

Analyzing Safety Management Practices affecting Safety Performance in the Electrical Industry: A Systematic Review

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ABSTRACT

Workplace accidents can be avoided through meticulous planning, systematic organization, and through evaluating the efficacy of implemented control measures. Acquiring high standards in a safety management system can be achieved using models that facilitate the execution of proactive steps to mitigate work-related risks. This study aimed to ascertain the presence of effective safety practices throughout the implementation of safety performance measures. A systematic literature review was carried out following the guidelines provided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Thirty articles in English, published between 2010 and 2020, were identified by a comprehensive search in the Scopus, Science Direct, and Web of Science databases, based on certain criteria. The results demonstrated the efficacy of safety management practices and their impact on safety performance. The predominant focus of the evaluations was procedural safety, with relatively little emphasis placed on the elements of human safety that were significantly overlooked.

Keywords- component; safety management; safety performance; climate

I. INTRODUCTION

Organizations increasingly recognize the critical importance of establishing a functional environment that safeguards not only workers, but also the surrounding community from the repercussions of escalating crises. These crises encompass various aspects, such as health, safety, climate, and other pertinent concerns. There is a growing emphasis on preventing even minor injuries as part of this proactive approach. Technological advancements have ushered in new technologies and structures, profoundly influencing human lifestyles and perceptions. Consequently, this transformation has exposed employees to potential risks stemming from significant changes due to mechanization and industrialization. The realm of science and innovation has facilitated the emergence of various intricate and high-risk endeavors. Therefore, there is a persistent occurrence of significant mechanical failures that inflict substantial damage on institutions and countries as a whole. Given the considerable

human suffering and economic devastation resulting from such accidents, it becomes imperative to prioritize the elimination or mitigation of occupational hazards to prevent their recurrence.

Despite a notable progress in accident prevention and ensuring a safe working environment for mechanical employees, certifying work safety remains paramount in building a secure workplace [1, 2]. Enhancing research comprehensiveness involves delving deeper into the specific strategies and technologies employed to address these occupational hazards, along with exploring the role of regulatory frameworks and organizational culture in fostering a safety culture. Additionally, considering case studies or real-life examples could offer practical insights into the effectiveness of different safety measures and their impact on alleviating risks within various industries.

A Safety Management System (SMS) provides a methodical framework for the ongoing identification and surveillance of hazards and the management of occupational

risks while ascertaining the availability of substantiating evidence regarding the efficacy of these risk minimization measures. An SMS is a formal approach to solving safety-related issues. The management of safety hazards is characterized by precision, clarity, and thoroughness. In addition to the existing statutory frameworks, the executive authority's approach is designed to correlate with establishing, categorizing, and evaluating occupational safety measures. Integrating an SMS within an organization is characterized by its seamless integration into the organizational structure, becoming an intrinsic component of its culture and influencing how personnel carry out their responsibilities [1]. An SMS can be defined as a unified structure that establishes and implements uniform rules and goals throughout an organization to safeguard the well-being of its workers and the environment [2]. In [3], an extensive analysis was carried out to differentiate between SMSs, classified as voluntary, mandated, and hybrid. The first strategy is grounded in a settled norm or internal policy. In contrast, the state legally mandates the second approach following Occupational Health and Safety (OHS) legislation. The third approach integrates aspects from both approaches.

According to the British Standards Occupational Health and Safety Assessment Series (OHSAS) in 2007, OHS pertains to the various conditions and factors that can affect the well-being and safety of employees and other individuals within a workplace setting [4]. Incorporating an OHSAS is fundamental to the comprehensive management framework of an organization, as it functions as a mechanism to formulate and implement organizational policies and efficiently manage the risks related to OHS [5]. The OHSAS 18001 standard outlines the elements necessary to oversee occupational health and safety within organizational settings. The universal international OHS standard was jointly developed by significant trade organizations, international standards organizations, and standardization companies to address the lack of a comprehensive global standard. The established framework is based on the Plan-Do-Check-Act (PDCA) cycle, where the stipulations are relevant and applicable to every process phase. The planning phase includes developing corporate policies, identifying workplace hazards, assessing risks, and formulating strategies to address health and safety objectives. Controls and preventive measures in the planning phase are carried out during the implementation phase. Additionally, individuals receive training to assure the safe execution of tasks and a comprehensive awareness of the relevance of OHSMS. The check phase includes the evaluation of controls and the operation of OHSMS while incorporating measures for corrective and preventive actions. The PDCA cycle is completed with the acting phase, which requires a comprehensive review by management to facilitate improvements in OHSMS [6].

