SCHOOL OF POSTGRADUATE STUDIES

AN ASSESSMENT INTO THE EFFECTS OF IMPLEMENTING CONTINUOUS IMPROVEMENT PRACTICES IN PRODUCTION LOGISTICS: A CASE STUDY OF THE INTERNAL LOGISTICS SYSTEM OF REAGENTS AT KANSANSHI MINING PLC

A RESEARCH REPORT SUBMITTED TO THE UNIVERSITY OF LUSAKA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A DEGREE OF MASTER OF SCIENCE IN PROCUREMENT, LOGISTICS AND SUPPLY CHAIN MANAGEMENT

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STUDENT'S DECLARATION

This is a declaration that the research project I've worked on is entirely original with no submissions to other universities for degree awards, and where work by others has been used, proper attribution has been given.

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SUPERVISOR'S DECLARATION

As the University Supervisor, I have given my consent for this project to be submitted for assessment.

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ACRONYMS

KMP	Kansanshi Mining Plc
JIT	Just in Time
TQM	Total Quality Management
TPM	Total Productive Maintenance
RFID	Radio-Frequency Identification
SPSS	Statistical Package for Social Sciences
ZCCM	Zambia Consolidated Copper Mines
KCM	Konkola Copper Mines
ZDA	Zambia Development Agency
FQM	First Quantum Minerals
UPND	United Party for National Development
SX/EW	Solvent Extraction and Electro-winning
CI	Continuous Improvement
CSR	Corporate Social Responsibility
PDCA	Plan-Do-Check-Act
DMAIC	Define, Measure, Analyse, Improve, and Control
BPR	Business Process Re-engineering
SC	Supply Chain
ESG	Environmental, Social and Governance
ZEMA	Zambia Environmental Management Agency
MSD	Mines Safety Department

ABSTRACT

This study assessed the effects of implementing continuous improvement (CI) practices in the internal logistics system of reagents at KMP. Using descriptive data analysis, the study explored the CI practices such as Root-Cause Analysis (RCA), Technology adoption, Training, Employee involvement, Feedback and Suggestion systems. With a population of 120 staff, a sample of 120 from the reagents section was picked entailing a census approach. Findings indicate “good” adoption of CI, particularly in root cause analysis with 61.8% of respondents indicating that Root-Cause analysis is frequently utilized, Training with 73.3% respondents indicating it is frequently utilized and technology use with 75.28% of respondents indicating frequent utilization of this practice. Employee involvement, feedback and suggestion is the least with 58.4%. The study established that CI is utilized but not to the fullest extent and that there is room for improvement.

The study also established a positive relationship between CI practices and logistics efficiency, evidenced by a multiple regression analysis model explaining 81.45% of the variance in the dependent variable, efficiency. Safety, health, and environmental benchmarks also showed improvement post-CI with an improved grand mean value post CI implementation. The regression model showed a positive 93.13% explanatory power with a P-value of 0.001 indicating significance. Leadership commitment and employee involvement emerge as crucial for successful CI implementation. The study suggests integrating CI with performance evaluation schemes for all staff, establishment of CI/quality circles with a champion to lead the process. Establishing a dedicated CI section with mission to push the CI agenda across the firm is also recommended. Training also needs reinforcement. It is also recommended that there is increased focus on internal customer satisfaction within the company

Keywords: Continuous Improvement, Logistics Management, Operational Efficiency, Employee Engagement, Customer Satisfaction, Lean, Total Quality Management, Agile, Emerging Economies, Safety, Health, Environment, Root Cause Analysis, Training, Feedback, Suggestion Systems, Leadership Commitment, Technology Utilization, Performance evaluation schemes, Technological Advancements.

CHAPTER ONE

1.0 Introduction

This chapter examines the back ground to the study, a synopsis of the mining industry's economic history in Zambia, and KMP's organizational history. The problem statement, research objectives, research questions, study significance and scope are further examined in this chapter.

1.1 Background of Study

Achieving success in the mining industry heavily relies on total overall operational excellence across all sectors of the business. This is because mining is often characterized by high operational costs amid difficult global economic environment. Challenges such as managing crucial resources like reagents also continue to plague the industry. In a nutshell, untimely availability and at times non-availability, improper storage, and inefficient transportation of reagents, as highlighted by Smith (2012), significantly impact the bottom line and overall operational efficiency.

Continuous improvement, often known as "kaizen," in Japan is widely recognized for its capacity to stimulate incremental and persistent enhancements that contribute to improved operational excellence in a business as highlighted by Imai (1986). However, the potential for continuous improvement in the context of mining, especially in reagent logistics, remains underexplored.

The absence of adequate research, coupled with KMP's eagerness to enhance its logistical operations, underscores the need for an in-depth analysis of the consequences of implementing continuous improvement in this context.

1.2 Organization Background

The KMP copper-gold mine, located in Zambia's North Western Province near Solwezi, has continually maintained its status as a leading operation for First Quantum Minerals Limited since its inception in 2005 as discussed by First Quantum Minerals (2021). It is joint venture with First Quantum Minerals Limited having an 80% ownership position and 20% by ZCCM-IH. This collaboration highlights the project's importance within the wider range of projects owned by First Quantum Minerals Limited.

In addition to being a significant mining project, the KMP operation shows the immense importance of the mining sector to both the local and national economy. Its contributes significantly to the ‘coffers’ of the country

KMP is largely renowned for its substantial copper and gold production, making a significant contribution to Zambia's overall copper output. Being the foremost copper producer in Africa, the mine plays a crucial role in maintaining the economic stability of the nation as indicated by First Quantum Minerals (2021).

Nevertheless, the influence of KMP extends well beyond its economic achievements. The mine plays a crucial role in providing job opportunities for the region, employing more than 13,000 workers, predominantly sourced from the local labor pool according to First Quantum Minerals (2021). This employment opportunity not only meets the job needs of the local area but also stimulates wider economic growth in the surrounding region.

An exceptional characteristic of the operation is its proficient capacity to effectively process 3 different types of ores, such as primary sulphide, mixed supergene, and oxide ores according to First Quantum Minerals (2021). KMP utilizes a wide range of advanced mineral processing methods such as crushing, milling, flotation, leaching, and Solvent Extraction and Electro-winning (SX/EW) to efficiently extract copper and gold from various types of ore.

KMP strictly follows the most rigorous industry norms for mining processes. It operates two open pits, namely Main and Northwest, where typical open-pit mining techniques are utilized. This involves the use of hydraulic excavators and a fleet of haul trucks as espoused by First Quantum Minerals (2021). The mine has adopted environmentally sustainable methods by incorporating electric trolley assist technology for mined ore transportation, thereby minimizing its impact on the environment.

1.2.1 Reagents in the Copper Processing Plant

Reagents are essential for the extraction and purification of copper ore in copper processing facilities. Flotation, leaching, and solvent extraction-electrowinning (SX-EW) techniques are utilized in various stages of the operation. Reagents, including collectors (SIBX, TLQ2, Betacol, PAX, NaEX ,Betamin), frothers(oreprep,F142) depressants(CMC, lime) , flocculants(floppam), organic extractants, and acid leaching reagents, play a crucial role in the copper processing as highlighted by Wills & Finch (2016), Biswas et al. (2019) and Dreisinger, (2006). The selection and adjustment of these reagents have been meticulously done to ensure the efficient extraction and purification of copper

1.3 Statement of the Problem

1.3.1 Low Logistical efficiency

Reagents are vital for extracting minerals like copper, and their efficient management is crucial for mining operational success according to Wills and Finch (2016). However, challenges in internal logistics management often lead to shortages of key reagents such as SIBX, TLQ2, and NAHS, causing interruptions, loss of copper recovery, increased expenses, and revenue loss. KMP face opportunities on a daily basis to enhance efficiency by addressing challenges such as delays, bottlenecks in logistical paths, high transportation costs, safety, health, and environmental concerns.

1.3.2 Compliance issues: KMP has a legal responsibility to adhere to the environmental management act number 12 of 2011 which is enforced by the Zambia Environmental Management Agency (ZEMA) as well adhere to Mines Safety Department (MSD) requirements as required by the Mines Minerals Development Act number 7 of 2008. These requirements mainly center on safety health and environment through the proper handling, management and transportation of reagents. KMP has also committed itself to adhering to Environmental, Social and Governance reporting (ESG) principles and standards which not only aligns with local and industry expectations but with global expectations as well. However, there is need to continue enhancing compliance to safety

health and environmental standards to avoid the likelihood of incidents. A case in point was the loss of reagents and injury to personnel in a storage shed fire at KMP reagents shed no. 3 as reported by the Times of Zambia (2015). The loss goes on to show the importance of maintaining high SHE standards. CI offers opportunities to always and continuously interrogate lingering compliances issues and rectifying them. In short, great strides have been made since the aforementioned accident, but great strides need to continue striding forward and continued efforts need to continue on a daily basis to achieve perfection.

1.4 Research Objectives

1.4.1 General Objective

To assess the effects of implementing continuous improvement practices in production logistics focusing on the internal logistics system of reagents (for the Copper/Gold processing plant) at KMP.

1.4.2 Specific Objectives

(1) To ascertain the extent to which CI practices are being implemented in the internal logistics system of reagents at KMP

(2) To examine the effects of implementing continuous improvement practices on the efficiency of internal logistics systems of reagents at KMP

(3) To establish the effects of implementing continuous improvement practices on safety, health and environmental levels of the reagents section at KMP.

1.5 Research Questions

(1) What CI practices are commonly utilized and to what extent?

(2) What are the effects of implementing CI practices on the efficiency levels of internal logistics system of reagents?

(3) What are the effects of implementing continuous improvement practices on the safety, health and environmental levels of the section?

1.6 Significance of Study

The complexity of managing reagent logistics in the mining sector presents a significant challenge with direct effects on efficiency, costs, safety and productivity. Integrating continuous improvement (CI) initiatives at KMP Reagents holds multifaceted significance.

1.6. 1 KMP: The study offers insight and recommendations that can be used to address operational inefficiencies and also challenges concerning Safety health and environment compliance through CI. Addressing operational inefficiencies through CI can unveil cost-saving avenues, crucial for KMP facing financial challenges, worsened by the closure of the Cobre Panama mine as noted by Buschschlutter(2023) and declining copper ore grades as highlighted by Mumba (2023). Addressing matters concerning Safety health and environment enhances KMPs standing as being among the nation's safest mine operators

1.6.2 Scholars & Researchers: This study contributes to the evolving body of knowledge on continuous improvement (CI) by not only addressing operational inefficiencies but also extending the application of CI principles to safety health and environment (SHE) compliance matters, shedding light on novel perspectives. The study's emphasis on cost-saving avenues and its practical insights into bridging gaps in CI implementation further enrich the discourse. Most notably, it opens up promising avenues for future research, recognizing the interconnected nature of CI with operational efficiency, SHE compliance, and resource optimization, thereby inspiring scholars and practitioners to explore innovative and interdisciplinary approaches within the dynamic landscape of organizational development.

1.6.3 The broader stakeholder ecosystem. The broader stakeholder ecosystem including suppliers, regulators, and customers, benefits from this study by the study's bringing to the front the need for CI integration into the industry culture and the broader society at large. This not only improves the mine industry as whole but also improves satisfaction among stakeholders

1.7 Scope of Study

The focus of this research is to investigate the effects of implementing continuous improvement initiatives within production logistics, particularly emphasizing the internal logistics of reagents at KMP. Given the specificity of the context, the study primarily centers on KMP Reagents (a section made up of 120 staff located under the concentrator department but servicing the entire processing plant). In this study, KMP Reagents serves as a microcosm that exemplifies the broader challenges and nuances associated with reagent internal logistics in the mining industry.

To maintain clarity and ensure exhaustive exploration of the chosen domain, the primary objectives encompassed a thorough understanding of the current CI initiatives and practices, effects of CI initiatives and practices on efficiency and on SHE (safety health & environment). Although the overarching theme orbits around Kaizen, it is pivotal to note that the research is not limited to theoretical explorations. Practical implementations, tangible outcomes, and feedback loops form integral components of the study, making it a blend of theoretical underpinnings and on-ground realities.

1.8 Definitions of Key Terms and Concepts

CI Practices/initiatives: It is based on the idea that small, incremental changes can lead to major improvements in productivity and quality as espoused by Imai (1986). In this study CI practices refers to methods, procedures and processes that are followed to achieve continuous improvement goals or outcomes

Production logistics*:* A subset of logistics management, it refers to the logistical processes and systems within a production facility, including the planning, implementation, and control of the efficient flow and storage of goods, services, and related information from the point of origin to the point of consumption as discussed by Harrison and van Hoek (2008).

Reagents: In the context of mining, reagents are chemicals used in the extraction of minerals from ores. Their proper management is crucial for effective, safe, and efficient mining operations according to Young (2003).

Operational efficiency: This refers to the capability of an enterprise to deliver products or services to its customers in the most cost-effective manner possible while ensuring the high quality of its products, service, and support (Parmenter 2015).

Stakeholder Ecosystem: It encompasses all individuals, entities, or groups with an interest or concern in a particular organization, which can be affected by the organization's actions, objectives, and policies. This includes internal and external stakeholders such as employees, suppliers, customers, and regulatory bodies as illustrated by Freeman (1984).

ESG standards: Refers to Environmental, Social, and Governance reporting mechanism, which are a set of principles that companies integrate into their business operations to ensure responsible and sustainable practices. These standards assess a company's impact on the environment, its social responsibility, and its governance structures. Adhering to ESG standards is increasingly important for companies aiming to meet ethical, sustainability, and transparency expectations from investors, stakeholders, and the broader community.

CI: Continuous improvement refers to a persistent endeavor to enhance goods, services, or procedures. These efforts may take the form of gradual advancements over time or sudden, revolutionary breakthroughs according to Deming (1993).

SC: According to Chopra and Meindl (2016), the supply chain is the network of all the people, businesses, institutions, assets, processes, and technological advancements involved in the production and marketing of a product, from the supplier's delivery of raw materials to the manufacturer's final delivery to the customer.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter examines the brief history of the CI concept, Significance of the CI focusing on safety health and environment (S H E) and operational efficiency. The chapter also looks at the theoretical framework and the conceptual frameworks

2.1 Brief History of the CI Concept

The history of continuous improvement (CI) is rooted in various management philosophies and methodologies that evolved over the 20th century. While the principles of continuous improvement have ancient roots, the modern concept gained prominence in the business and manufacturing sectors. Here's a brief historical overview:

2.1.1 Scientific Management (Late 19th to early 20th century)

The roots of CI can be traced back to the Scientific Management era pioneered by Frederick W. Taylor. In the late 19th and early 20th centuries, Taylor (1911) introduced the concept of scientific analysis of work tasks to enhance efficiency. Though primarily focused on manufacturing processes, Taylor's work laid the groundwork for systematic approaches to improve productivity.

2.1.2 Statistical Process Control (1920s - 1930s)

Walter A. Shewhart, a statistician at Bell Telephone Laboratories, developed Statistical Process Control (SPC) in the 1920s. Shewhart's methods involved statistical analysis of manufacturing processes to identify and control variations. This laid the foundation for understanding the importance of data in quality improvement.

2.1.3 Total Quality Management (TQM) (1940s - 1950s)

The mid-20th century saw the emergence of Total Quality Management (TQM) principles, notably in Japan after World War II. Influential figures such as W. Edwards Deming and Joseph M. Juran played pivotal roles in introducing statistical quality control methods and management philosophies that emphasized continuous improvement. The Japanese embraced these ideas, leading to the development of the renowned Japanese quality movement.

2.1.4 Kaizen Philosophy (1950s - 1960s)

The term "Kaizen," meaning continuous improvement in Japanese, gained prominence in the 1950s and 1960s according to Imai (1986). Kaizen principles, rooted in the work of Kaoru Ishikawa and others, emphasize small, incremental improvements made by all employees. This philosophy became a cornerstone of Japanese management practices and was integral to the success of Japanese industries.

2.1.5 Lean Manufacturing (1980s - 1990s)

Building on earlier principles, the concept of Lean Manufacturing emerged in the 1980s, largely influenced by the Toyota Production System (Ohno, 1988). Taiichi Ohno and Shigeo Shingo at Toyota emphasized eliminating waste, improving efficiency, and empowering workers to contribute to continuous improvement. Lean principles, with concepts like Just-In-Time production, became widely adopted globally.

2.1.6 Six Sigma (1980s - 1990s)

Six Sigma, introduced by Motorola in the 1980s and later popularized by companies like General Electric, integrates statistical methods with quality management principles as highlighted by Harry and Schroeder (2000). The goal is to reduce defects and variations in processes to achieve near-perfect quality. Six Sigma became a widely adopted methodology for process improvement in various industries.

2.1.7 Agile and Scrum (2000s - Present)

In the software development realm, agile methodologies and Scrum practices emerged in the early 2000s according to Schwaber and Sutherland (2017). These approaches emphasize iterative and collaborative development, allowing teams to respond quickly to changing requirements. Continuous improvement is inherent in agile practices through regular retrospectives, where teams reflect on their performance and adjust processes accordingly.

Continuous Improvement has evolved into a multifaceted discipline, drawing from various historical influences. Its principles have transcended industries, becoming a fundamental aspect of organizational culture and management philosophy worldwide.

2.2. The Significance of Continuous Improvement

CI plays a critical role in various organizations especially pertaining to efficiency and Safety, health and environment. Below is a brief discussion on the aforementioned.

