



Occupational health and safety management systems in South African Universities: a systematic review

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Abstract

Occupational Health and Safety Management Systems (OHSMS) play a crucial role in ensuring workplace safety and compliance with regulatory standards in higher education institutions. However, the efficiency of OHSMS implementation in South African universities remains largely unexplored. This systematic review assesses global studies on OHSMS in universities to identify key challenges, efficiency factors, and best practices that may inform South African institutions. This systematic review, conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, assesses global studies on OHSMS in universities to identify key challenges, efficiency factors, and best practices that may inform South African institutions. A structured search across ScienceDirect, PubMed, Web of Science, Scopus, and Google Scholar was conducted using keywords related to OHSMS in universities. Subsequently, limited relevant studies were discovered but none of the studies focused on South African universities, highlighting a significant OHSMS research gap across the country. Moreover, the limited results of relevant studies indicate that universities with structured OHSMS frameworks, such as ISO 45001 and OHSAS 18001, experience reduced workplace incidents, improved regulatory compliance, and enhanced safety awareness. However, barriers such as leadership commitment, financial constraints, and regulatory alignment impact efficiency. This highlights the necessity for further research on OHSMS implementation in South African universities to gain a deeper understanding of their unique challenges and operational dynamics. Additionally, the study recommends strategic policy interventions aimed at strengthening occupational health and safety management frameworks within institutions of higher education in South Africa.

Keywords Occupational health and safety · Occupational health and safety management system · Higher education · South African universities · ISO 45001

Introduction

Occupational Health and Safety Management Systems (OHSMS) play a crucial role in ensuring safe working and learning environments across various sectors (ILO 2011). Universities and other higher education institutions present unique occupational health and safety (OHS) challenges due to the diversity of their activities, including laboratory research, construction projects, and large-scale

administrative functions (Paul et al. 2022). Globally, institutions have recognized the importance of implementing structured OHSMS frameworks to mitigate risks associated with hazardous materials, ergonomic concerns, fire safety, and compliance with regulatory standards (Fatemi et al. 2022). These systems provide a structured approach to managing workplace hazards, ensuring adherence to legal requirements, and fostering a culture of continuous safety improvement. According to Kashyap and Nandan (2015), universities are complex organizations that interact with a diverse range of individuals, including students, lecturers, and employees. Providing educational services in a healthy and safe environment is paramount to ensuring their well-being. While many universities actively engage in OHS-related activities, these efforts are often insufficient unless they are governed by a standardized system to ensure

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effectiveness and compliance (Subhani 2010). Despite the global recognition of OHSMS frameworks, their application in South African universities remains underexplored. Existing research tends to focus on industries and hospitals, with limited emphasis on higher education contexts. This systematic review addresses the gap by examining the global literature on OHSMS implementation in universities, identifying key challenges, efficiency factors, and best practices that can inform strategies suitable for South African universities.

Universities that have successfully implemented OHSMS frameworks, such as ISO 45001 and OHSAS 18001, have reported improvements in workplace safety, a reduction in workplace incidents, and enhanced employee awareness of occupational hazards (Subhani 2010). Research conducted in various industries has demonstrated that organizations implementing structured OHSMS frameworks experience reduced lost workdays, fewer workplace accidents, and lower costs associated with occupational diseases (Yang and Maresova 2020). A study by Wang et al. (2016) on 73 Chinese manufacturing firms revealed a strong positive association between OHSMS adoption and the efficiency of achieving sustainability goals, indicating that such systems contribute to both safety and long-term institutional success. Additionally, Çalış and Büyükcakıncı (2019) found that OHSMS not only enhances workplace safety but also fosters improved productivity, employee satisfaction, and operational efficiency.

In the university context, these benefits are crucial for maintaining a safe academic environment while ensuring institutional compliance with legal and regulatory standards (Ngcece 2018). Some institutions have adopted internationally recognized frameworks, while others struggle with limited financial resources, leadership commitment, and fragmented safety policies (Ngcece 2018). Research conducted in universities across Malaysia, Iran, and South Africa has shown that institutions with structured OHSMS frameworks perform better in reducing occupational risks and fostering a culture of safety awareness (Mugivhisa et al. 2021). However, significant barriers persist, including poor enforcement of safety policies, lack of institutional prioritization, and reluctance to adopt systematic safety practices (Kunodzia et al. 2024).

In the context of South African universities, the lack of research on OHSMS implementation presents a critical knowledge gap. While international studies highlight the benefits and challenges of OHSMS, there is limited empirical evidence on how these frameworks are applied in South African higher education institutions. Given the regulatory and operational challenges faced by universities in the country, further research is needed to evaluate the feasibility, effectiveness, and sustainability of OHSMS adoption in South Africa. This study aims to identify global best practices for implementing OHSMS in higher education

institutions, assess their relevance and adaptability within the South African university context, and ultimately address the national research gap by proposing strategic approaches for effective OHSMS adoption in the sector. By doing so, the study contributes to the understanding of OHSMS frameworks within South African universities and provides insight into strategies for improving occupational health and safety practices in higher education.

In conclusion, the implementation of an OHSMS in universities offers a structured and effective approach to managing workplace hazards, ensuring legal compliance, and fostering a culture of safety. Research demonstrates that institutions with well-established OHSMS frameworks experience reduced workplace incidents, improved productivity, and enhanced safety awareness. However, financial constraints, leadership challenges, and regulatory misalignment continue to hinder widespread adoption, particularly in South African universities. Given the paucity of research on OHSMS implementation in South African higher education institutions, this study underscores the urgent need for further investigation to develop context-specific safety management strategies. By adopting structured OHSMS policies, universities can enhance safety culture, improve risk management practices, and promote long-term compliance with health and safety regulations.

Literature search

This systematic review included studies that examined the implementation, efficiency, and challenges of Occupational Health and Safety Management Systems (OHSMS) within universities or higher education institutions. Studies were included if they focused on OHSMS in higher education institutions such as universities or higher education institutions. Both South African and global studies providing comparative insights were considered. Only peer-reviewed journal articles, government reports, and conference proceedings were included. Eligible study designs encompassed empirical research, including quantitative, qualitative, and mixed-method studies, as well as systematic reviews related to OHSMS implementation. Additionally, studies were limited to those published in English and those with full-text access available through institutional or open-access databases. Studies were excluded if they focused on OHSMS in industries, hospitals, or corporate workplaces, lacked specific reference to higher education institutions, or were opinion pieces, editorials, or commentary articles without empirical research. Duplicate publications and secondary analyses of previously included studies were also excluded. Studies meeting these criteria were categorized based on geographical context, study focus, and key themes related to OHSMS efficiency, challenges, and best practices. The literature search was conducted across five peer-reviewed

academic databases, which included Scopus, Web of Science, ScienceDirect, PubMed, as well as Google Scholar, to identify the literature. A structured search strategy was developed using Boolean operators (AND, OR), truncation, and phrase searching to refine results. The following search terms were applied across databases: ("Occupational Health and Safety Management System"OR"OHSMS"OR"Management System") AND ("Universities" OR"Higher Education Institutions"OR"Universities"). To manage citations and

remove duplicates, the reference management tool Mendeley was used. The search yielded 786 articles initially, which were screened by title and abstract. After applying inclusion and exclusion criteria, 13 studies listed in Appendix A were retained for full-text review and qualitative synthesis. To date, there are no studies that have focused specifically on South African universities, highlighting a significant research gap.

The study selection process followed the PRISMA 2020 flow diagram. Figure 1 below is a PRISMA Flow Diagram,

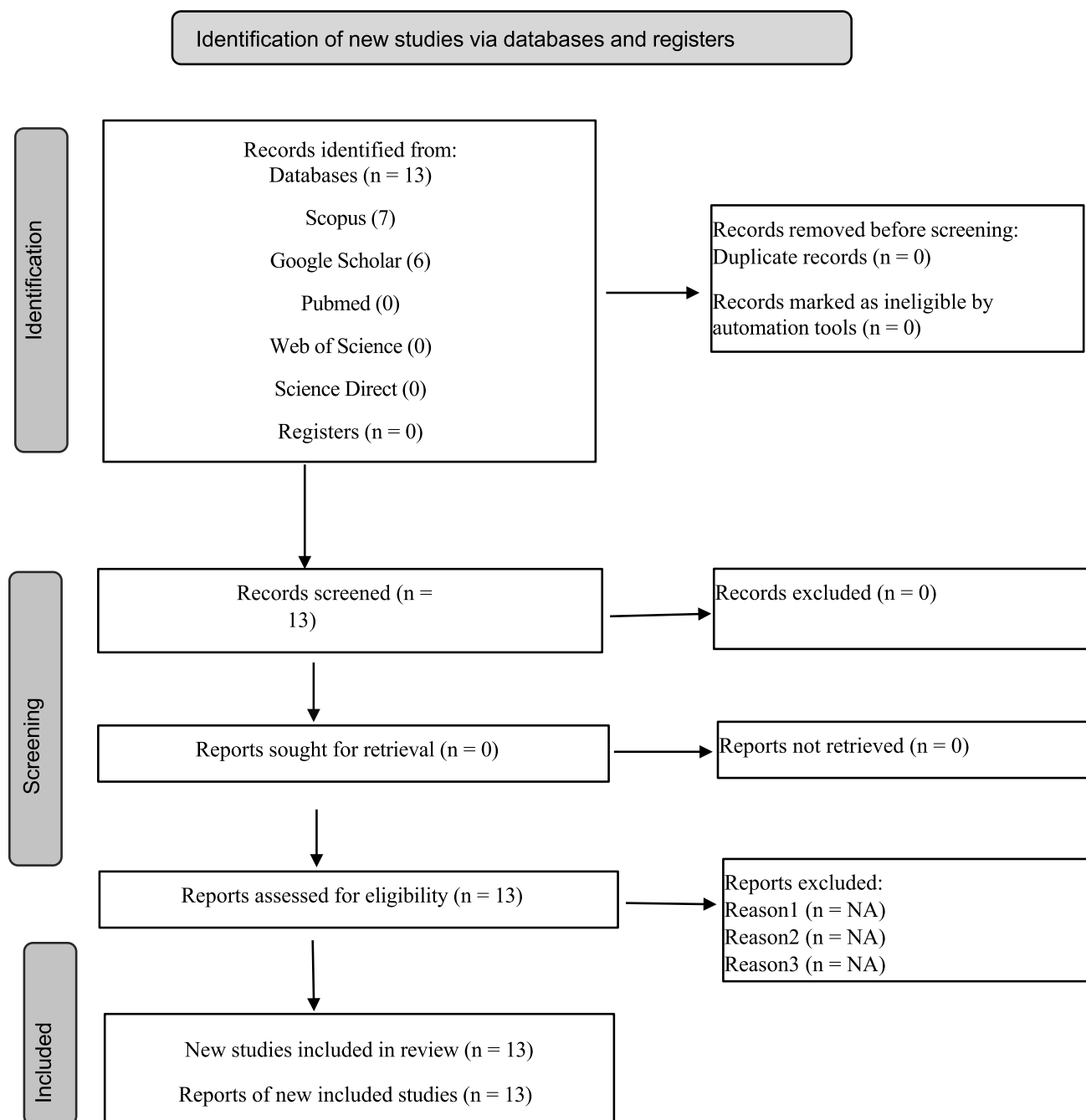


Fig. 1 PRISMA flow diagram

documenting all stages from identification to final inclusion. A total of 13 studies met all inclusion criteria and were included in the final synthesis. These studies spanned countries such as Malaysia, Iran, Turkey and the UK.

