

Corporate Factors Affecting Workplace Health and Safety Performance and Management Decisions. A Literature Review

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Abstract – The environment of companies, especially large companies, is complex and rapidly changing. In addition to the technical and economic conditions that directly influence the operation, the effects of external factors also fundamentally change the operation of companies. The corporate processes affecting occupational health and safety (OHS) have also become complex, and this represents a serious challenge for the managers. Knowing the factors and processes affecting the company's OHS performance is necessary for managerial decisions that improve its effectiveness. The purpose of this work is to delve into the methods companies use to monitor and manage OHS performance. A systematic literature review was conducted of studies published in the field of OHS performance management. This overview provides knowledge about which methods determine the OHS management of companies. The review highlights and discusses performance management strategies and the main difficulties, constraints and challenges managers face in influencing OHS performance. The study concludes that improving OHS performance has become a complex task for medium and large companies. Most of the literature investigating safety performance management focuses on the technical issues of overall measurement. Limited attention is paid to the use of information from the measurement of OHS performance, and to the factors influencing managerial decisions resulting in improved performance.

Keywords: Occupational health and safety; Safety performance; Safety management; Review

I. INTRODUCTION

The European Commission's Strategic Framework on Safety and Health at Work 2021-2027 [1] underlines that the protection of workers' health from risks at work is a key element in achieving sustainable working conditions. In addition, there are also economic arguments in favour of workers' personal

well-being. In addition to reducing the costs of workplace accidents, the aim is to ensure a more productive and sustainable business. The role of health and safety at work was highlighted by the Covid-19 pandemic, as workplaces played a key role in managing the pandemic, protecting workers' health and thus ensuring the continuity of activities critical to the functioning of the economy and society. Accordingly, the current EU strategy for health and safety at work aims to maintain and further develop the priority given to health and safety at work.

The regulatory framework developed by the EU and the Member States provides a basis for identifying risks at work and the measures needed to prevent them. Effectiveness is ensured by the tripartite system of occupational safety and health, i.e. the involvement of employers and workers, alongside the state, in the design and implementation of occupational safety and health measures.

The OSH Strategy 2014-2020 [2] focused on the prevention of work-related diseases, the management of demographic change and the implementation of legislation. The strategy for 2021-2027 focuses on ever-faster change and the increasingly complex workplaces that this will bring. Accordingly, while maintaining the priorities of the previous period, it has set three priorities:

- Anticipating and managing the new challenges of sustainability and digitalization, and the changes brought about by demographic change;
- Better prevention of accidents and illnesses at work;
- Preparing for possible future health crises.

Achieving these goals will require active involvement of industry and business, alongside action by the EU and Member States.

The EU's OSH strategy already foresees the concept of Industry 5.0, which will enable the economy to become more environmentally conscious, sustainable and ensure worker well-being through technological change and innovation.

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Reducing the environmental impact of production processes, the transition to green industry requires new trends, new skills, new jobs - in other words, major changes in the workplace. The focus shifts from ownership to stakeholder value, reinforcing the role and contribution of industry to society. Workers' well-being becomes the focus of production activity. It uses new processes and technologies to create well-being in the workplace. It aims to achieve a sustainable, people-centered European industry.

People focus, well-being at work, new technologies, innovation. So many new tasks and challenges for safety and health professionals and managers in companies. Creating safe and healthy workplaces, continuously improving and managing safety and health performance in a context of constant change requires a constant development of professional knowledge and the acquisition and application of competences and experience beyond safety and health expertise. The safety performance of a company is influenced by several factors that challenge managers. Management decisions to improve the effectiveness of health and safety at work require knowledge of these factors.