2.2.1 CI and Safety

Continuous improvement, as a dynamic organizational philosophy, permeates the landscape of safety by instigating a culture of proactive risk management and incident prevention as asserted by Niu et al. (2018). The application of CI methodologies, such as Lean or Six Sigma, to safety protocols enhances the discernment and mitigation of potential hazards. Noteworthy examples include the encouragement of routine safety audits and near-miss reporting, emblematic of a continuous feedback loop fortifying safety frameworks.

Yet, the integration of CI into safety initiatives necessitates judicious equilibrium. An undue emphasis on efficiency gains, divorced from considerations of safety protocols, holds the potential to compromise worker well-being. Thus, organizations must ensure the alignment of CI initiatives with robust safety standards and the active engagement of employees in the continuous improvement process as acknowledged by Hallowell et al., (2019).

2.2.2 CI and Health

In the realm of health, CI practices contribute substantively to the optimization of occupational health and wellness programs. Lean methodologies, for instance, engender the streamlined delivery of healthcare services within organizational contexts as acknowledged by van den Heuvel et al. (2017). The applicability of CI extends to the identification and elimination of workplace stressors, thereby fostering a healthier work milieu and mitigating the risk of occupational illnesses.

However, the potential impact of CI on health is nuanced. An intensive focus on productivity and efficiency, if not managed discerningly, may culminate in escalated workloads and heightened stress levels, potentially jeopardizing employee well-being. Consequently, organizations are tasked with the imperative of balancing productivity goals with health-conscious practices, ensuring that CI initiatives contribute positively to the holistic well-being and vitality of the workforce.

2.2.3 CI and the Environment

The amalgamation of CI and environmental sustainability underscores a commitment to operational efficiency that mitigates environmental impact as noted by Graedel and Allenby (2017). CI practices, often synonymous with optimized resource utilization, waste reduction, and energy efficiency, manifest in tangible operational benefits. Instances include the application of lean principles, which culminate in streamlined production processes, consequentially reducing waste generation and fostering sustainable practices.

However, the environmental impact of CI transcends operational efficiency. Organizations must meticulously evaluate the ecological ramifications of improvement initiatives, contemplating factors such as carbon footprint, resource depletion, and strict adherence to environmental regulations as Melnyk et al. (2020) suggests. The integration of environmental sustainability into CI necessitates a comprehensive approach, prompting organizations to actively seek environmentally friendly alternatives and engage stakeholders in responsible decision-making.

2.2.4 CI and Operational Efficiency

Continuous improvement (CI) is fundamentally centered on the refinement of procedures and the elimination of waste within organizational processes. This concerted effort to enhance operational efficiency has a profound impact on various facets of organizational performance. By systematically streamlining workflows and reducing unnecessary elements, CI brings about increased productivity, allowing teams to accomplish more with the same or fewer resources. The commitment to efficiency improvement is particularly crucial in driving down operational expenses, contributing to overall cost-effectiveness. Moreover, the streamlined procedures facilitated by CI result in faster reaction times to changing circumstances, fostering adaptability and responsiveness. As Taiichi Ohno (1988) emphasized, these efficiency gains have an immediate and tangible effect on the bottom line of an organization, influencing its financial health and competitiveness in the market. In essence, the continuous pursuit of improvement through CI not only optimizes internal processes but also establishes a foundation for sustained growth and success.

2.3 Continuous Improvement tools and practices

2.3.1 Root Cause Analysis: Unearthing Systemic Issues

Root Cause Analysis (RCA) is a systematic process used to identify the underlying causes of problems or incidents. A cornerstone of CI, RCA is designed to go beyond superficial fixes, promoting long-term solutions that prevent issue recurrence as Wilson et al. (1993) emphasizes. Techniques such as the "Five Whys" and Ishikawa (fishbone) diagrams are employed within RCA to trace the origin of failure or inefficiencies according to Ohno (1988). These methodologies encourage a deeper understanding of organizational processes, which is essential for substantive improvement

2.3.2 Training: Empowering the Workforce

Training is an indispensable component of CI that equips employees with the requisite skills and knowledge to identify inefficiencies and implement solutions effectively. The literature emphasizes the importance of a skilled workforce that can adapt to new methods and technologies, underscoring the role of training in fostering a culture of learning and adaptability. Bessant (1999) posits that continuous training is not only about skill enhancement but also about instilling a mindset that embraces change and improvement as constants.

2.3.3 Technology Adoption: The CI Catalyst

The adoption of new technologies plays a significant role in CI by enabling organizations to leapfrog existing performance benchmarks. Davenport (1993) points out that technological advancements offer novel ways to streamline operations, enhance productivity, and improve quality. However, technology adoption is not without its challenges; it requires careful planning and integration into existing work practices Leonard-Barton (1988) cautions. Furthermore, Cooper & Zmud (1990) stresses the importance of the human aspect of technology adoption, with employee acceptance and adaptation being key determinants of successful technology implementation

2.3.5 Employee Involvement

Employee involvement is a fundamental tenet of CI, predicated on the belief that those closest to the work are best positioned to identify areas for improvement. Engaging employees in the CI process not only leverages their tacit knowledge but also fosters a sense of ownership and motivation, Lawler III (1992) emphasizes. A multitude of studies have also shown that when employees are empowered to contribute to CI, the potential for innovation and efficiency gains is significantly amplified as noted by Cotton (1993).

2.3.6 Feedback and Suggestion Systems: Harnessing Collective Insight

Feedback and suggestion systems form an essential feedback loop for CI, capturing the collective insights and recommendations of the workforce. These systems encourage the submission of ideas for process and product enhancements often leading to incremental but impactful changes. Bessant and Caffyn (1997) posits that the effectiveness of feedback and suggestion systems is contingent upon management's responsiveness and the implementation of a transparent process for evaluating and acting upon employee input

The exploration of these CI practices reveals a multifaceted approach to organizational improvement. Root-Cause Analysis provides the depth of insight necessary for systemic change, while Training ensures a competent and agile workforce. Technology Adoption emerges as a catalyst for advancement, requiring a nuanced understanding of human-technology interaction

2.4 Implementing Continuous Improvement Practices

2.4.1 Dedicated Leadership

The promotion of continual improvement must be backed by upper management. Covey (1990) asserts that the organization's improvement path is established, given resources, and offered a clear vision

2.4.2 Workers' Engagement

Workers are a great source of suggestions for process improvement because they are frequently the ones closest to the operations. Through cross-functional teams, suggestion systems, and training, organizations should promote and facilitate their involvement according to Imai (1986).

2.4.3. Data-Informed Decision Making

Data plays a vital role in the process of continual improvement. Eckes (2000) stresses that metrics and key performance indicators (KPIs) are useful tools for measuring the effects of changes and identifying areas that require improvement

2.5 Empirical Literature Review

Continuous Improvement (CI) methodologies have been widely studied and applied across various industries, demonstrating their versatility and profound impact on organizational efficiency and effectiveness. Scholars such as Wickens (1990) emphasize the crucial role of teamwork in CI evolution, exemplified by managerial leadership at the Nissan Motor Plant in the UK. This underscores the significance of collaboration, adaptability, and excellence, which foster teamwork and commitment through direct interaction and communication between workers and leaders.

Building upon this foundation, Teian (1992) extends the perspective on CI as not just a developmental approach but also a response to daily workplace challenges. CI's broad applicability is highlighted, as any area in need of improvement can benefit from its principles. Hammer et al. (1993) further distinguish between CI and innovation, emphasizing gradual modifications versus significant advancements through new technology or radical process redesign, aligned with the Business Process Re-engineering (BPR) concept. Deniels (1995) took a different but good approach at CI and advocates for empowering operators to develop and align their measures with business objectives, fostering meaningful change on the shop floor. Operator expertise and responsibility, coupled with coaching, are identified as catalysts for positive transformations. Performance reviews are deemed crucial for establishing high-quality manufacturing businesses.

Quality management strategies are explored by Yeo et al. (1995), highlighting the importance of concepts like "zero defects" and "continuous improvement" in ensuring quality. The "Do it Better Every Time" (DIBET) approach emphasizes persistent efforts to minimize process unpredictability. Newitt (1996) took it further and integrates CI principles into business process management, suggesting that embracing CI liberates management and staff minds, fostering innovation and value creation across organizational levels.

2.5.3 Critique of Existing Literature

This table below provides an overview of the key findings, along with identified gaps, in existing literature related to this study.

Table 1: Literature Gap Analysis

Author & Year	Findings	Gap
Chen et al. (2000)	Application of CI in small production system for cost reduction in meat tenderizer manufacturing.	Lack of detailed exploration on the long-term sustainability and scalability of the implemented CI strategies.
Chanda, M.D(2017)	Relationship between Continuous Improvement practices and operations’	Need for insights into the specific CI practices that drive

	performance improvement in Zambian manufacturing companies.	performance improvement and potential contextual factors unique to Zambian manufacturing. Study focused on manufacturing only
Lee (2000)	Implementation of CI at Nichols Foods leading to improved work atmosphere and efficiency through 5S approach and team building.	Limited discussion on potential challenges faced during the CI implementation and ways to overcome them.
Ashmore (2001)	Toyota's strategic use of CI to tackle competition, with emphasis on SS for waste elimination and JIT implementation.	Lack of insight into the cultural and organizational changes required for successful CI adoption at such a large scale.
Palmer (2001)	CI implementation in inventory management at BAE SYSTEM resulting in significant time and cost savings.	Limited exploration of the broader organizational impact and potential resistance to change during the CI process.
Ahmed et al. (2005)	Exploration of CI implementation in a manufacturing firm using casting techniques, highlighting enhanced operational efficiency.	Insufficient discussion on the specific challenges faced in the casting industry and potential industry-specific CI strategies.
Dehghan et al. (2006)	CI project in Chaharmahal-Bakhtiari Agriculture Organization, demonstrating improvements through 5S and process improvement.	Limited examination of the cultural shifts required for successful CI adoption in agricultural settings, especially considering the diverse workforce.
Kikuchi et al. (2007)	Illustration of CI's applicability in reducing costs in the semiconductor industry.	Limited discussion on the adaptability of CI methodologies to different product lines within the semiconductor industry.
Chandrasekaran et al. (2008)	Application of CI strategies to address 'component mismatch' in an automotive assembly line.	Insufficient exploration of potential challenges in maintaining CI strategies over an extended period in the dynamic automotive industry.

In conclusion, the gap analysis above provides insights into CI and guided the study in evaluating CI practices at KMP reagents

2.6 Theoretical Framework

2.6.1 Kaizen Theory

2.6.1.1 Introduction

In the realm of continuous improvement practices, Total Quality Management (TQM) and Kaizen theory emerge as formidable paradigms, each offering unique perspectives and methodologies. While TQM provides a comprehensive framework for organizational excellence, Kaizen theory embodies the ethos of incremental improvement and continuous refinement. This section embarks on the exploration of Kaizen theory within the broader context of TQM, elucidating its principles, methodologies, and synergies in fostering sustained organizational improvement.

2.6.1.2 Understanding Kaizen Theory

Kaizen, a Japanese term meaning "change for the better" or "continuous improvement," embodies a philosophy rooted in the relentless pursuit of incremental enhancements according to Imai (1986). At its core, Kaizen espouses the notion that small, incremental changes, when consistently implemented over time, yield significant improvements in organizational processes, products, and services as Imai (1986) emphasizes. This theory underscores the importance of empowering every organizational member to contribute to the improvement process, thereby fostering a culture of continuous learning, innovation, and adaptation.

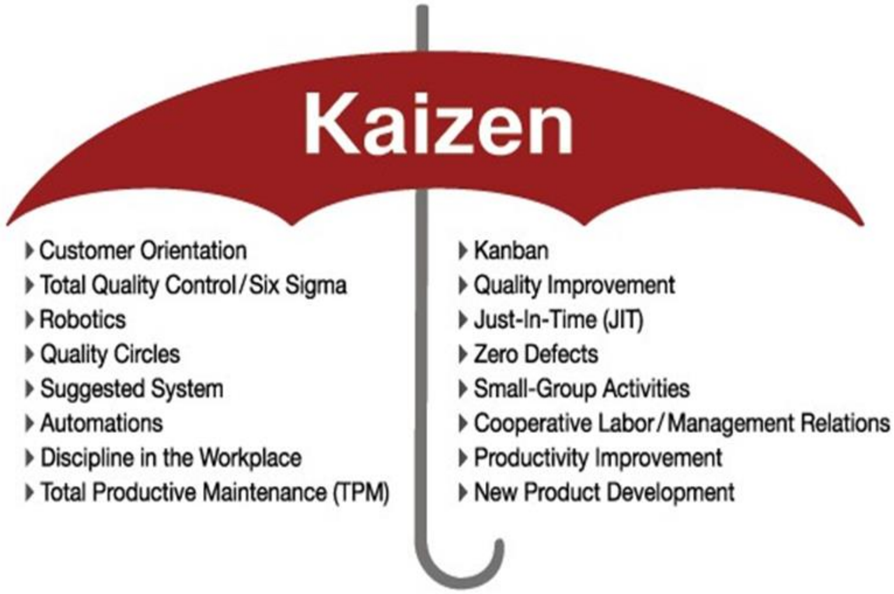

Figure 1: The Kaizen Theory

[Adapted from www.kanbachi.com]

2.6.1.3 Principles of Kaizen

Central to Kaizen theory are several key principles that guide its implementation. Firstly, Kaizen emphasizes the involvement of all employees, from frontline workers to senior management, in identifying improvement opportunities and implementing solutions as highlighted by Imai (1986). This principle underscores the democratization of improvement initiatives, fostering a sense of ownership and accountability among organizational members.

Secondly, Kaizen advocates for a systematic approach to improvement, often manifested in the form of Kaizen events or workshops as noted by Imai (1986). These events bring together cross-functional teams to analyze processes, identify inefficiencies, and brainstorm solutions in a collaborative manner. By harnessing the collective expertise and perspectives of diverse stakeholders, Kaizen events facilitate the rapid implementation of improvement initiatives.

Thirdly, according to Imai (1986) Kaizen encourages the use of simple, low-cost solutions to effect change. This principle reflects the philosophy of "good change," wherein organizations prioritize pragmatic, feasible solutions over grandiose, resource-intensive endeavors. By focusing on incremental improvements that can be implemented quickly and efficiently, Kaizen ensures that progress is sustainable and accessible to all levels of the organization.

2.6.2 TQM Theory

2.6.2.1 Introduction

Total Quality Management (TQM) stands as an enduring paradigm in contemporary organizational management, underpinning a holistic philosophy that transcends mere operational methodologies. The richness of TQM lies not only in its procedural rigor but in its profound implications for organizational culture, performance metrics, employee engagement, customer satisfaction, supply chain integration, risk management, and the cultivation of a learning-oriented environment.

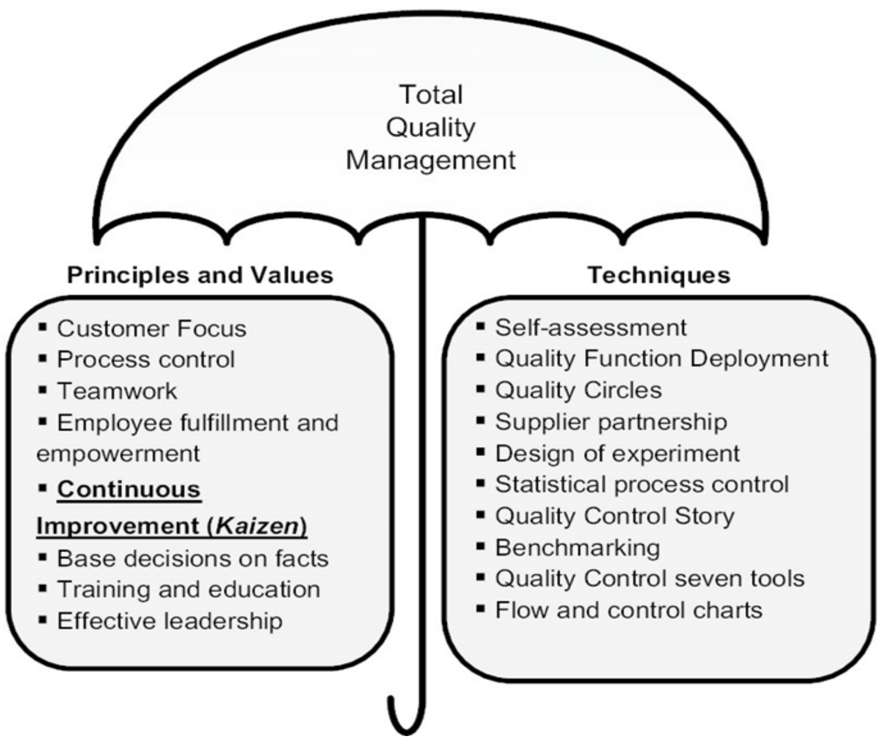

Figure 2: The TQM theory.

[Adapted from Imai, 1986 p.40]

2.6.2.2 The Essence of TQM Principles

At the core of TQM lies an unwavering commitment to customer-centricity. The seminal work of Deming (1986) expounds on the imperative of understanding and meeting customer needs, positing customer satisfaction as the fulcrum upon which organizational success pivots. This principle is not a mere dictum but a foundational philosophy, shaping the contours of organizational behavior, strategy, and decision-making as stressed by Deming (1986).

In tandem with customer focus, TQM enunciates the principle of continuous improvement as a relentless pursuit of perfection. Deming's (1986) assertion that improvement is not a one-off event but a continuous process underscores the dynamic and iterative nature of TQM. This principle requires organizations to be in a perpetual state of self-reflection, identifying opportunities for refinement and innovation.

