and 36 in plant B, signaling a growing concern over chronic exposure and need for both engineering and behavioral interventions, such as consistent PPE usage and worker rotation. Similarly, mechanical hazards scored 30 in plant A and 36 in plant B, reinforcing the need for proper lockout/tag out procedures and behavior-based audits to migrate to machinery-related risks.

Notably, unsafe behaviors consistently ranked among the top hazards in both plants, reinforcing the core thesis of this research; that human actions remain the most significant determinant of workplace safety. This aligns with earlier survey results, where over 94% of the respondents attributed workplace incidents primarily to human error rather than systematic or environmental causes.

The comparative hazard analysis confirms that while physical and environmental risks are inherent in cement manufacturing, behavioral risk factors dominate incident causality and severity. The high-risk rating associated with caught in between incidents, unsafe behaviors and slips and trips reflect recurring behavioral failures such as inattention, noncompliance with procedures and risk normalization. These behaviors demand targeted behavioral interventions, consistent safety reinforcement, and improvement real-time supervision-all central to a BBS frame work.

Moreover, the moderate to high ratings of logistical and equipment-related hazards suggest that BBS strategies must not operate in isolation but rather be integrated with engineering controls and standard operating procedures to ensure comprehensive risk mitigation. Behavioral tools such as observation checklists, peer feedback and safety coaching can complement physical controls by fostering consistent adherence to safety protocols.

The variation in risk ratings between plants are associated to differences in organizational safety culture, implementation maturity and workforce engagement levels, for instance, higher scores in mechanical and noise hazards in plant B may indicate insufficient behavioral controls or underreporting in plant A. This underscores the importance of continuous BBS performance audits and cross-plant learning exchanges to human safety practices.

The consistently high ranking of unsafe behaviors in this study shows that worker behavior continues to drive most workplace incidents and therefore requires central attention in safety management. Within Uganda's cement industry, the study reveals that behavior related risks persist across plants with different operational scales and workforce compositions, moving beyond prior research that only broadly advocates for Behavior Based Safety. These findings support the adoption of a structured Behavior Based Safety Management Framework that goes further than general awareness by embedding hazard specific training, continuous observation and feedback cycles, and reinforcement mechanisms into routine operations. Unlike many earlier studies, the proposed framework explicitly integrates physical and organizational determinants of behavior such as workload intensity, peer influence, and supervisory practices, demonstrating that unsafe behavior is shaped by systemic conditions rather than individual choices alone. These findings align with those of Çakıt et al., (2020) and Han et al., (2020), who argue that targeted interventions are necessary in diverse workforces to effectively reduce unsafe behaviors. Practically, the risk profile across Uganda's cement plants underscores the need for a behavior centered and systematically integrated safety approach, while theoretically, the study reinforces socio technical and systems based perspectives by showing that safety behavior emerges from interactions between workers, organizational structures, and operational conditions rather than from isolated individual actions.

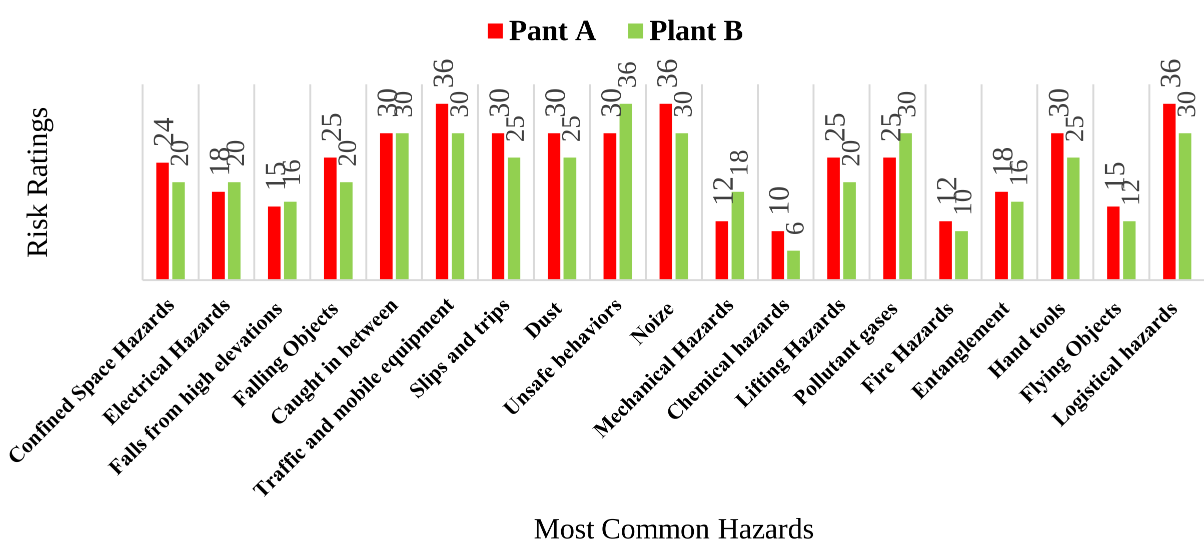

Figure 3: Risk ratings for the most common hazards in routine cement manufacturing processes

4.6 Behavior Based Safety Management Results

This section presents the results obtained regarding the effectiveness of the existing BBS programs within the respective study plants.

4.6.1 Univariate level results

At univariate level, the study revealed compelling insights into the perceptions, experiences, and implementation outcomes of BBS programs in Uganda's cement manufacturing sector. In both Plant A and Plant B, an overwhelming 94.61% and 96.71% of respondents, respectively attributed nearly 95% of workplace incidents to worker behavior, in contrast to only 3% of incidents attributed to materials, equipment, or environmental factors. These results underscore the critical importance of targeting human behavior in occupational safety management and provide empirical justification for the BBS approach within high-risk industrial environments.

Moreover, 91.48% of Plant A and 89.18% of Plant B respondents agreed that engineering controls alone are insufficient to maintain a safe working environment without complementary BBS strategies. This consensus reflects a shared recognition that safety performance must be reinforced not only through sustained behavioral interventions that cultivate accountability, hazard recognition, and risk mitigation at the individual levels.

from management was reported by 62.33% and 59.15% of respondents, while 81.61% and 77.00% agreed that management is committed to the success of the BBS programs. 61% and 53.52% of respondents were satisfied with employee involvement in BBS programs, compared to 74.89% and 64.79% who trusted management's intentions in implementing these programs. 90.13% and 91.08% reported reduced incident rates, with 84.3% and 85.45% attributing these reductions to the BBS programs. Only 66.82% and 56.81% believed their colleagues could effectively spot incident-causing hazards.