Several researchers have looked at the factors that influence a company's OSH performance. The key drivers identified by Mohammadi et al. were motivation, company regulations, competencies, safety inputs, resources, working conditions, company culture, employee attitudes, and management systems [3]. According to Peçiño, organizational factors are the determinants of employees' attitudes and safe behavior towards occupational health and safety. His research shows a strong link between organizational factors and safe worker behavior and risk attitudes [4]. Paul and Maiti have also shown that safety performance is significantly influenced by human factors such as job satisfaction and organizational factors such as regular training or encouraging managerial behavior [5]. Fabiano et al. highlighted the role of behavior, safety attitudes and attitudes towards risk as individual dimensions that influence OSH performance in companies [6]. Among the organizational factors, the role of communication, job stress and motivation were emphasized. Ghahramani [7] underlined the commitment of senior managers to safety and the active involvement and support of employees.

The rapidly changing economic, sociological and technical environment is a constant challenge for business leaders. Knowledge of the corporate information and organizational processes that can inform decisions to improve health and safety at work will determine the effectiveness of any OSH manager's efforts. The world of work is undergoing fundamental changes and these changes affect the conditions for safe working conditions. OSH professionals are faced with new challenges that require preparedness to deal with a rapidly changing industrial and manufacturing environment.

Particularly, OSH managers must not only understand and manage the new risks generated by constant change, but also compete for the attention of decision-makers and for the available company resources.

The aim of our study is to review the literature to identify the most recent research and to explore the factors that underpin managerial decision-making to improve OSH performance and influence its effectiveness.

II. METHODOLOGY AND SEARCH CRITERIA

2.1. Preparation of the study

To understand the direction and results of recent research in the field of occupational health and safety management, we examined the publications published in the last 5 years (2018-2023) using the systematic literature review method.

A systematic literature review is a specific method that allows you to identify, select and evaluate all the literature related to a specific research question or topic [8].

2.2. Literature search

A systematic literature search was conducted using the PRISMA protocol. [9] PRISMA stands for "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" and is a generally accepted protocol. PRISMA aims to improve the transparency and scientific merit of a systematic review or meta-analysis. The protocol is also frequently used in literature research in the field of occupational health and safety [10 – 12].

The literature research was conducted between December 2023 and March 2024. A deductive approach was used for the literature review as illustrated in Figure 1. Keywords from 30 previous relevant articles were collected into one document. The keywords were used to create a word cloud using the online word cloud generator software worldclouds.com. The full content of the same article was used to create word clouds per article. The list of words in the resulting word clouds was exported to a csv file using the word cloud software and aggregated. Finally, using the aggregated list, another word cloud was created as shown in Figure 2. The most frequently occurring words were used as search terms.

Word clouding is a commonly used method to display textual data in a graphical format, providing a visual aid for evaluation. They can be used effectively to filter large amounts of text data as a starting point for further analysis [13]. A word cloud is a visual representation of the frequency of words in a text. The more frequently a word appears in the text being analyzed, the larger the word in the generated image. Word clouds can be used as a simple tool to identify the focus of written text [14].