A key focus was to evaluate existing literature on how universities implement OHSMS and the impact of these systems on workplace safety. Additionally, the study reviewed OHS policies of South African universities to determine whether they comply with the Occupational Health and Safety Act 85 of 1993 (Sect. "Challenges of implementing Occupational Health and Safety Management System in the South African Context") and align with international OHS standards such as ISO 45001. In addition to evaluating implementation and compliance, the study also explored key challenges affecting OHSMS adoption in universities. These challenges included funding limitations, leadership commitment, and institutional support. Further, the study examined the level of OHS training and awareness among university staff and students, which plays a crucial role in fostering a strong safety culture within higher education institutions. While these aspects are not the central focus of the study, they provide valuable insights into the barriers and facilitators of OHSMS effectiveness in universities.

Inclusion and exclusion criteria

The study applied specific inclusion and exclusion criteria to ensure the relevance and quality of the selected literature. Studies were included if they focused on the implementation, efficiency, or challenges of Occupational Health and Safety Management Systems (OHSMS) in higher education institutions. Research examining OHSMS frameworks such as ISO 45001 and OHSAS 18001 or other institutional safety practices was considered, as well as studies that provided comparative insights on OHSMS efficiency and best practices in universities. Additionally, only studies published in English and available as full-text through institutional or open-access databases were included in the review. This language restriction may have excluded valuable research published in other languages, potentially limiting the global perspective of the review highlighted by numerous scholars (Madonsela et al. 2023; Madonsela 2023). Conversely, studies were excluded if they primarily focused on OHSMS in industries, hospitals, or corporate workplaces or did not explicitly address higher education institutions. Opinion pieces, editorials, and commentary articles lacking empirical research were also excluded. Furthermore, duplicate publications and secondary analyses of previously included studies were omitted to maintain the integrity and originality of the reviewed literature.

Background on the importance of occupational health and safety management system

Throughout history, civilizations have recognized the paramount importance of safeguarding the well-being of workers, prompting the enactment of laws and regulations to address concerns surrounding occupational health and safety (ILO 2016). According to Kunodzia et al. (2024) the International Labour Organisation (ILO) estimates that more than 2.78 million people die annually because of occupational accidents or work-related ailments. In 2017 alone, over 2.78 million fatalities and 374 million non-fatal injuries were attributed to workplace incidents worldwide, with a noticeable rise in non-fatal workplace injuries since 2010 (Debela et al. 2021). In the United States, a reported 2.7 million workplace injuries and illnesses in 2020 cost an estimated \$164 billion (Viswanathan et al. 2024). African countries like Ethiopia, Kenya, Nigeria, Congo, and Rwanda are grappling with significant challenges related to occupational injuries, with prevalence rates ranging from 9.7% to 97.5% in various regions (Debela et al. 2021). South Africa also faces a substantial burden, with approximately 198,000 workplace injuries and 22,000 cases of occupational diseases reported annually, totalling 220,000 occupational incidents yearly (SHA Risk Specialists 2024). This high frequency of occupational incidents underscores the prevalence of workplace injuries and diseases in South Africa, posing risks not only to employees' health and safety but also imposing significant financial strains on organizations and the broader economy. In South Africa, the Compensation Fund plays a vital role in providing compensation for disabilities resulting from occupational injuries or illnesses in the country (Parliament of South Africa 2023). Established under the Compensation for Occupational Injuries and Diseases Act of 1993, the fund ensures that employees receive the necessary support in case of work-related disabilities or fatalities (Parliament of South Africa 2023). The Compensation Fund's dedication is evident in its annual reports, where numerous employers from various sectors submit Return of Earnings (ROEs) to the Compensation Fund, demonstrating active participation in providing assistance to injured workers (DEL Annual Report 2023). The fund's disbursement of over R 4 billion in benefits for occupational injuries and diseases further signifies its commitment to aiding affected individuals and their dependents through various support initiatives (Parliament of South Africa 2023). However, despite these efforts, the ongoing underreporting of occupational incidents remains a hurdle, underscoring the need for enhanced awareness, reporting mechanisms, and preventative measures to

ensure the safety and well-being of workers across all sectors in South Africa. While previous endeavours have been made to enhance Occupational Health and Safety (OHS), there has been no significant improvement in overall performance as high-level injuries, risks, and fatalities persist (Kunodzia et al. 2024). Previous studies have indicated that implementing an OHSMS leads to a reduction in on-site accidents, although challenges during its implementation are prevalent (Kunodzia et al. 2024). The OHSMS is designed to manage Occupational Health and Safety (OHS) by ensuring that workplaces are free from hazards and risks such as chemical exposure, falls, electrocution, ergonomic issues, machinery-related injuries, and other occupational hazards that can compromise employee well-being (Rahmi and Ramdhan 2021). The evolution of OHSMS can be traced back to quality management methodologies, as noted by Karanikas (2021). The introduction of International Organization for Standardization (ISO) 9001 and ISO 14001 standards in the early 1990s prompted discussions on the necessity of an ISO standard for OHSMS (ILO 2011).

Various OHSMS are available for implementation in organizations (Ligade and Thalange 2013). These systems encompass resources such as the HSE Guidance Booklet HS(G)65 "Successful Health and Safety Management," the British Standard BS OHSAS 18001:2007 "Occupational Health and Safety Management Systems-Requirements," and the International Labour Office ILO-OSH-2001 "Guidelines on Occupational Safety and Health Management Systems" (Ligade and Thalange 2013). ISO 45001 as a sister standard of ISO 9001 and ISO 14001 was established in February 2018 replacing OHSAS 18001 (Joo 2024). As of 2021, more than 370,000 workplaces were certified as ISO 45001 (Joo 2024). The framework below (Table 1) highlights key milestones, developments, and trends in occupational health and safety management. Various standards and guidelines have been developed to date for OHSMS, including OHSAS 18001, ILO-OSH-2001 and ISO 45001 (Lee et al. 2020).

These OHSMS frameworks highlighted on Table 1 are designed to facilitate effective management of health and safety in the workplace, all centred around the "plan-do-check-act" (PDCA) management model, known for its systematic approach to driving continuous improvement (Ligade and Thalange 2013). The PDCA Cycle stands out as a key tool for promoting ongoing enhancement within organizations (Méndez et al. 2021).

Occupational health and safety assessment series 18,001

Jones (2017) cited in Karanikas' study (2021) mentions that in 1991, the British Standards Institution (BSI) introduced Occupational Health and Safety Assessment

Series (OHSAS) 18001:2007 as a foundational international standard. OHSAS 18001:2007 was developed to align with ISO 14001 for Environmental Management and International Organisation for Standardization 9001 (ISO 9001) for Quality Management, making it relatively easy for organizations to implement. It quickly became the global benchmark for OHSMS (Karanikas 2021). The main goal of this framework is to facilitate continuous improvement through the Plan–Do–Check–Action (PDCA) cycle, enabling comprehensive enhancements in enterprise health and safety management (Wang et al. 2020). Since its inception, OHSAS 18001:2007 has been widely adopted in many developed countries. By 2009, 56,250 facilities in 116 countries had obtained OHSAS 18001:2007 certification (Wang et al. 2020). Major corporations such as Apple, Boeing, HP, and Coca-Cola have achieved OHSAS 18001:2007 management system certification and require the same from their suppliers (Wang et al. 2020). According to Singh (2024) OHSAS 18001 was a voluntary standard until September 2021 and later transitioned to ISO 45001.

International labour organization—guidelines on occupational safety and health management systems

The International Labour Organization (ILO) is a specialized agency of the United Nations (UN) established in 1919 with the primary aim of setting standards and policies to promote decent work globally (ILO 2016). Since its establishment, the ILO has adopted 189 conventions and 204 recommendations to improve working conditions and environments, with a specific focus on advancing Occupational Health and Safety (OSH) principles to reduce workplace accidents and illnesses (ILO 2016). Additionally, it aims to provide better protection for workers against hazards in challenging work environments. The ILO has developed guidelines for occupational safety and health management systems, such as the ILO-OSH 2001, with the objective of safeguarding workers, improving their well-being, and achieving higher levels of health and safety in the workplace through clearly defined responsibilities for all stakeholders (ILO 2016). The voluntary adoption of ILO-OSH 2001 guidelines includes key elements like policy formulation, organizational structure, planning and implementation, performance measurement, audit, and review. These elements help organizations create safer and healthier work environments by effectively managing occupational health and safety risks (ILO 2011). By embracing these guidelines, organizations not only fulfil their ethical responsibilities but also enhance the well-being and productivity of their workforce (ILO 2011).