An SMS is formed by developing tools to identify and mitigate hazards tied to work-related tasks and has the potential to foster ongoing enhancement and streamline the dependability of undertakings, procedures, and offerings. The results include a potential decrease in work-related incidents and problems, reduced process expenses, improved worker well-being, enhanced organizational reputation, and increased

competitiveness and profitability [4]. Although this issue is examined in interdisciplinary studies, further research is needed on the practices that affect safety performance and the occurrence of work-related accidents and disorders. Therefore, studies must consider a wide range of safety practices that are interconnected or related to the incidence of accidents. Consequently, this study examines optimal strategies for implementing safety practices to identify the most efficient approaches for assessing and implementing safety precautions.

II. METHODOLOGY AND MATERIALS

This study deployed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to perform a systematic literature review. This approach to reviewing the literature differs from others in that it adopts a repeatable, transparent, and scientific methodology [7]. Initially, the objectives were to determine research inquiries, databases for article searches, and specific research terms. Thus, three research questions were developed to determine the safety management practices currently in use and the characteristics associated with the implementation and evaluation of safety performance.

- What safety management procedures are used in industries?
- What are the most exciting safety management practices used in general industries?
- What results are expected from implementing safety practices on safety performance?

Three electronic databases, Science Direct, the Web of Science, and Scopus, were put into service to discover articles from 2010 to 2020 in English. A preliminary screening of the articles was performed to identify the most appropriate ones. The texts were then subjected to a qualitative analysis employing content analysis to determine whether they answered the study questions [8]. Finally, the relevant data were extracted.

A selection of suitable research phrases was determined on the review goals. A collection of primary terms along with logical operators (AND, OR) was used. The chosen keywords focused on concepts relevant to the purpose of the study, including safety management system, workplace safety, practices in safety management, anticipated outcomes, evaluation, management of occupational health and safety, methodical administration, OHSMS, legal frameworks, labor regulations, established safety methodologies, frequently employed, performance in safety, and impact. After thoroughly exploring all the database options, 150 articles were identified, accounting for duplicate entries. The article content was evaluated to be specified whether it addressed the research questions. Relevant data from the selected publications were collected in Microsoft Excel spreadsheets. EndNote X9 was utilized to eliminate duplicates, resulting in the exclusion of 50 research articles. Figure 1 presents the review process, and Table I provides the review protocol.

An initial screening of abstracts and titles was conducted to evaluate the relevance of articles to the research objectives, leading to the identification of 75 suitable publications for

analysis. Based on the introductory and concluding content of these articles, specific questions were addressed to find out whether an article should be included or excluded according to predefined criteria. Subsequently, an initial descriptive analysis was carried out to quantify the word count in the full texts of the 30 chosen papers. The NVivo version 10.0 software, designed to help classify, evaluate, and organize information within qualitative or unstructured data studies, was engaged for the analysis. In addition, a descriptive and academic evaluation was carried out. This process presented details about academic journals, place of publication, research country, methodologies adopted in the studies (qualitative, quantitative, or combination), consideration of research inquiries, and year of publication.

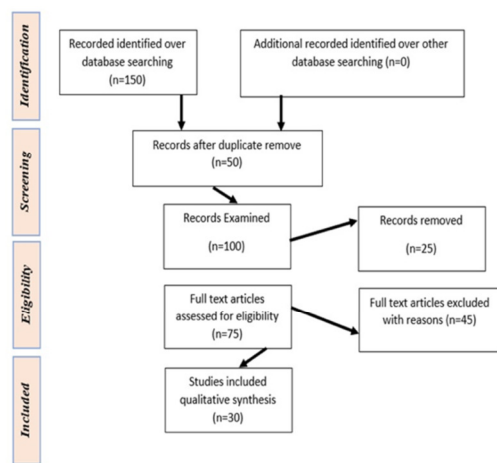


Fig. 1. Article review process.

TABLE I. PROTOCOL OF THE SYSTEMATIC REVIEW

Review stage	Data collected
Search in the database and an initial selection	Years
	Database
Assessment of the contents	Journal
	Authors
	Titles
	Keywords
Data extraction	Methodology
	Objectives
	Main Results
	Research questions related.
	Definition of SMS practices and their common applications in industries.
	Predominance of established methodologies or effective approaches within SMS.
	Outcomes resulting from the application of SMS practices on safety performance.