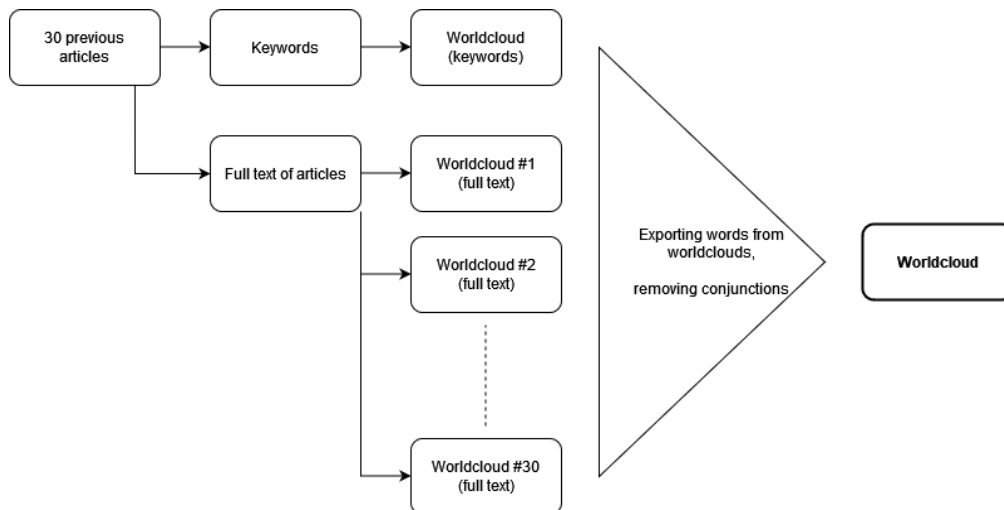


Fig. 1. Deductive approach to defining keywords.
Source: own editing.



Fig. 2. The word cloud of keywords. Source: own editing.

Table 1 Preliminary results

Database	Number of publications
Scopus	731
Web of Science	176
Google Scholar	48

In the text analysis we carried out, the most frequently used words in order of number of occurrences were SAFETY, MANAGEMENT, OCCUPATIONAL and PERFORMANCE.

The search term was created using the keywords found. The filtering was performed on three bibliographic databases, Scopus, Web of Science and Google Scholar. The selection criteria were defined as publications on the topic of occupational safety and health in medium and large enterprises.

The period covered is from 2018 to 2023. We have narrowed the search to articles published in this period to find out the latest research from the scientific community. The bibliographic search is limited to research conducted in medium and large companies in the European Union or the United States. Articles available in full in English were included. After an initial screening of the databases, several hits were received on transport, construction

jobs and health care, for which exclusion criteria were set and the screening was repeated.

The search term used in the Scopus database is occupational AND safety AND performance AND management AND NOT construction. Web of Science database term: (Title) AND safety (Title) AND performance (Title) AND management (Title) NOT construction (Title) NOT road (Title) NOT vehicle (TITLE). The results of the preliminary search are shown in Table 1. The literature research process is shown in Figure 3.

2.3 Literature selection, pertinence criteria

In the process of filtering scientific databases, it was inevitable that duplicated publications would appear, as the same document could be indexed into different databases. After excluding duplicates, 924 hits were found. The first matching criterion for these references was determined by analyzing the title, abstract and keywords, filtering out publications that did not cover medium or large company activities or that fell outside the territorial scope. Thus, publications on hospital care, construction and transport were filtered out. The selected publications were analyzed to find new, relevant articles for our study. This selection resulted in 82 hits, which were downloaded for archiving, as the full text of these more relevant articles had to be read.

After reading the full content of the articles, we considered relevant those studies that met the predefined criteria and that contained relevant studies and new research findings related to our research topic. The final analysis resulted in a selection of 49 articles.