Despite the promising impacts of existing BBS initiatives, the findings suggest room for further enhancement. While 62.33% of respondents in plant A and 59.15% in plant B expressed satisfaction with BBS-related feedback from management and 81.61% and 77,00% perceived strong management commitment to program success, fewer employees-61% in plant A and 53.52% in plant B-felt adequately involved in program implementation. However, 74.89% and 64.79% respectively, indicated trust in management's intentions, signaling a strong foundation for improving participatory mechanisms in safety decision-making.

The efficacy of the BBS programs was evident in reported safety performance. A majority-90.13% of the respondents in plant A and 91.08% in plant B-reported a reduction in incident rates post-implementation, and 84.3% and 85.45%, respectively, attributed this decline directly to the BBS programs. These outcomes validate the effectiveness of behavior-oriented interventions in achieving measurable safety improvements.

However, perceived gaps in hazard recognition remain. Only 66.82% and 56.81% 0f employees believed their peers could effectively identify incident-causing hazards, suggesting a need for continuous, targeted training. Notably, while only 62.33% 0f the respondents in plant A and 67.61 % in plant B had received structured BBS training prior to program development, an overwhelming 91.03% and 90.61% believed that enhanced training could further improve the system's effectiveness.

Historical reflections demonstrated the positive transformation resulting from BBS implementation. 95.07% and 94.84% of participants reported high incident rates before the adoption of BBS, while 81.61% and 70.42% now considered their respective programs among the best operational safety system in place. A strong majority-98% of responds in each plant advocated for BBS implementation in tandem with other systems for long-term sustainability, and 98.65% and 95.77% cited significant safety benefits. Moreover 87.44% and 90.14% agreed that workforce diversity plays a vital role in influence the success of BBS initiatives.

Current satisfaction with BBS stood at 81.61% in plant A and 79.81% in plant B and an average of 98% of all of all respondents recommended the adoption of similar programs across other cement plants in Uganda. However, resistance to technological integration emerged, with 57.00% in plant A and 49.28% in plant B opposing the digital literacy development as the industry moves toward modern safety solutions.

The findings reaffirm the central role of worker behavior in occupational incident causation and strengthen the behavioral foundation of safety management in high-risk environments such as cement manufacturing. The substantial reduction in workplace incidents following Behavior-Based Safety implementation at both plants demonstrates that behavioral interventions do not merely complement traditional engineering controls but function as an essential component of effective safety management. Moreover, high levels of management commitment, employee trust, and overall job satisfaction indicate that BBS programs can meaningfully shape and strengthen safety culture within developing industrial contexts.

At the same time, the results highlight critical areas that require strategic attention to optimize BBS effectiveness. Limited employee involvement in program design and feedback processes signals the need to enhance participatory governance mechanisms within Occupational Safety, Health, and Environment structures. Additionally, observed gaps in workers' hazard recognition abilities underscore the importance of continuous competency development through scenario-based hazard identification exercises and regular refresher training.

The resistance to digital transformation of BBS systems emerges as a significant challenge in an increasingly data-driven safety landscape. While this hesitation may reflect limited familiarity or infrastructural constraints, it also presents an opportunity to build capacity and gradually integrate digital safety tools that align with local operational realities. Practically, the study confirms that well-structured BBS programs can reduce incidents and foster stronger safety cultures in Uganda's cement sector. Theoretically, the findings reinforce socio-technical and systems-based perspectives on safety by illustrating that safe performance results from the dynamic interaction between human behavior, organizational structures, and technological systems rather than from technical controls alone.

4.6.2 Bivariate level results

During the bivariate analysis, we considered only variables with a p-value less than 0.05 for plant-specific analysis, as shown in Table 1. The results indicate that several factors significantly influence behavioral change among workers, though strength and presence of relationships vary by plant:

Employee capabilities were significantly associated with behavioral change in both plants ($p = 0.025$ in plant A; $P = 0.002$ in plant B), suggesting that workers with enhanced skills and awareness are more likely to adopt and sustain safe behaviors under BBS programs. Employee intentions showed a robust relationship with behavioral change (p = 0.000 in plant A; p = 0.008 in plant B), confirming the role of intrinsic motivation and willingness in driving positive safety behavior. Quality of BBS programs was also statistically significant in both plants (p = 0.002 in plant A; p = 0.000 in plant B), highlighting that the effectiveness and structure of program design directly impact behavioral outcomes. Management commitment emerged as a significant predictor in plant A (p = 0.020), but not in plant B, possibly due to variations in leadership involvement, communication style, or safety governance structures.

In contrast, incident-related variables-including incident reduction, witnessed incidents and incident rates were significant in plant B only (p = 0.000, 0.001 and 0.008 respectively). This suggests that the workers in plant B may be more responsive to incident trends and peer experiences, influencing their behavioral adaptation to safety program. Several other variables demonstrated statistical significance in plant B: BBS improvement (p = 0.006), workforce diversity (p = 0.007), continuous implementation (p = 0.000), BBS contribution to safety (p = 0.000) and combination of BBS usage with other innervations (p = 0.009). These results underline the multi-dimensional factor shaping behavior dynamics and reinforce the important of a holistic, inclusive approach to BBS implementation. Notably, BBS program recommendation to other plants was significant only in plant A (p = 0.016), possibly reflecting higher employee confidence or satisfaction in the existing programs.

These findings provide critical empirical validation for the core talents of the BBS management framework and its applicability to the Ugandan cement industry. First, the statistically significant influence of employee capabilities and intentions in both plants affirms the behavioral change is not solely a function of top-down enforcement but also of individual agency, competence and internal motivation. This supports the need for structured, continuous training programs that enhance not only knowledge but also attitude and behavior.

The quality of BBS programs emerged as another cross-cutting determinant. High quality program elements such as clarity in goals, consistent feedback, and practical tools for observation and reinforcement drive engagement and behavioral consistency. Organizations must therefore prioritize the design and contextual fit of BBS protocols to ensure relevance and sustainability.

Interestingly, plant B demonstrated stronger relationships between behavioral change and incident-related variables, suggesting that behavioral responsiveness is highly sensitive to perceived risk and past incident exposure. This provides a compelling argument for integrating real-time incident reporting, peer testimonials and visual incident trend dashboards into BBS systems to reinforce behavior change.

Furthermore, variables like continuous implementation, diversity and combined usage of BBS with other safety systems which were significant only in plant B, point to a broader organizational maturity in BBS adoption. These insights advocate for systems-thinking approach, where BBS is not treated in isolation but as a dynamic component within the broader occupational OSHE framework. The absence of significance in some variable across plants also reveals potential differences in organizational culture, managerial involvement, or workforce demographics, all of which merit further qualitative exploration.