The queries were categorized into two sets: Group 1, consisting of exclusion criteria questions that required positive responses across the board, and Group 2, comprising inclusion criteria questions that demanded at least one affirmative response (as shown in Table I). After this stage, 30 articles were selected to be included.

- Group 1 (All answers should be yes):

- G1-1 Do the objectives of the article look clear?
- G1-2 Are SMS-related goals included in the objectives of the article?
- G1-3 Does the study show its contribution?
- Group 2 (at least one answer should be yes)
 - G2-1: Does the study identify SMS practices?
 - G2-2: Does the research introduce SMS models that influence safety performance?
 - G2-3: Does the research present data analysis on SMS?

III. RESULTS

A. Descriptive Analysis of the Articles

The inclusion and exclusion criteria, reflected in the questions, were met by 30 articles. Table II indicates that most of the articles (86.66%) employed a quantitative approach. Given the prevalence of quantitative elements in SMS studies, this finding may point to the need to adopt a quantitative strategy in such an investigation. There was also a discernible geographical pattern, with most of the studies conducted in Europe and Asia. These two regions have well-established SMS research communities.

TABLE II. ARTICLE DISTRIBUTION

Ref.	Country	Research Method
[9]	India	Quantitative
[10]	China	Quantitative
[11]	Taiwan	Quantitative
[12]	Hong Kong	Quantitative
[13]	Taiwan	Quantitative
[14]	Spain	Quantitative
[15]	South Korea	Quantitative
[16]	South Africa	Quantitative
[17]	Jordan	Quantitative
[18]	Australia	Structured interviews, archival data, and questionnaires
[19]	Taiwan	Quantitative
[20]	Spain	Quantitative
[21]	Hong Kong	Mix Methods
[22]	Italy	Quantitative
[23]	USA	Quantitative
[24]	China	Quantitative
[25]	Palestine	Quantitative
[26]	South Korea	Quantitative
[27]	China	Quantitative
[28]	Pakistan	Mix Methods
[29]	Norway	Quantitative
[30]	Saudi Arabia	Quantitative
[31]	Canada	Quantitative
[32]	Turkey	Quantitative
[33]	Sweden	Quantitative
[34]	USA	Quantitative
[35]	USA	Quantitative
[36]	Singapore	Quantitative
[37]	China	Quantitative
[38]	Iran	Quantitative

The 30 articles chosen were published according to the acknowledged inclusion criteria, as observed in Table III. Regarding the articles, the questions G2-2 (Does the research introduce SMS models that influence safety performance?) and

equipment, and the physical environment [46]. To coordinate this systematic monitoring, the SMS organizes all safety management processes.

C. Successful Practices of an SMS that Affect Safety Performance And Controlling Work Hazards

In [9], the extent of the implementation of safety performance within industrial workshops in India and the techniques deployed to gauge this safety performance were investigated, considering the roles of knowledge and motivation in terms of safety as intermediaries. The results underscored the need to provide safety training to the workforce. In [10], a novel conceptual framework was introduced to address the execution of safety protocols in small and large industries in China, incorporating elements, such as role ambiguity/conflict, safety communication, safety training, and managerial commitment to assess their impact on safety performance. The findings emphasized that employees must exercise additional diligence to comply with safety standards and policies and assist their colleagues. In particular, the impact of safety communication alone on the willingness to exhibit safety proficiency was limited. In the context of the Chinese coal industry, job obstacles and job resources were identified as autonomous variables that influence safety performance [24]. This study employed participation in the job as an intermediary, showing that it partially mediated the associations between the resources of the job and various dimensions of safety performance. This stresses the significance of job characteristics in shaping the design of the work system through the differential effects of job hindrances and resources. Similarly, in [27], safety performance was investigated in the Chinese construction industry, considering the safety climate, safety culture, safety attitude, and safety behavior as independent factors. The results shed light on the causal connections between safety performance elements and objectives, which could facilitate improving overall safety effectiveness. In [37], the influence of safety commitment, safety training, and encouragement of participation on safety performance in the Chinese mining sector was explored. The results showed that commitment, training, and promotion of employee engagement exert direct effects on safety performance. These effects are also influenced by the mediating impacts of safety knowledge and motivation, highlighting the multifaceted nature of the determinants of safety performance.