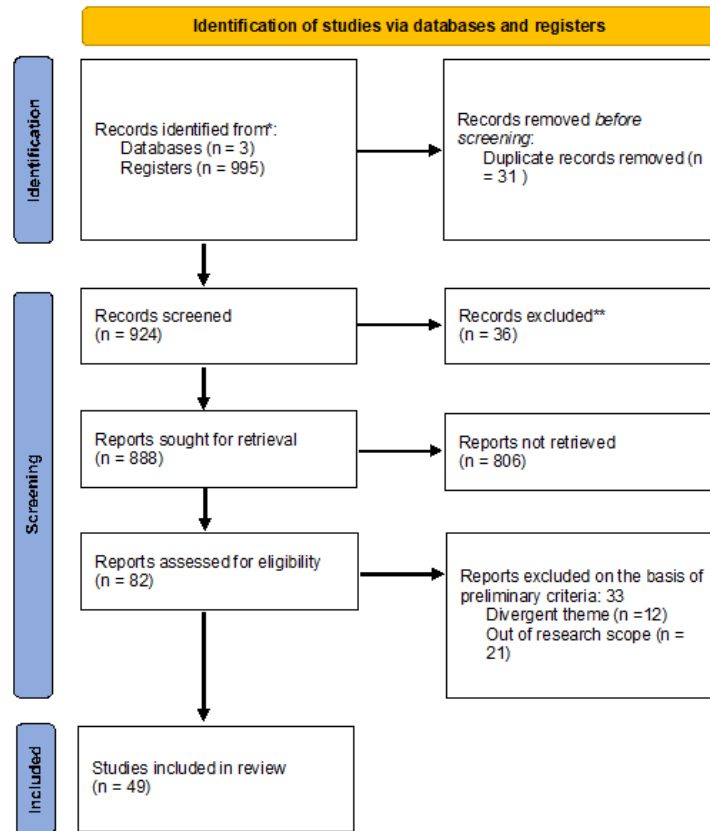


Fig. 3. Flowchart of the systematic literature review.
Source: Own editing based on PRISMA recommendation.

Table 2 Research results examined additional factors affecting safety performance, including corporate culture, organizational factors, accident analysis, safety-related measures, among others

#	Research area	Articles
1	Key performance indicators	10
2	Management systems	8
3	Employees, human factors	6
4	Performance management, performance evaluation	5
5	Leadership behavior	5
6	Risk assessment, risk management	5
7	Corporate culture	4
8	Organizational factors	2
9	Accident analysis	2
10	Safety measures	1
11	Process safety	1

III. RESULTS AND DISCUSSION

3.1. Literature classification

The selected publications were grouped into the categories presented in Table 2, based on the purpose and topic of the study.

Of the publications identified in the literature review, 10 research topics focused on key performance indicators, 8 on OSH management

systems, 6 on employees and human factors, 5 on performance management and performance evaluation, 5 publications on management behavior and 5 on risk assessment and management. Further research examined additional factors affecting safety performance, including corporate culture, organizational factors, accident analysis, safety-related measures, among others (Table 2).

3.2. Analysis of the reviewed literature

Johanson et al. on the further development of the conceptual framework for integrated performance management systems [15] aimed at helping to understand performance management systems in organizations. They identified some problems, including the need for coherence between the different system elements, not only in terms of functional and contextual factors, but also in terms of underlying beliefs and values.

The benefits of integrating an occupational health and safety management system into a corporate management system have also been examined in other studies. The results of these studies have shown that integrated performance management is a prerequisite for results- and resource-efficient OHS management [16].

Vidosav et al. also stress the importance of integrating management systems to achieve an organizational approach, to reduce production costs, to make good use of resources, to motivate workers

and to meet the needs of customers and stakeholders [17] and developed an integrated risk management model for standardized management systems.

According to Peter and Gensarik, the effectiveness of increasing awareness and proactivity is greatly influenced by approaching the problem from a systems perspective [18]. This offers a way forward in understanding and proactively managing risk, safety and sustainable performance in organizations and ultimately in society.

Blokland proposes systemic organizational culture fit model [19]. By looking at sociotechnical systems from a systems perspective, he shows that mental models guide the behavior of sociotechnical systems and determine their outcomes. This is also the case for individuals who are themselves systems and as such are elements of these socio-technical systems. Individual behaviors are derived from individual perceptions (mental models). These individual behaviors ideally generate the desired outcomes of the system (team/organization/society) and create value.

However, mental models and their associated individual behaviors have undesirable, value-destroying consequences. Therefore, understanding and managing mental models in organizations is of paramount importance for achieving safety and sustainable safe performance. This implies the need to create the necessary mental models in organizations and society that create success, while avoiding or eliminating harmful perceptions and ideas to protect the value created.

Creating and managing mental models involves leadership; leadership skills; and the ability to develop a shared vision, mission and ambition, as this helps to define what is valuable and enables alignment of individual mental models. This enables the development of well-aligned corporate cultures that create and protect value and generate sustainable, secure performance.

After an analysis of performance assessment methods for occupational health and safety management systems, Riascos points to the need to be familiar with the methods and indicators used to effectively use Occupational Health and Safety Management System (OHSMS) to improve safety performance [20].