The involvement of all organizational members in the improvement process is a linchpin of TQM's approach to human resources. As posited by Juran and Gryna (1988), employee participation is not a mere tokenism but an imperative for organizational success. This principle signifies a paradigm shift towards a more egalitarian and collaborative workplace, where each employee is recognized as a stakeholder in the pursuit of excellence.

2.6.2.3 Process Orientation and Data-Driven Decision Making

A distinctive facet of TQM lies in its process-oriented worldview. Organizational processes are viewed as interconnected systems that demand scrutiny, measurement, and optimization as pointed out by Juran & Gryna (1988). This process orientation transcends functional silos, necessitating a systemic understanding of organizational dynamics.

Data-driven decision making constitutes another hallmark of TQM. Oakland (2014) shows that metrics and statistical methods serve as the compass guiding organizations through the labyrinth of continuous improvement. These quantitative measures provide an objective basis for decision-making, rendering organizational strategies anchored in empirical insights.

2.6.2.4 Employee Empowerment and Supplier Relationships

The principle of employee empowerment amplifies the significance of human capital within the TQM framework. Deming (1986) stressed that employees are not passive recipients of directives but active contributors to organizational success. This empowerment engenders a sense of ownership, accountability, and commitment among the workforce, fostering a culture of innovation and resilience.

In extending its principles beyond organizational boundaries, TQM advocates for robust supplier relationships. Collaborative engagement with suppliers, as advocated by Dale (2015), is integral to ensuring the quality of incoming materials and components. This collaborative ethos permeates the entire supply chain, fortifying the organization against disruptions and enhancing overall quality.

In summation, TQM theory unfolds as a multifaceted tapestry of principles, intricately woven to foster a culture of excellence, innovation, and continuous improvement. Its influence permeates organizational culture, human resources, and strategic decision-making, and external relationships. As the study embarked on assessing the effects of continuous improvement practices, the depth and sophistication of TQM theory provide an analytical lens through which the intricate dynamics of organizational evolution can be comprehensively scrutinized. This exploration not only enriches the study's theoretical understanding but furnishes practical insights for organizational practitioners navigating the complex terrain of contemporary management.

2.6.3 Synergies with TQM

Kaizen theory intersects harmoniously with the broader principles of Total Quality Management (TQM), amplifying its impact on organizational excellence. Firstly, Kaizen embodies the spirit of continuous improvement espoused by TQM, albeit with a sharper focus on incremental, grassroots-level enhancements as explained by Imai (1986). By integrating Kaizen principles into TQM initiatives, organizations can cultivate a culture of continuous learning and adaptation, driving sustained improvement across all facets of the organization.

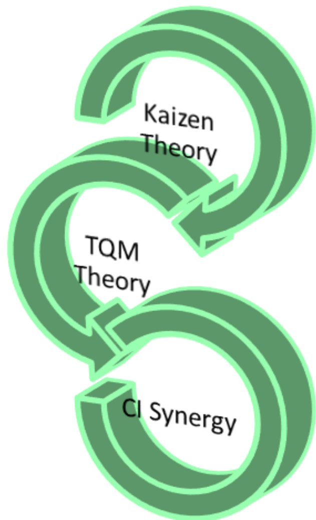

Figure 3: Kaizen & TQM Synergies

[Source: Author (2023)]

Secondly, Kaizen's emphasis on employee involvement resonates deeply with TQM's advocacy for participative management as illustrated by Imai (1986). By empowering employees to actively engage in the improvement process, organizations tap into a rich reservoir of tacit knowledge and frontline expertise, thereby enhancing the efficacy and sustainability of improvement initiatives.

Thirdly, Kaizen's systematic approach to improvement complements TQM's emphasis on data-driven decision-making and process optimization as shown by Imai (1986). By aligning Kaizen events with TQM's performance metrics and key performance indicators (KPIs), organizations can systematically monitor progress, identify areas for improvement, and drive continuous refinement of organizational processes.

In conclusion, Kaizen theory stands as a potent complement to Total Quality Management (TQM), offering a nuanced approach to continuous improvement rooted in incremental enhancements and grassroots-level engagement. By integrating Kaizen principles into the broader framework of TQM, organizations can foster a culture of continuous learning, innovation, and adaptation, driving sustained improvement across all facets of the organization. This synergistic convergence of TQM and Kaizen theory underscores the transformative potential of continuous improvement practices in navigating the complexities of today's dynamic business environment.

2.7 Key Performance Indicators

Internal logistics performance is a critical aspect of supply chain management that can significantly impact a company's overall competitiveness and profitability. It involves the efficient and effective movement of materials, goods, and information within an organization. To assess internal logistics performance comprehensively, it is often categorized into four key dimensions: cost, time, quality, and productivity as discussed below.

2.7.1 Cost

(a) Cost Efficiency: A key component of logistics success is cost. The goal of effective internal logistics operations is to reduce expenses related to warehousing, inventory management, transportation, and procurement, among other tasks as outlined by Christopher (2016).

(b) Total Cost of Ownership: This measure takes into account all inventory ownership and management expenses, including holding, storage, and possible obsolescence costs, in addition to direct operating costs as noted by Monczka et al (2015).

(c) *Costs of Transportation:* The efficiency of transportation activities can be evaluated by looking at the cost per mile, cost per trip, or cost per unit transported (Bowersox et al., 2013).

(d) Inventory Holding Costs: Assessing capital, insurance, and warehousing expenses associated with maintaining an excessive amount of inventory according to Simchi-Levi et al.(2019).

2.7.2 Time

(a) Lead Time: It's important to consider how long it takes a product to travel through the supply chain, from the moment an order is placed to the time it is delivered. Chopra & Meindl (2016) points out that agility and better customer service can result from shorter lead times.

(b) On-Time Delivery: Preventing delays in production or inventory management and maximizing customer satisfaction depend on deliveries occurring on time according to Jacobs et al (2017).

(c) Cycle Time: Analyzing the amount of time needed for particular operations, such manufacturing or order fulfilment, can assist spot bottlenecks and suggest areas for improvement just as Jacobs et al. (2017) advises

(d) Response Time: This indicator shows an organization's agility and adaptability by gauging how quickly it can react to shifts in client demand or market conditions as recommended by Stevenson and Hojati (2020).

2.7.3 Quality

(a) Quality Order Accuracy: An essential quality statistic is the proportion of orders that are filled accurately and without errors or discrepancies. According to Bowersox et al. (2013), high order accuracy lowers returns, rework, and customer complaints.

(b) Defect Rates: Measuring the quantity of supplies or products that are defective upon receipt or production reveals possible problems with quality in internal logistics procedure

(c) *Metrics for health and safety:* It is critical to provide a safe workplace for workers as well as for the preservation of goods. Internal logistics performance might be inferred from safety indicators like incident rates according to Chopra & Meindl(2016).

(d) Environmental Sustainability: An organization's commitment to sustainable and ethical logistical operations is reflected in environmental indicators like carbon emissions and trash reduction as discussed by Sarkis (2019).

2.7.4 Productivity

(a) Labor Productivity: Metrics that gauge the effectiveness of the workforce include units handled per hour and orders processed per employee according to Stevenson and Hojati (2020).

(b) Process Efficiency: According to Monczka et al., (2015). Lean and Six Sigma approaches are utilized to analyze the efficiency of internal logistics processes in order to identify areas that might be optimized

(c) Technology Utilization: According to Bowersox et al. (2013), productivity can be greatly increased by making the most of technology, such as automation solutions or warehouse management systems (WMS).

(d) Resource Utilization: Internal logistics performance, which includes productivity, quality, cost, and time, is crucial for organizations to maximize their operations. Proper measurement and management of these parameters can lead to operational excellence, cost reduction, enhanced customer service, and competitiveness.

2.8 Conceptual Framework

2.8.1 CI Practices for the Study

Within the CI approach or philosophy, there are many related and frequently overlapping techniques, tools, and activities. However, the root cause analysis, recommendation systems, employee involvement, and adoption of new technology were the main topics of this study.

2.8.2 Operations Performance

The 2 aspects of operations performance management that were the focus of the study were ***efficiency and safety health &environment (SHE).*** These align with the four fundamental elements of cost, quality, speed, and productivity that are typically used to represent a company's operations performance criteria according to Ward et al. (1995).

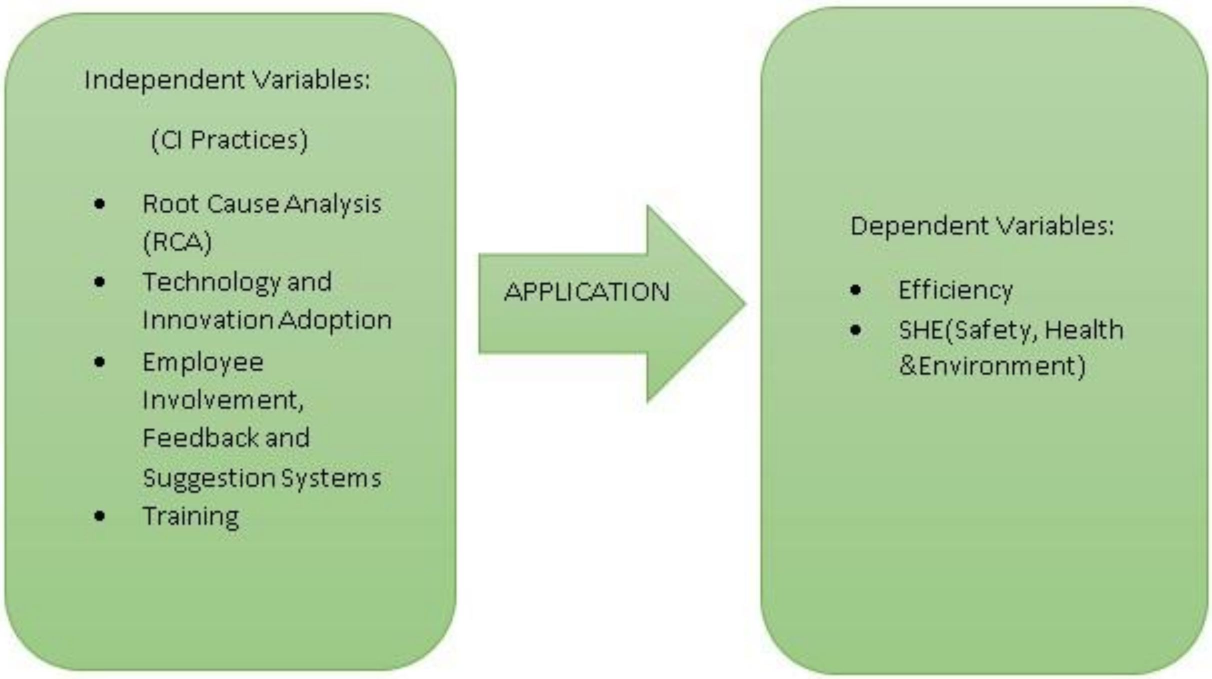

Figure 4: The Conceptual Framework.

[Source: Author (2023)]

2.9 Research Gap

There has been a lot that has been elaborated, through literature, about the effects of the implementation of the CI practices in different sectors but much more research is needed in Zambia. Authors like Chanda (2017) have significantly contributed to shedding light on the application of Continuous Improvement (CI) practices, with a specific emphasis on the manufacturing industry. However, there is little study on CI effects on logistics systems later on, on **reagents** logistics systems. Hence the need for this research to provide insight on challenges and opportunities for CI in logistics processes.

2.9.1 Research Hypothesis

Based on the literature review and conceptual framework, the study established the following hypothesis:

- H0: Adoption of CI practices have NO significant effect on the Reagents' internal logistics system performance at KMP.
- H1: Adoption of CI practices HAVE a significant effect on the Reagents' internal logistics system performance at KMP

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

In this chapter, the research design used to conduct the study is presented followed by other research methodologies consisting of the target population, sample size, data gathering methods, sampling procedures, and data analysis methods.

3.1 Research Design

Bryman and Bell (2003) describes research design as a plan that guides a researcher on how to organize research activities. This study adopted a descriptive and correlational design.

3.1.1 Descriptive Study Design

In accordance with Neuman (2013)'s description of a descriptive study design, the primary objective of this research is to provide a comprehensive and trustworthy description of a phenomenon. The major purpose of this kind of study is to provide answers to queries concerning the "what," "who," "where," and "how many" aspects of a specific subject matter. This approach required the collection of qualitative and quantitative data through the use of techniques and tools such as questionnaires, observations, content analysis, or case studies. The purpose of the study was to achieve a full understanding of the topic that was being looked at.

3.2 Population

A population refers to a collection of individuals or objects that share common characteristics that are of interest to the researcher as acknowledged by Gall et al. (2006). The research sample consisted of a total of 120 persons who were the subjects of examination. The data was methodically collected, processed, and interpreted from a target group consisting of 120 individuals. For the purposes of this study, the population was defined as the entire group of employees or participants who were directly engaged with or impacted by the logistics management system of reagents at KMP.

The choice to employ a "census" technique in this study, which involves including the entire population, was motivated by the population's relatively small and easily controllable size as indicated by Kothari (2007)

3.3 Sampling Techniques

Given the manageable population size of 120, the study adopted a census approach, wherein data was collected from every member of the population. This approach ensured that the sample accurately represented the entire population according to Kothari (2007).

3.3.1 Census Approach

The census approach involves gathering data from every person or element in the population according to Cooper and Schindler (2019). All 120 participants in the study were included in the research, guaranteeing a fair chance of representation for every member of the population in the analysis. When the population is tiny and under control, this strategy works especially well acknowledges Bryman and Bell (2019).

3.4 Data Collection Methods

The data collection techniques used in the study are covered in this section. Accurate and trustworthy data collecting required careful consideration of the methodologies of data collection.

3.4.1 Survey Questionnaires

All 120 participants were given structured survey questionnaires to complete in order to gather information on relevant variables. One popular technique for gathering quantitative data from a large number of respondents is to employ survey questions according to

Fowler Jr., (2013). In order to guarantee that information regarding the factors under inquiry and their relationships was gathered, the questionnaires were meticulously designed.

Because the questionnaires were structured, data collection was consistent, which made it simpler to evaluate and interpret the responses.

Regarding the implementation of CI practices in the reagents logistics system, participants were asked among other things to rate their opinions on a Likert scale that went from strongly disagree to strongly agree on a scale of 1-5. This was also utilized when evaluating how well CI practices are utilized with scale of 1-5 with options such as frequently utilized, extensively utilized, fairly utilized, rarely utilized and never utilized at all as options

3.4.2 Document Review and analysis

Apart from the survey questions, pertinent documents, records, or reports that could potentially provide information about the variables being studied were examined. Reviewing documents is a useful way to gather data, particularly if they have historical or current information that might shed light on the study topics as acknowledged by Yin (2014).

Internal reports on logistics performance, records of continuous improvement implementation, historical data on reagent logistics, and any pertinent policies or guidelines pertaining to logistics management were among the papers evaluated. These records added more context to the study and provided a historical viewpoint, which enhanced the survey results.

The study triangulated data from several sources by combining survey questionnaires and document analysis, which improved the validity and reliability of the study findings as recommended by Creswell and Creswell (2017).

3.5 Data Analysis

In this section data analysis techniques that were employed in the study are discussed. Data analysis is a critical step in research, as it allows researchers to draw meaningful conclusions from the collected data.

3.5.1 Descriptive Analysis

Descriptive statistics were used to summarize and describe the data obtained from the study. Descriptive statistics provide a clear and concise overview of the characteristics of the variables within the population noted Aron et al (2019). This analysis included measures such as means, standard deviations, frequencies, and percentages.

For example, the mean score of participants' responses to specific survey questions provided an average measure of their perceptions. Standard deviations indicated the degree of variability or dispersion within the data. Frequencies and percentages helped in understanding the distribution of responses for categorical variables.

Analysis of data was done using excel analysis Tool Pak and analysis Tool Pak-VBA

3.6 Ethical Considerations

In this section ethical considerations that guided the research process are discussed, ensuring the study was conducted with the highest ethical standards.

3.6.1 Informed Consent

An essential ethical component of the study was informed permission as stipulated by Resnik (2011). The study's 120 participants were given clear and understandable information on the goals, methods, possible dangers, and rewards of the research. They were told that their involvement was completely optional and that they may stop at any time without facing any repercussions.

3.6.2 Privacy and Confidentiality

The confidentiality and privacy of the participants were strictly maintained. Anonymized participant data were gathered, and the answers were unrelated to any identifiable information. The raw data was kept safe to avoid unwanted access and was only available to the research team.

3.6.3 Research Ethics Approval

To ensure that the research complies with ethical rules and regulations, the study applied for ethical permission from the university's ethics committee. Any ethical questions or problems that surfaced during the study were quickly resolved in compliance with protocols.

The study sought to preserve the integrity and credibility of the research process while safeguarding the rights and welfare of the participants by abiding by these ethical guidelines

3.7 Validity and Reliability

To ensure the correctness and consistency of the data gathered, it was crucial to ensure the validity and reliability of the study instruments as recommended by Bryman and Bell, (2019).

3.7.1 Validity

Pre-testing and piloting were done to evaluate the survey questionnaires' validity. To find any ambiguities, contradictions, or problems with the questions, a small group of people who were similar to the study's target population were given the questionnaires. To improve the validity of the instruments, changes and improvements were made in response to the input that was obtained during this stage.

3.7.2 Reliability

The consistency and stability of research tools are referred to as reliability according to Bryman and Bell (2019). Two reliability-related elements were evaluated in this study: (a) Inter-Rater Reliability: To make sure that various raters or coders produced consistent results when numerous people participated in data collection or coding (such as during document review), inter-rater reliability was assessed as stipulated by Bryman and Bell, (2019). In this assessment, the identical set of data were compared to the ratings or codes given by several raters. (b) Internal Consistency: Statistical measures like Cronbach's alpha were used to evaluate the internal consistency dependability of data obtained from survey questionnaire. Through analysis, it was possible to ascertain whether the elements on a scale or construct consistently measured the same underlying notion.