In [11], novel approaches were introduced in the Taiwan transportation sector, including safety policy, perceived supervisor safety behaviors, and safety management. The results revealed a positive correlation between safety policy, supervisors' perceived safety attitudes, and safety performance. This finding implies that cultivating an effective safety environment requires the combination of these elements. Similarly, in [13], the relationship between the levels of safety leadership, safety climate, and safety performance was explored in the Taiwan petrochemical sector, highlighting the role of safety climate as a mediator in the relationship between safety leadership and performance. In [19], the effects of safety management practices, moral leadership, and self-efficacy on safety behaviors in the airline industry were reviewed. The

findings displayed that moral leadership only exerts an indirect influence on pilot safety conduct, with this association being completely mediated by the safety motivation of the pilot.

In [12], the impact of safety communication, safety processes, and safety committees on safety performance in the Hong Kong construction sector was evaluated. The findings demonstrated that the construction industry paid relatively less attention to safety management committees despite these committees being empirically proven to strongly influence project success. In [21], the focus was on assessing the degree of correlation between safety commitment, safety rules, safety responsibility, and safety performance. The results confirmed the presence of an adverse connection between these practices and the occurrence of self-reported near misses and injuries. Furthermore, notable positive associations were identified between the safety environment measured by Risk Management And Assessment (RMAA) and safety performance metrics, such as participation and compliance, within the Hong Kong construction industry.

In [14], the relationship between team leader practices and safety performance was investigated within the nuclear power industry in Spain. The results showed that leaders who exhibit empowered behaviors increased safety enforcement and participation among team members while reducing unsafe actions. In [20], the impact of safety leadership and risk management on safety performance in various industries in Spain, including small and large organizations, was explored. The findings highlighted the importance of employee safety actions to improve safety outcomes. In addition, the role of constructive risk management and transformational leadership in promoting positive safety performance was emphasized. In [26], the impact of implementing OHSMS practices on safety performance in the South Korean construction industry was examined, disclosing that the use of OHSMS led to a notable reduction in workplace injuries and fatal injury rates. In addition, correlations between personal attributes, work-related stress, self-perceived fatigue, safety culture, safe environment, and safety performance were analyzed. This study manifested that organizational elements and individual aspects, such as personal traits, work-related stress, and self-perceived exhaustion, influence safety performance substantially.

In [16], the effect of commitment and safety, employee participation and empowerment, project supervision, safety planning, safety communication, safety resources, and safety training on safety performance in the construction industry in South Africa was examined. The results revealed that proactive measures are safety elements that could inform companies about their safety performance. Additionally, safety activities reflect a low safety culture in South Africa. In [18], safety investments, safety climate, and project hazard levels were investigated to study safety performance in Australian building projects. The results exhibited that basic safety investments have a greater positive impact on injury prevention, safety culture, and project danger. However, the impact of basic safety investments on the prevention of accidents might not be positive if the hazard and safety culture levels are low.

In [17], the correlation between management commitment, interrelationship harmony, continuous improvement, employee

empowerment, and safety performance within small and large industries in Jordan was explored. The results showcased that Jordanian organizations had effectively increased safety awareness and self-efficacy. However, more robust practices and policies are needed to enhance safety performance. In [25], the influence of work stress and work burnout were investigated as independent variables on safety performance in the Palestinian construction industry. The findings revealed that construction industry professionals experienced emotional stress and hidden burnout, but, interestingly, this study displayed that work stress and burnout did not essentially affect safety performance. In [30], the relationship between motivated workers, improved working conditions, and safety performance was explored in the Saudi Arabian construction sector. The study found a positive perspective on safety within companies but noted a low level of safety culture in the Saudi Arabian construction domain. In [32], the influence of safety prevention costs, safety performance, and employee satisfaction on accident costs in Turkey was explored. The findings showed that prevention costs had a notable positive impact on other factors. In addition, employee satisfaction played an important role in reducing accident costs. This study also stressed the substantial positive influence of workplace safety performance on employee satisfaction and savings in accident costs.

In [38], the relationship between safety commitment, social support, workplace safety, emergency preparation, and safety performance in Iran's cement industry was studied. The findings demonstrated that safety climate factors positively affected safety performance and that the commitment to safety was interconnected with social support and production pressure in positive or negative ways. Similarly, social support and production pressure exhibited mixed effects on safety knowledge and motivation for safety. In [22], the potential relationship between prosocial and proactive safety behaviors and safety performance in the Italian chemical industry was investigated. This study concluded that the benefit of distinguishing between prosocial and proactive safety behaviors when it comes to improving safety performance would be a reduced accident rate.