Johanson and colleagues have been investigating the interaction between the sustainability business model and the internal performance management system [21]. They propose to manage health and safety at work as a key element of the business and to manage its processes within the business processes accordingly. The study concluded that if the performance management system is decoupled from the business model, the long and short-term occupational health and safety benefits and sustainable value propositions for stakeholders will not be realized.

The integration of performance management and risk management at the conceptual level puts a new perspective on the previously competing

understandings of performance and risk supporting the idea that risk research and practice can be improved to meet performance needs, and vice versa [22]. An integrated perspective on performance and risk has the potential to create significant innovations in the overall planning and decision making of organizations, for example in corporate performance management or corporate risk management.

Several researchers have questioned the strategies needed for effective risk management, as well as human error, looking at both positive and negative consequences. In this context, Galanti examined risk management in the context of the pandemic COVID-19 emergency [23]. His results confirm what emerges from recent literature that organizations urgently need to create a culture of intelligent risk-taking that leads to learning and better knowledge, and that involves the participation of all employees. It also stresses the benefits of error management training in emergency situations.

A recurring question in OSH management research is whether the adoption of management system standards is related to operational performance. Management system standards have been implemented by hundreds of thousands of companies worldwide, but it remains unclear whether organizations that adopt these standards perform better than others and whether the adoption of these standards improves performance. This question has also been raised in the context of the OHSAS 18001 (Occupational Health and Safety Management System) standard. The results of Viswanathan et al. suggest that the safety performance of companies that adopt the standard is higher than that of companies that do not [24]. However, the direct impact of the implementation of a management system is not clear. The research concludes that the implementation and certification of management systems is more common in companies that are already striving to improve their OSH performance.

Other studies have also shown that certified workplaces perform better than non-certified workplaces in terms of OSH tasks [25]. Madsen et al. concluded that those with certified management systems provide higher levels of occupational health and safety management than those without.

The effects of OHSAS 18001 on relevant occupational health and safety outcomes, such as reducing the number of accidents at work, are under-researched in scientific literature. The impact of this standard on other aspects of performance such as profitability and productivity has received more attention. The results of the study by Heras-Saizarbitoria et al. show that OHSAS 18001 certification is only loosely associated with improved performance in terms of the rate of workplace accidents [26]. They found that the propensity for OHSAS 18001 certification is more specific to economic sectors that show worse performance in terms of workplace accident rates. There is evidence of a negative selection effect of the main international

management standard for occupational health and safety.

Research has shown that there is a significant gap between the accident scenarios predicted by corporate safety management systems and the actual scenarios observed in major accidents. This gap points to flawed risk assessments, leaving hazards unmitigated, compromising the safety of workers, endangering the environment and jeopardising the continuity of the company. Lindhout and colleagues have compiled a literature review on this topic, based on a review of scientific literature, to provide a summary of the published views on how to deal with the problems [27]. Their findings suggest that safety managers who attempt to reduce and eventually close this gap are not only faced with the pitfalls of poor safety studies, but also with the acceptance of "unknown risk" as a phenomenon. They conclude that companies are lulled to sleep by inadequate process safety indicators. This is compounded by the unsettled debate between paradigms for improving process safety in a dynamic industrial environment.

In addition to management systems, research has also focused on the application of performance indicators and the interpretation and use of the information conveyed by indicators.

Caldarescu et al. found a direct correlation between the two types of indicators by examining the relationship between lagging performance indicators and leading performance indicators [28]. They suggested that further studies can be conducted to correctly identify the minimum number and types of performance indicators that can contribute to improving the performance of OSH management.

Walaski [29] also examined the role of lagging and leading indicators and called for a shift to leading indicators.

Vranješ et al. investigated the effectiveness of selecting performance indicators with the help of workers to optimize the management of occupational safety and health [30].

