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Safety culture co-creation in forest industry manufacturing mills – A systematic literature review and conceptual model

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ABSTRACT

The forest industry has high accident and injury rates, and although research and practice recognize safety culture playing an important role in sustainable accident prevention, research about how safety culture is formed jointly is scattered among disciplines and knowledge traditions. Thus, this review adopts a co-creation lens to synthesize conflicts, agreements, and future research avenues of safety culture in the forest industry and comparable high-risk manufacturing and processing industries. To this extent, a descriptive statistical analysis of 60 articles and a systematic literature review of 25 articles were conducted and combined to develop a conceptual model. The descriptive statistical analysis shows a highly international field with few international and multidisciplinary collaborations. Quantitative methods and health and engineering fields are dominant, calling for more diverse research designs and increased international and interdisciplinary collaboration. The systematic literature review synthesizes the current research landscape, showing that safety culture is co-created in response to organizational, individual, contextual, and interventional factors. Additionally, it is shown that safety culture co-creation happens dynamically in horizontal and vertical directions in the organization, but also extends to external stakeholders. Thus, safety culture co-creation is no one-way street, but rather a dynamic and inclusive dialogue that happens vertically and horizontally within an organization, but also in relation to external factors and stakeholders. Training, communication, knowledge sharing, and collaboration are identified to be effective leverage points for practitioners to foster effective safety culture co-creation.

Keywords

bibliometrics, co-creation, forest industry, occupational safety, safety culture, systematic literature review, workplace safety

Citation

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INTRODUCTION

Worldwide, the forest industry, understood here as industries processing forest-based raw materials such as sawmills, pulp mills, and paper mills, is one of the most affected by fatal accidents (Knecht et al 2024, Best et al. 2021, Ulvenblad and Barth 2021, Tremblay and Badri 2018, Mylek and Schirmer 2015). There is a broad body of knowledge about measurable and physical safety aspects, such as organizational safety regulations, technological and procedural safety measures, personal protective equipment, as well as national safety policies and laws. However, there is a need for an improved understanding of safety in the forest industry from a perspective that takes human factors and intangible safety factors into consideration (Almanza Floyd et al. 2024, Christian et al. 2019). In addition, research about intangible safety factors is often scattered among different disciplines, knowledge traditions, and methodological approaches (Kalteh et al. 2021, He et al. 2019). Also, there is no comprehensive account of the current knowledge and research status of intangible safety factors in the forest industry, although this is an important step for further theoretical and practical development (Lundell and Marcham 2018, Beus et al. 2016). Thus, there is a need for systematically capturing the current status of academic efforts in researching intangible safety factors in the forest industry.

Safety culture refers to the shared attitudes, values, and perceptions that managers and employees have regarding safety and the working environment. It is one of the most important intangible safety factors, as its positive and sustainable effect on accident prevention and safety performance improvement is a consensus in theory and practice (Nævestad et al. 2021, Petitta et al. 2017). Safety culture has been researched in a variety of industrial contexts and with differing thematic focus, for example in connection to leadership in oil and gas industries (Ojuola et al. 2020), safety culture's impact on safety performance in hydropower projects (Aboubakar and Li 2024) or from a safety behavior and knowledge transfer perspective in construction (Duryan et al. 2020, Farrand and Carhart 2020). There have also been studies about aspects that relate to safety culture, such as the role of communication forms for safety awareness and training (Chaudhuri et al. 2021) or the influence of organizational commitment on safety climate (Sakallı and Kansoy 2023). However, systematic research about how safety culture is formed in relation to its determining factors in the forest industry is scarce. Also, while safety culture dimensions and layers (Edwards et al. 2013; Vierendeels et al. 2018) as well as safety culture as part of other national or organizational cultures

(Tear and Reader 2023, Casey et al. 2015, Haukelid 2008) are well researched, knowledge about the ways of safety culture creation is still to be developed further, especially in a forest industry context where participation of workers and management is a key component of safety (Mattson et al. 2025).

As safety culture permeates the organization's culture and is created and maintained both in groups and by individuals on all hierarchical levels, co-creation is a suitable concept to utilize. Co-creation means value creation through innovation and interaction, and it has evolved to be connected to management aspects such as partnerships, learning, knowledge, participation, and networks (Ulvenblad and Barth 2021). This makes co-creation a very fitting concept for the aim of synthesizing research about how safety culture is formed collectively, as co-creation factors are considered an increasingly important way to improve work safety further in areas where physical measure-focused factors do not have a sufficient effect (Cooper and Lindley 2015).