3.8 Limitations

Although the goal of this study was to offer insightful information about how CI practices can affect production logistics, there were a number of obstacles that affected the study's findings.

3.8.1 Response Bias

Participants' self-reported replies served as the primary source of data for this investigation. This raised the risk of response bias, in which participants might have given responses they thought would be acceptable in society or consistent with the goals of the study. Several tactics were used in the research to reduce or mitigate response bias. For instance, it encouraged more candid and open responses by using anonymous surveys. Furthermore, the study utilized a variety of techniques for gathering data, including integrating self-reports with behavioral or observational measures, in order to provide a more thorough grasp of the phenomenon being studied.

3.8.2 Generalizability

The results of the study may only apply to the reagent logistics management system at KMP. It is advisable to exercise caution when extrapolating the findings to other contexts or sectors.

3.8.4 Cross-Sectional Nature

This research adopted a cross-sectional approach, collecting data at a single point in time. A longitudinal study might offer a more comprehensive understanding of the effects of continuous improvement implementation.

3.8.5 Sample Size

The census approach included all 120 participants, but the size of the sample remained relatively moderate. Larger sample sizes might have provided more robust statistical power.

Despite these limitations, the study's findings were expected to contribute valuable insights into the relationships between CI practices implementation and production logistics within the specific context of KMP.

3.9 Summary

The research approach for a descriptive and correlational study with 120 participants was described in this chapter. The results of this methodology were presented, examined, and debated in the ensuing chapters. The strategy included the target population, sampling strategies, data analysis, data collection methodologies, and research design. The study aimed to enhance theoretical knowledge and practical applications in the field by providing a complete and rigorous methodological framework that would allow for a well-rounded understanding of the influence of continuous improvement strategies in KMP's reagent logistics management.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.0 Introduction

This chapter presents and analyses the findings of the research study. The chapter begins by outlining the response rate from the administered questionnaires, followed by outlining the demographics of the respondents. It later presents and analyzes the findings of the research study, according to the objective themes.

4.1 Response Rate

The population for the study was 120 staff from KMP reagents section. A census approach was utilized where all the 120 were given an equal opportunity to respond to the questionnaire. In the end feedback from 89 members was acquired. This represented a 74% questionnaire return rate. Survey data was supplemented by observation, interviews and document analysis. However, the questionnaire was the primary data collection tool

4.1.1 Reliability

Table 2: Cronbach Alpha for Surveyed data

	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Technology Adoption and Automation	0.3	0.9
Efficiency Levels	0.79	0.84
SHE Levels	0.76	0.84
Continuous learning and Training	0.61	0.87
Employee engagement, feedback and Suggestion systems	0.83	0.83

	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Root Cause Analysis	0.82	0.83

Cronbach's Alpha	Number of Items
0.88	6

4.2 Demographics

4.2.1 Gender

Table 3: Gender

Sex	Frequency	%
M	77	86.52%
F	12	13.48%
Total	89	100%
Invalid	0	0%
Total	89	100%

The table above and the pie chart below shows the percentage of respondents, 13.48% (12 members of staff) of the respondents were female and 86.52% (77 members of staff) of the respondents were male. From this distribution, it is clear that the department is a male-majority department

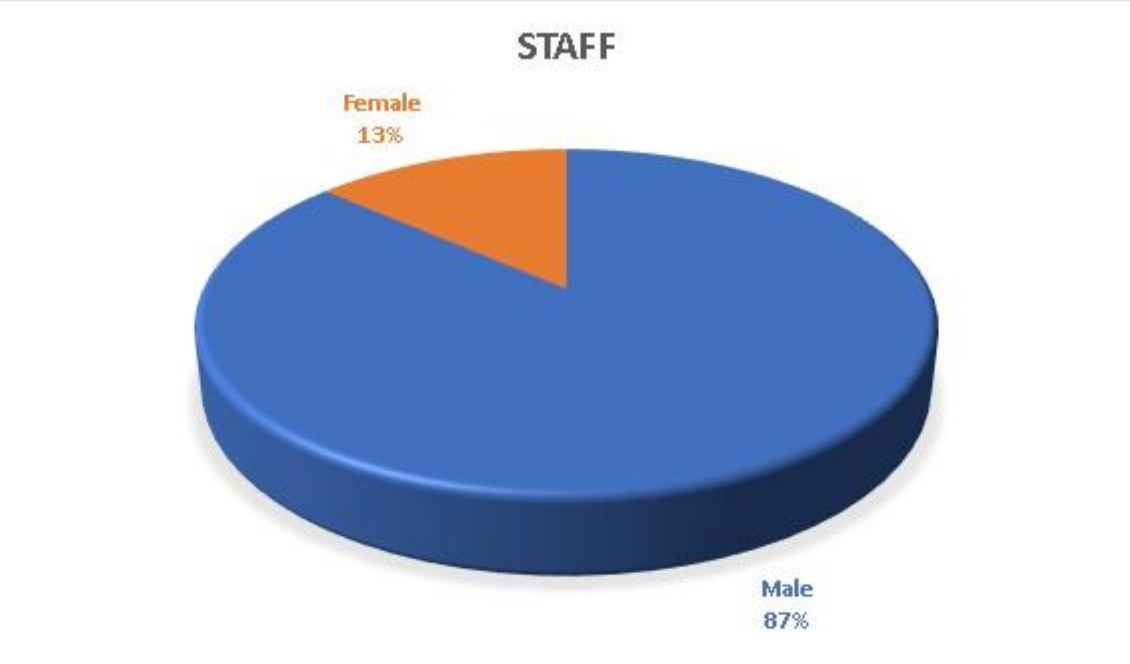

Figure 5: Gender of Respondents

[Source: Study findings (2023)]

4.2.2 Responsibilities and Roles

Table 4: Roles & Responsibilities

Role/Responsibility	Frequency	%
Plant Operative	24	26.97%
Reagents Operative	23	25.84%
Specialist/Engineer	10	11.24%
Supervisor	8	8.99%
Mechanical Fitter	4	4.49%
Instruments Technician	4	4.49%
Electrician	4	4.49%
CRO	4	4.49%

Role/Responsibility	Frequency	%
Senior Supervisor	3	3.37%
Ancillary worker	2	2.25%
IT specialist	1	1.12%
Safety Officer	1	1.12%
Compliance Officer	1	1.12%
Total	89	100%
Invalid	0	0%
Total	89	100%

As illustrated by the figure below, it can be concluded that the majority of the respondents are reagent and plant operators with a combined total count of 47 or 53% of respondents forming the operating core of KMP reagents. This is followed by11% of respondents who are KMP reagent specialists/metallurgists, 8 supervisors (9%) and 4 Control Room Operators (CROs) (5%), Mechanical Fitters (5%), Electricians (5%), Instruments Technicians (5%) and senior supervisors with (3%)

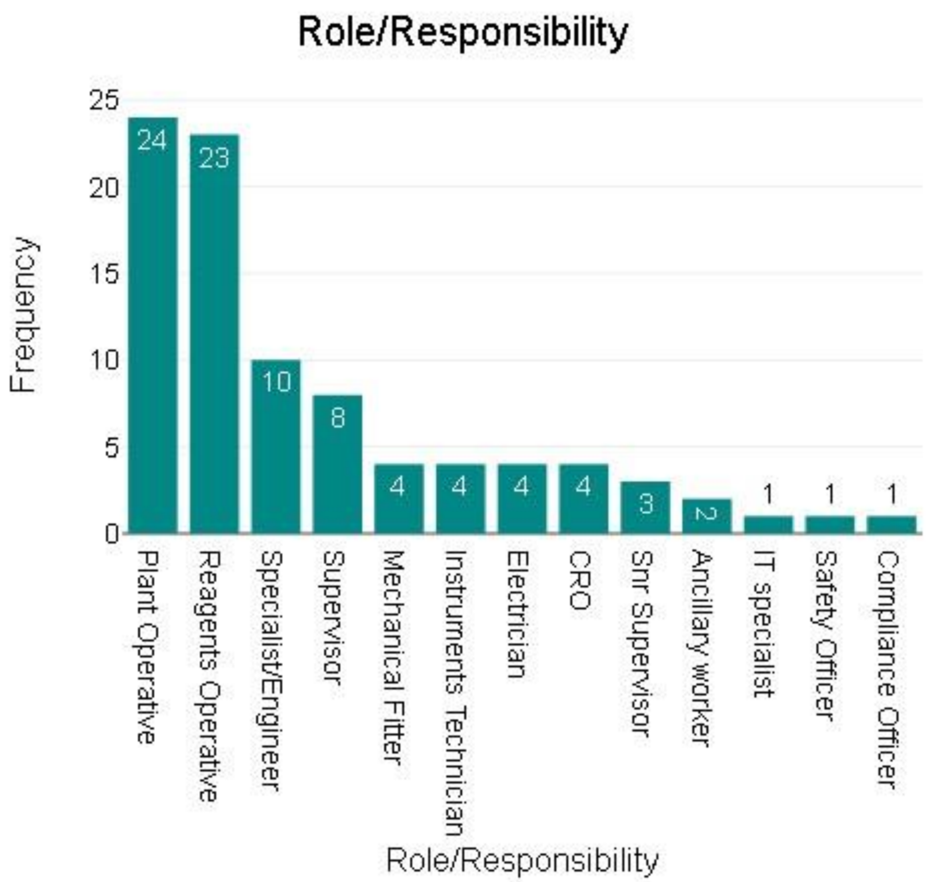

Figure 5: Distribution of Staff by Roles.

[Source: Study findings (2023)]

4.2.3 Educational Qualifications

As highlighted in figure below, a majority of staff at the reagents section are grade 12 certificate holders, this is evidenced by a total number of 44 respondents followed by the crafts and certificate holders represented by the total number of 10 respondents and grade 9 school certificate at 9 respondents. The diploma holders were represented by the 8 participants and lastly the degree holders were represented by the total number of 13 respondents. Masters' degree holders with 5. This means that more than 58% of employees at the reagents section are grade 12 certificate holders or below. Craft certificate holders make up 11% and the diploma holders make up 8% of the work force. Degree and master's degree holders make up 21% combined.

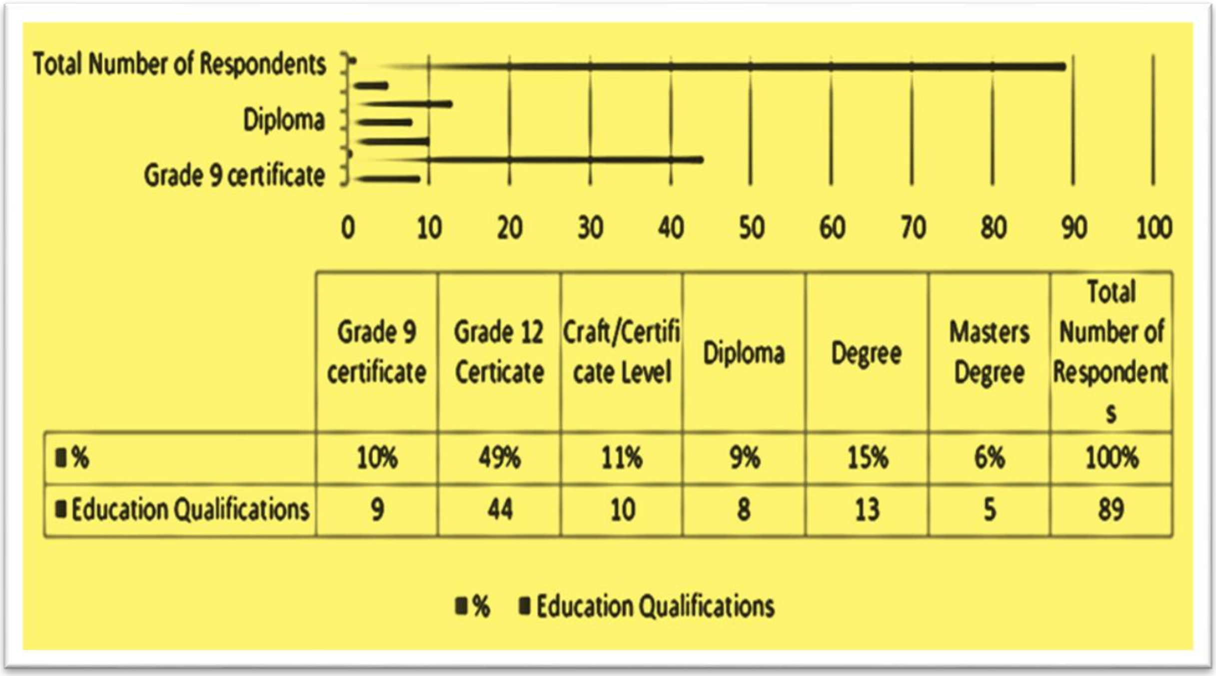

Figure 6: Education background for Reagents Staff.

[Source: Study findings (2023)]

4.2.4 Years in Service

Table 5: Years in Service

Experience in the current position	Frequency	%
5-10years	32	35.96%
1- 5years	25	28.09%
>10 years	24	26.97%
<1 year	8	8.99%
Total	89	100%
Invalid	0	0%

Experience in the current position	Frequency	%
Total	89	100%

KMP reagents has a healthy headcount of experienced personnel. This is evidenced by the 24 respondents who have worked for more than 10 years at the section representing about 27% of the respondents. 32 respondents have worked at the section for 5 to 10 years representing 36% of the respondents. This is followed by the 25 respondents that have worked for the section between 1 to 5 years representing about 28% of the respondents. Only 8 respondents have worked for less than 1 year representing 9% of the respondents.

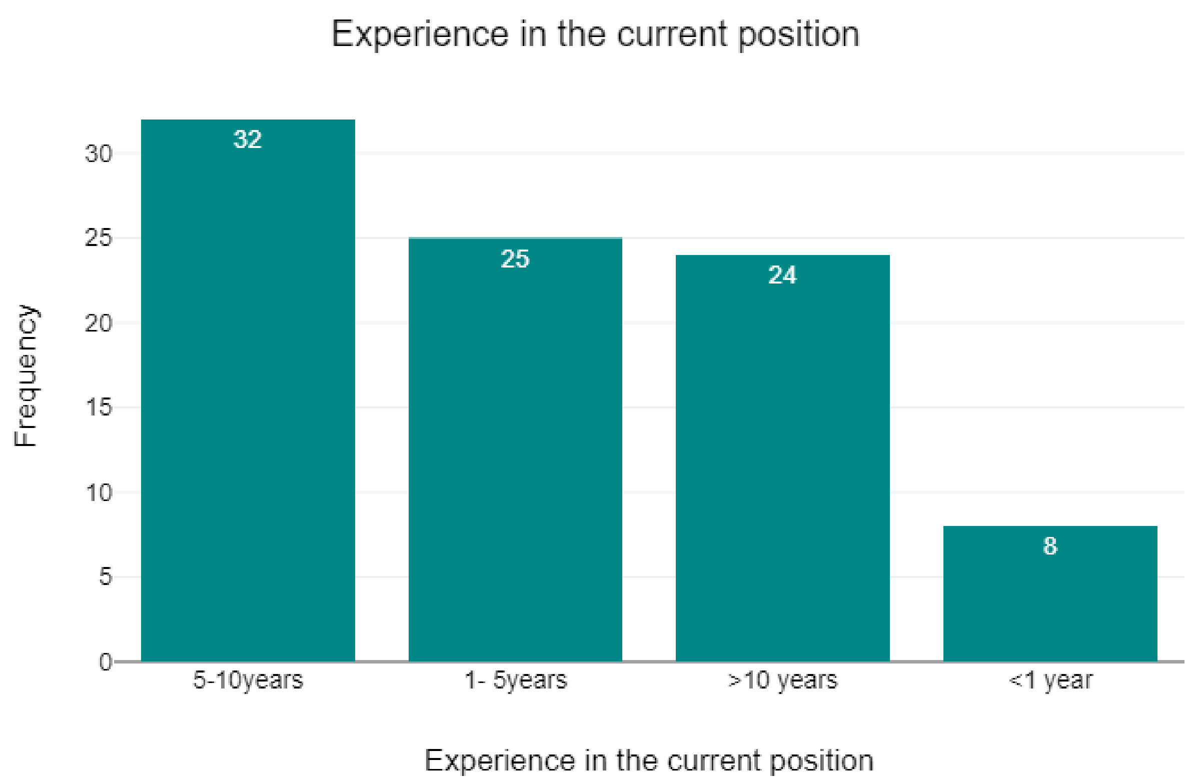

Figure 7: Years in Service.

[Source: Study findings (2023)]

4.3 The Extent to which CI Practices and tools are being implemented in the Reagents logistics system

4.3.1 Root Cause Analysis

Table 6: Root Cause Analysis

Root Cause Analysis	Frequency	%
Frequently Utilized	55	61.8%
Fairly utilized	15	16.85%
Extensively Utilized	9	10.11%
Rarely utilized	7	7.87%
Not Utilized At All	3	3.37%
Total	89	100%
Invalid	0	0%
Total	89	100%

The figure below presents the frequency of responses for the utilization of Root Cause Analysis as part of a CI philosophy. It is evident that the most frequent response category is "*frequently utilized*," with over 55 counts representing 61.8%, indicating a strong adoption of root cause analysis among the respondents. The least utilized categories are "*fairly utilized*" with 15 counts representing 16.9%, *"extensively utilized"* with 9 counts representing 10.1%, *"Rarely utilized"* with 7 counts representing 7.9% and *"Not utilized at all"* with 3 counts representing 3.37 % which suggests that while root-cause analysis is widely used, its adoption is not deeply ingrained across all levels or areas. The distribution of responses points to a potential opportunity for increasing the depth of root cause analysis practice within the section.