Pera and colleagues proposed a conceptual framework for defining key indicators for measuring safety performance [31]. The aim is to develop a structured pathway for identifying indicators from literature and those widely used by experts for all elements of a management system.

Bayramova et al. based on a literature review of leading indicators [32] found that important elements of leading indicators are invaluable tools. Their application offers organizations the opportunity to track not only past errors and accidents, but also performance indicators that lead to improvements in health and safety at work. Despite their tangible benefits, the definition, application and function of leading indicators are mostly unclear and inconsistent in literature.

Process safety indicators can be used to predict the possibility of major accidents in manufacturing processes. Shmitz et al. have shown that organizational factors have an indirect effect on

accident processes by strongly influencing the quality and reliability of safety barriers [33]. Qualitative and quantitative monitoring of organizational factors can provide a picture of their functioning and effectiveness.

Researchers in Norway have developed a method for developing safety indicators based on systems engineering considerations [34]. Traditional approaches use probabilistic risk assessment or linear accident models, which assume that accidents are linear chains of events and do not consider complex system factors and interactions. In their approach, they used the STAMP (System-Theoretic Accident Model and Processes) accident causation model to identify system-specific indicators. The results of their studies show that STAMP-based modelling allows a better understanding of safety systems. The STAMP-based indicator development process helps to focus on specific issues that could lead to a threat. The process considers human and organizational factors as well as technical elements.

Zwetsloot stressed the importance of leading indicators for preventive OSH management [35] in describing the process of developing proactive leading indicators of safety, health and well-being at work. Proactive lead indicators not only serve to better manage and control OSH processes, but also support the development of a preventive culture.

Other researchers have presented a data-driven method for observing the basic functions of security constraints to rule out human interpretation errors. [36] The approach converts process safety performance indicators (PSPIs) into online, globally available safety indicators that eliminate variability in human interpretation.

The management of security, and of security barriers, involves the use of performance information, i.e. the use of security performance indicators. For this information to be useful, the indicators must be of sufficient quality to meet certain predefined quality criteria. Without a good quality demonstration, indicators are generally not able to provide sufficient evidence to support the management of the queue, which can lead to poor decisions. Selvik et al. examined the use of so-called SMART criteria to assess the quality of safety performance indicators in the manufacturing industry [37]. The acronym SMART covers five key aspects and criteria for evaluating the quality of an indicator: 'specificity', 'measurability' or 'manageability', 'achievability', 'relevance' and 'time-based'. The ability of indicators to demonstrate adequate quality by meeting these criteria was discussed. The conclusion is that all SMART criteria must be met for a safety performance indicator to show acceptable quality and be considered useful in supporting barrier management decision making. However, it was also observed that the inclusion of criterion M in the quality assessment is not necessary. If all the other criteria are met, the conclusions should not be misleading because of measurability or manageability considerations.

Therefore, for the quality of safety performance indicators, it is sufficient to assess only four criteria and it was suggested that the acronym should be abbreviated to "STAR".

The European Union's road safety policy is based on the European Directive 2019/1936/EC. Among the safety management procedures and strategies, road safety audits are an effective tool to prevent the risk of accidents and to reduce the frequency and severity of accidents on existing road networks. The European Road Safety Council encourages the extension of these measures to major urban and rural roads through the 5th Road Safety Action Programme. Vaiana et al. carried out a safety benchmarking exercise to identify all road infrastructure features with poor safety conditions [38]. Significant correlation was found between accident frequency/total number of injuries and pavement markings deficiencies.

A demonstrable link between management commitment to health and safety at work and employee satisfaction and safety performance [39]. The results suggest that management commitment to occupational health and safety has a positive impact on employee satisfaction. Employee satisfaction directly and positively affects safety performance. However, no direct relationship was found between management commitment to OSH and safety performance.

Tappura and colleagues found that a commitment to performance measurement promotes its effective use [40]. The use of performance information requires appropriate measurement systems.