Table 1 Guidelines and standards for OHSMS

Standard	Mandatory/Voluntary Adoption	Key elements/Requirements for achieving compliance	The benefit of adopting the standard or guideline	Reference
OHSAS 18001 —Occupational Health and Safety Assessment Series	Voluntary standard	Policy, Planning, Implementation and Operational Controls, Checking and Corrective Measures, Management Review	The primary goal of this standard is to reduce Occupational Health and Safety risks and ensure the safeguarding of human resources. The OHSAS 18001 standard's criteria are structured around the Plan, Do, Check, Act (PDCA) cycle, enhancing its compatibility with various other international standards. Some of the benefits highlighted by Singh (2024) include: • Improve image of the institution and credibility • Improve cost control • Use evidence-based decision-making Create a culture of continual improvement	Hammer (2019) Ghahramani (2017) Singh (2024)
ISO-OSH 2001 —Guidelines on occupational safety and health management systems	Voluntary guidelines	Policy, Organizing, Planning and Implementation, Measuring Performance Audit, Management Review	It is designed for use at both organizational and national levels on a voluntary basis. At the organizational level, the guidance advocates for integrating components of OHSMS into the organization's overall policy and management structure. Similarly, at the national level, it promotes the creation of a national framework for OSHSM that is backed by national laws and regulations. The model consists of five key elements: OSH policy, planning, implementation, measurement and evaluation, and management review	International Labour Organization (2011) Simukonda et al. (2020)

Table 1 (continued)

Standard	Mandatory/Voluntary Adoption	Key elements/Requirements for achieving compliance	The benefit of adopting the standard or guideline	Reference
ISO 45001 - International Organization for Standardization (ISO) standard for management systems of occupational health and safety (OHS)	Voluntary Standard	Context of the organization, Leadership, Planning, Support, Operation, Performance Evaluation, Improvement	The primary purpose of the ISO 45001 standard is to act as a valuable tool for proactively enhancing Occupational Safety and Health (OSH) performance, regardless of the organization's size, type, or nature. ISO 45001 was developed to assist organizations in improving their OSH performance by integrating OSH into their business management systems and processes. Additionally, ISO 45001 highlights the importance of top management's leadership and involvement in OSH management, encourages workers' participation in safety management, and mandates that the needs of various stakeholders, including workers, be considered in the organization's operations. Similar to other related ISO management standards, ISO 45001 follows the Plan-Do-Check-Act approach (focusing on procedural conformity rather than substantial changes) and does not include specific performance requirements. Some of the benefits include: • Improve your image and credibility • Improve cost control • Use evidence-based decision-making • Create a culture of continual improvement • Engage people	Organization for Standardization (ISO) (2023) Joo and Baek (2024)

International organization for standardization 45,001

ISO 45001 is a voluntary international standard developed by the International Organization for Standardization (ISO) that emphasizes the organizational context in managing occupational health and safety (ISO 2023). Unlike its predecessor, OHSAS 18001, which primarily focused on hazard identification and risk assessment, ISO 45001 adopts a broader, more strategic approach by embedding occupational health and safety within the organization's overall business processes (Yang and Maresova 2020). It requires organizations to consider both internal and external factors influencing workplace safety and underscores the critical role of top management in leading OHSMS implementation (Yang and Maresova 2020). The adoption of ISO 45001 can significantly enhance an organization's reputation, credibility, and regulatory compliance. The standard promotes a proactive, risk-based approach that fosters employee engagement, accountability, and the integration of stakeholder needs into decision-making processes (ISO 2023; Joo and Baek 2024). Leadership involvement and active worker participation are central to its framework, contributing to the development of a robust safety culture and more resilient operations (Joo and Baek 2024). ISO 45001, like other ISO management system standards, is structured around the Plan-Do-Check-Act (PDCA) methodology. It emphasizes procedural conformance over specific performance outcomes, guiding organizations through continuous improvement cycles without imposing fixed benchmarks (Joo and Baek 2024). Table 1 outlines key developments and milestones in the evolution of OHSMS, including OHSAS 18001, ILO-OSH 2001, and ISO 45001 (Lee et al. 2020).

In the South African context, certification in OHSMS remains voluntary. Fourteen certification bodies are accredited by the South African National Accreditation System (SANAS) to certify organizations against standards such as ISO 45001 and OHSAS 18001 (DEL 2019). While the Department of Employment and Labour (DEL) mandates OHSAS 18001 implementation for the iron and steel sector, other industries and institutions, including universities, may choose to adopt these systems at their discretion. The South African Bureau of Standards (SABS) oversees the adoption of ISO 45001 as the national standard, registered as SANS/ISO 45001 (DEL 2019). Organizations seeking accreditation as Conformity Assessment Bodies (CABs) are evaluated by SANAS for competence, with certificates issued upon successful assessment (DEL 2019). Organizations previously certified under OHSAS 18001 were required to transition to SANS/ISO 45001 by September 2021 (DEL 2019). This shift reflects a global trend toward harmonizing occupational health and safety practices through ISO 45001 as a unified, internationally recognized framework. Although

certification is not legally required in many countries, adopting ISO 45001 allows organizations to demonstrate a proactive commitment to workplace safety, regulatory alignment, and continuous improvement.

The state of health and safety in the university setting

The South African higher education system comprises twenty-six (26) public universities, categorized into traditional universities (eleven), comprehensive universities (nine), and universities of technology (six) (DHET 2023). Governance of both the public and private sectors falls under the Higher Education Act (101 of 1997). The latest South African statistics indicate that about 57,507 academic employees are involved in teaching and research (ChaaCha and Oosthuysen 2023). In 2019, the combined enrolment at 26 public universities and 131 private institutions amounted to 1,283,890 students, highlighting a disparity between the number of enrolled students and academic staff (ChaaCha and Oosthuysen 2023).

Despite their primary role in delivering education, universities are recognized as industries that present health and safety risks to staff and students due to their design and structure (Ngcece 2018). As highlighted by Subhani (2010), universities can present various health and safety risks, encompassing hazards in the physical environment (e.g., slippery floors, poorly lit stairwells), exposure to hazardous materials (e.g., chemicals in laboratories), and mental health challenges (e.g., stress, burnout). Ahmad and Iqbal (2022) further asserts that High Education Institutions (HEIs) encounter Occupational Health and Safety (OHS) challenges, ranging from traditional infrastructural and environmental hazards such as ventilation and electrical risks to hazards posed by laboratory chemicals and animal facilities on campus. Addressing these challenges necessitates the implementation of robust OHS practices and adherence to safety regulations to ensure a safe and healthy learning and working environment within HEIs (Ahmad and Iqbal 2022). A study by Farrukh et al. (2019) revealed that in many Pakistani universities, OHS practices fall below acceptable standards (Ahmad and Iqbal 2022). Recent incidents have drawn the attention of concerned authorities, policymakers, and the government, prompting Higher Education Institutions (HEIs) to implement OHS practices in their workplaces (Ahmad and Iqbal 2022). Consequently, HEIs in Pakistan are under pressure from regulatory bodies, national and international organizations, and other stakeholders to enhance their physical environment in terms of OHS practices to achieve recognition as sustainable organizations (Ahmad and Iqbal 2022). In light of these circumstances, HEIs face pressing questions: How can they effectively adopt OHS practices?

What internal and external factors contribute to successful OHS adoption? And what are the outcomes of successful OHS adoption that led to sustainable HEIs? Unfortunately, existing research has not provided satisfactory answers to these questions (Ahmad and Iqbal 2022). In a study conducted in South Africa, Rodriguez et al. (2013) acknowledges safety risks as a significant concern within South African Tertiary Education Institutions (TEIs). Despite this acknowledgment, the study emphasizes the importance of unintentional injuries, which include accidents and incidents related to traffic, as crucial safety risks that could potentially lead to fatalities within the university setting. Rodriguez et al. (2013) refers to a specific investigation carried out by Van Rensburg et al. (2002), which focused on unintended traffic-related injuries involving students at the University of South Africa (UNISA)'s Muckleneuk campus. The study revealed a notable proportion of participants encountering challenges while crossing roads surrounding the campus. Additionally, Rodriguez et al. (2013) highlights a study by Bozsik (2010) that identified fires and incidents of electrocution as significant risk factors in educational environments. The study notes the occurrence of 93 fires reported in South African educational institutions during 2009, with approximately 8% of these fires attributed to electrical causes. The malfunction of electrical equipment, including extension cords and appliances, emerged as principal factors contributing to these occurrences. Rodriguez concluded that although there is limited existing research on campus safety in South Africa, the reviewed research indicates that campus safety is a valid and important concern that needs to be explored. On the other hand, Subhani (2010) brings attention to the widespread occurrence of accidents within laboratory settings, emphasizing that particular events within these laboratories bear significant importance, possibly leading to injuries or, in specific cases, even fatalities among both students and instructors. To mitigate these risks, appropriate controls must be put in place to prevent further occurrences of such events (Labour Guide 2023). In other words, an incident investigation must be performed to find out what happened, why it happened, and identify ways to prevent it from happening again. This forward-thinking methodology aligns with the provisions of the Occupational Health and Safety (OHS) Act (85 of 1993) (Labour Guide 2023).

The OHS Act 85 of 1993 as amended, is the main Act that governs Occupational Health and Safety (OHS) in practically all sectors in South Africa other than the mines (DEL 2019). OHS Act 85 of 1993 requires an employer to maintain as far as it is reasonably practicable, a workplace that is safe and without risk to the health of employees (Labour Guide 2023). Sect. "Discussion and implications" of the OHSA stipulates the general duties of employers to their employees (DEL 2019). Sect. "Discussion and implications" (1) clearly stipulates that the employer is obligated to

provide and maintain a workplace that is safe and without risk to the health of their employees (Labour Guide 2023). Section 16 of the same act deals with the proper delegation of health and safety duties. The legislator starts with the person "who is responsible for the overall management and control" of the business or body corporate, the Chief Executive Officer or Managing Director (Labour Guide 2023). This appointment is referred to as the Sect. 16(1) appointee. The Chief Executive Officer or Managing Director of the organization is the person that is responsible for assigning health and safety duties to the rest of management under his or her control (Labour Guide 2023).

As per May et al. (2019), leadership holds significant importance in accident prevention. Clarke and Taylor (2018) further suggests that the decision-making and resource allocation by leaders contribute to shaping the organizational safety culture, establishing an environment that mirrors the organization's commitment to safety. As accident prevention is known as an umbrella term that encompasses all steps taken by an entity to reduce the risk of accidents, to save lives, and to mitigate the risks of injury or to lessen its severity thus maximizing safety (Clarke and Taylor 2018). The objective of May et al. (2019) study was to assess leadership in occupational safety through a case study approach. The study employed the seven steps of leadership and worker involvement training methodology and gathered data through diagnostics, training sessions, structured interviews, accident monitoring, and statistical analysis. The findings revealed that assertive leadership behaviour has a positive impact on occupational safety management. This type of leadership resulted in a significant reduction of over 50% in accidents that has previously resulted in injuries (May et al. 2019). Based on these results, the study concludes that there is a correlation between safety leadership behaviour and a decrease in the occurrence of accidents. Effective safety leadership, characterized by assertiveness and proactive measures, is crucial for enhancing occupational safety and reducing the likelihood of workplace accidents (May et al. 2019).