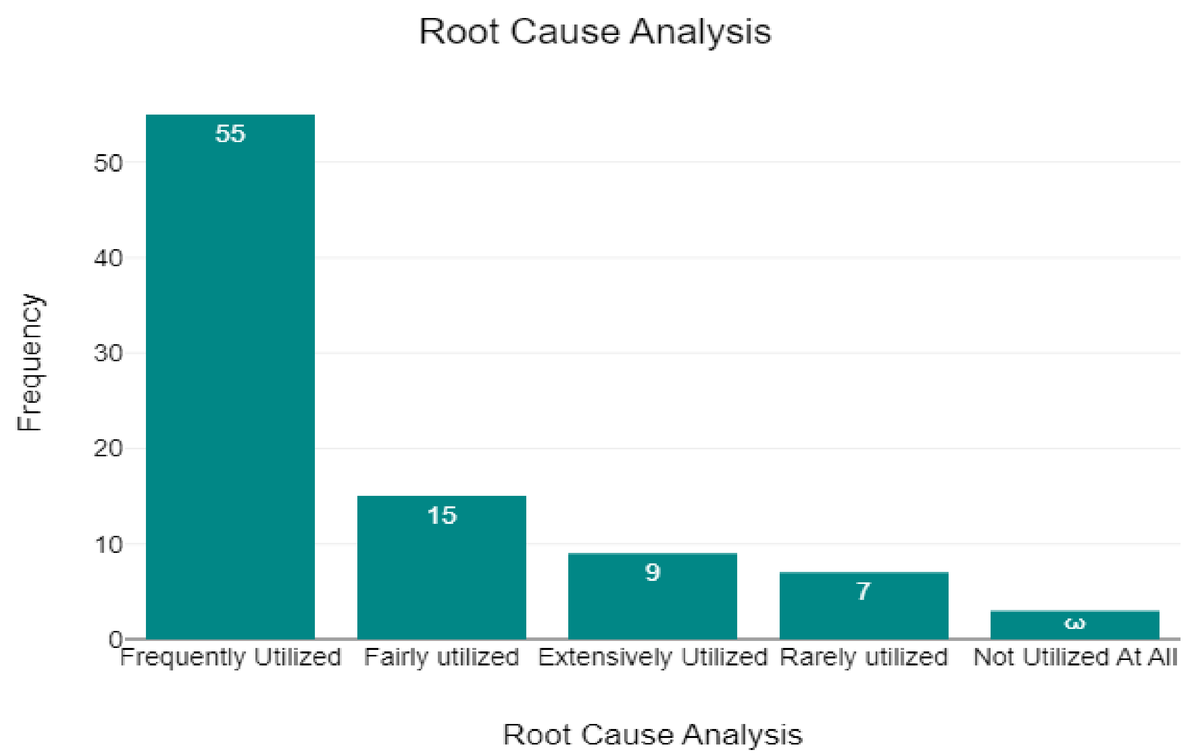

Figure 8: Root Cause Analysis (RCA) frequency of Use.

[Source: Study findings (2023)]

4.3.2 Employee Involvement, Feedback and Suggestion Systems (EFS)

Table 7: Employee involvement, feedback & Suggestion systems

Employee engagement, feedback and Suggestion systems	Frequency	%
Frequently Utilized	52	58.43%
Rarely utilized	20	22.47%
Not Utilized At All	7	7.87%
Extensively Utilized	6	6.74%
Fairly utilized	4	4.49%
Total	89	100%

Employee engagement, feedback and Suggestion systems	Frequency	%
Invalid	0	0%
Total	89	100%

The table above and figure below illustrates the distribution of responses regarding the level of utilization of the *“employee engagement, feedback, and suggestion systems”* CI practice. The *"frequently utilized"* category dominates the responses with 52 counts representing 58.43%, highlighting that these systems are well-established and regularly used within the section. The *“Rarely utilized”* with 20 counts representing 22.47%. The relatively low frequency of *"extensively utilized"* suggests that while the systems are in place and used, there may be room for enhancing their reach and impact. *"Not Utilized at All"* option has minimal responses and *“fairly utilized*” has 4 counts representing 4.49%, reflecting a positive sign that the majority of employees are, to some degree, engaged with these systems

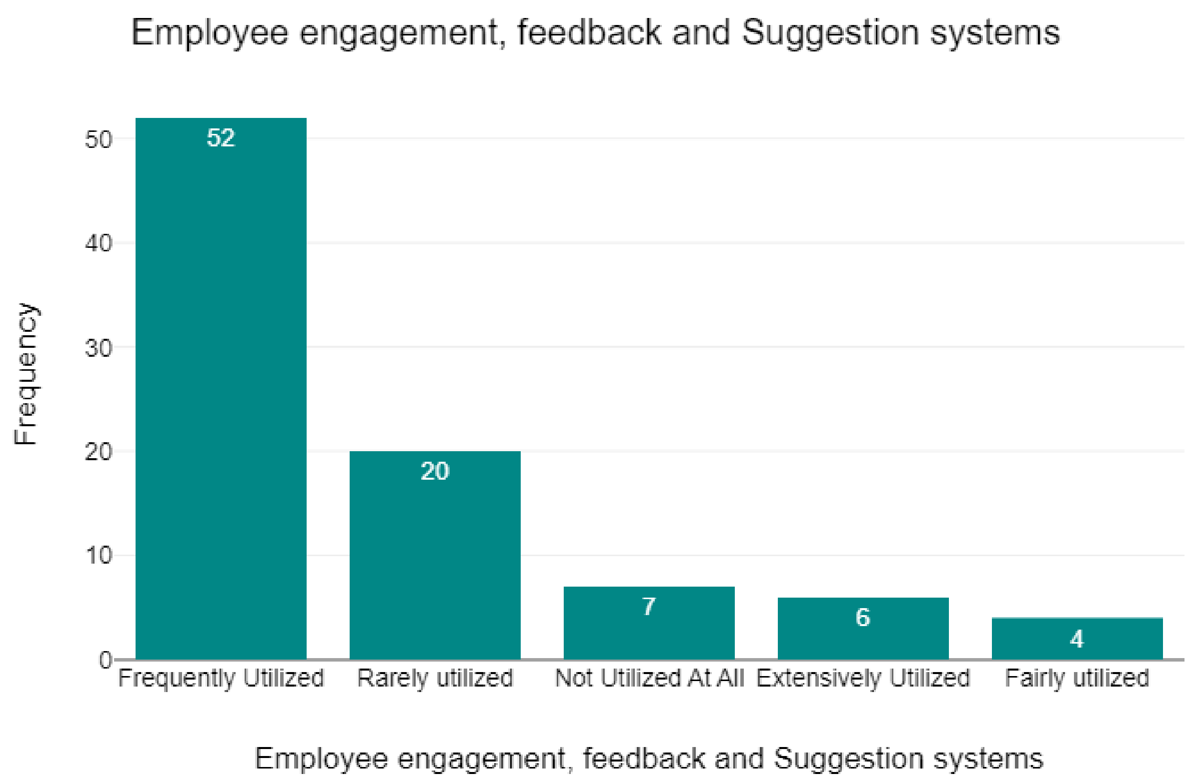

Figure 9: Employee engagement, Feedback & Suggestion Systems frequency.

[Source: study findings (2023)]

4.3.3 Training

Table 8: Indicating training levels

Continuous learning and Training	Frequency	%
Frequently Utilized	65	73.03%
Extensively Utilized	11	12.36%
Rarely utilized	7	7.87%
Fairly utilized	6	6.74%
Total	89	100%
Invalid	0	0%

Continuous learning and Training	Frequency	%
Total	89	100%

The table above and the figure below shows the response frequency for the level of utilization of the "*Continuous Training"* CI practice. It shows a significant leaning toward *"Frequently Utilized,"* with the count of 65 representing 73.03% markedly higher than any other category under training. This indicates a strong culture of learning and development within the department, with continuous training being a norm. The lower counts for *"Fairly Utilized"* with 6 counts representing 6.74% and *"Extensively Utilized"* with 11 counts representing 12.36% suggest that while continuous learning is common, it might not be as comprehensive or deeply integrated across the department.

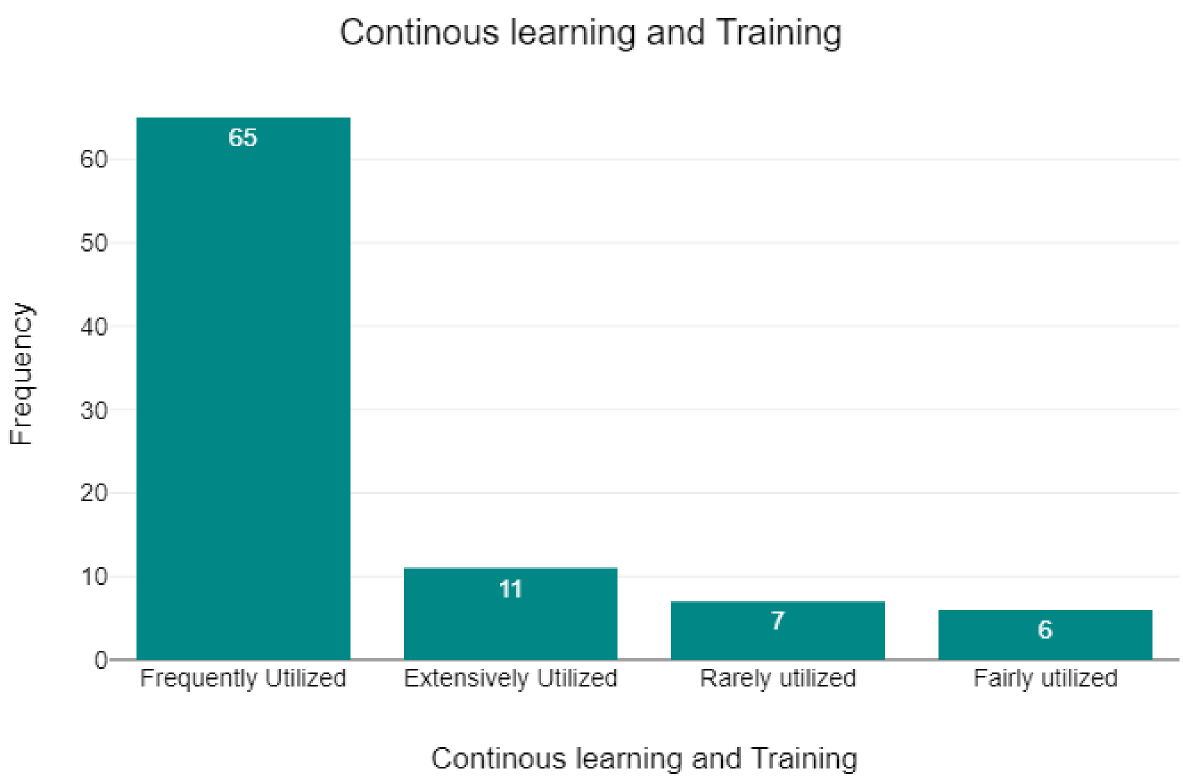

Figure 10: Training response frequency.

[Source: study findings (2023)]

4.3.4 Technology Adoption and Automation

Table 9: Response rate for technology and adoption

Technology Adoption and Automation	Frequency	%
Frequently Utilized	67	75.28%
Extensively Utilized	22	24.72%
Total	89	100%
Invalid	0	0%
Total	89	100%

The table above and figure below, displays the frequency of responses for *"Technology Adoption and Automation"*. The overwhelming majority of respondents indicate that technology and automation are *"Frequently Utilized"* with 67 counts representing 75% within the department, signifying a forward-leaning approach towards modernization and efficiency. The "*Extensively Utilized"* category has a lower count off 22 representing 25%, which may imply that although technology is widely used, there is still potential for broader or more intensive application across different areas of the organization. This distribution signals a positive trend in the embracement of technology, with room for growth in its extensive application.

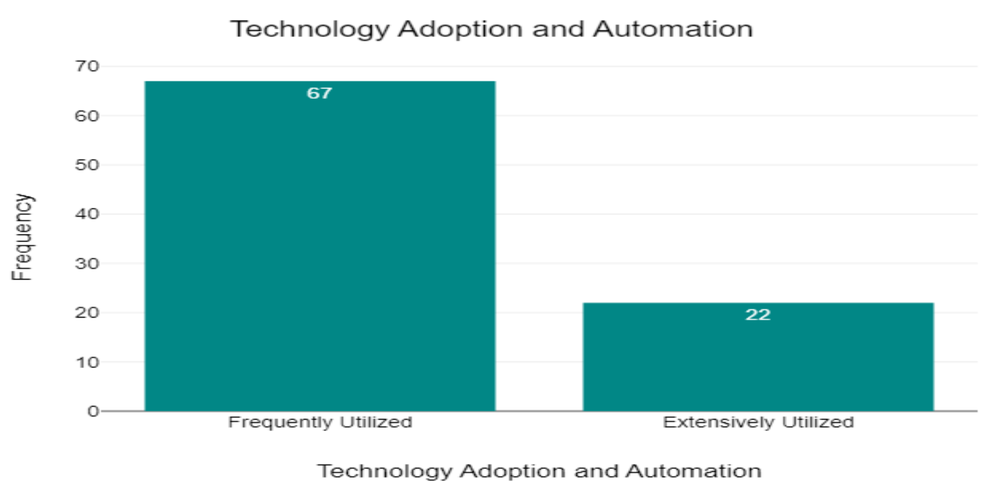

Figure 11: Frequency of Responses for Technology adoption and Automation.

[Source: Study findings (2023)]

4.3.5 Comparisons among CI practices on the extent of Utilization

Table 10: Totalized response rate among the adopted CI practices

Level Of CI utilization	RCA	E,F and Suggestion	Training	Technology Adoption
Frequently Utilized	61.80%	58.43%	73.03%	75.28%
Fairly utilized	16.85%	6.70%	6.74%	
Extensively Utilized	10.11%	4.49%	12.36%	24.72%
Rarely utilized	7.87%	22.47%	6.74%	
Not Utilized At All	3.37%	7.87%		

As shown in above table, in terms of the utilization, the results indicate that Technology Adoption, is the most preferred CI practice at KMP reagents followed by Training, Root cause analysis and lastly Employee involvement, feedback and suggestion systems

4.3.5 Efficiency Indicators

Table 11: Mean scores for efficiency indicators

	Put-away time is short	Reagent personnel Service is timely	Replenishment Time is good	Reduced Transport Costs	Reduced Inventory Costs	Reduced Labour Costs	Efficiency is high in Reagent Shed Receiving	Proper Utilisation of Reagent Space	Optimized Stocks Levels and reduced carrying costs	Information sharing with main warehouse
Mean	**4.01**	**3.57**	**4.08**	**3.69**	**3.11**	**3.66**	**3.64**	**3.58**	**3.99**	**3.24**

Std. Deviation	**0.68**	**0.81**	**0.88**	**1.33**	**0.9**	**1.05**	**1.38**	**1.22**	**1.29**	**0.99**
Variance	**0.47**	**0.66**	**0.77**	**1.76**	**0.81**	**1.11**	**1.91**	**1.5**	**1.67**	**0.98**
Minimum	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Maximum	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Grand mean	**3.7**									

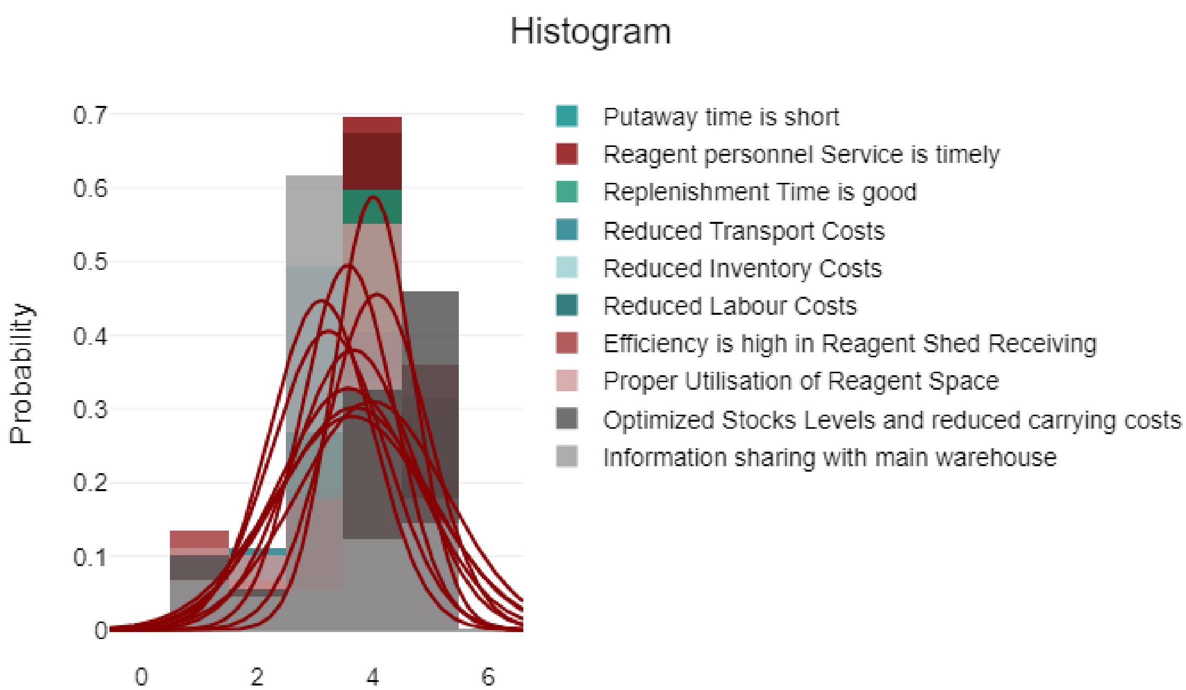

Figure 12: Key Performance indicators for Efficiency in the logistics System for KMP Reagents

[Source: Study Findings (2023)]

4.3.5 1. Put-Away-Time (Mean: 4.01, Std. Deviation: 0.68, Variance: 0.47): The high mean score indicates that respondents generally find put-away time to be short and efficient. The low standard deviation and variance suggest a relatively consistent agreement among respondents regarding put-away time.