In this regard, the review aims to unveil the current status and future research avenues, including measurable bibliometric aspects as well as the scholarly discourse about safety culture co-creation, to provide a theoretical starting point for research as well as for practitioners seeking to improve their safety work through increased understanding. The contribution of this paper is therefore two-sided: on the one hand, the current research and knowledge status is analyzed to provide informed theory and practice recommendations for accident prevention, and on the other hand, valuable insights about research gaps as points of departure for future studies are given. The findings culminate in a conceptual model about safety culture co-creation that can serve as a basis for theoretical and practical advancement efforts in accident prevention. Thus, the review contributes with synthesizing the current knowledge status of how safety culture is formed jointly in the forest industry, which is one of the most accident-affected. The review also contributes to developing a new understanding of intangible safety factors by employing a co-creation lens as a novel perspective for exploring workplace safety. These contributions are achieved by employing the following research questions:

RQ1: What is the current research state of research on safety culture co-creation in the forest industry?

RQ2: Based on the synthesis of the current research status, what theoretical advancements, future research avenues, and practical implications can be identified concerning safety culture co-creation in the forest industry?

This systematic literature review revolves around co-creation factors and safety culture in the forest industry. Thus, this study concentrates on literature that explicitly has a forest industry context, including processing and manufacturing contexts from sawmills, paper mills, and pulp mills. After presenting the methodology, a descriptive statistical analysis is undertaken to gain an overview of the field. The second analysis part, namely the systematic literature review, illustrates the current knowledge status about safety culture co-creation. In the last chapter, the results are discussed, and theoretical conclusions as well as practical implications are provided to answer the research questions. The last chapter also includes a conceptual model about safety culture co-creation.

MATERIALS AND METHODS

According to Snyder (2019), a systematic review provides transparent and reliable findings by minimizing bias through rigorous standards, which allows researchers to draw conclusions and make decisions on a solid foundation. However, as the chosen body of literature for the review is heterogeneous in terms of applied methodologies and disciplines, a meta-analysis is not possible to conduct. Instead, a descriptive statistical analysis provides quantitative insights into the current status of the research, including statistical insights about the countries of the study context, publication amounts per year, applied methodologies, journals and journal disciplines, number of articles per discipline, co-authorship, and co-word occurrence.

Tranfield et al. (2003) and Davis et al. (2014) are especially considered in this review, as both provide useful perspectives on possibilities, challenges, and approaches for conducting systematic literature reviews in social and management studies. Tranfield et al. (2003) provide clear and rigorous guidelines for conducting a systematic literature review in business and management disciplines, divided into stages and phases. The review conduction stage consists of the phases of identifying the relevant research, selecting the articles to be included in the review, assessing the

study quality, extracting the data, monitoring the progress of the review, and synthesizing data. From the research questions, preliminary keywords for the literature search are identified. The first test searches are conducted with these keywords, followed by the most suitable articles from the first test searches being utilized to refine the search strategy further and to identify additional suitable search keywords. Moreover, the search strings and keywords are evaluated regarding whether they bring the desired results that align with the purpose and research questions of the review and, if necessary, adjusted. This process is repeated iteratively several times (Figure 1) while trying out different search strategies, search string combinations, and keywords. Additionally, the bibliometric analysis software VOSviewer, version 1.6.20 (Van Eck and Waltman 2025) helps to identify keyword patterns and clusters, which results in the acceptance of new keywords and further refinement of the search strategy. This process results in a search strategy including different search strings with a variety of search keywords, as shown in Table 1. The columns in Table 1 represent the different search strings utilized in the literature search. Moreover, several keywords are actively omitted in the search strategy to prevent the search results from including irrelevant articles.