In the context of the institution of Higher Learning in South Africa, Vice-Chancellors and Rectors are the Chief Executive Officers (CEO) of institutions, therefore the overall accountability and responsibility for ensuring a safe working environment lies with them as stipulated in section of the OHSA 85 of 1993. This aligns with information from the University of Cape Town's Human Resources webpage, which emphasizes that the Occupational Health and Safety Act imposes specific and precise obligations on the University's Vice-Chancellor. The Vice-Chancellor is entrusted with the task of ensuring full compliance with the Act's provisions (UCT, Human Resources 2023). Therefore, effective leadership, particularly entrusted to Vice-Chancellors, is crucial for ensuring workplace safety

and health, as emphasized by May et al. (2019). These leaders must prioritize the well-being of employees and stakeholders not only to meet legal obligations but also as a moral duty and for the institution's success. Additionally, Vice-Chancellors are empowered by the Act to delegate duties while retaining responsibility and liability (May et al. 2019). Consequently, leadership safety behaviours, including safety management commitment, play a vital role in organizational safety programs, as noted by Zhang et al. (2022). On the other hand, Ghahramani (2017), states that a successful health and safety compliance system is founded on the principle that hazards in the workplace must be identified, reported, and addressed consistently. This aligns with Sect. "Discussion and implications"(2)(d) of the Occupational Health and Safety Act (OHS Act 85 of 1993), which mandates employers to identify potential hazards and implement precautionary measures to protect workers' health and safety, as well as Sect. 14(d), which requires employees to report any unsafe or unhealthy situations to their employers. Consequently, employers and employees share the responsibility of promoting health and safety in the workplace, and both must be proactive in identifying hazards and implementing control measures to reduce the risk of exposure. The existence of a health and safety system is necessary to facilitate this effort (Ghahramani 2017).

It is worth noting that legislation on occupational health and safety in South Africa is enforceable, however, there are voluntary technical standards that are reliable references, whilst not legally enforceable, industries recognize, and adopt to be part of their Occupational Health and Safety Management System (DEL 2019). It is important to highlight that OHS Act 85 of 1993 does not provide specifications for managing health and safety at work, however, it does provide clear guidelines on health and safety responsibilities and accountability for the management of health and safety in a workplace (Labour Guide 2023). This means that the implementation of an OHSMS is at the discretion of an employer. In essence, employers are not required by law to implement a health and safety management system instead, it is a system that organizations may utilize to regulate and manage health and safety in the workplace. As per ILO-OSH (2001) guidelines, OHSMS do not carry legal obligations and are not designed to replace national laws, regulations, or accepted standards. In the context of South Africa, DEL (2019) confirms that OHSMS certification is of a voluntary nature. DEL (2019) goes on to indicate that there exist 14 certification bodies accredited by the South African National Accreditation System (SANAS) for overseeing OHSMS, encompassing standards like OHSAS 18001 and ISO 45001 amongst others. Furthermore, DEL (2019) highlights that while some companies within certain sectors such as iron and steel are

obligated to implement OHSAS 18001, the adoption of OHSMS is generally left to the discretion of organizations.

The efficiency of implementing occupational health and safety management systems at higher education institutions

In the assessment of OHSMS effectiveness in universities, it is evident that these institutions, despite their core function of education delivery, pose significant health and safety risks to both staff and students due to their structural design (Ngcece 2018). These risks encompass various hazards such as slippery floors, poorly lit stairwells, exposure to hazardous materials in laboratories, and mental health challenges like stress and burnout (Subhani 2010). Ahmad and Iqbal (2022) highlights that Higher Education Institutions (HEIs) face a range of infrastructure and environmental risks, including those associated with laboratory chemicals and animal facilities. To address these risks, robust OHS practices and adherence to safety regulations are crucial to fostering a safe and healthy environment. However, Farukh et al. (2019) in the study of Ahmad and Iqbal (2022) reveals subpar OHS practices in many Pakistani universities, prompting calls from regulatory bodies and stakeholders for improvements in OHS protocols within HEIs. Similarly, in South Africa, safety concerns are significant, with studies identifying issues such as unintentional injuries, traffic accidents, fires, and electrocutions in educational settings (Rodriguez et al. 2013).

According to Subhani (2010), many universities are striving to improve the health and safety of their employees and students by developing OHS-based activities such as having a procedure for the prevention of ill-health or injuries or conducting OHS awareness programs. However, simply having these activities is insufficient without a system to ensure their performance and effectiveness. Current OHS efforts at universities are capable of meeting many requirements outlined in various OHSMS standards and guidelines. The potential for implementing an OHSMS in universities is promising, requiring only commitment and some effort to develop standardized OHSMS for a better working environment (Subhani 2010). OHSMS have garnered global recognition for their remarkable adaptability, offering tailored solutions to businesses of diverse sizes and types in effectively managing workplace safety concerns (Musungwa and Kowe 2022). Concurrently, certain companies strategically implement OHSMS to mitigate lost workdays, reduce workplace accidents, and cut costs associated with occupational illnesses (Wang et al. 2020). Delving deeper into the realm of OHSMS, Sullivan (2023) advocates for the skilful integration of OHSMS within an overarching framework to enhance a company's capacity

to proactively address workplace hazards and minimize expenses related to occupational injuries, illnesses, and fatalities.

To gauge the efficiency of OHSMS implementation, Rahmi and Ramdhan (2021) undertook a comprehensive study aimed at identifying the critical factors contributing to the successful integration of OHSMS. Through an extensive literature review spanning a decade, Rahmi and Ramdhan (2021) unearthed a complex interplay of internal and external factors that significantly influence the effectiveness of OHSMS. These factors encompass a broad spectrum, including management commitment, leadership quality, employee engagement levels, prevailing safety culture, resource availability, financial performance metrics, company size dynamics, incentive structures, communication strategies, procedural frameworks, and risk control strategies, all of which play pivotal roles in shaping the efficacy of OHSMS within organizational settings. Kunodzia et al. (2024) delves deeper into the complex network of internal and external factors influencing the adoption of Occupational Health and Safety Management Systems (OHSMSs), particularly within the construction sector. Internally, Kunodzia et al. (2024) highlights the importance of factors such as management commitment, OHS policies, cost allocation, company size, training, employee involvement, culture, communication, regulations, procedures, system integration, and uncertainties in reporting systems in shaping OHSMS implementation. Externally, Kunodzia et al. (2024) points out that factors like the enforcement of OHS regulations, support from authorities, auditing practices, and external incentives also play critical roles in influencing OHSMS implementation. Mappangile and Ramdhan (2022) conducted a study on factors associated with the effectiveness of occupational health and safety program performance, revealing diverse factors categorized into personal, work environment, technical, and organizational groups (Mappangile and Ramdhan 2022). These factors collectively have a significant impact on the efficiency of occupational safety and health programs, with addressing them enabling organizations to enhance safety performance and cultivate healthier work environments (Mappangile and Ramdhan 2022). In a study by Karakavuz and Gereide (2017) focusing on factors contributing to the success of OHSMSs in ground-handling firms in Turkey, various factors were identified, including a positive safety culture, senior management support, stakeholder attitudes and traits, OHSMS practices, and the role of OHS professionals (Karakavuz and Gereide 2017). The research underscored the pivotal roles of senior management commitment, organizational dedication to safety, support from senior management in human resource allocation for OHSMS implementation, pressures from stakeholders, and the quality and quantity of OHS

training as critical success determinants (Karakavuz and Gereide 2017). These studies collectively highlight several common factors crucial for the effectiveness of OHSMS implementation, such as management commitment, robust OHS policies and procedures, active employee involvement and engagement, fostering a strong safety culture, regulatory compliance, providing adequate training, resource allocation, effective communication channels, continuous improvement initiatives, and external support and stakeholder involvement. Addressing these factors comprehensively underscores the multifaceted nature of OHSMS implementation, emphasizing the need for a comprehensive approach to effectively address various aspects and ultimately contribute to improved occupational safety and health outcomes. Kineber et al. (2023) indicates that numerous obstacles hinder the adoption of OHSMSs, with a significant challenge being the lack of awareness about systems like OHSMSs, serving as a crucial barrier to their implementation due to insufficient economic and informational resources within companies (Kineber et al. 2023). Liu et al. (2023) research on barriers hindering the effectiveness of ISO 45001 certification within Chinese-certified organizations highlights factors such as employees' lack of awareness or adverse attitudes towards occupational health and safety, absence of a safety culture, insufficient employee participation, inadequate internal motivation, lack of top management's commitment and support, deficiencies in OHS policy, financial resources within an organization, and obstacles posed by certification organizations as fundamental factors significantly influencing various aspects during the OHSMS implementation process (Liu et al. 2023). The study by Garnica and Barriga (2018), focuses on small Brazilian enterprises, aimed to identify primary obstacles in implementing OHSMS, revealing differing viewpoints among stakeholders regarding challenges encountered during implementation. While owners and managers tended to attribute obstacles to employees and governmental entities, external factors like labour auditors and OHS consultants ascribed them to management and resource allocation. However, stakeholders reached a consensus on critical barriers, including inappropriate management conduct, ineffective information and communication practices, and prioritization of production over safety, which have substantial implications for theoretical understanding and practical application. Overcoming these barriers is crucial not only for seamless OHSMS implementation but also for enhancing overall management conditions in small-scale businesses, ultimately leading to safer work environments and improved operational management (Garnica and Barriga 2018). In conclusion, OHSMSs are globally recognized for their adaptability and effectiveness in addressing workplace hazards. These systems, tailored to businesses

of all sizes, aim to reduce accidents, injuries, and health risks while enhancing overall safety protocols. Studies by Sullivan (2023) and Rahmi (2021) emphasize the crucial role of factors like management commitment, employee engagement, and regulatory compliance in optimizing OHSMS efficiency. Additionally, Kunodzia et al. (2024) highlights both internal and external factors such as training, communication, and regulatory enforcement as critical determinants of successful OHSMS implementation, particularly within the construction sector. Despite their potential benefits, barriers to OHSMS adoption persist, as evidenced by Kineber et al. (2023), Liu et al. (2023), and Garnica and Barriga (2018). These barriers include lack of awareness, insufficient resources, and organizational resistance, underscoring the need for proactive measures to overcome such challenges. By comprehensively addressing these factors and barriers, organizations can cultivate safer work environments and enhance overall occupational health and safety outcomes.