4.3.5.2. Reagent Personnel Service (Mean: 3.57, Std. Deviation: 0.81, Variance: 0.66): The mean score suggests a moderate satisfaction level with reagent personnel service. The standard deviation and variance indicate moderate variability in responses, suggesting differing opinions about the timeliness of personnel service.

4.5.3 3. Replenishment Time (Mean: 4.08, Std. Deviation: 0.88, Variance: 0.77): The high mean score indicates that respondents generally find replenishment time to be good. The standard deviation and variance suggest a relatively consistent agreement among respondents regarding replenishment time.

4.5.3.4. Reduced Transport Costs (Mean: 3.69, Std. Deviation: 1.33, Variance: 1.76): The mean score suggests a moderate perception of reduced transport costs. The higher standard deviation and variance indicate greater variability in responses, suggesting diverse opinions about the effectiveness of cost reduction in transportation.

4.5.3.5. Reduced Inventory Costs (Mean: 3.11, Std. Deviation: 0.9, Variance: 0.81): The lower mean score indicates that there may be room for improvement in reducing inventory costs. The standard deviation and variance suggest moderate variability in responses regarding inventory cost reduction.

4.5.3.6. Reduced Labor Costs (Mean: 3.66, Std. Deviation: 1.05, Variance: 1.11): The moderately high mean score suggests a positive perception of reduced labor costs. The standard deviation and variance indicate moderate variability in responses, suggesting diverse opinions about the effectiveness of labor cost reduction.

4.5.3.7 Efficiency in Reagent Shed Receiving (Mean: 3.64, Std. Deviation: 1.38, Variance: 1.91): The moderately high mean score suggests a positive perception of efficiency in reagent shed receiving. The higher standard deviation and variance indicate greater variability in responses, suggesting diverse opinions about the efficiency of the receiving process.

4.5.3.8. Proper Utilization of Reagent Space (Mean: 3.58, Std. Deviation: 1.22, Variance: 1.5): The moderate mean score suggests that there may be room for improvement in the proper utilization of reagent space. The standard deviation and variance indicate moderate variability in responses, suggesting diverse opinions about space utilization.

4.5.3.9. Optimized Stocks Levels and Reduced Carrying Costs (Mean: 3.99, Std. Deviation: 1.29, Variance: 1.67): The high mean score suggests that respondents generally find optimized stock levels and reduced carrying costs to be positive. The standard deviation and variance indicate moderate variability in responses.

4.5.4.0. Information Sharing with Main Warehouse (Mean: 3.24, Std. Deviation: 0.99, Variance: 0.98). The mean score suggests a moderate level of satisfaction with information sharing with the main warehouse. The standard deviation and variance indicate moderate variability in responses, suggesting diverse opinions about the effectiveness of information sharing.

4.3.6 Effects of implementing Continuous Improvement practices on the efficiency levels of the internal logistics system of Reagents

To investigate the effects of the variables RCA, EFS, Technology Adoption and Training on the variable Efficiency, a multiple linear regression analysis was carried out.

Model Summary

Table 12: Summarized multiple linear regression results

R	R^2	Adjusted R^2	Standard error of the estimate
0.91	0.82	0.81	0.45

(a) The correlation coefficient, or R,

The correlation coefficient, or R, measures how well the model predicts the dependent variable Efficiency based on the independent factors and the observed values of the variable. *A strong positive correlation between the observed data and the model's prediction is indicated by the R value of 0.91.*

(b) R^2, or R-squared

The coefficient of determination represents the proportion of the dependent variable's variance that can be explained by the independent variables in the regression model

With an R^2 of 0.82, the model's independent variables account for 82.5% of the variation in the dependent variable. Stated differently, the independent variables account for *82.5% of the change in Efficiency that can be predicted*.

(c) R2 adjusted

The R2 value is modified by adjusted R-squared, which takes into account the number of variables and observations in the model. A measure with numerous independent variables is more accurate. *In this case, it indicates that around 81.45% of the variance in the dependent variable is explained after adjusting for the number of predictors*.

(d) In brief

In conclusion, the model explains 81.45% of the variance in the dependent variable and demonstrates a very high positive relationship between the observed values and the prediction.

ANOVA

Table 13: Summarized ANOVA results

Model	df	F	p
Regression	5	79.18	<.001

(a) P-value

Because the results have a p-value of less than 0.001, or <.001, they are very statistically significant. This implies that there is a high degree of confidence in rejecting the null hypothesis. The observed results are highly unlikely to be the result of chance, suggesting that the independent variables (predictors) in the model have a statistically significant effects on Efficiency, the dependent variable.

In conclusion, the regression model appears to be statistically significant based on the ANOVA results, indicating a better fit than a model with no predictors.

The findings for each independent variable in the model, including the constant (intercept), are displayed in this table. For every unit increase in the corresponding independent variable, the expected change in the dependent variable Efficiency is shown by the unstandardized coefficient B.

Table 14: Summarized table of coefficients

	Unstandardized Coefficients	Standardized Coefficients				95% confidence interval for B	
Model	B	Beta	Standard error	t	p	lower bound	upper bound
(Constant)	0.74		0.53	1.41	.163	-0.3	1.78
RCA	0.06	0.06	0.16	0.39	.696	-0.25	0.38
EFS	0.24	0.11	0.19	1.24	.219	-0.15	0.62
Technology Adoption	0.57	0.43	0.13	4.45	<.001	0.32	0.83
Training 4	-0.87	-0.38	0.22	-3.98	<.001	-1.31	-0.44
Training 5	0.29	0.13	0.18	1.62	.109	-0.07	0.64

(b) Constant

This is the y-intercept of the regression line. It represents the expected value of the dependent variable when all independent variables are zero. In this context, it means that when RCA, EFS, Technology Adoption, Training 4 and Training 5 are zero, the dependent variable Efficiency is expected to be around 0.74. The p-value is .163, indicating that the intercept is not statistically significantly different from zero. More precisely the null hypothesis that the coefficient of (Constant) is zero in the population is not rejected.

(c) RCA (Root Cause Analysis)

Efficiency's value changes by 0.06 units for every unit change in the RCA variable's value. With a p-value of.696, we may conclude with confidence that there is no statistically significant difference between this coefficient and zero, meaning that RCA has no effect on the dependent variable. More specifically, there is no rejection of the null hypothesis, which holds that the population's coefficient of RCA is zero.

(d) EFS (Employee Involvement, Feedback and Suggestion Systems)

Efficiency's value varies by 0.24 units if the value of the EFS variable changes by one unit. Since the coefficient is not statistically significantly different from zero (p-value =.219) we cannot be certain that EFS has an effect on the dependent variable. More specifically, there is no rejection of the null hypothesis, which holds that the population's coefficient of EFS is zero.

(e) Adoption of Technology

Efficiency's value changes by 0.57 units for every unit that the Technology Adoption variable's value changes. Technology adoption has an impact on the dependent variable, as evidenced by the p-value of less than.001, which indicates that the coefficient is statistically significant different from zero. More specifically, the null hypothesis—which holds that the population's coefficient of technology adoption is zero—is rejected.

(f) Training

Efficiency is a variable that varies by -0.87 units if the value of Training 4 changes by one unit. We have proof that Training 4 has an effect on the dependent variable because the p-value is less than.001, which indicates that this coefficient is statistically significantly different from zero. More specifically, the null hypothesis—which holds that the population's coefficient of Training 4 is zero—is rejected.

4.3 The effects of implementing continuous improvement practices on safety, health, and environmental benchmarks of the section

4.3.1 Key Indicators of SHE Performance (Descriptive)

Table 15: Indicators of SHE performance results

	Availability of SOPs	Zero discrepancy in Storage areas	Chemical labelling Compliance	Temperature monitoring	Chemical spill incidents reduced	Reagents Stacking methodology	Emergency equipment and procedures	Availability and usage of the PPE	Occupation health Monitoring	Air and Water Quality Monitoring	Waste Management

							availa bility				
Mean	3.81	3.27	3.63	3.9	3.75	3.73	3.17	3.19	3.32	3.25	3.36
Std. Devia tion	0.84	1.04	1.28	0.66	0.79	0.72	0.91	0.98	1.11	0.85	0.87
Minim um	1	1	1	1	1	1	1	1	1	1	1
Maxi mum	5	5	5	5	4	4	5	5	5	5	5
Gran d Mean	3.5										

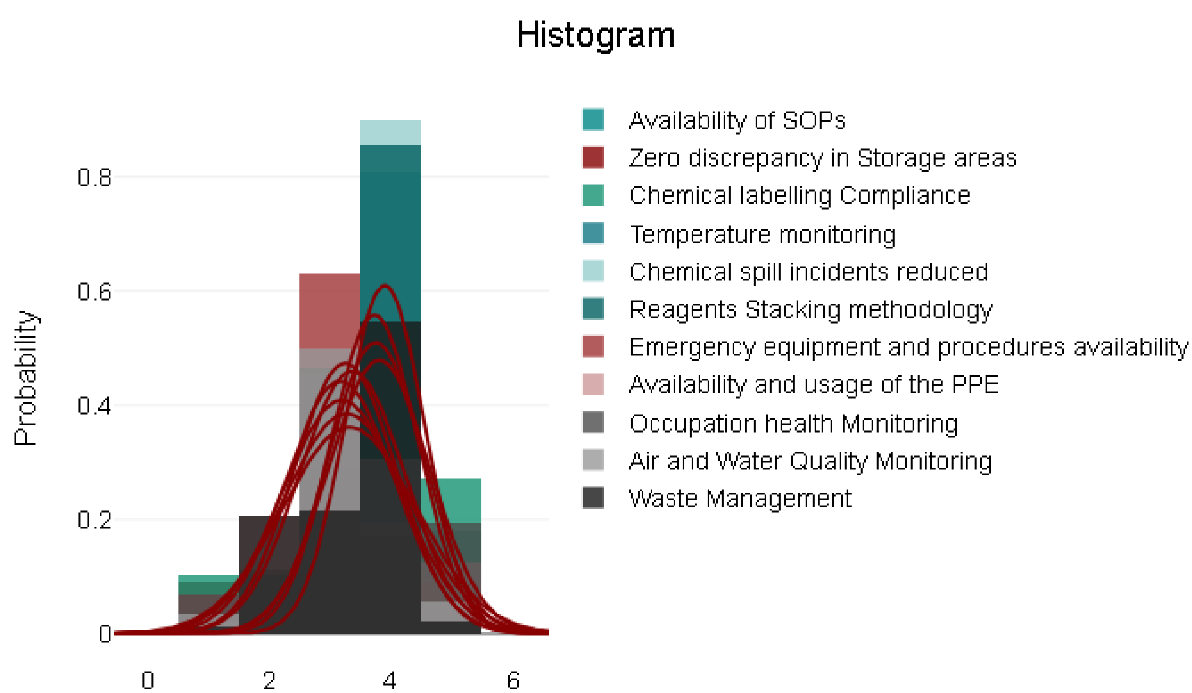

Figure 13: Key performance Indicators of SHE performance levels on KMP Reagents

[Source: Study findings (2023)]

4.3.1.1. Availability of SOPs [Mean: 3.81, Std. Deviation: 0.84]: Indicates a relatively high average score, suggesting that Standard Operating Procedures (SOPs) are generally available with moderate variability.

4.3.1.2. Zero Discrepancy in Storage Areas [Mean: 3.27, Std. Deviation: 1.04]: The lower mean and higher standard deviation suggest variability and a slightly lower overall compliance with zero discrepancies in storage areas.

4.3.1.3. Chemical Labelling Compliance [Mean: 3.63, Std. Deviation: 1.28]: Moderate mean with higher variability implies that there is room for improvement in ensuring consistent compliance with chemical labeling standards.

4.3.1.4. Temperature Monitoring [Mean: 3.9, Std. Deviation: 0.66]: A high mean indicates good compliance with temperature monitoring, and a low standard deviation suggests relatively consistent practices.

4.3.1.5. Chemical Spill Incidents Reduction [Mean: 3.75, Std. Deviation: 0.79]: A high mean suggests a positive trend in reducing chemical spill incidents, with relatively low variability.

4.3.1.6. Reagents Stacking Methodology [Mean: 3.73, Std. Deviation: 0.72]: Indicates a generally good adherence to reagents stacking methodology with low variability.

4.3.1.7. Emergency Equipment and Procedures Availability [Mean: 3.17, Std. Deviation: 0.91]: The lower mean suggests a potential area for improvement in the availability of emergency equipment and procedures.

4.3.1.8. Availability and Usage of PPE [Mean: 3.19, Std. Deviation: 0.98]: Suggests moderate compliance with the availability and usage of Personal Protective Equipment (PPE) with some variability.

4.3.1.9 Occupational Health Monitoring [Mean: 3.32, Std. Deviation: 1.11]: Indicates moderate adherence to occupational health monitoring practices, with higher variability.

4.3.2.0 Air and Water Quality Monitoring [Mean: 3.25, Std. Deviation: 0.85]: Suggests moderate compliance with air and water quality monitoring, with relatively low variability.

4.3.2.11 Waste Management [Mean: 3.36, Std. Deviation: 0.87]: Indicates moderate adherence to waste management practices, with moderate variability.

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In summation, KMP Reagents demonstrates a commitment to safety, health, and environmental benchmarks, as evidenced by positive scores in various operational aspects. However, the analysis highlights specific areas for improvement, such as achieving uniformity in storage practices, enhancing compliance with chemical labelling, and ensuring consistent availability of emergency resources. Addressing these opportunities will not only strengthen safety protocols but also contribute to a more resilient and sustainable operation at KMP Reagents. Ongoing monitoring, regular reviews, and proactive measures will be instrumental in fostering a culture of continuous improvement and excellence in safety, health, and environmental practices.

4.3.2 Using regression analysis

To investigate the effects of the variables RCA, EFS, Technology Adoption, and Training on the variable SHE (Safety, Health & Environment), a multiple linear regression analysis was carried out.

4.3.2.1 Model Summary

Table 16: Summarized multiple linear regression results

R	R^2	Adjusted R^2	Standard error of the estimate
0.97	0.94	0.93	0.34

(a) R (Correlation Coefficient)

R is the correlation between the model's predictions based on the independent factors and the observed values of the dependent variable SHE. *The observed values and the model's prediction have a very strong positive correlation, as indicated by the R value of 0.97.*

(b) R^2 (R-squared)

R^2 is the percentage of the dependent variable's variance that the regression model's independent variables can account for. With an R^2 of 0.94, the independent variables in the model account for 93.51% of the variance in the dependent variable. *Stated differently, 93.51% of the variation in SHE can be anticipated based on the independent variables*.

(c) Adjusted R^2

The value is modified by adjusted R-squared, which takes into account the number of variables and observations in the model. A measure with numerous independent variables is more accurate. *This indicates that approximately 93.13% of the variance in the dependent variable is explained after correcting for the number of predictors*.

(d) In brief

In summary, the model shows a very high positive relationship between the observed values and the prediction, explains 93.13% of the variance in the dependent variable

4.3.2.2 ANOVA

Table 17: Summarized ANOVA results

Model	df	F	p
Regression	5	242.23	<.001

(a) P-value

With a p-value of <.001, which is less than 0.001, the results are highly statistically significant. This suggests you can reject the null hypothesis with a high degree of confidence. It's very unlikely that the observed results are due to chance, indicating that the independent variables (predictors) in your model have a statistically significant effect on the dependent variable SHE.

(b) Summary

In summary, the ANOVA results indicate that the regression model is statistically significant, suggesting a good fit compared to a model without any predictors.

4.3.2.4 Coefficients

Table 18: Summarized table of coefficients

	Unstandardized Coefficients	Standardized Coefficients				95% confidence interval for B	
Model	B	Beta	Standard error	t	p	lower bound	upper bound
(Constant)	1.82		0.39	4.62	<.001	1.04	2.6
RCA	0.16	0.12	0.12	1.32	.19	-0.08	0.39
EFS	-0.32	-0.12	0.15	-2.18	.032	-0.61	-0.03
Technology Adoption	0.61	0.37	0.1	6.37	<.001	0.42	0.81
Training 4	-1.45	-0.51	0.16	-8.82	<.001	-1.78	-1.12
Training 5	0.74	0.28	0.13	5.51	<.001	0.47	1

The findings for each independent variable in the model, including the constant (intercept), are displayed in this table. The predicted change in the dependent variable SHE for every unit increase in the corresponding independent variable is shown by the unstandardized coefficient B.