The statistical analysis confirms that employee behavioral change in the Ugandan cement industry is multi-factorial, context-sensitive and significantly influenced by both individual and organizational variables. The findings underscore the critical role of capability-building, program quality and motivational alignment in driving successful BBS outcomes (Guo et al., 2016; Saedi et al., 2020). For a BBS framework to be fully effective in such industrial settings, it must be evident-driven, inclusive, continuous and integrative, reinforcing safe behaviors through a combination of personal development, leadership engagement and responsive system design (Zaira & Hadikusumo, 2017). These results provide essential insights for industrial safety stakeholders, reinforcing the urgency of tailoring BBS programs to workforce realities and ensuring their alignment with broader OSHE management systems for long-term sustainability and incident reduction.

Table 5: Bivariate Analysis for Plants A and B

Dependent Variable	Independent Variable	P – Value (Plant A)	P-Value (Plant B)
Employee behavioral change with BBS	Employee Capabilities	0.025	0.002
	Incidents Reduction	-	0.000
	Employee Intentions	0.000	0.008
	Witnessed Incidents	-	0.001
	Quality of BBS Programs	0.002	0.000
	BBS Improvement	-	0.006
	Management commitment	0.020	-
	Incidents Rates	-	0.008
	BBS program Recommendation to other plants	0.016	-
	BBS and Workforce Diversity	-	0.007
	Continuous Implementation	-	0.000
	BBS Contribution	-	0.000
	Combination of Usage	-	0.009

4.6.3 Multi variate level results

Multivariate analysis used employee behavioral change as a dependent variable to fit logistic models for each plant, as shown in Tables 3 and 4. Only variables with a significant relationship at the bivariate level were included in the binary logistic model, which relied on odds ratios to assess the likelihood of the dependent variable's binary outcomes. This approach identified significant predictors impacting the binary outcome.

Employees trained to identify unsafe behaviors through BBS education were more likely to achieve positive behavioral changes. Cement workers eager to participate in BBS programs were seven times more likely to adopt positive changes than those with negative attitudes. In plant A, workers who believed in the quality of BBS programs were twice as likely to achieve positive behavioral changes compared to those who doubted the programs. Furthermore, more workers in plant A believed management was committed to BBS success, highlighting the importance of management support for sustainable OSHE performance. Workers in plant A who recommended their BBS programs to other plants were three times more likely to experience positive behavioral changes.

In Plant B, the effectiveness of Behavior-Based Safety (BBS) programs in reducing workplace incidents and promoting positive change is highlighted by several key findings. Workers who believed that BBS programs significantly reduced incidents outnumbered those with negative views by a ratio of seven to one, indicating strong support for BBS's role in improving safety. Workers with strong BBS skills were twice as likely to achieve positive changes compared to those with weaker skills, further emphasizing the importance of effective training. Those who suggested improvements to the BBS programs were six times more likely to achieve positive changes, demonstrating that active participation and understanding of BBS principles contribute to better outcomes. Cement workers with positive attitudes toward BBS were twice as likely to adopt positive changes as those with negative attitudes.

The introduction of BBS appears to have coincided with a period of high incident rates, as four times more respondents believed incident rates were high before BBS was implemented, underscoring its effectiveness. Additionally, workers supporting multiple BBS programs outnumbered those preferring a single program by three to one, suggesting that a combination of approaches is more effective in addressing unsafe behaviors. Finally, those advocating for the continuation of the existing BBS program were seven times more than those who did not, reinforcing its perceived success. Workers recommending BBS programs to other plants were five times more likely to have achieved positive behavioral changes compared to those who were not supportive, indicating that successful experiences with BBS inspire broader endorsement.

The findings indicate that merely designing safe; tools, equipment, and procedures is inadequate to establish a safe workplace without the implementation of proactive BBS programs. These programs effectively enable managers to identify, monitor, and control unsafe workers' behaviors and implement the necessary interventions. Additionally, the programs proactively enable managers to detect the most prevalent hazards and risks hence preventing the occurrence and recurrence of workplace incidents. The results suggest that BBS feedback and strong management commitment are essential to the success of any BBS program. The results are consistent with those of studies by Guo et al., (2018). Employee trust in management's objectives for implementing the specific BBS program increases worker engagement for overall program performance, according to the findings. The results are consistent with those by Choudhry (2014) and Boateng et al., (2018), who highlighted the importance of trust and employee participation in the success of any BBS program.

The existing Hazard Observation Card System (HOCs) and Stop Job Policies (SJPs) strongly improved the culture of prevention within the cement plants due to a reduction in incidents rates. The HOC system was highly appreciated by workers in all sections of the respective plants due to its effectiveness at uncovering unsafe acts and creating a hazard free working environment. The study found that existing BBS programs significantly reduced incidents, leading to improved overall system performance. These findings were consistent with those of Nunu et al., (2017) who highlighted that employee unsafe behaviors have a significant impact on incidents causality. The findings show a significant increase in employee participation in both existing BBS programs and overall OSHE activities, such as risk assessment, toolbox talks, safety meetings, workplace inspections, and audits, potentially enhancing the performance of the safety management system. These findings were consistent with those from studies by Dağdeviren & Yüksel, (2008) and Jafaralilou et al., (2019) who noted that, effective use of BBS programs has a significant contribution towards employee participation hence elevating a firm's overall safety culture of prevention. These findings align with studies conducted by Nunu et al., (2018) and Depasquale & Geller, (1999), which investigated critical success factors for Behavior Based Safety. A study by Li et al., (2015) concurred that employees avoid being held accountable to management through appraisals and will thus do everything within their power to comply with BBS rules regulations and procedures.

The majority of respondents with negative attitudes towards the existing BBS programs were mostly not in agreement with the system's minimum standard for each employee to report at least a hazard or unsafe behavior on a daily basis. This typically fosters an authentic safety culture that promotes active employee engagement, thanks to the mutual trust established between labor and management. The bivariate analysis revealed that the quality of BBS programs, as well as employee capabilities and intentions, were critical in driving behavioral change among employees within both facilities. The findings align with those of studies by Choudhry, (2014) and Guo et al., (2018). The findings further elucidate that employees who actively participate in routine mandatory hazard observation, communication, and control processes frequently provide positive behavior-based feedback. In a 1999 study by Krause et al., (1999), it was noted that employees are willing to go to great lengths to distance themselves from negative behaviors within an organization that rewards positive conduct and penalizes risky behaviors. This study expands on existing OSHE programs that target employee behaviors to promote a safe working attitude, which could lead to positive results.