According to ILO (2011), the application of OHMS is based on relevant occupational safety and health (OSH) criteria, standards and performance. It aims at providing a method to assess and improve performance in the prevention of workplace incidents and accidents via the effective management of hazards and risks in the workplace (ILO 2011). It is a logical, stepwise method to decide what needs to be done, how best to do it, monitor progress toward the established goals, evaluate how well it is done and identify areas for improvement (ILO 2011). It is and must be capable of being adapted to changes in the business of the organisation and to legislative requirements. In this study, an in-depth examination was undertaken to evaluate the efficacy of OHSMSs within South African universities. The research methodology involved a thorough examination of the websites of all South African public universities to evaluate the content of their respective Occupational Health and Safety Policy Statements. The primary objective of this research was to examine the content of Occupational Health and Safety (OHS) Policies in line with the criteria of OHSAS 18001, with a specific focus on the OHS policy. According to Kashyap and Nandan (2015), the OHSAS 18001 clause on OHS policy requires a well-documented, communicated, and actively maintained OHS policy that is supported by top management and integrated into the overall OHSMS. This policy forms the cornerstone of an effective OHSMS, guiding the organization in complying with legal requirements, preventing injuries and illnesses, reducing hazards, and continually improving health and safety performance (Kashyap and Nandan 2015). To support this approach of conducting an in-depth examination of the OHS policies of all South African public universities, a study by Hossain et al. (2015) suggests that regulatory pressure, top management commitment, and

social factors directly and positively influence a university's intention to adopt OHS measures. Furthermore, top management commitment is reflected through formal policies, formal training, and encouragement. Stojanovic (2015) emphasizes the importance of having a documented OHS Policy as a key requirement specified in the OHSAS 18001 standard. Additionally, Stojanovic (2015) underscores that the OHS Policy delineates the fundamental principles and guidelines governing the organization's approach to occupational health and safety. As per the stipulations of OHSAS 18001, the OHS Policy statement should be initiated by top management, serving as a foundational directive for how all employees within the organization should adhere to occupational health and safety practices. This is where the company's commitments to managing and improving occupational health and safety standards are articulated (Stojanovic 2015). Furthermore, a study by Hossain et al. (2015) suggests that top management's commitment to OHS is reflected through formal policies, formal training, and encouragement. An organization with a positive management attitude toward OHS is more likely to develop OHS-related policies.

On the other hand, the South African OHS Act 85 of 1993 mandates companies to develop a health and safety policy under the guidance of chief inspectors (Machabe and Indermun 2013). Sect. "Challenges of implementing Occupational Health and Safety Management System in the South African Context" of the OHS Act underscores the importance of the SHE policy in protecting the health and safety of employees in the workplace (Machebe 2013). Furthermore, the act specifies that the CEO must approve this policy, clearly outlining the company's dedication, responsibilities, and accountability for promoting health and safety in the workplace (Machebe 2013). While the creation and implementation of an OHS Policy under Sect. "Challenges of implementing Occupational Health and Safety Management System in the South African Context" of the OHS Act 85 of 1993 may not be mandatory for all organizations, employers are still responsible for educating their workforce about potential workplace risks and hazards, as well as communicating preventive measures against these risks (Labour Guide 2023). Therefore, the adoption of a health and safety policy plays a crucial role in fulfilling this obligation, emphasizing the importance of work-related policies and procedures, as per the (Labour Guide 2023). Consequently, this study examined the content of the OHS Policy statements of the 26 South African Universities.

This study rigorously analysed the key components outlined in an OHS Policy Statement. These essential elements were derived from the guidelines outlined by Labour Guide (2023) as well as Stojanovic (2015). Both Labour Guide (2023) and Stojanovic (2015) cover

essential elements for an effective OHS policy, including legal compliance, safety commitment, management responsibility, continual improvement, and communication. However, Labour Guide (2023) provides additional details such as an organizational overview, specific health and safety principles, general responsibilities, policy issuance date, and CEO's signature, which are not explicitly covered by Stojanovic (2015). Despite these differences, the core principles advocated by both authors align closely, emphasizing a comprehensive and committed approach to occupational health and safety.

Among the 26 public universities in South Africa, 11 universities demonstrated a strong commitment to maintaining occupational health and safety standards by developing robust Occupational Health and Safety Policy Statements. The subsequent synthesis of these policy statements was carefully crafted by employing the "Plan Do Check Act" Cycle (PDCA) methodology, as recommended by Sullivan (2023). Sullivan (2023) breaks down the PDCA cycle into four key steps: Plan, Do, Check, and Act, each playing a vital role in the iterative process of enhancing OHSMS performance. This concept of the "Plan-Do-Check-Act" Deming Cycle (PDCA), designed in the 1950s to monitor business performance on a continual basis (ILO 2011). When applied to Occupational Safety and Health (OSH), "Plan" involves the setting of an OSH policy, planning including the allocation of resources, provision of skills and organisation of the system, hazard identification and risk assessment. The "Do" step refers to actual implementation and operation of the OSH programme. The "Check" step is devoted to measuring both the active and reactive performance of the programme. Finally, the "Act" step closes the cycle with a review of the system in the context of continual improvement and the priming of the system for the next cycle (ILO 2011). The PDCA cycle, is recognized as a framework for continual process improvement, steers organizations through a systematic approach of planning actions, executing them, assessing their alignment with the plan, and making corrective actions based on feedback, Sullivan (2023). Moreover, Nolan (2015) highlights the significant role of the PDCA cycle in ISO 9001, 14001, and 45001 standards, stressing its importance in the realm of OHSMS. Notably, Kunodzia et al. (2024) observes that the construction industry frequently utilizes the PDCA model to monitor and implement OHSMS continuously, providing a structured framework for improvement strategies and enabling adjustments to project plans based on evolving insights. A comprehensive summary detailing the meticulous application of the Plan-Do-Check-Act (PDCA) cycle during the development of the OHS Policy in the universities under review is presented in Table 2 for reference and detailed examination.

Analysis of PDCA tool used to measure the implementation of OHSMS in South African universities

As illustrated in Fig. 2, the PDCA framework was used as a thematic lens to assess the Occupational Health and Safety (OHS) policies of 11 South African universities. Each institution was evaluated against the four core PDCA components: Plan (hazard identification and risk assessment), Do (implementation of operational controls), Check (monitoring and evaluation), and Act (continuous improvement initiatives). The goal was to determine the extent to which universities are aligning their Occupational Health and Safety policies with a structured, cyclical management approach to occupational health and safety. The analysis revealed that 64% of the universities demonstrated fully integrated all four PDCA components in their OHS policy statements. The universities such as Central University of Technology (CUT), Cape Peninsula University of Technology (CPUT), Vaal University of Technology (VUT), University of Cape Town (UCT), Nelson Mandela University (NMU), North-West University (NWU), and Sol Plaatje University (SPU) achieved a 100% PDCA compliance rate, reflecting comprehensive alignment with the PDCA model. In contrast, 36% of the universities, namely Rhodes University (RU), University of Pretoria (UP), University of the Free State (UFS), and Fort Hare University (FHU) achieved a 75% compliance rate, indicating partial implementation. These institutions consistently lacked the "Check" component, with no evident monitoring or evaluation mechanisms articulated in their policy documents. This omission is significant, as the "Check" phase is critical for verifying the effectiveness of health and safety measures and guiding necessary corrective actions. On an individual component level, 100% of the universities addressed the Plan, Do, and Act phases, highlighting a strong sector-wide commitment to identifying risks, enforcing safety protocols, and promoting continuous improvement. However, only 73% incorporated the Check phase, making it the most underrepresented element across the sample.

These findings align with the global evidence presented in the 13 reviewed studies. For instance, studies in Iraq (AlShaheen 2021) and Turkey (Balci, 2024) reported significant gaps (up to 85%) between current OHS practices and ISO 45001 standards, particularly in the monitoring and feedback mechanisms. Similarly, Khon Kaen University in Thailand (Chaiear et al. 2019), despite having an established OHS structure, still faced recurring safety issues due to lapses in continuous monitoring and hazard control. Conversely, countries such as Indonesia and Thailand have demonstrated structured and phased implementation strategies aligned with PDCA principles. At the University of Muhammadiyah Jakarta, Fitrijaningsih et al. (2023) reported the successful deployment of OSHMS using a structured strategy comprising exploration, installation, initial implementation, and

Table 2 Application of the PDCA Cycle in Developing University Occupational Health and Safety Policies

South African Universities	Policy Overview	Key Elements (Deming Cycle)			Reference(s)
		Plan (Hazard Identification and Risk Assessment)	Do (Operational Controls)	Check (Monitoring and Evaluation)	
Central University of Technology (CUT)	The university's Safety, Health and Environment (SHE) Statement emphasize its proactive role in safeguarding the well-being of the university community through hazard identification, risk assessment, the implementation of safety measures, compliance with regulations, and a commitment to environmental sustainability	The SHE Unit identifies and assesses health, safety, and environmental hazards/risks	The unit provides clear instructions to employees and students regarding safe working procedures	The unit continuously provides competent advice and support to all stakeholders on the implementation of OHSMS	The SHE Unit's focus on striving towards environmental sustainability and its dedication to achieving the university's vision of 2030 Central University of Technology (2023)
Cape Peninsula University of Technology (CPUT)	The university's Safety, Health, and Environment (SHE) Statement emphasizes the university's commitment to safety, health, and the environment, outlining the roles and responsibilities of the SHE Unit and the steps taken to ensure compliance, leadership, and a culture of safety and well-being	The statement mentions the commitment to provide a work and learning environment that is safe and without risk to health, as prescribed in the Occupational Health and Safety Act 85 of 1993 and its Regulations. This aligns with the "Plan" step's focus on understanding risks and ensuring a safe environment	The unit's responsibilities also include providing guidance in conducting Hazard Identification and Risk Assessment (HIRA): This reflects the implementation of control measures through risk assessment	The unit is charged with ensuring that all incidents and accidents are reported, recorded, and investigated: This aligns with the "Check" step's focus on monitoring, reporting, and evaluating	Developing, Implementing, and Maintaining SHE Procedures suggests an ongoing commitment to refining processes and ensuring an effective SHE Management System, in line with the "Act" step's emphasis on improvement Cape Peninsula University of Technology (2023)

Table 2 (continued)

South African Universities	Policy Overview	Key Elements (Deming Cycle)			Reference(s)	
		Plan (Hazard Identification and Risk Assessment)	Do (Operational Controls)	Check (Monitoring and Evaluation)		Act (Continual Improvement)
Vaal University of Technology (VUT)	The university's Safety, Health, and Environment (SHE) policy underscores its commitment to complying with legal regulations, proactively managing risks, promoting safety standards, involving staff in safety initiatives, and ensuring a safe and healthy working and learning environments for all	Mention of conducting hazard identification and risk assessment indicates the intention to implement processes to identify and assess risks	The commitment to ensuring that VUT staff serve as appropriate role models for students and promote health, safety, and environmental standards; This suggests the implementation of control measures by involving staff as role models and promoting safety standards	The statement indicates a commitment to monitor the effectiveness of health, safety, and environmental provisions in consultation with management and health and safety representatives; This aligns with the "Check" step's focus on monitoring and evaluating	The intention to encourage worker participation in the management of health, safety, and performance of business indicates a proactive approach to continuous improvement	Vaal University of Technology (2021)
Rhodes University (RU)	The policy emphasizes the University's commitment to creating a safe and healthy working environment for all members of its community. It recognizes the importance of individual and collective responsibility, sets expectations for managers and heads of departments, and underscores the university's intention to comply with relevant regulations to ensure the well-being of all stakeholders	The commitment to ensuring the health, safety, and welfare of all staff, students, mandatories (agents, contractors or subcontractors), and visitors indicates the intention to understand risks associated with the working environment. This aligns with the "Plan" step's focus on identifying potential hazards and risks	The commitment to comply with the regulations and conditions set out in the Occupational Health and Safety Act 85 of 1993 (OHS Act) indicates an intention to implement legal requirements and control measures	While the statement does not explicitly mention monitoring or evaluation, the emphasis on compliance with regulations suggests the importance of checking adherence to legal requirements	The statement's goal of ensuring the health, safety, and welfare of all members of the University community suggests a continuous improvement approach by prioritizing ongoing well-being	Rhodes University (2023)