However, in day-to-day operations, the management of safety at work is usually sidelined to the operational management. This division between the two areas can be explained by conflicts between the risk-oriented logic of OSH management and the effectiveness of operational management [41]. These conflicts are manifested in differences in objectives, in the rationale behind practices, and in the organization of OHS and operational tasks. The future of safety science requires research into the relationship between the two fields to increase the impact of the OSH field.

Accou and Carpinelli explored the possibility of combining human and organizational factors, combining human and system analysis, to safely and sustainably manage the performance of socio-technical systems [42].

The results of an investigation into the relationship between organizational factors and management performance in occupational safety and health show that organizational factors applied at the firm level have a stronger influence on workers' behavior than organizational factors applied at the individual level [4]. Thus, safety management at the corporate level can be an important practical tool for developing safe behavior and attitudes towards workplace risks in the organization.

Each organization is unique in the way it operates, the training of its employees, its relationships with

other organizations, its history, its organizational culture, its relations with regulators. Accordingly, each organization's workplace safety management has its own strengths and weaknesses. There is therefore no one-size-fits-all approach to improving companies' OSH performance. It must be based on a thorough analysis of the organization concerned, leading to tailor-made solutions. To support such analysis and customization, Stroeve et al. developed the Occupational Health and Safety Management System Maturity Assessment approach in combination with a review of methods for improving the people-related soft aspects of safety management [43].

Homann and colleagues identified the factors that determine and influence the commitment of factory workers to OSH [44]. The main drivers of engagement were:

- (a) The safety focus of the company in its organizational and social aspects;
- (b) The quality and consistency of safety communication; and
- (c) The psychological environment, which includes the relationship between workers and managers.

Of these, the trusting relationship between OSH managers and workers appeared to be the most influential factor in terms of committed safety behavior. The safety focus - communication - environment are closely interrelated and should be considered as a whole, rather than as separate and distinct domains.

Turner and colleagues have examined the extent to which human resource management practices - selection, training, performance appraisal, compensation and empowerment - predict subsequent injury rates at the organizational level [45]. They found that only empowerment predicted subsequent organizational-level injuries. Organizations promoting empowered working had lower injury rates. They conclude that it is worth looking beyond traditional occupational health and safety management systems to understand how more general human resource management practices can help improve workplace safety.

Boczkowska and colleagues proposed a measure of workers' active involvement in OSH, considering the depth and extent of involvement [46].

The direct impact of organizational culture on occupational safety and health has also been identified by other researchers [47]. This finding highlights the key role of organizational culture in shaping and influencing safety and health management practices within an organization. A positive organizational culture can contribute to a safer working environment by promoting a safety culture, encouraging employee involvement and promoting leadership in occupational safety and health. The direct impact of organizational culture on business performance has also been confirmed. This highlights the critical role of organizational culture in shaping overall business performance. The study found that OHS management

has a direct impact on business performance. This finding suggests that effective safety and health management practices can positively impact business performance by reducing workplace accidents, improving employee well-being and optimizing resource utilization.

OSH training and competence has a significant positive impact on worker participation and involvement; while worker participation and involvement have a significant positive impact on worker satisfaction; and safety performance has a significant positive impact on worker satisfaction [48]. Furthermore, it has also been found that employee satisfaction is indirectly affected by safety training and competence through employee participation and involvement.

An examination of the relationship between the maturity of corporate safety culture and employee satisfaction found that overall employee satisfaction with the safety culture is primarily influenced by employee engagement. [49] Employee engagement, in turn, is highly dependent on the commitment of top management, mediated by supervisor commitment and safety training. The correlations identified suggest that the dimensions of individual safety culture should not be developed in isolation, as they are all interrelated. It is also important that mature communication can explicitly support workers' commitment to safety at work without the commitment of supervisors.

Aven emphasizes the importance of integrating safety and risk sciences to further develop concepts, approaches, principles, methods and models for understanding, assessing, communicating and managing system performance [50]. It argues that there is potential to further develop these safety aspects through the integration of risk science knowledge.