(a) Constant

The regression line's y-intercept is located here. When all independent variables are zero, it represents the dependent variable's expected value. In this case, it indicates that the dependent variable SHE should be about 1.82 when RCA, EFS, Technology Adoption, Training 4 and Training 5 are all zero. The intercept is statistically substantially different from zero, as indicated by the p-value of less than.001. More specifically, the null hypothesis—which holds that the population's coefficient of (Constant) is zero—is rejected.

(b) RCA (Root Cause Analysis)

The value of the variable SHE changes by 0.16 units for every unit change in the value of the variable RCA. We are unable to declare with confidence that RCA has an effect on the dependent variable because the p-value of.19 indicates that this coefficient is not statistically significantly different from zero. More specifically, it is not disputed that the population's coefficient of RCA is zero.

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(c) EFS (Employee Involvement, Feedback and Suggestion Systems)

The variable SHE's value changes by -0.32 units if the variable EFS's value changes by one unit. Since the coefficient is statistically substantially different from zero (p-value =.032), we can conclude that EFS has an effect on the dependent variable. More specifically, the null hypothesis—which holds that the population's coefficient of EFS is zero—is rejected.

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(d) Technology Adoption

The value of the variable SHE varies by 0.61 units if the value of the variable Technology Adoption changes by one unit. Technology adoption has an impact on the dependent variable, as evidenced by the p-value of less than.001, which indicates that the coefficient is statistically significant different from zero. More specifically, the null hypothesis—which holds that the population's coefficient of technology adoption is zero—is rejected.

(e) Training

The variable SHE's value changes by 0.74 units if the value of Training 5 changes by one unit. We have proof that Training 5 has an effect on the dependent variable because the p-value is less than.001, which indicates that this coefficient is statistically significantly different from zero. More specifically, the null hypothesis—which holds that the population's coefficient of Training 5 is zero—is rejected.

4.3.3 Comparison of Mean scores for Perception of SHE standards prior to/and after Significant Investments in CI initiatives (Baseline year: 2020)

The table below summarizes the descriptive statistics for each benchmark category, both pre and post CI implementation:

Table 19: Mean scores for pre-CI & post-CI

Metric	Safety Pre-CI	Safety Post-CI	Health Pre-CI	Health Post-CI	Environmental Pre-CI	Environmental Post-CI
Count	89	89	89	89	89	89
Mean	70.60	80.82	64.11	72.05	59.75	65.94
Std	10.13	10.40	14.35	14.01	20.85	20.44
Min	44.47	57.77	23.41	35.11	5.21	9.08
25%	63.56	72.55	56.05	63.57	47.73	54.55
50%	70.94	80.25	63.87	71.46	60.64	66.15
75%	77.37	88.47	73.08	82.68	75.36	78.95

The table above details the descriptive statistics for safety, health, and environmental benchmarks before and after the significant investments in CI initiatives with 2020 as the baseline year. It shows an increase in the mean scores post-CI increased investments across all three categories, indicating a positive effects of CI practices. The Safety Pre-CI mean score improved from 70.60 to 80.82 in Safety Post-CI, the Health Pre-CI mean score increased from 64.11 to 72.05 in Health Post-CI, and the Environmental Pre-CI mean score went up from 59.75 to 65.94 in Environmental Post-CI. The standard deviation remains relatively similar pre- and post-CI, suggesting consistent variation around the mean. The minimum scores increased across the board, which could indicate that the lowest performing segments saw improvements. The 25th, 50th (median), and

75th percentiles all shifted higher post-CI, further underscoring the overall enhancement in performance metrics.

4.4 Conclusion

The findings from this chapter provide evidence on the value of implementing CI initiatives within an organizational context, specifically within the realm of logistics management of reagents. The analysis indicates that CI practices are well established in certain areas, as seen by the frequent utilization of root cause analysis, employee engagement systems, continuous learning, and technology adoption. However, there is room to deepen the effects of these practices, particularly to extend their extensive utilization. It is evident that CI philosophy is not only instrumental in driving incremental progress but is also pivotal in fostering a culture of excellence that manifests in measurable enhancements across various operational domains. It is therefore established that the research hypothesis that ***H0: Adoption of CI practices have NO significant effect on the Reagents' internal logistics system performance at KMP is rejected. Indeed, CI practices have significant effect on the Reagents' internal logistics system performance at KMP***

The chapter also underscores the significance of embedding CI into the organizational fabric and advocates for a strategic emphasis on its broader application to realize full potential benefits. As the company continues to navigate an ever-evolving business landscape, the insights garnered herein should guide future efforts to sustain and amplify the gains from Continuous Improvement initiatives

CHAPTER FIVE

DISCUSSION OF THE FINDINGS

5.0 Introduction

This chapter examines how CI deployment affects logistical efficiency, safety health and environmental levels. The study compares empirical data from frequency distributions and regression models to CI literature. The chapter seeks to assess CI's effects on KMP and identify strengths and weaknesses. Root cause analysis, employee engagement, feedback and suggestion systems, training, and technology adoption are discussed to show how they influence the company culture. The study analyses how CI improves KMP's logistics management's efficiency, safety, health, and environmental standards by examining its operational effects.

5.2 The extent to which CI practices are being implemented in the internal logistics system of reagents KMP.

Table 10's indication of "Frequently Utilized" as the predominant category for root cause analysis (RCA) aligns with the literature highlighting the importance of RCA as a core component of CI practices according to Watson (1986). The strong adoption of RCA among respondents is reflective of Deming's (1986) emphasis on problem-solving and quality control methods within organizations. However, the limited use in the "Extensively Utilized" category suggests a need for a deeper cultural integration of these practices, as supported by Suzaki's (1987) advocacy for CI as an ideology with no endpoint to improvement. This presents an opportunity for KMP to further embed RCA into its organizational fabric, leveraging its potential to enhance operational efficiency and quality as espoused by Deming (1995) and Imai (1986).

The findings in table 10 underscore the established presence of employee engagement systems within the organization, resonating with the literature on the significance of employee involvement in CI practices as shown by Crosby (1979) and Deming (1986). While the high frequency of use indicates a positive trend, the relatively low "Extensively Utilized" responses suggest room for growth, echoing the need for leadership commitment and employee empowerment discussed by Covey (1990) and Imai (1986). This suggests that while KMP has laid the groundwork for engaging employees in CI practices, there remains potential to enhance these systems' effectiveness and reach, thereby fostering a more robust culture of continuous improvement.

The strong leaning towards "Frequently Utilized" for continuous learning and training, as depicted in table 10, showcases a commitment to CI that is in line with Senge's (1990) perspective on the importance of creating a learning culture within organizations. However, the lower frequency in the "Extensively Utilized" category signals a gap that KMP could address by investing more in training and development to deepen employees' understanding of CI methodologies, as suggested by Womack and Jones (2003) and George (2002).

Table 10's demonstration of the frequency of technology adoption and automation usage supports the literature's view that modern CI practices are increasingly reliant on technology as noted by Ashmore (2001) and Chandrasekaran et al. (2008). The prevalence of "Frequently Utilized" responses highlights KMP's alignment with industry trends towards modernization. Nevertheless, the scope for more "Extensively Utilized" technology suggests that KMP could benefit from further integrating technology and automation in its processes, consistent with the principles of Lean and Six Sigma that advocate for technological leverage to optimize operations as acknowledged by Womack and Jones (2003) and George (2002). This room for growth indicates that while KMP has embraced the shift towards technological solutions, there is potential for a more comprehensive application across all organizational levels, potentially enhancing efficiency and productivity in line with Lean principles.

The synthesis of the empirical findings with the literature review suggests that KMP has embraced CI practices to a considerable extent, but with variability in the depth of their implementation. This reflects the findings in the literature where CI is often adopted in varying degrees across different organizations, influenced by factors such as leadership commitment, employee involvement, and the extent of technological integration as noted by Burns (2000), Lee (2000) and Palmer (2001).

The fact that RCA and employee engagement systems are frequently utilized but not extensively suggests that while there is a foundation for CI, the practices may not be fully integrated into the company's culture and operations. This is consistent with the literature that emphasizes the need for CI to be an organization-wide endeavor, requiring active participation from all staff members as indicated by Bassant and Caffyn (1994) and Imai (1986).

The literature also highlights that CI is not just a set of practices but a philosophy that demands continuous learning and adaptability according to Senge (1990) and Womack and Jones (2003). The data showing significant utilization of continuous learning indicates that KMP recognizes the importance of developing a culture that supports ongoing improvement. However, the disparity between "Frequently Utilized" and "Extensively Utilized" suggests that continuous learning could be more deeply ingrained in the organization's practices.

Finally, the positive trend in technology adoption mirrors the literature's recognition of the increasing importance of technology in driving CI as discussed by Chandrasekaran et al. (2008) and Kikuchi et al. (2007). The lower count in "Extensively Utilized" may point to opportunities for KMP to leverage technology further, supporting the literature's notion that technology is a critical enabler of CI as acknowledged by Ashmore (2001) and Palmer (2001).

5.2 Effects of implementing Continuous Improvement practices on the efficiency levels of the internal logistics system of Reagents

The regression model, comprising independent variables such as Root Cause Analysis, Technology Adoption, Continuous Training, Employee Engagement, Feedback, and Suggestion Systems, was assessed to understand its efficacy in explaining the variation in the dependent variable, Efficiency.

The R-squared value of approximately 82.5% indicates that the included independent variables collectively account for a substantial proportion of the observed variability in

Efficiency. This suggests a strong overall fit of the model to the data, highlighting the effectiveness of the chosen predictors in explaining changes in efficiency.

Furthermore, considering the adjusted R-squared value, which accounts for the number of predictors in the model, approximately 81.45% of the variance in the dependent variable is explained. The adjustment for the number of predictors is crucial, as it provides a more conservative estimate of the model's explanatory power, preventing potential overestimation due to the inclusion of irrelevant variables.

The inclusion of Root Cause Analysis, Technology Adoption, Continuous Training, Employee Engagement, Feedback, and Suggestion Systems as independent variables signifies a holistic approach to understanding efficiency. Root-Cause Analysis suggests a focus on identifying and addressing fundamental issues, while Technology Adoption indicates the relevance of up-to-date tools. Continuous Training emphasizes the importance of ongoing skill development, and Employee Engagement, Feedback, and Suggestion Systems highlight the significance of a participative and responsive organizational culture.

In summary, the model, with a high R-squared and adjusted R-squared, implies that the selected independent variables effectively contribute to explaining the observed variations in Efficiency. The consideration of both metrics reinforces the robustness of the model, providing confidence in its ability to capture and elucidate the factors influencing efficiency within the reagents sector. This shows that indeed implementing root cause analysis, technology adoption, training, employment engagement and suggestion systems have major effects on efficiency levels on the reagents circuit

5.3 Effects of implementing continuous improvement practices on the safety, health, and environmental benchmarks of the section

In examining the effects of Continuous Improvement (CI) practices on safety, health, and environmental benchmarks at KMP, as presented in table 21, it was observed that significant improvements across all metrics post-implementation of CI. These findings are in line with the principles of CI discussed in the literature, particularly the works of Imai (1986) and Womack and Jones (2003).

The safety benchmarks show a notable increase from a pre-CI mean score of 70.60 to a post-CI score of 80.82, suggesting the effectiveness of CI in enhancing safety measures. This improvement reflects Deming's (1986) emphasis on process enhancement and aligns with the enhanced safety culture that CI practices are known to foster. Despite this improvement, the consistency in standard deviation indicates that the range of safety performance across the company has remained stable, highlighting potential areas for future CI interventions as discussed by Ohno (1988).

Similarly, health benchmarks have shown substantial improvement, with the mean score increasing from 64.11 to 72.05. This aligns with the Total Quality Management (TQM) approach of holistic quality management emphasized by Juran (1988) and suggests that CI practices have successfully enhanced workplace health standards at KMP. The steady standard deviation in health benchmarks, however, suggests that there's room for targeted improvements, a concept supported by Teian (1992).

Environmental performance has also seen significant gains, with the mean environmental score rising from 59.75 to 65.94. This improvement, likely due to waste reduction and efficiency efforts, reflects lean principles as described by Womack and Jones (1996). The notable increase in the maximum environmental score suggests that segments within the company have adopted advanced environmental practices, demonstrating a commitment to environmental sustainability as outlined by Williamson (1997).

The upward shift in the 25th, 50th, and 75th percentiles in all categories post-CI implementation indicates an organization-wide effects of CI initiatives, as suggested by Chandrasekaran et al. (2008). This shift not only points to an improved average but also to raised performance bounds, indicating the comprehensive nature of CI initiatives at KMP.

The use of root-cause analysis and employee engagement strategies, as indicated by the high frequency of utilization in table 10, have likely contributed to these improvements. These CI practices, focusing on identifying and rectifying underlying issues and involving employees in improvement processes, resonate with Imai's (1986) and Suzaki's (1987) emphasis on employee involvement in CI.

The adoption of technology and automation in CI practices, as highlighted in table 10, could have been pivotal in improving environmental metrics through more efficient processes (Ashmore, 2001). This technology adoption aligns with the growing trend of incorporating digital solutions into CI strategies for enhanced efficiency and sustainability.

Despite these positive trends, the consistent standard deviation across benchmarks suggests that there are still areas within KMP that have not realized as much improvement. This highlights the need for a more focused CI approach in these areas, potentially employing more specialized CI tools and methodologies (Chen et al., 2000)

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5.3.1 Implications of Results from the Multiple Regression Model

In the assessment of the regression model, the correlation coefficient (R) serves as an initial indicator of the relationship between the predicted values based on independent factors and the observed values of the dependent variable, Safety, Health, and Environment (SHE). The high correlation coefficient of 0.97 reveals a very strong positive correlation, signifying that the model's predictions align closely with the actual observed values of SHE. This suggests a robust connection between the selected independent variables and the safety, health, and environmental outcomes.

Moving beyond correlation to explain variance, the R-squared (R^2) value of 0.94 provides a deeper understanding of the model's explanatory power. This metric asserts that the independent variables, namely Root Cause Analysis (RCA), Training, Technology Adoption, and Employee Feedback and Suggestion Systems (EFS), collectively account for an impressive 93.51% of the variance in SHE. This implies that the model effectively captures and elucidates the factors influencing safety, health, and environmental outcomes.

To address concerns related to model complexity, the adjusted R-squared further refines the understanding. The adjusted R-squared, at approximately 93.13%, takes into consideration the number of variables and observations in the model. This adjustment ensures a more accurate representation of the model's explanatory capacity by correcting for potential overestimation associated with numerous independent variables. Consequently, even after considering the complexity introduced by multiple predictors, the model maintains a high level of accuracy in explaining around 93.13% of the variance in SHE.

Delving into the specific independent variables, the inclusion of Root Cause Analysis (RCA), Training, Technology Adoption, and Employee Feedback and Suggestion Systems (EFS) emphasizes a comprehensive approach to understanding safety, health, and environmental outcomes. Root-Cause Analysis is indicative of a proactive stance toward identifying and addressing fundamental issues, while Training signifies a commitment to skill development. Technology Adoption highlights the relevance of modern tools, and Employee Feedback and Suggestion Systems underscore a participatory and responsive organizational culture.

The above interpretation affirms the model's strength in explaining safety, health, and environmental outcomes. The high correlation, coupled with the substantial R-squared and adjusted R-squared values, attests to the model's efficacy in capturing the complex interplay of independent variables and their influence on SHE. The inclusion of specific independent variables reflects a holistic understanding of the factors contributing to safety, health, and environmental well-being within the organizational context. This model stands as a valuable tool for anticipating and enhancing safety, health, and environmental outcomes based on the identified predictors.

In conclusion, data from regression analysis and also descriptive statistics demonstrates the effective application and significant effects of CI practices on improving safety, health, and environmental benchmarks on the reagents section. This improvement aligns with the broader literature on CI and underscores the importance of CI as a strategic approach within organizations. For sustained improvement, KMP should continue investing in CI, focusing on areas with lesser improvement, and integrating CI into all organizational levels as posited by Granja et al. (2005).

5.4 Conclusion

The comprehensive examination of CI practices at KMP reagents reveals a substantial, albeit varied, effects on logistics management. The data indicates significant progress in safety, health, and environmental benchmarks, showcasing CI's capacity to drive meaningful improvements. These enhancements align well with the literature, affirming the efficacy of CI strategies in operational contexts. However, the variation in the depth of CI adoption, particularly in logistics efficiency which can potentially lead to end-user satisfaction, underscores a need for a more integrative approach. The findings suggest that while KMP has effectively implemented certain aspects of CI, there remains untapped potential, especially in achieving a uniformly deep-rooted CI culture. The chapter's insights into the differential effects of CI on various operational metrics provide a roadmap for future enhancements. It advocates for a holistic adoption of CI practices, emphasizing the need for continuous learning, increased technology integration, and a more profound organizational commitment to CI principles. This approach could further elevate KMP's operational standards, ensuring sustained improvement and robust competitiveness in an increasingly dynamic industrial landscape.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

The purpose of this chapter is to provide a findings summary, conclusions, and recommendations of this research study. The chapter starts by first outlining the summary of the findings in line with the research objectives, followed by the conclusions and recommendations of the study.

6.1 Summary of Findings of the Study

The study on the implementation of continuous improvement (CI) practices at KMP reagents offers a detailed and insightful view into the operational transformations within the organization. The findings shed light on several key aspects of CI deployment and their effects on logistics management, particularly focusing on reagents.

One of the primary observations from the study is the adoption of Root Cause Analysis (RCA) in logistics management. The majority of respondents indicated that RCA is 'Frequently Utilized,' illustrating its significance in identifying and addressing operational issues. This finding aligns with Watson's (1986) perspective on the importance of problem-solving in CI practices and suggests that RCA is a well-established component in KMP's operational strategy. However, the less frequent usage in the 'Extensively Utilized' category points to potential opportunities for deeper integration of RCA into the organizational culture.