Table 6: Logistic Model for Plant A

Independent Factor	**Category**	**Odds Ratio**	**Standard Error**	**P- Value**	**Confidence Interval (95%)**	
Employee Capabilities	No	1.000	.	.	.	.
	Yes	1.299	0.670	0.622	0.459	3.677
Employee Intentions	No	1.000	.	.	.	.
	Yes	6.683	3.937	0.001	2.106	21.206
Quality of BBS systems	No	1.000	.	.	.	.
	Yes	2.163	1.207	0.167	0.724	6.457
Management commitment to BBS	No	1.000	.	.	.	.
	Yes	1.178	1.178	0.774	0.384	3.614
BBS recommendation to other plants	No	1.000	.	.	.	.
	Yes	3.218	3.328	0.304	0.384	29.830
Constant		0.555	0.618	0.597	0.062	4.931

Table 7: Binary logistic model for plant B

Independent factor	Category	Odds Ratio	Standard Error.	p-value	Confidence interval (95%)	
Incidents reduction due to BBS	No	1	.	.	.	.
	Yes	5.879	4.961	.036	1.125	30.732
Witnessed incidents	No	1	.	.	.	.
	Yes	1.526	1.266	.61	.301	7.751
Employee capabilities	No	1	.	.	.	.
	Yes	1.805	1.157	.357	.514	6.342
BBS improvement	No	1	.	.	.	.
	Yes	5.894	3.675	.004	1.736	20.009
Employee intentions	No	1	.	.	.	.
	Yes	2.024	1.298	.272	.576	7.113
High incident rates before BBS introduction	No	1	.	.	.	.
	Yes	3.709	3.259	.136	.663	20.753
Quality of existing BBS programs	No	1	.	.	.	.
	Yes	1.158	.738	.817	.332	4.036
Combined usage of BBS programs	No	1	.	.	.	.
	Yes	2.518	4.281	.587	.09	70.502
BBS and workforce diversity	No	1	.	.	.	.
	Yes	1.346	1.304	.759	.201	8.989
Continuous implementation of existing BBS programs	No	1	.	.	.	.
	Yes	7.312	9.311	.118	.603	88.702
BBS recommendation to other plants	No	1	.	.	.	.
	Yes	4.549	10.226	.5	.056	372.741
Constant		.001	.003	.025	0	.416

4.6.4 Validation of the logistic models

For Plant A, the overall model fit was strong, with an LR chi-square value of 25.08 and a p-value of 0.0001. The goodness-of-fit test showed a Pearson chi-square of 22.93 with a p-value of 0.0857. The model had a sensitivity of 99.51%, specificity of 10.00%, and an overall accuracy of 91.89%. For plant B, the model also showed a strong fit with an LR chi-square value of 42.9 and a p-value of 0.0000. The Pearson goodness-of-fit test, with 213 observations and 69 covariate patterns, had a Pearson chi-square of 66.25 and a p-value of 0.1643, indicating a good fit. The model had a sensitivity of 98.96%, specificity of 35.00%, and an overall accuracy of 92.96%. These statistics suggest that the models fit reasonably well and are appropriate for the data, given the balance between the number of covariate patterns and observations.

4.7 Respondents Attitudes Towards the Existing BBS Programs

The analysis of behavioral safety perceptions at two cement plants, Plant A and Plant B reveals significant disparities in employee attitudes towards workplace safety. As illustrated in Figure 4, Plant A recorded 69% positive, 23% negative, and 7% indifferent responses regarding safety behavior and practices. In contrast, Plant B demonstrated a more favorable safety perception with 82% positive, 13% negative, and only 5% indifferent responses among its workers.

This comparative outcome underscores a notable divergence in the implementation of and effectiveness of safety management frameworks across the two facilities. Plant B outperforms Plant A in fostering positive safety behavior, indicating the presence of a more robust or better-internalized BBS culture. The lower negative and indifferent responses at Plant B suggests that employees are more actively engaged, better informed, and possibly more motivated to adhere to safety protocols.

The substantial 13 percentage point difference in positive responses between the two plants may reflect disparities in the consistency and quality of BBS program execution. Plant B's superior performance likely stems from more effective hazard communication, stronger management commitment, and regular training and feedback mechanisms that reinforce safety behavior. On the other hand, the higher proportion of negative (23%) and indifferent (7%) attitudes at Plant A may signal underlying challenges such as insufficient employee involvement, weak supervisory oversight, or inadequate feedback loops.

The indifference levels, though numerically small, are critical indicators of latent risk. Indifferent employees typically exhibit disengagement, which can contribute to unsafe practices if not addressed through targeted interventions, such as participatory safety dialogues and individualized coaching. These results emphasize the necessity of customizing BBS frameworks to the contextual realities of each plant, particularly within the Uganda cement industry (Li et al., 2015). Organizational leadership at Plant A should prioritize participatory safety audits, targeted retraining, and reinforcement mechanisms to improve behavioral safety performance (Naji et al., 2021). In contrast, Plant B should maintain its current trajectory while integrating continuous improvement strategies such as regular program evaluations using the PDCA cycle to sustain performance.

In conclusion, while both plants have adopted BBS frameworks to some extent, the analysis reveals that Plant B exhibits a stronger behavioral safety culture. These findings reinforce the critical importance of contextualized implementation, ongoing feedback, and continuous assessment to achieve and maintain high safety performance in industrial workplaces.

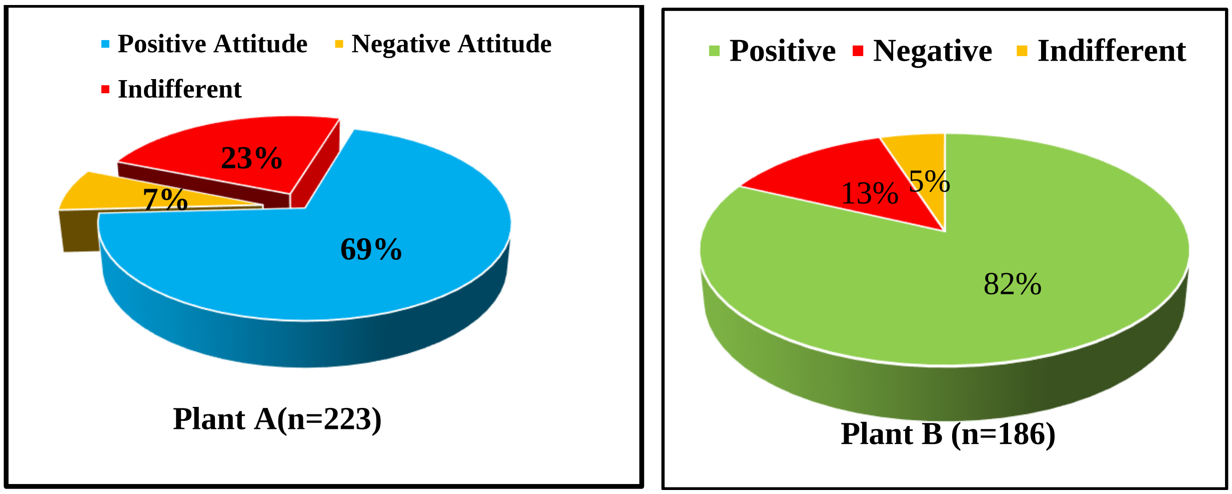

Figure 4: Respondents Attitudes Towards the existing Hazard Observation Card System at the Plant