Safety and safety management is a key factor in the safety of an organization, and safety management studies have received a lot of attention recently. An analysis has been made of the status and trends in safety management research [51].

Sawhney examined the impact of different safety leadership behaviors on safety motivation [52]. He pointed out that positive leadership behaviors have an impact on safety motivation. In addition, safety attitudes and safety norms mediated the relationship between active safety leadership behaviors and safety motivation. Perceived safety control did not mediate the leadership attitudes-safety motivation relationship in any of the five leadership behaviors.

A similar conclusion was reached by Peker, who with his co-authors examined the motivational effects of the behavior of occupational health and safety officers and managers [53]. Their research results draw attention to the importance of managerial behavior, both in relation to safety motivation and safety results at the organizational level.

A number of security measures, such as security-related rules and security management procedures, are

applied to ensure security-related behavior in risky operations. It is reasonable to assume that all these lead to compliance with the rules, but the question is how do they interact? Experiments have shown that some combinations of measures, the interaction of several measures, can have a strong detrimental effect on safety, although overall they have been assumed to reduce risks [54]. In practice, this means that the effects of safety measures depend on their combination and may lead to undesirable effects. It can be argued that unintended adverse effects of a combination of several safety measures may distort the outcome of efforts to reduce workplace incidents and accidents. The definition of OSH management measures should consider the complexity and diversity of safety-related measures at different organizational levels.

Safety mistakes at work can lead to organizational learning. The role of error severity (error attribute) and negative affectivity of a personal trait (personal attribute) in learning from error was examined. [55] The view that fault traits must be severe enough to attract attention was undermined. The severity of error contexts increased both affective learning and cognitive learning. The results suggest that some errors in the workplace, at least those with minor consequences, may not receive much attention and can be easily forgotten. To fully exploit the learning potential and to be effective in preventive safety management, organizations need to pay attention to all errors and take them seriously, regardless of the severity of the immediate consequences of the error.

Incorporating human factors into decision making is a difficult challenge for manufacturing companies because human factors data is difficult to perceive and incorporate into decision making processes. A review of the relevant literature has provided guidance on different methods of measuring human factors, solutions to reduce occupational stress on workers, and the technical options for integrating these measures into a complex industrial decision system. [56] The analysis has shown the main differences between approaches to short-term fatigue, long-term physical strain and psychosocial risks. Long-term physical exertion is the topic that has focused most research efforts, mainly using physical and simulation techniques to highlight physical limitations in the workplace. Short-term fatigue and psychosocial limitations are a growing concern in industry due to new technologies that increase the demands on workers' cognitive activities.

A similar result was confirmed by Norwegian researchers [57]. During the analysis of accidents in the European process industry, it was found that accidents were caused by human factors in addition to process and design errors, mainly deficiencies in the technical and non-technical skills of the workers.

Based on the analysis of the causes of unsafe behaviors leading to serious accidents, a comprehensive approach to improving occupational health and safety performance is that OSH managers

and employers should devote more resources to studying and preventing adverse working conditions and unsafe behaviors among workers, regardless of age group [58].

IV. CONCLUSION

Most of the literature on measuring safety performance focuses on the technical issues of measurement, the effectiveness of the application of an occupational health and safety management system, or the differences between the use of leading and lagging indicators. Limited attention has been paid to the use of information from OSH performance measurement and the factors that influence management decisions leading to improvements in OSH performance. [59], [60]

The literature suggests that the effective use of information can lead to improved organizational performance. OSH experts agree that the OSH performance of companies is related to how well they track, manage and use the information provided by leading indicators. [61] Companies often have a lot of information about safety performance, but how and how effectively they use this data to make decisions is still a question.

The effective use of information from process measurement into tasks can be problematic. This problem is a "knowledge-action" problem, but it can also be described as an information-action problem, i.e. the difficulty of moving from performance measurement to performance management.

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