Employee engagement, feedback, and suggestion systems (EFS) are also notably well-embedded within the organization, as evidenced by their frequent usage. This aligns with Deming's (1986) emphasis on employee involvement in the CI process and suggests a positive trend in employee participation. However, there's room for enhancing the effectiveness and reach of these systems, which is a vital aspect for fostering a robust CI culture, as highlighted by a lower count on the 'extensively used'

The study indicates that while KMP has laid a solid foundation for engaging employees in CI practices, there is potential to further optimize these systems, thereby enhancing overall organizational efficiency and innovation.

In terms of continuous learning and training, the study shows a significant inclination towards frequent utilization, reflecting a strong culture of learning and development within KMP. This is consistent with Senge's (1990) concept of a learning organization and indicates KMP's commitment to fostering continuous skill and knowledge enhancement among employees. However, the disparity between 'Frequently Utilized' and 'Extensively Utilized' responses suggests that while continuous learning is established, it might not be as comprehensive or deeply integrated across the organization as it could be.

Technology adoption and automation within KMP's CI practices reveal a forward-leaning approach towards modernization and efficiency. Most respondents indicate frequent utilization of technology and automation, suggesting a progressive attitude towards embracing modern solutions. However, the lower frequency of 'Extensively Utilized' responses suggests potential for a broader application of technology across different areas, resonating with literature that emphasizes the role of technology in enhancing CI practices as espoused by Chandrasekaran et al. (2008).

The study also examines the effects of CI on logistics efficiency and Safety health and Environment. The findings from the logistics efficiency indicators suggest that while many logistics processes at KMP are rated highly efficient, there remains a segment with scope for improvement. This is in line with Lean principles and indicates the need for targeted CI interventions in specific areas as discussed by Ohno(1988) and Womack and Jones (2003). The multiple regression model further highlights the fact that indeed root cause analysis, technology, training and employee engagement have a strong influence on the efficiency levels of the logistics system of reagents

Regarding the effects of CI on safety, health, and environmental benchmarks, the study presents a positive trend with significant improvements post-CI implementation plus the multiple linear regression shows a very strong positive relationship and a strong influence on safety, health and environmental aspects of the firm. This aligns with the principles of TQM and Lean, indicating that CI practices at KMP have successfully enhanced operational standards across these benchmarks. However, the consistent standard deviation suggests areas within the company that have not fully realized improvements, highlighting the need for a more focused CI approach.

In summary, the findings of the study provide a comprehensive view of CI implementation at KMP, highlighting its positive effects on operational efficiency and safety, health, and environmental (SHE) standards. While significant strides have been made in integrating CI practices, there are areas where deeper implementation and a more nuanced approach could yield further improvements. The study emphasizes the importance of leadership commitment, employee involvement, continuous learning, and technology integration as key drivers for successful CI implementation. Additionally, it underscores the need for a holistic approach to CI, one that not only focuses on operational efficiency but also considers the broader aspects of employee engagement, customer satisfaction, and sustainable practices.

6.2 Overall Conclusions

The analysis of continuous improvement (CI) practices at KMP, based on the extensive data and literature review, culminates in a multifaceted understanding of the role and effects of CI in a large-scale industrial setting. The study encapsulates the journey of KMP in embedding CI philosophies within its operational, logistical, and cultural frameworks, revealing significant achievements along with areas ripe for further development.

A key takeaway from the study is the affirmation of CI as a pivotal strategy for enhancing organizational efficiency, quality, and responsiveness. The findings demonstrate that KMP has successfully integrated CI practices into various facets of its operations, notably in logistics management and in fostering a safety, health, and environmentally conscious work environment. The improvements in safety, health, and environmental benchmarks post-CI implementation are particularly noteworthy, as they reflect a commitment to holistic organizational development and align with global standards of operational excellence.

However, the study also underscores the complexities and challenges inherent in implementing CI practices effectively across all organizational levels. While KMP has shown a commendable adoption of CI methodologies, such as root cause analysis, employee engagement systems, and technology utilization, the depth of implementation varies. This variation points to the need for a more uniform and deeply ingrained CI culture, one that permeates every department and function within the organization.

Furthermore, the study sheds light on the critical role of leadership in driving CI initiatives. Leadership commitment, coupled with active employee involvement and continuous learning, emerges as a cornerstone for the successful integration of CI practices. The findings advocate for a continuous investment in employee development and training, ensuring that the workforce is equipped with the necessary skills and knowledge to contribute effectively to CI initiatives.

In conclusion, the study provides valuable insights into the implementation and efficacy of CI practices in a complex industrial setting. It highlights the achievements of KMP in enhancing operational efficiency and standards while also pointing out areas for further improvement. The findings from this study serve as a roadmap for organizations embarking on or advancing their CI journey, emphasizing the importance of a comprehensive, inclusive, and dynamic approach to continuous improvement.

6.3 Recommendations of the Study

Based on the analysis and findings of this study on continuous improvement (CI) practices at KMP, several key recommendations emerge. These recommendations are aimed at enhancing the effectiveness of CI initiatives, ensuring sustained improvements, and aligning with best practices in organizational development and management. The following are detailed recommendations:

1. Deepening CI Integration Across All Levels:
    - KMP should endeavor to further embed CI practices into every facet of the organization. This includes not only operational areas but also

administrative and strategic functions. CI should be a way of life and a way of working

- More focus on training and development programs tailored to different levels of the organization can help inculcate a deeper understanding and commitment to CI principles among all employees.

2. Strengthening Leadership Commitment and Involvement:

   - Senior management should actively champion CI initiatives, demonstrating commitment through resource allocation, policy-making, and personal involvement. It is suggested that the General Manager and the board should be the overall champions this endeavor as it becomes easier to cascade downwards to every one
   - Encourage leadership at all levels to regularly engage with CI projects and teams, providing guidance and support to sustain momentum and ensure alignment with organizational goals.

3. Enhancing Employee Engagement and Involvement:

   - Create more platforms and opportunities for employee involvement in CI activities, such as suggestion schemes, quality circles, innovation forums, and cross-functional teams.
   - Recognize and reward employee contributions to CI initiatives, fostering a culture of appreciation and motivation for continuous improvement.

4. Expanding Training and Development Programs:

   - Implement comprehensive training programs on CI tools and methodologies, ensuring all employees are equipped with the skills and knowledge required for effective participation.
   - Consider external training and partnerships with CI experts and institutions to bring in fresh perspectives and advanced knowledge.

5. Increasing Focus on internal Customer-Centric Measures:

- Incorporate internal customer feedback and satisfaction metrics more prominently in CI evaluation frameworks.
- Regularly review and adapt CI strategies based on internal customer feedback and market trends to ensure that CI efforts are aligned with internal customer needs and expectations.

6. Conduct regular performance reviews not only for individuals but also for processes and workflows. Use these reviews to identify areas of inefficiency or bottlenecks that can be addressed for improvement
7. Foster collaboration between different departments and teams. Cross-functional teams often bring diverse perspectives and ideas, leading to more innovative and effective solutions

6.4 Suggested Areas for Further Research

The study on the implementation of Continuous Improvement (CI) practices at KMP provides valuable insights into the current state of CI within the organization. However, there are several areas where further research could provide deeper understanding and more comprehensive guidance for future improvements. Here are detailed suggestions for areas of further research, incorporating relevant citations and references:

1. Comparative Analysis of CI Implementation across Industries: Exploring how CI practices are implemented in different industries, especially contrasting manufacturing with service sectors, could provide broader insights. This comparison would allow for a better understanding of industry-specific challenges and best practices in CI implementation as acknowledged by Womack & Jones, (2003) and Liker (2004).

2. Longitudinal Studies on the Long-Term Effects of CI: Research focusing on the long-term effects of CI practices would be valuable. A longitudinal study could track the progress and effects of CI over several years, providing insights into

sustainability and evolution of CI initiatives as noted by Deming (1986) and Imai (1986) in their respective researches.

3. The Role of Leadership in Sustaining CI Culture: Further research is suggested to explore the role of leadership in embedding and sustaining a culture of continuous improvement within an organization. This could include case studies of successful and unsuccessful CI implementations, focusing on leadership styles and strategies as recommended by Covey (1990) and Kaplinsky(1995).
4. Effects of Technological Advances on CI Practices: With rapid advancements in technology, there is a need for research into how modern tools such as AI, IoT, and big data analytics are changing the landscape of CI practices. Studies could focus on the integration, challenges, and outcomes of technology-driven CI initiatives as noted by Ashmore (2001) and Chandrasekaran et al. (2008).
5. Employee Engagement and Empowerment in CI: Research focused on employee perspectives on CI, their level of engagement, and the factors that motivate or hinder their participation would be insightful. This could include qualitative studies exploring employee experiences and attitudes towards CI as suggested by Suzaki, (1987) and Teian (1992).
6. Effectiveness of Different CI Methodologies: Comparative studies of different CI methodologies such as Lean, Six Sigma, TQM, and Agile in various operational contexts could provide a clearer understanding of their effectiveness and applicability in different organizational settings. This research could include case studies and meta-analyses to evaluate the outcomes and challenges associated with each methodology as noted by George (2002) and Juran (1988).

Each of these suggested areas for further research holds the potential to significantly expand the current understanding of CI practices and their effects on organizational performance, employee engagement, customer satisfaction(internal and external), and overall business resilience. These studies would not only contribute to academic knowledge but also provide practical insights for businesses seeking to implement or enhance their CI initiate

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Appendix I:

QUESTIONAIRE

Dear Respondent,

I am kindly requesting for your invaluable participation in our research study, which delves into the effects of implementing a Continuous Improvement philosophy on the performance of KMP's reagents logistics system. Your insights and expertise are crucial in providing a comprehensive understanding of how Continuous Improvement practices influence this critical aspect of KMP's operations. As organizations increasingly turn to Continuous Improvement for efficiency and competitiveness, your perspective on the effectiveness of these initiatives within the logistics system is of utmost importance. Your participation, involving confidential interviews and surveys, will contribute significantly to refining logistics best practices and optimizing KMP's operations. We highly value your expertise and eagerly await your positive response, as your involvement is central to the success of our study.

Sincerely,

Enerst Ndaipeni (0964782707) Email::ndaipenienerst@gmail.com

SECTION ONE: BACKGROUND INFORMATION

Indicate your answer with an (X) on your appropriate response in the corresponding Box

1. Age: 18-25 years ☐ 226-35 years ☐ 36-45 years ☐ above 45 years ☐

2. Sex: Male ☐ Female ☐

3. Educational Qualification: G9 school certificate ☐ G12 School Certificate ☐ Craft Certificate ☐ Diploma ☐ Degree ☐ Master's Degree ☐

4. Current Position: Operator: ☐ Supervisor: ☐ Snr Supervisor: ☐ Specialist/engineer: ☐ Superintendent: ☐

5. Number of years of service in the current position:

1 to 5 years ☐ 5 to 10 years ☐ 10 to 15years ☐

SECTION B: CONTINUOUS IMPROVEMENT (CI) TOOLS AND ENABLERS UTILISATION IN THE DEPARTMENT

RQ: *To what extent are each of the following continuous improvement practices and enablers utilized in your organization? (Please indicate your choice by marking with an X on an appropriate Box: Where, 1= Not Utilized. 2 = Minimally Utilized, 3 = Moderately Utilized. 4 = Frequently Utilized, 5=Extensively Utilized)*

STATEMENT: (CI TOOLS AND ENABLER)	1	2	3	4	5
Root Cause Analysis (RCA): RCA techniques, such as the 5 Whys and Cause-and-Effect Analysis, are used to identify the underlying causes of problems or defects and develop corrective actions.					
Employee Involvement, Feedback and Suggestion Systems: Regularly collecting and analysing employee feedback aids operational, product, and service enhancements, including idea generation and hazard identification					
Continuous Learning and Training: *Investing in employee training and development ensures that the workforce is equipped with the skills and knowledge needed to drive continuous improvement efforts.*					
Technology Adoption & Automation: *Integrating digital tech like data analytics, automation, and IoT streamlines processes and provides real-time data for informed decisions*					

SECTION C: RELATIONSHIP BETWEEN CONTINUOUS IMPROVEMENT(CI) AND REAGENTS LOGISTICS PERFORMANCE.

Please indicate your choice by marking with an X on an appropriate Box: Where, 1 =

Strongly Disagree, 2 = Disagree, 3 = neither agree nor Disagree, 4 = Agree, 5 = Strongly Agree.

Please indicate the extent to which you agree with the following statements "*on the effect that the use of Continuous Improvement(CI) tools and enablers*" listed in section (B) above have on "*logistics performance indicators listed below".*

Time indicators: (How has CI tools affected logistics performance?)	1	2	3	4	5

Reagent personnel serve end users on reasonable time i.e. from the time a requisition to transfer reagents to a particular area to the time reagents are actually transferred					
Receiving time is short most of the times (Time it takes to offload reagent items from the delivery transport.)					
Put away time is short (Time between the instant when product is offloaded until its storage in its designated place)					
Replenishment Time: The mixing and storage tanks are well replenished and there is zero stock outs					

Cost indicators: (How has CI has affected logistics performance?)	1	2	3	4	5
Use of continuous improvement strategies has led to reduced transportation costs					
Use of CI has led to reduced inventory costs					
Use of CI has contributed to reduced labour costs in the reagent internal logistics					

Efficiency Indicators: (How has CI has affected logistics performance?)	1	2	3	4	5
Efficiency is high for the Reagent shed receiving through the use of proper inventory management (Number of vehicles offloaded per labour hour.)					
There is proper utilisation of warehouse space by Reagent Shed personnel i.e. the total warehouse storage space actually being used out of the total storage space available.					
CI practices impacted our inventory management in terms of optimizing stock levels and reducing carrying costs					
There is a standard reagent shed operating procedure (SOPs) in place that provides guidelines on how work must be carried out (e.g. how to receive, bin, carry stock take and pick and dispatch stock items) to prevent accidents, damage, and theft of stock items					
There is no inventory discrepancy on most storage locations at all times.					

Safety Indicators:(How has CI has affected logistics performance?)	1	2	3	4	5
Chemical Labelling Compliance: The percentage of reagent containers properly labelled with hazard information, handling instructions, and expiration dates					
Reagent Shed Temperature monitoring compliance: Filling out of the temperature logs sheets and continuous high temperature alarms monitoring through SCADA					
Chemical Spill Incidents: The number of chemical spills and incidents within the reagents section and the processing plant reagents bays					
Reagents Stacking Methodology: *Use of the approved reagents stacking standards as approved by the industry regulator(Zambia Environmental Management Authority), Mines Safety Department*)					

SECTION D: ADOPTION OF TECHNOLOGY AND INNOVATION IN REAGENTS LOGISTICS MANAGEMENT. Please indicate your choice by marking with an X on an appropriate Box: Where, 1 =Strongly Disagree, 2 = Disagree, 3 = neither agree nor Disagree, 4 = Agree, 5 = Strongly Agree.

RQ: To what extent has the company adopted technology and innovation in Logistics management?

STATEMENT	1	2	3	4	5
Reagent sheds uses modern ICT tools such as inventory management software to carry out activities such as receiving, stock taking, picking and shipping efficiently					
Reagents & process personnel are trained and know how to use Sensors(heat, level, temperature, flow etc.), RFID, SCADA, valves, pumps					
Reagents Sheds shares inventory information with the main warehouse efficiently and quickly.					

SECTION E: CONTINUOUS IMPROVEMENT CULTURE

(a)When was the last time you submitted an idea to improve process or operational performance *(i)* 3 months ago ☐ *(ii.)* 6 months ago☐ *(iii)* more than1 year ago ☐ *(iv.)*Never ☐

(b)What do you think are the chances that your 'idea generated' *will end up being implemented by the department?* (1) Below 25% ☐ (2)Below 50% ☐ (3)Above 50%☐ (4)Above 70% ☐

(c)What do you think are the chances that your 'idea generated' *will contribute to the overall performance improvement in the department?* (1) Below 25% ☐ (2)Below 50% ☐ (3)Above 50% ☐ (4)Above 70% ☐

(d)Do you think the company needs to do more to improve the continuous improvement culture?

Yes ☐ No ☐

Comment (on Yes/No):

Thank you for your Participation!

Appendix II: Ethical Clearance letter

UNIVERSITY OF LUSAKA

SCHOOL OF POSTGRADUATE STUDIES

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UNILUS-RESEARCH ETHICS COMMITTEE

Ref no: FWA00033228-16912/23

Date: 28th December 2023

STUDENT NAME: ENERST NDAIPENI

AN ASSESSMENT INTO THE EFFECTS OF IMPLEMENTING CONTINUOUS IMPROVEMENT PRACTICES IN PRODUCTION LOGISTICS: A CASE STUDY OF THE INTERNAL LOGISTICS SYSTEM OF REAGENTS AT KANSANSHI

MINING PLC(KMP)

The above research was submitted to the research ethics committee for review. The study has no major ethical problems and is approved subject to the following:

1. The study cannot be changed without express permission of the UNILUS research ethics committee.
2. Approval from the necessary authority should be sought.
3. Congratulations and the committee wishes you success in your work.

Professor Kasonde Bowa

MSc(Glasgow), M.Ed.(UNZA), FRCS(Glasgow), FACS, FCS, DPH(LSTMH), MPH (

UCL)

Chairman- UNILUS REC

Professor of Urology and Consultant Urologist

Deputy Vice-Chancellor – Research and Innovation

Executive Dean - School of Medicine and Health Sciences