4.8 BBS Framework

Ensuring occupational safety in industrial environments demands a proactive, systematic approach that goes beyond engineering controls and administrative protocols (Chatterjee, 2014). Among the most effective strategies for mitigating workplace accidents and enhancing safety culture is the implementation of Behavior-Based Safety (BBS) frameworks. BBS operates on the premise that unsafe behaviors are a primary contributor to workplace incidents, and that modifying these behaviors through observation, feedback, and reinforcement can significantly reduce accident rates and improve overall safety performance (Zhang et al., 2019).

In high-risk industrial settings where hazards related to machinery, hazardous substances, and physical strains are prevalent, the role of human behavior in safety performance is particularly critical. Traditional safety programs often focus on compliance and hazard elimination, yet they tend to overlook the human factors that influence decision-making and risk perception on the shop floor (Fabiano et al., 2019). BBS bridges this gap by systematically identifying unsafe behaviors, analyzing their underlying causes, and promoting safe practices through continuous engagement with workers at all levels of the organization (Li et al., 2015).

This study introduces a structured BBS management framework designed specifically for industrial workplaces. The framework integrates principles of psychology, organizational safety culture, and performance management to create a sustainable system of safety improvement (Guo et al., 2018). It encompasses four core components including behavior observation, data-driven feedback, participatory training, and performance reinforcement (Zhang et al., 2019). Each component aims to cultivate a safety-conscious workforce by empowering employees to recognize, report, and correct unsafe practices in real time (Adinyira et al., 2020).

Moreover, the proposed framework aligns with internationally recognized safety standards and emphasizes continuous improvement through iterative assessments and stakeholder involvement. By fostering a culture of shared responsibility and proactive intervention, the BBS framework not only reduces incident rates but also enhances employee morale and operational efficiency (Guo et al., 2018).

The introduction of this behavior-based safety management framework, as detailed in the subsequent results section, responds to the urgent need for evidence-based, people-centered safety interventions in industrial sectors. It provides both theoretical grounding and practical guidance for organizations seeking to institutionalize safety as a core organizational value.

4.8.1 Development and implementation of an OSHE management system

In the cement industry, an inherently high-risk sector due to its intensive mechanical operations, dust emissions, and chemical exposure, implementing a comprehensive OSHE management system is essential for safeguarding worker wellbeing and ensuring regulatory compliance (Adeyanju & Okeke, 2019). An effective OSHE management framework must be structured around six foundational elements including strong management commitment, systematic hazard identification, transparent communication protocols, and risk control, ongoing OSHE education and training, thorough incident investigation and corrective action, and active employee participation supported by accountability mechanisms (Demirkesen, 2020).

These core components create a robust safety culture that not only aligns with national legislation but also adheres to regional and international OSHE standards such as ISO 45001. In Uganda's cement sector, where rapid industrial growth often outpaces safety governance, the establishment of such a system is critical. It provides a structured platform engaging workers in safety initiatives, fostering shared responsibility, and institutionalizing behavior-based interventions aimed at reducing unsafe acts and conditions (Fang & Mohamed, 2007). This foundational OSHE structure sets the stage for the integration of a Behavior-Based Safety (BBS) management framework, which further enhances safety performance by focusing on modifying human behavior human behaviors through observation, feedback, and positive reinforcement (Mazlina Zaira & Hadikusumo, 2017).

By embedding these six elements into the operational fabric of cement plants, the industry can proactively manage safety risks, comply with statutory obligations, and cultivate a resilient, safety-conscious workforce capable of sustaining long-term occupational health and environmental integrity.

4.8.2 Implementation of an effective hazard identification and control strategies

The development and implementation of effective hazard identification, communication, and control programs are essential for establishing a safe workplace and identifying unsafe behaviors (Alveriuse et al., 2023). These programs focus on enabling workers to recognize, report, and manage hazardous conditions related to major hazard areas, such as materials, equipment, processes, working environments, and employees (Fabiano et al., 2019). By equipping workers with these capabilities, the programs contribute to reducing workplace hazards and promoting a culture of proactive incidents prevention.

4.8.3 Formulation of OSHE production committees

The development of comprehensive hazard identification, communication, and control programs are critical to fostering a safe and behavior-driven work environment in the cement industry (Alveriuse et al., 2023). Within the Ugandan context, where operational conditions often involve exposure to dust, high heat, heavy machinery, and complex production processes, such programs form a cornerstone of effective Behavior-Based Safety (BBS) management.

These programs aim to empower workers to actively detect, report, and manage hazardous conditions across key risk domains, including materials handling, equipment operation, process safety, environmental factors, and human behavior (Fabiano et al., 2019). By embedding hazard recognition into daily routines, the framework not only addresses physical risks but also targets unsafe behaviors that often precede incidents.

Moreover, clear and consistent hazard communication ensures that all employees regardless of rank or role receive timely and actionable safety information (Passetti et al., 2020). This reinforces individual accountability while fostering a shared commitment to incident prevention (Depasquale & Geller, 1999). Ultimately, by equipping workers with the skills and systems to mitigate hazards proactively, these programs reduce workplace risk, enhances safety performance and cultivate a culture of continuous safety improvement in Uganda's cement manufacturing sector.

4.8.4 Identification of critical unsafe behaviors

Additionally, Occupational Safety, Health, and Environment managers must systematically identify critical unsafe behaviors that warrant immediate intervention, using baseline observational methods as outlined by Li et al., (2015). This process involves conducting structured behavior-based observations to pinpoint recurring actions or omissions that pose significant safety risks within the cement production environment. Unsafe behaviors frequently recorded through hazard reporting systems or observed during routine operations such as improper use of personal protective equipment (PPE) bypassing safety procedures, or poor manual handling practices should be prioritized (Lamy & Perrin, 2020). By targeting these high-risk behaviors, OSHE managers can implement focused corrective strategies and behavioral enforcements that enhance overall workplace safety and drive sustained cultural change in the Ugandan cement industry.