Table 2 (continued)

South African Universities	Policy Overview	Key Elements (Deming Cycle)			Reference(s)
		Plan (Hazard Identification and Risk Assessment)	Do (Operational Controls)	Check (Monitoring and Evaluation)	
University of Pretoria (UP)	The university's Occupational Health and Safety (OHS) policy prioritizes the protection of its stakeholders and property through the implementation of practical health and safety standards, education, shared responsibility, awareness promotion, risk elimination, and adherence to statutory requirements. The policy's multi-faceted approach aims to create a secure and conducive environment for work and learning	The commitment to design and implement practicable health and safety standards reflects the intention to address risks and hazards through control measures	The mention of instruction in health and safety as part of training, academic programs, and induction of visitors and contractors: This demonstrates the implementation of control measures through education and training	The statement's emphasis on promoting awareness programs for employees and students' interest and involvement in health and safety suggests a focus on monitoring and evaluating safety culture and awareness	The commitment to eliminating actions and work procedures that are unhealthy and unsafe reflects a continuous improvement approach, focusing on eliminating potential hazards and risks
University of Free State (UFS)	The university's Occupational Health and Safety (OHS) policy centres on preventing accidents, promoting risk-free tasks, emphasizing management responsibility, fostering shared responsibility, and creating a safe work environment. The policy encompasses various commitments to train employees, eliminate unsafe conditions, promote contractor compliance, and ensure the health and safety of all stakeholders	The statement's assertion that all accidents and unhealthy work environment can be prevented aligns with the "Plan" step's focus on identifying and understanding risks to prevent incidents	The commitment to eliminate unhealthy and unsafe acts and conditions indicates a focus on implementing control measures to address hazards	While the statement does not explicitly mention monitoring or evaluation, the emphasis on creating and maintaining a healthy and safe place to work suggests the importance of regularly checking the workplace environment	The commitment to protect the occupational health and safety of employees and those affected by business activities reflects a continuous improvement perspective by emphasizing ongoing protection

Table 2 (continued)

South African Universities	Policy Overview	Key Elements (Deming Cycle)			Reference(s)
		Plan (Hazard Identification and Risk Assessment)	Do (Operational Controls)	Check (Monitoring and Evaluation)	
University of Cape Town (UCT)	The university's Occupational Health and Safety (OHS) policy prioritizes safety, health, and welfare through compliance with regulations, collaboration, responsibilities for both management and employees/students, setting objectives, exceeding legal requirements, and ensuring sufficient resources are allocated for compliance and continual improvement	The statement emphasizes the commitment to removing or reducing risks to the health, safety, and welfare of various stakeholders. This aligns with the "Plan" step's focus on identifying and understanding risks	The responsibilities assigned to Management to provide a safe working environment, safe systems, maintained plant and substances, and information/training for safety indicate the implementation of control measures	The mention of commitment to consult and collaborate with employees, students, and contractors suggests a focus on monitoring and evaluating practices and involving stakeholders in the "Check" step	The policy's objective to achieve high occupational health, safety, and welfare standards and a continual improvement of occupational health and safety performances reflects a commitment to continuous improvement
Nelson Mandela University (NMU)	The university's Occupational Health and Safety (OHS) policy is focused on creating a safe and healthy working environment through resource allocation, compliance with regulations, effective management systems, education, and adherence to high health, safety, and welfare standards	The commitment to ensure a working environment that is safe and without risk to health aligns with the "Plan" step's focus on identifying and understanding risks	The commitment to provide safe working conditions, systems of work, workshops, machinery, information, training, and appropriate equipment demonstrates the intention to implement control measures throughout the organization	The policy's intention to maintain high standards of health, safety, and welfare in all activities suggests the importance of monitoring and evaluating these standards	The commitment to annually review this policy statement and the systems in place to ensure their effectiveness reflects a continual improvement approach by focusing on evaluating and enhancing the systems

Table 2 (continued)

South African Universities	Policy Overview	Key Elements (Deming Cycle)				Reference(s)
		Plan (Hazard Identification and Risk Assessment)	Do (Operational Controls)	Check (Monitoring and Evaluation)	Act (Continual Improvement)	
North-West University (NWU)	The university's Occupational Health and Safety (OHS) policy underscores its commitment to providing a safe, healthy, and secure environment for all individuals within its community, and to continuously improve its OHS performance while complying with relevant regulations and standards	The commitment to provide and maintain a working environment that is safe and without risk to the health of employees and others reflects the intention to plan for control measures	The commitment to educate staff on OHS risk management and occupational health and safety principles demonstrates the intention to implement control measures through education and training	The policy's intention to measure occupational health and safety performance and ensure quality control suggests a focus on monitoring and evaluating safety practices and performance	The commitment to ensure a consistent approach to the management of OHS issues across the university reflects a continuous improvement approach by focusing on uniformity and standardization	North-West University (2019)
Sol Plaatje University (SPU)	The university's Occupational Health and Safety (OHS) policy reflects a comprehensive approach to health, safety, and environmental management, aiming to create a secure and sustainable environment for all stakeholders	The commitment to provide and maintain a healthy, safe, and risk-free working and learning environment aligns with the "Plan" step's focus on identifying and understanding risks	The policy's emphasis on conducting risk assessments and Occupational Health, Safety and Environment audits/inspections indicates a proactive approach to implementing control measures through assessment and review	The policy's commitment to maintaining the OHS&E Management System performance under continuous management review and implementing improvements reflects a focus on monitoring, evaluating, and continuous improvement	The policy's goal to maintain a condition that is safe and without risks to health and safety, and to provide and maintain means of access and egress reflects a continuous improvement approach by focusing on maintaining and improving safety conditions	Sol Plaatje University (2020)

Table 2 (continued)

South African Universities	Policy Overview	Key Elements (Deming Cycle)			Reference(s)
		Plan (Hazard Identification and Risk Assessment)	Do (Operational Controls)	Check (Monitoring and Evaluation)	
Fort Hare University (FHU)	The university's Occupational Health and Safety (OHS) policy emphasizes collaboration, shared responsibility, commitment to safety, and compliance with relevant regulations to create a secure environment for employees, students, and visitors	The statement's emphasis on bringing about and maintaining a safe work environment aligns with the "Plan" step's focus on identifying and understanding risks	The commitment to provide other protective measures for a safe workplace reflects the intention to implement control measures	The statement does not explicitly mention monitoring or evaluation, but the commitment to constituting a health and safety committee suggests a form of monitoring and collaboration	The policy's goal to provide and maintain a safe workplace and operate a residence system for employees and students, and to provide information, instruction, training, and supervision reflects a continuous improvement approach by focusing on maintaining a safe environment and enhancing safety practices
					Fort Hare University (2023)

sustainability. A similar strategy was employed by Eridani et al. (2020) at Diponegoro University, who applied the Scrum Model to develop and validate an OSHMS tool that aligned with institutional goals. These approaches mirror the PDCA cycle and offer a replicable framework for improving OHSMS in South African universities. Technological integration in OHSMS also emerged as a best practice in international cases. Indonesian universities, such as Diponegoro University (Mahachandra et al. 2021), developed web-based Occupational Safety and Health Management Information Systems (OSH-MIS), which received positive usability ratings and facilitated real-time access to safety data. Thailand's higher education sector, as demonstrated by Patipat and Meerpradit (2021), further innovated by building and testing web-based recommendation systems that received positive feedback from both specialist and non-specialist users. In contrast, South African universities lack such digital infrastructure in their OHSMS implementation, highlighting an opportunity for modernization. Leadership commitment emerged as a recurring enabler in effective OHSMS adoption. In South Africa, policies often lacked clear executive oversight or designated authority, particularly in institutions with partial PDCA integration. Internationally, universities with strong leadership engagement, such as those in Thailand and Malaysia, showed higher compliance and better institutional safety culture. This suggests that Vice-Chancellors and senior management in South Africa must play a more active role in OHS governance, aligning with Sect. 16(1) responsibilities under OHSA 85 of 1993.

In conclusion, despite shared themes, each university's policy mirrors its distinct institutional culture, priorities, and objectives. Some policies specifically mention their commitment to environmental sustainability, while others stress compliance with legal obligations. Additionally, policies differ in how they emphasize engagement, collaboration, and shared responsibility among all stakeholders to create a safe and healthy environment. The policies highlight the universities' dedication to establishing an environment where health and safety are paramount. They aim not only to meet legal requirements but also to nurture a safety culture, proactive risk management, and continual improvement. The diversity in approach reflects the universities' efforts to align their OHS policies with their respective missions, visions, and values, while also ensuring the well-being of their entire community.