In [23], the impact of safety culture (safety knowledge and motivation) in the US was discussed. The findings provide compelling support for the application of safety standards in a national context and also emphasize the need for more research in small workshops in other contexts. In [34], the relevance of the safety management system (time frame, type of injury, source of injury, body part injury, development of safety plans) and safety performance in American industrial manufacturing plants was evaluated, showing that industrial facilities in Louisiana had obtained a good safety report. In [35], the effect of safety climate (policy and plans) on the recognition and perception of safety risk in the US construction sector was examined. A positive climate displayed a higher identification of hazards and higher levels of perceived safety risk. In addition, the safety climate mechanism influences the perception of safety risks.

In [28], the impact of the safety climate on safety performance in the Pakistani construction industry was explored, showing that the safety climate has a significant

impact and suggesting the examination of this relationship in other industries. In [29], the effects of safety competence, safety systems, safety supervision, and work pressure on safety compliance in the Norway gas and oil industry were examined. The findings demonstrated that work pressure was the most important factor in explaining the variance in safety compliance. This result suggests that when designing measures to improve compliance, the most effective means are related to training and ensuring a sound balance between safety and production. In [31], the influence of individual resilience and the safety climate on safety performance in the construction sector was investigated, indicating that individual resilience had a direct and unfavorable impact on psychological stress while not influencing physical safety results. The results underscored the importance of both organizational and personal factors in ensuring the effectiveness of individual safety and psychological well-being.

Furthermore, in [33], the relationships between safety culture, priority in the work environment, company size, and occupational health and safety management practices in small and large manufacturing companies in Sweden were investigated. The results suggested that company size, safety culture, and financial health correlate better with the big companies and poorly with the small companies. Finally, in [36], the relationships between safety climate practices (planning, policy, communication, control, and training) and safety performance in the Singapore construction industry were examined. The results did not display significant contact between the management commitment and the SMS but illustrated the aspects of the safety culture that management must note to successfully enforce the SMS.

IV. DISCUSSION AND CONCLUSION

Safety priority is of utmost importance, not just a fashionable term but also a fundamental value that guarantees the well-being and efficiency of employees. This study explored the complexity of SMS, its broad definition, and key strategies that have a crucial impact on safety results in many industries. A significant observation is that attention to safety often outweighs attention to employee well-being. This assertion underscores a fundamental perspective and calls for action. It indicates that despite the adoption of different safety management system practices, the core objective remains consistent: to notably reduce workplace accidents and safeguard the workforce's safety [47]. It is apparent that safety climate practices, which entail policy implementation, training initiatives, effective communication, organizational commitment, preventive methods, and strong safety leadership, play a substantial role in achieving optimal safety performance. This impact was demonstrated in many studies, including [9, 11, 12] among others. Furthermore, it is important to acknowledge the significant influence of social dynamics on various aspects, such as work demands and awareness of safety, as indicated in [2, 14, 30].

An essential observation is the emphasis on studies on China, Taiwan, and the Middle East. However, there are still intriguing and undiscovered possibilities to pursue. Some practices and principles require testing new terrains and cohorts. These may include implementing action plans to

prevent accidents or proactively improving safety measures within government entities. A notable research deficiency can be observed in areas such as Iraq and Syria and in sectors such as electricity generation within the Middle East, which is considered a practical research gap. Similarly, in [48], it was shown that there is a poor safety culture in Middle Eastern countries like Saudi Arabia. The subject under consideration represents a domain that has not yet been extensively explored, offering the potential to uncover significant and innovative knowledge. Furthermore, although substantial research has been conducted on safety investigations, there is a noticeable deficiency in theoretical exploration. Studies such as [36] advocated including a wider range of participants in research studies, encompassing employees and managers. Furthermore, it is evident that the existing level of safety knowledge, particularly in the context of safety culture, needs to be improved [2, 30].

In conclusion, the goal can be delineated into two distinct objectives. Initially, it is necessary to identify the most effective SMS practices that contribute to improving safety in various industries and regions. Furthermore, the objective is to address the significant gaps in the current body of literature. The ultimate objective is to optimize safety measures in critical industries, such as electrical production within the Middle East, while also establishing a comprehensive theoretical framework to support these efforts. Collectively, this offers the potential to enhance safety from a superficial compliance measure to a tangible and immersive reality.

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