4.8.5 BBS training

Occupational Safety, Health, and Environment (OSHE) training whether induction-based, formal or task-specific plays a critical role in enhancing worker's capacity to recognize and avoid unsafe behaviors (Kaynak et al., 2016). Following the identification of unsafe behaviors, managers must implement targeted Behavior-Based Safety (BBS) training programs tailored to the specific needs of high-risk departments or job functions (Mazlina Zaira & Hadikusumo, 2017). This training may take the form of structured OSHE education, work-specialized instruction, or retraining initiatives, all designed to reinforce safe behavioral norms and cultivate a proactive safety culture across the organization (Li et al., 2015). Upon completion of the training phase, BBS implementers should initiate systematic rollout of the framework, focusing on continuous monitoring and reinforcement of safe behaviors in strategically selected operational zones. This approach ensures that behavioral improvements are both measurable and sustainable, thereby strengthening the safety performance of Uganda's cement industry.

4.8.6 Provision of BBS feedback

Managers and BBS implementers must provide continuous, constructive feedback to reinforce safe behaviors and discourage unsafe practices, thereby promoting a culture of open, two-way communication and mutual accountability (Choudhry, 2014). Regular, positive reinforcement not only motivates workers to maintain compliance with safety protocols but also strengthens their psychological ownership of workplace safety. To sustain behavioral change and drive long-term incident reduction, organizations should formally recognize and reward employees who consistently demonstrate proactive engagement in BBS initiatives and exhibit exemplary safety practices (Guo et al., 2018). Structured reward systems, delivered on a periodic basis serve as a critical incentive for maintaining high safety performance and institutionalizing a culture of safety excellence within Uganda's cement industry.

4.8.7 Continuous BBS improvement

BBS implementers must systematically evaluate the effectiveness of Behavior-Based Safety programs and associated training interventions through the structured application of the Plan-Do-Check-Act (PDCA) continuous improvement cycle (Mohammadfam et al., 2017a). By planning targeted safety strategies, implementing them across relevant operational areas, monitoring behavioral outcomes, and refining approaches based on observed performance, organizations can institutionalize a dynamic feedback mechanism that enhances program responsiveness (S. Han et al., 2014). This iterative process not only fosters continuous learning and adaptation but also reinforces sustained safety behaviors among employees. Ultimately, the consistent application of the PDCA framework, drives measurable reductions in workplaces incidents and strengthens the overall safety culture within Uganda's cement industry. Figure 5 presents the proposed BBS framework for the mitigation of unsafe behaviors within the cement manufacturing industry.

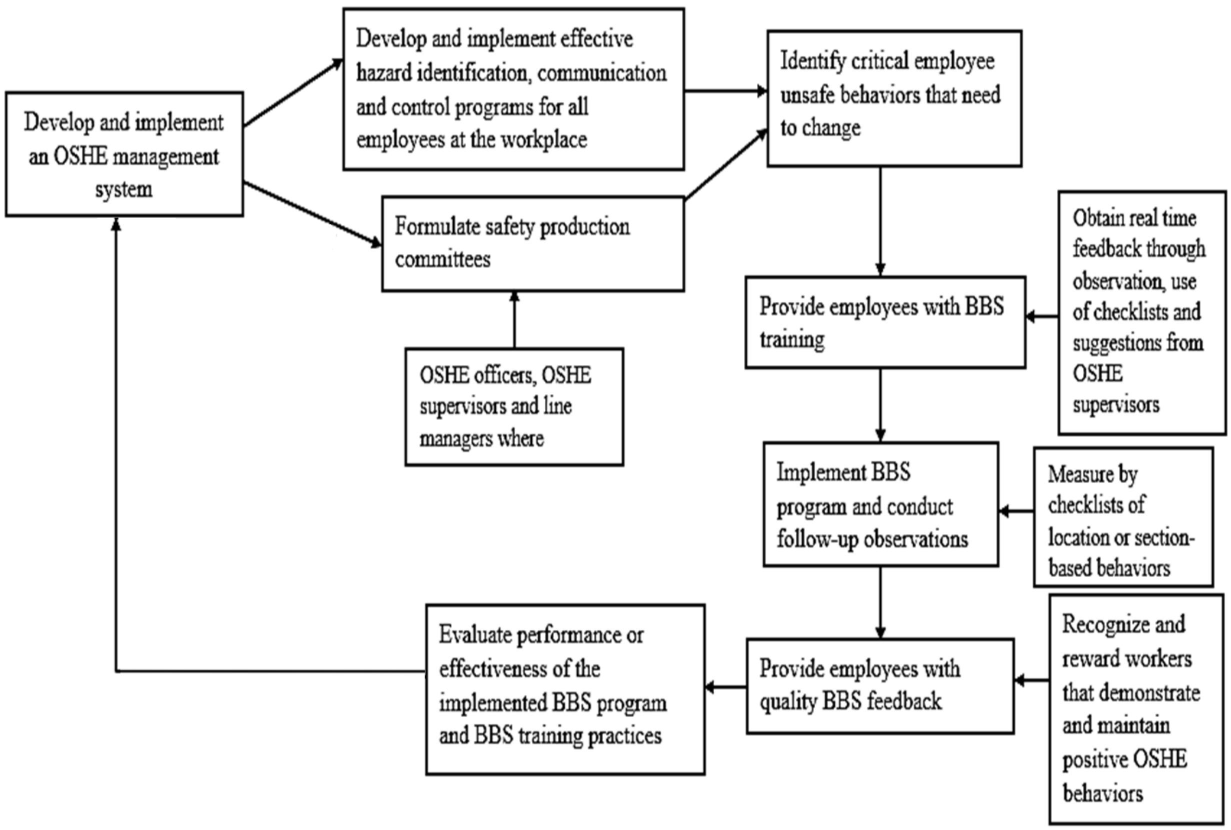

Figure 5: Behavior Based Safety implementation framework

4.9 Study Limitations

This study faces three key limitations that constrain the interpretation of its findings. The cross-sectional design prevents the study from establishing causal relationships between Behavior-Based Safety (BBS) programs and reductions in workplace incidents, as it captures data at only one point in time rather than tracking behavioral and safety performance changes longitudinally. The reliance on self-reported perception data introduces response, social desirability, and recall biases, which may have led participants to overstate compliance with safety practices and the effectiveness of BBS initiatives, despite the use of supplementary checklist-based inspections. Additionally, the study's focus on only two cement manufacturing plants restricts the generalizability of the results, since variations in organizational culture, management commitment, safety reporting systems, and operational practices across other plants and contexts may produce different BBS outcomes.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study successfully achieved all four research objectives by systematically examining hazards, risks, perceptions, and implementation strategies related to Behavior-Based Safety (BBS) in two Ugandan cement plants. To achieve objective one, the study identified and characterized key workplace hazards in routine cement operations, including dust, noise, mechanical risks, confined spaces, and recurring unsafe behaviors, demonstrating the sector's inherently high-risk nature. In addressing the second objective, the study assessed the associated risks using a structured risk matrix, establishing that high production pressures, labor-intensive tasks, and weak safety oversight increased the likelihood of incidents, particularly where safety discipline and root-cause investigations were limited. For the third objective, the study evaluated employee perceptions of existing BBS programs and found that workers acknowledged their role in improving hazard recognition, reporting, and behavioral safety, although inconsistent management feedback and workforce diversity constrained full effectiveness. To fulfill the fourth objective, the study developed a context-specific BBS implementation framework that integrates continuous improvement through the Plan-Do-Check-Act cycle, stronger leadership engagement, enhanced feedback mechanisms, and targeted recognition of safe behaviors. Collectively, the findings confirm that BBS can improve safety performance in Uganda's cement industry when implemented systematically, but they also highlight the need for sustained managerial commitment, worker participation, and behavior-focused safety practices to achieve long-term OSHE resilience.