Challenges of implementing occupational health and safety management system in the South African context

As outlined by Lui (2023), the adoption of an OHSMS is increasingly perceived by organizations as a systematic approach to managing OHS risks and opportunities, with the aim of advancing their sustainability goals. Nonetheless, there remains a lack of consensus regarding the effectiveness of

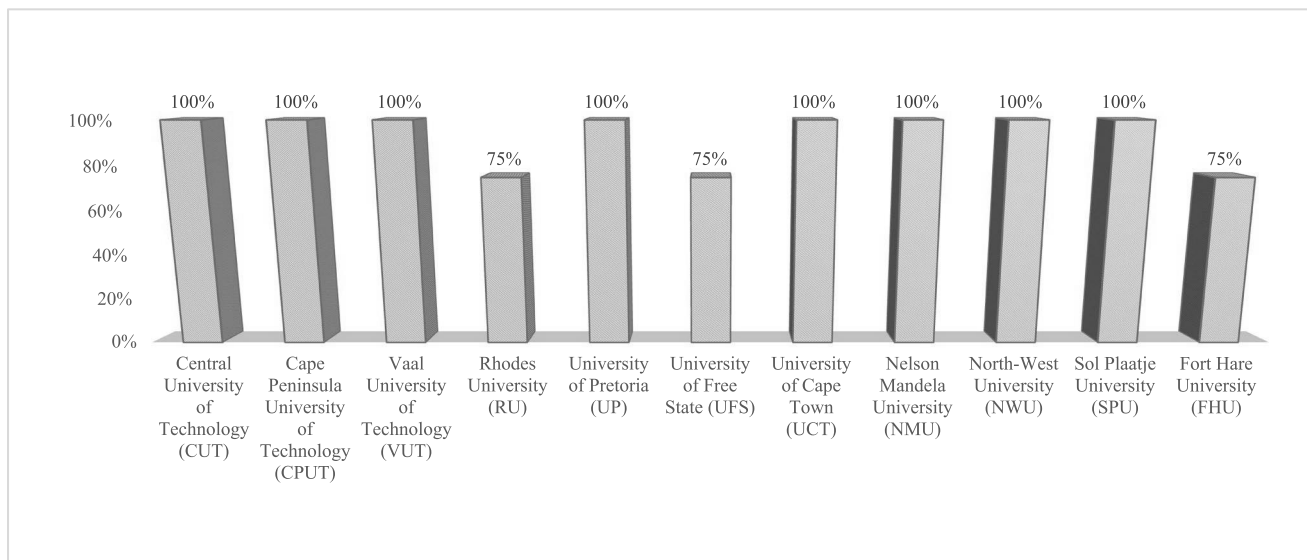


Fig. 2 PDCA implementation levels across South African universities

various certified OHSMSs, including ISO 45001, in achieving their intended objectives. Lui (2023) research reveals that crucial factors such as employees' limited awareness or negative perceptions of OHS, absence of a robust safety culture, and inadequate employee engagement are significant considerations. Furthermore, the study suggests that insufficient internal motivation, lack of commitment and support from top management, absence of comprehensive OHS policies, inadequate financial resources, and challenges posed by certification bodies serve as fundamental and pervasive factors that can impact other aspects of the OHSMS implementation process (Lui 2023). Additionally, Lui (2023) proposes that these findings can provide valuable direction for a range of stakeholders, including organizations, third-party certification bodies, and government regulatory agencies, to formulate and execute effective measures aimed at improving the efficacy of ISO 45001 certification, consequently bolstering an organization's sustainable development strategy. Moreover, Lui (2023) research underscores that the efficacy of ISO 45001 certification is shaped by a multitude of interconnected factors, with obstacles from certification bodies exerting a primary impact. Furthermore, Lui (2023) stresses the pivotal influence of top management's commitment and support, which can significantly affect various implementation barriers.

In a South African context, Kunodzia et al. (2024) investigation, which aims to prioritize factors influencing the implementation of OHSMS on construction sites and analyse its application in South Africa's Western Cape construction industry using the Plan Do Check Act (PDCA) method, it is highlighted that despite previous efforts to improve Occupational Health and Safety (OHS), significant advancements remain elusive, with persistent occurrences of severe injuries, risks, and fatalities. Kunodzia et al. (2024) acknowledges earlier research suggesting

that while the implementation of OHSMS can potentially reduce on-site accidents, its execution encounters various challenges. The study of Kunodzia et al. (2024) identifies both internal and external factors influencing implementation. Internally, crucial elements include risk management strategies, commitment from senior management, and communication channels, while external influences comprise pressures related to client project deliveries, company reputation, OHS compliance enforcement, and government legislation. Kunodzia (2023) puts forward a framework based on the PDCA method, derived from the study's findings, proposing a systematic approach to enhance the effectiveness of OHSMS implementation within the construction sector.

Moyo et al. (2015) highlights the global issue of limited access to occupational health and safety services for workers in South Africa, Zimbabwe, Zambia, and Botswana. The study identifies a shortage of qualified professionals and experts in the field, as well as a deficiency in training programs and educational opportunities related to occupational health and safety. Mashwama et al. (2018) focuses on the challenges faced by Small and Medium Enterprises (SMEs) in the construction industry. The study identifies poor communication within SMEs regarding occupational health and safety practices, inadequate occupational health and safety education, lack of technical skills, insufficient inspections and audits, and insufficient management supervision as challenges hampering OHSMS implementation. Myeni (2020) highlights the fragmented legislative framework for occupational health and safety in South Africa, which incorporates different levels of registered professionals and lacks a single agency with overall accountability. The study points out the absence of harmonization, incentives for compliance, and coordination in the implementation of occupational

health and safety programs. Iden and Samuel (2022) emphasizes the challenges faced by African youth in terms of workplace safety. Many young workers lack proper safety measures, and a significant portion of them are not actively involved in education, employment, or training. The absence of a social safety net exposes them to potential hazards without adequate support in case of job loss, injury, or other unforeseen circumstances (Iden and Samuel 2022). The studies state that addressing these challenges requires a comprehensive approach involving increased financial resources, improved expertise and training programs, enhanced communication and education efforts, strengthened enforcement mechanisms, and the establishment of coordination and support structures (Iden and Samuel 2022). It is essential to prioritize worker safety, promote awareness and compliance, and develop inclusive occupational health and safety policies tailored to the specific circumstances of South Africa (Iden and Samuel 2022). In conclusion, the studies examined reveal both common and unique challenges encountered in the implementation of occupational health and safety (OHS) measures. Among the common challenges are a lack of commitment from top management, insufficient personnel competency, language barriers, inadequate worker awareness, tight working schedules, resource constraints, high labor turnover rates, limited access to OHS services, shortage of qualified professionals, deficiency in training programs, poor communication within small and medium enterprises (SMEs), inadequate technical skills, insufficient inspections and audits, and minimal management supervision. However, one distinctive challenge highlighted is the vulnerability of African youth to workplace safety issues due to a lack of safety measures and social support systems. Addressing these challenges necessitates a comprehensive approach involving increased financial resources, enhanced expertise and training programs, improved communication and education efforts, strengthened enforcement mechanisms, and the development of inclusive OHS policies tailored to regional contexts. Prioritizing worker safety and promoting awareness, compliance, and supportive policies are crucial steps in fostering safer work environments across various sectors and regions.

Discussion and implications

A detailed analysis of the Occupational Health and Safety (OHS) policies of 11 South African universities using the Plan-Do-Check-Act (PDCA) cycle revealed substantial variability in the extent of implementation. Specifically, 64% of institutions demonstrated full integration of all four PDCA components, while 36% partially implemented the framework, consistently omitting the "Check" phase (monitoring and evaluation). Although all universities addressed the "Plan," "Do," and "Act" components (100%), only 73% incorporated the "Check" phase, underscoring a critical weakness in feedback mechanisms and performance monitoring. This

finding mirrors broader national challenges in South Africa, where performance evaluation in OHSMS remains underdeveloped. These findings are consistent with global literature. For instance, studies conducted in Iraq (AlShaheen 2021) and Turkey (Balci 2024) using gap analysis approaches identified significant disparities up to 85% between current OHS practices and ISO 45001 standards, with the weakest areas being monitoring and feedback systems. Similarly, research from Thailand's Khon Kaen University (Chaiear et al. 2019) reported that despite having a formalized OHS structure for over 18 years, persistent issues with hazard control and repeated safety faults stemmed from inadequate continuous monitoring.

By contrast, universities in Indonesia and Thailand have demonstrated phased, structured implementation strategies aligned with PDCA principles. At the University of Muhammadiyah Jakarta, Fitrijaningsih et al. (2023) documented the successful rollout of OHSMS through a systematic approach involving exploration, installation, initial implementation, and sustainability phases. Likewise, Eridani et al. (2020) used the Scrum Model to develop an OHSMS tool tailored to the Engineering Faculty of Diponegoro University, achieving alignment with stakeholder expectations. These structured approaches provide replicable models for South African institutions. Moreover, digital innovation emerged as a common enabler of OHSMS efficiency in international contexts. Indonesian universities, such as Diponegoro University (Mahachandra et al. 2021), developed a web-based Occupational Safety and Health Management Information System (OSH-MIS), which received high usability ratings and enabled real-time access to safety-related data. In Thailand, a web-based recommendation system developed by Patipat and Meerpradit (2021) for occupational health and safety management in higher education received positive evaluations from both specialist and general academic users. These cases highlight the transformative potential of integrating technology into OHSMS, a practice largely absent in South African universities, where manual reporting and limited digital infrastructure prevail. Leadership commitment is another critical factor differentiating implementation outcomes. In South Africa, several institutions lacked clear executive oversight or formal delegation of OHS accountability, particularly in universities with partial PDCA integration. In contrast, international institutions with demonstrable top-management engagement—such as through safety committees or executive-endorsed strategic plans—reported stronger safety cultures and higher levels of compliance (Chaiear et al. 2019). This aligns with Sect. 16(1) of South Africa's Occupational Health and Safety Act (85 of 1993), which places ultimate responsibility for workplace safety on the institution's most senior official, typically the Vice-Chancellor or Rector.

In conclusion, while South African universities have made commendable progress in adopting OHS policies, international comparisons reveal persistent gaps in monitoring, digital infrastructure, and executive involvement. These findings point to the urgent need for institutionalizing the "Check" phase of the PDCA cycle, embracing digital transformation in safety management, and enforcing leadership accountability. Furthermore, the diversity in OHS policy approaches among South African universities reflects differences in institutional culture, resource allocation, and strategic priorities, suggesting the need for a national OHSMS framework tailored to the higher education sector. Integrating global best practices, such as phased implementation, digital platforms, and leadership-driven governance, can significantly enhance the efficiency, compliance, and sustainability of OHSMS in South African universities.

Conclusion and recommendations

One of the most notable findings of this study is the absence of OHSMS-specific research focused on South African universities, which highlights a substantial gap in the national academic and policy landscape. Although the systematic review identified 13 international studies examining OHSMS implementation in higher education institutions across various countries, none addressed the South African context directly. This lack of published research significantly limits the ability to benchmark institutional safety performance and identify contextually relevant best practices. The review also underscores considerable deficiencies in the efficiency and consistency of OHSMS implementation within South African universities. While some institutions have established formal OHS policies, the effectiveness of these frameworks is undermined by inadequate leadership commitment, limited financial investment, inconsistent enforcement, and the absence of structured monitoring mechanisms. Without a standardised national approach, OHSMS implementation across universities remains fragmented and largely dependent on institutional will rather than coordinated national oversight. By contrast, findings from international studies indicate that universities with structured, well-resourced OHSMS frameworks, particularly those aligned with ISO 45001 experience fewer workplace incidents, higher compliance levels, and stronger safety cultures (Mugivhisa et al. 2021). South African institutions, however, continue to face persistent systemic barriers such as resource limitations, lack of regulatory clarity, and fragmented enforcement mechanisms (Ngcece 2018). The effectiveness of

OHSMS implementation is closely tied to key enabling factors including executive leadership engagement, continuous training, dedicated funding, and a commitment to ongoing improvement.