5.2 Recommendations

5.2.1 General Recommendations

i. Cement plant managers should continuously strengthen and refine Behavior-Based Safety (BBS) programs using the Plan-Do-Check-Act (PDCA) cycle to ensure structured, adaptive, and performance-driven safety management that responds to changing operational demands and emerging risks.

ii. Management should prioritize sustained investment in workforce training and capacity building to enhance employees' competence in recognizing, reporting, and addressing unsafe behaviors and hazardous conditions, thereby reinforcing a proactive and participatory safety culture.

iii. The industry should institutionalize a system-based approach to safety investigations that emphasizes root-cause analysis rather than individual blame, fostering organizational learning, accountability, and long-term improvements in Occupational Safety, Health, and Environment (OSHE) performance.

5.2.2 Recommendations for Future Work

i. Future studies should conduct quantitative assessments of occupational exposures, particularly PM_{10}, $PM_{2.5}$, and noise levels in cement plants, to generate objective empirical data that can inform evidence-based mitigation strategies.

ii. Researchers should examine how fluctuating production pressures, workload variations, and operational schedules influence the frequency and severity of workplace incidents to identify high-risk conditions that require targeted interventions.

iii. Further research should explore the relationship between workforce diversity, BBS management practices, and OSHE performance to develop tailored behavioral safety strategies that account for cultural, educational, and occupational differences among workers.

iv. Future studies should undertake longitudinal evaluations of the proposed BBS framework to assess its long-term effectiveness in reducing incidents, improving safety culture, and sustaining behavioral change over time.

v. Researchers should apply quantitative modeling techniques, such as structural equation modeling or predictive analytics, to analyze the relationship between unsafe behaviors, organizational factors, and accident outcomes, thereby strengthening the empirical basis of BBS interventions.

vi. Additional studies should validate the proposed BBS framework across other high-risk industries and in different countries to test its transferability, contextual relevance, and applicability beyond Uganda’s cement sector.

5.2.3 Policy Recommendations

i. Through coordinated action, industry stakeholders should strengthen and refine BBS programs by applying the Plan–Do–Check–Act (PDCA) cycle to drive continuous improvement and proactive safety management.

ii. Sustained investment in workforce training is essential for industry stakeholders to enhance employees' capacity to identify, report, and address unsafe behaviors and workplace hazards.

iii. To embed organizational learning, industry stakeholders should institutionalize a system-based approach to safety investigations that prioritizes root-cause analysis over individual blame and supports long-term improvements in OSHE performance.

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Appendix One: Perception Survey Questionnaire

My name is Lutaaya Francis and I am currently undertaking research on the Impact of the existing Behavior Based Safety (BBS) Management Programs on Accident Prevention in Uganda's Cement Industry. Your plant is among those selected for the study. This tool aims at collecting your perception and attitudes towards the existing BBS management programs within your cement plant. Your kind contribution demonstrated through filling of this questionnaire will lead to the development of the necessary policy and technical interventions leading to improvements in the OSHE/EHS/HSE/OSH practices of these plants. Note: I have received full top-management support through your respective plant Human Recourse (HR) manager to collect this data and information. Thus, you should feel free to share the required information/data. The information and data obtained in the survey will be used for conducting analysis on an aggregate basis for educational purposes and shall be kept confidential.

1. **What is the name of your company?**

Hima Cement Kasese ☐ Tororo Cement Plant ☐

2. **In which age bracket are you?**

Below 18 ☐ 18-25 ☐ 25-30 ☐ 30-35 ☐ 35-40 ☐

40-45 ☐ 45-50 ☐ 50-55 ☐ 55-60 ☐ 60 and above ☐

3. **Gender?**

Male ☐ Female ☐

4. **What is your level of education?**

O-Level ☐ A-level ☐ Certificate ☐ Diploma ☐ Degree ☐ Masters ☐ Apprentice ☐

5. **What is your religious background?**

Islam ☐ Catholic ☐ Anglican ☐ Adventist ☐ Traditionalist ☐ Other ☐

Basic Plant Details

6. **Which types of cement are produced by your plant? Tick as many options as there are.**

Ordinary Portland Cement ☐ Portland Pozzolana Cement ☐ White Cement ☐ Oil Well Cement ☐

Portland Blast Furnace Cement ☐ Sulphate Resisting Cement ☐ Other ☐

7. **In which section of the plant do you work?**

Quarry ☐ Crushing ☐ Pre-Homogenization ☐ Grinding ☐ Rotary Kiln ☐ Cooler Section ☐

Clinker Storage ☐ Blending ☐ Cement Grinding ☐ Cement Silos ☐ Storage ☐

Packaging ☐ Maintenance ☐ Transportation ☐

8. **How many work shifts exist at your plant?**

Two shifts ☐ Three shifts ☐ Four shifts ☐

9. **In which shift do you work at the plant?**

8:00AM-4PM ☐ 4:00PM-12PM ☐ 12:00PM-8:00AM ☐

10. **For how many years have you been working at the plant?**

1-5 years ☐ 5-10 years ☐ 10-15 years ☐ over 15 years ☐

11. **What position do you hold at the plant?**

Manager ☐ Assistant Manager ☐ Team Leader ☐ Technician ☐ Driver ☐

Shift supervisor ☐ Mechanic ☐ Foreman ☐ Other ☐

12. **How many employees do you think are in your plant?**

0-200 ☐ 200-300 ☐ 300-400 ☐ 400-500 ☐ 500-600 ☐ 600-700 ☐ Over 700 ☐

13. **Do you have the following systems at your cement plant? Tick all the systems that are available.**

Safety management system ☐ Quality management system ☐ Environmental management system ☐

Management Commitment to Health and Safety

14. **Does management provide Personal Protective Equipment to all workers at all times within your plant?**