In the absence of these critical enablers, South African universities risk continued inconsistency in the adoption and execution of safety management systems, thereby increasing health and safety risks for both staff and students. The findings underscore the urgent need for national-level standardisation and enforcement of OHSMS frameworks across the higher education sector. In addition, there is a pressing requirement for localised research that explores institution-specific challenges and supports the development of tailored, scalable safety management solutions.

Based on the findings, the following recommendations are proposed:

- Develop a national digital OHSMS monitoring platform for universities, drawing on successful models from Indonesia and Thailand, to support real-time hazard tracking, incident reporting, and compliance evaluation.
- Mandate the appointment of OHSMS Coordinators or Safety Officers at the executive level in all higher education institutions, ensuring alignment with Sect. 16(1) of the Occupational Health and Safety Act (OHSA) 85 of 1993, which delegates legal responsibility to institutional heads such as Vice-Chancellors.
- Integrate ISO 45001 principles into national higher education safety standards, supported by training programs and certification incentives to improve adoption and ensure consistency across institutions.
- Encourage the adoption of web-based Occupational Safety and Health Management Information Systems (OSH-MIS) at university level to digitise health and safety processes, improve data accessibility, and foster a culture of accountability.
- Strengthen monitoring and evaluation mechanisms—specifically the “Check” component of the PDCA cycle—through annual audits, internal reporting, and performance feedback loops to ensure continuous safety improvements.
- Facilitate cross-institutional learning and benchmarking, using structured comparisons with international case studies to adapt global best practices to the South African higher education context.

By adopting these recommendations, South African universities can enhance workplace safety, improve institutional compliance, and foster a sustainable culture of health and safety in alignment with both national laws and international standards.

Appendix A

List of selected studies

No	Author	Publication Year	Title	Country	Research Methods	Key Findings
1	Balci, R	2024	A New Approach to Examining the Current State of ISO 45001 in the Education Sector: Gap Analysis	Turkey	A gap analysis method was used to evaluate the difference between current OHS conditions and ISO 45001 standards across five high schools in Merzifon, Turkey	The analysis revealed a significant gap between actual OHS practices and ISO 45001 standards, indicating a pressing need for the schools to adopt appropriate corrective measures
2	Albarouni, M.A. and Shafighi, N	2021	Establishing occupational health & safety management system at the University of Tripoli according to the German universities. University of Tripoli	German	A quantitative, descriptive-analytical approach was used. Data were collected via questionnaires and analyzed using SPSS. Respondents included students, faculty, and administrative staff	The study found a lack of effective OHS systems or services at the University of Tripoli. It recommended establishing a dedicated OHS department and training staff to enhance awareness and improve occupational safety practices
3	AlShaheen, S.A.L.F	2021	Evaluate the Application of the Occupational Health and Safety Management System Based on International Standard (ISO 45001: 2018): A Case Study in the Iraqi Ministry of Education	Iraqi	A checklist-based assessment was used to measure the implementation of ISO 45001:2018 in educational institutions. Data were analyzed using arithmetic mean and percentage to determine conformity levels and gaps	The study found a significant gap of 85% between current practices and ISO 45001 requirements, with only 15% of the standard being fulfilled, primarily due to lack of adoption of the OHS standard
4	Chaiear, N., Seehamoke, C., Krisorn, P., Soonthornvinit, W., Janpho, P., Lerdrumampattana, S. and Song-Arsa, T	2019	Occupational Health and Safety Management System: Implementation at the Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand	Thailand	A longitudinal observational approach was used, detailing the evolution of OHSMS implementation from 2001 to present, including the establishment of committees and systematic policy development	Khon Kaen University has maintained a formal OHS structure for over 18 years. While health services were well-structured and implemented, gaps remained in workplace safety, as evidenced by recurring faults and hazard control issues

No	Author	Publication Year	Title	Country	Research Methods	Key Findings
5	5. Eridani, D., Windasari, I.P., Septiana, R., Purba, J.K., Hasbi, F. and Reviana, D.A.E	2020	Occupational Health and Safety Management System in Engineering Faculty of Diponegoro University Using Scrum Model. In Proceedings of the 2020 International Conference on Engineering and Information Technology for Sustainable Industry	Indonesia	The study applied the Scrum Model methodology to develop an Occupational Health and Safety Management System (OHSMS) and used test cases to validate whether the resulting application met client expectations.	The application developed through the Scrum Model successfully met client expectations, indicating that the method was effective for OHSMS implementation in the university context
6	Fitrijaningsih, F., Purnamawati, D., Srisantyorini, T., Baktiasyah, A. and Triyono, A	2023	Implementation of occupational safety and health management system in the education sector	Indonesia	This study was operational research that employs an implementation framework, which involves the entire population in the faculty as the research sample. Data was analyzed descriptively both qualitative and quantitative	The Occupational Safety and Health Management System (OSHMS) was successfully implemented at the Public Health Faculty of the University of Muhammadiyah Jakarta. Key actions included the establishment of safety policies, the formation of an OSH committee, OSHMS socialization, and the installation of workplace safety signage. The implementation followed a structured strategy comprising exploration, installation, initial implementation, and sustainability phases, effectively guiding the institution in realizing its OSHMS goals

No	Author	Publication Year	Title	Country	Research Methods	Key Findings
7	Hoque, Z., Gadag, V. and Sarkar, A	2022	A study of the effectiveness of workplace health and safety programmes in a university setting in Canada	Canada	The study compared two cross-sectional online surveys of employees of a Canadian university regarding workplace health and safety with a previously conducted cross-sectional study and thematic analysis of key informant interviews to address the issues raised in the surveys	The study found that participation in health and safety presentations improves safety understanding and practices. Factors such as age, employment status, and work duration influenced knowledge, attitudes, and behaviors among staff and graduate students. Key informant interviews revealed initiatives including the formation of health and safety committees across university buildings, development of a safety app and management system, routine annual inspections, and the introduction of orientation sessions for undergraduates on general safety rules
8	Mahachandra, M., Purba, J.K. and Windasari, I.P	2021	Development of Web-Based Occupational Safety and Health Management Information System (OSH-MIS) at Engineering Faculty of Diponegoro University	Indonesia	A usability-focused system design approach was used to develop a web-based Occupational Safety and Health Management Information System (OSH-MIS). Usability was assessed using Nielsen's method with 20 OSH committee members	The OSH-MIS website received a usability score of 4/5, indicating good user satisfaction. The main area for improvement was clearer error warnings. The system is expected to support OSHMS implementation at FT UNDIP

No	Author	Publication Year	Title	Country	Research Methods	Key Findings
9	Nugroho, A., Herzanita, A., Latief, Y. and Sagita, L.,	2021	Evaluation of an Occupational Health and Safety Management System in Universitas Indonesia	Indonesia	The study used interviews and archive analysis validated by experts and practitioners via a structured questionnaire based on Indonesian OHSMS regulations and ISO 45001:2018	Universitas Indonesia had implemented key OHSMS components (policy, planning, operation, monitoring, and improvement) and established a dedicated unit for developing and executing OHS procedures. The system was found to be well-structured and compliant with national and international standards
10	Patipat, P. and MEEPRADIT, P	2021	Recommendation System for Occupational, Safety, Health and Environment for Higher Education Institutions in Thailand	Thailand	The study employed a mixed-method approach in three phases. In Phase 1, the Delphi technique was used with 17 occupational health professionals to gather expert consensus on OSHE management needs in higher education institutions. In Phase 2, four OSHE management manuals were developed and evaluated. In Phase 3, a web-based recommendation system was designed using HTML5, CSS3, JavaScript, PHP 5.6, and MySQL, and tested with 55 participants, including both occupational health instructors and non-specialist instructors	The study found a 94.1% consensus on the need for workplace safety risk assessments and a 100% consensus on promoting OSHE awareness among senior management and staff. There was also full agreement on establishing a dedicated safety agency governed by a committee of executives. The developed safety manuals were rated highly for content and format. The web based OSHE system received equal satisfaction ratings from both user groups, indicating its broad suitability for higher education institutions

No	Author	Publication Year	Title	Country	Research Methods	Key Findings
11	Patipat, P., Meepradit, P., Amphawan, K. and Meepradit, Y	2022	Development of a Recommendation System for Occupational Safety, Health and Environmental Management for Higher Education Institutions in Thailand	Thailand	This study used a systems development approach to design a website-based recommendation system for occupational safety, health, and environmental management in higher education institutions. The system was built using web technologies such as HTML5, CSS3, JavaScript, PHP 5.6, and MySQL 5.6, with phpMyAdmin 4.9 for database management	The resulting system allowed both administrators and users to access safety and health management tools online. Although usability or performance results were not detailed in the abstract, the system's development represents a structured attempt to integrate technology into OHS management for universities
12	Ramzi, Z.S. and Abdulwahid, R.F	2021	Health and safety management assessment among administrative staff and health and safety committee members in University of Sulaimani	Iraq	The study employed a descriptive cross-sectional design involving 135 administrative staff and members of health and safety committees at the University of Sulaimani. Data were collected using two standardized questionnaires assessing both health and safety management practices and the participants' knowledge, attitudes, and skills. Data analysis was conducted using SPSS version 22	The findings showed that the majority of participants were male (68.9%) and worked in academic faculties (56.3%). Most participants fell within the age groups of 35–44 and 45–54 years. The results revealed that participants had a high level of awareness regarding the managerial aspects of health and safety, indicating generally positive knowledge and attitudes toward occupational health and safety management

No	Author	Publication Year	Title	Country	Research Methods	Key Findings
13	Sigit, A. and Azizah, A.N	2019	Analysis Implementation of Occupational Health and Safety Management System in Building Construction Project at “7 in 1” Project, Yogyakarta State University	Indonesia	The study employed a mixed-method approach, combining quantitative methods through direct field observation and qualitative descriptive analysis using unstructured interviews. The aim was to assess the implementation of the Occupational Health and Safety Management System (OHSMS) in the “7 in 1” construction project at Yogyakarta State University, based on the Indonesian Minister of Labor Regulation PER.05/MEN/1996	The results showed that while the OHSMS had been implemented in alignment with the regulation, the execution in the field was not optimal. Several challenges hindered full compliance, indicating a need to strengthen OHSMS practices to reduce construction site accidents

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T.M.B. Validation, formal analysis, and editing.

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