Yes ☐ No ☐ Not Sure ☐

15. **Do supervisors ensure effective usage of PPE in all tasks where possible within your cement plant?**

Yes ☐ No ☐ Not Sure ☐

16. **The plant has an OSHE policy that is signed and displayed for everyone to see.**

Yes ☐ No ☐ Not Sure ☐

17. **There is an OSHE/HSE officer at the plant**

Yes ☐ No ☐ Not Sure ☐

18. **There is a separate OSHE/HSE/EHS office purposely for health and safety activities.**

Yes ☐ No ☐ Not Sure ☐

19. **There is a budget for training, procurement of PPE and for rewarding employees for active participation in OSHE/HSE/EHS activities at the plant.**

Yes ☐ No ☐ Not Sure ☐

20. **Do you think the existing Health and Safety Policy is regularly reviewed by management? (At least once a year)**

Yes ☐ No ☐ Not Sure ☐

21. **Do you think top-management gets actively involved in the different health and safety activities such as meetings, workplace inspections and audit among others?**

Yes ☐ No ☐ Not Sure ☐

22. Does Top-management actively fund Health and Safety improvement effects such as internal and external EHS/HSE/OSH audit activities for continuous performance enhancement?

Yes ☐ No ☐ Not Sure ☐

23. Does management clearly define and communicate employee health and safety roles and responsibilities at your plant?

Yes ☐ No ☐ Not Sure ☐

Hazard Identification, Communication, and Control

24. Are you aware of any injury and accident-causing hazards within your section or department at work?

Yes ☐ No ☐ Not Sure ☐

25. Have you ever participated in workplace inspection activities at the plant?

Yes ☐ No ☐ Not Sure ☐

26. Have you ever participated in a job or task risk assessment activity at the plant?

Yes ☐ No ☐ Not Sure ☐

27. Are employees issued with work permits before each dangerous task or job such as welding, working at height and entry to confined spaces among others at the plant?

Yes ☐ No ☐ Not Sure ☐

28. Do you have a system for identifying, reporting, and controlling hazards at the plant? Like a suggestion scheme or where do employees report hazards on a regular basis?

Yes ☐ No ☐ Not Sure ☐

29. What are the commonest hazards in your department or section?

Noise ☐ Dust ☐ Hot Objects ☐ Ergonomics ☐ Manual Handling ☐

Hand and power tool hazards ☐ Respiratory hazards ☐ Fire hazards ☐ Fall from high elevations ☐

Enlargement ☐ Strips ☐ Trips ☐ Chemical Hazards ☐ Electrical Hazards ☐

Mechanical Hazards ☐ Moving vehicle hazards ☐ Unguarded machines ☐ Poorly maintained equipment ☐

Workout/Old tools ☐ Cuts ☐ Caught in between hazards ☐ Confined Space Entry Hazards ☐

Poor Ventilation ☐ Hazardous Materials ☐ Unsafe fellow employees ☐ Option 26 ☐

Flying Objects ☐

30. Are there other hazards in your department/section or plant that are not listed in the list above? Mention accordingly. ....

Appendix Two: Questionnaire for Behavior-Based Safety (BBS) Management

1. Experts believe that materials, tools, and processes contribute only 30% to all cement plants; workers due to their unsafe and risky behavior contribute 95% of all accidents in cement plants while the remaining 2% are due to acts of God like floods among others. At what rate do you agree on this nation as a cement worker?

Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐

2. Engineering controls like Machine guarding and maintenance cannot significantly reduce workplace accidents without the use of effective Behavior Based Safety (BBS) systems. At what rate do you agree with this notion as a cement worker?

Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐

3. Which one(s) of the following BBS systems is/are employed at your current plant?

Stop Job Policy. Where each worker is allowed to stop any job as long as they have sensed anything hazardous with the fellow worker, machine, tool, materials or environment. ☐

Hazard Observation Card: Where employees write hazards, they see and put the card in a suggestion box. ☐

Unsafe Behavior Cards: Where employees are given Yellow, Red or Green cards if found doing unsafe acts like failing to wear PPE and for failing to attend HSE meetings among others. (The employee doing tasks acts as the player while the person issuing the card acts like a referee). ☐

1. Irrespective of the BBS system or systems selected in the questionabove, is it analog whereby you use cards or write on a piece of paper or it is digital where you use a smartphone to report hazards and sometimes if possible include photos or images?

Digital ☐ Analog ☐

2. If the BBS system is analog, do you think it should be made digital?

Yes ☐ No ☐ Not Sure ☐

3. Does management give positive feedback on employee safety behaviors at the plant?

Yes ☐ No ☐ Not Sure ☐

4. Do you think employees are effectively involved in the existing BBS programs?

Yes ☐ No ☐ Not Sure ☐

5. Do you think that management's intention is to improve employee safety performance through BBS or it is to place blame on employees so as to cut costs through punishments and penalties?

Yes ☐ No ☐ Not Sure ☐

6. Do you think injuries and accident rates have reduced in your department and plant in general since the introduction of BBS system?

Yes ☐ No ☐ Not Sure ☐

7. Do you trust your workmate abilities to identify, communicate and right control the right unsafe behavior at the plant?

Yes ☐ No ☐ Not Sure ☐

8. Do you think the existing BBS system(s) can improve with more employee training?

Yes ☐ No ☐ Not Sure ☐

9. Do you trust in your workmates intentions to identify, report and control unsafe behaviors at the plant

Yes ☐ No ☐ Not Sure ☐

10. Injury and accident rates were high at the plant before the introduction of BBS.

Yes ☐ No ☐ Not Sure ☐

11. Do you think the existing BBS system is the best for your plant or department?

Yes ☐ No ☐ Not Sure ☐

12. If your answer is no, in the question above which of the following BBS systems do you think would work best at your plant?

Stop Job Policy ☐ Hazard Observation Card System ☐ Unsafe Behavior Card system ☐

13. Do you think the implemented BBS system employed at the plant has contributed positively to employee behavior changes?

Yes ☐ No ☐ Not Sure ☐

14. Do you trust in management 's commitment to the success of the existing BBS program?

Yes ☐ No ☐ Not Sure ☐

15. Do you think the existing differences in language, religion, education and culture of workers impacts on employee safety behavior at the plant?

Yes ☐ No ☐ Not Sure ☐

16. Do you think some employees are uncomfortable with the existing BBS system at the plant?

Yes ☐ No ☐ Not Sure ☐

17. Do you think plant management should continue implementing the existing BBS system(s) at the plant?

Yes ☐ No ☐

18. Would you recommend the use of the same BBS system(s) to other cement plants?

Yes ☐ No ☐

19. On a scale of 0-10, Please rate your level of commitment to the existing BBS system.

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