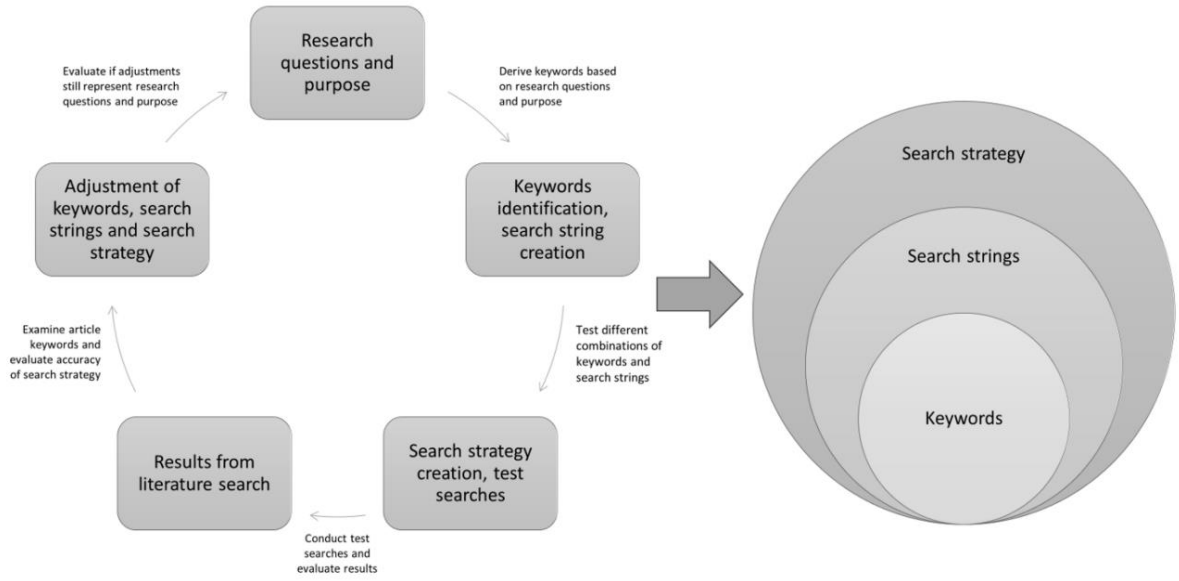

Figure 1. The iterative process of conducting a systematic literature review.

Table 1. Overview of search strategy including search keywords and search strings.

Context	Perspective	Area of interest
forest industry, wood industry, timber industry, paper industry, pulp industry, lumber industry, pulp mill, sawmill, paper mill	business, manufacturing, processing, factory, production, company, enterprise, leadership, management	safety, work safety, workplace safety, job safety, safety culture, occupational safety, safety climate, safety training, safety environment, safety behavior, safety opinion, safety attitude, safety risk, safety motivation, safety awareness, safety perception, safety management, safety intervention, accident prevention

After iteratively setting up the search strategy, the final literature search was conducted in late April 2024 using OneSearch. OneSearch is a search service that includes the local university's library catalogues and most scientific databases (Halmstad University, n.d.). Although test searches were also conducted in other databases, the results in OneSearch showed higher degrees of quality and relevancy because this database provided the most relevant contributions due to more developed filtering options. This was necessary because the literature review maps an interdisciplinary and narrow field of research. Due to this literature review being conducted in April 2024, some time-sensitive results, such as the number of publications per year, may be influenced by delays in publication cycles. Apart from the already presented confinements, the search was limited to peer-reviewed articles to ensure scientific quality. In addition, because this paper aims to characterize the current research status, the results were also limited to a period between 2016 and the present. Also, only articles written in English were considered. We acknowledge that this could introduce bias into the review and reduce scientific rigor, as some relevant articles written in other languages might be omitted due to this approach. However, we deemed this procedure suitable as it enables readers and authors of this paper to understand the argumentation and conclusions in this literature review. Doing so ensures transparency and credibility to the readership of this article. Sixty articles (Appendix A) were preselected for the descriptive statistical analysis based on the screening of keywords, titles, and abstracts. From this dataset, 25 (Appendix B) were further selected for the systematic literature review based on examining whether the full text matches the research aim and scope. This approach serves the

purpose of this article, as a broader database for the statistical analysis paints a more general picture of the field that provides insights into the overall research status. At the same time, the narrowed database for the systematic literature review provides more tailored content insights into the topic of interest, namely intangible safety culture co-creation factors.

The following inclusion and exclusion criteria were applied to retrieve the contributions that were part of the systematic review (refer to Table 2). Criteria for inclusion are that the article is focused on safety culture co-creation aspects, such as leadership, risk management, collaboration, communication, training, work environment, safety behavior, knowledge, motivation, awareness, perception, and attitude. Other inclusion criteria are that the research context of the article is located in the manufacturing and processing sector in the forest, paper, or pulp industry. On the other hand, exclusion criteria encompass articles focused mainly on medicine, ergonomics, and technical or engineering aspects of safety, such as specific tools, machinery, or protective equipment. Moreover, an article was not included in the review if its research context was mainly something different than the forest-, paper-, or pulp industry, for example, related fields such as forest management, forestry, logging, or felling. However, contributions with such a thematic focus and study context may be included in the systematic review if they also provide insights that are inside the scope of the review.

Table 2. Overview of exclusion and inclusion criteria.

Inclusion criteria	Exclusion criteria
The article deals with safety culture co-creation aspects, such as leadership, risk management, collaboration, communication, training, work environment, safety behavior, knowledge, motivation, awareness, perception, and attitude.	The article is focused on medicine, ergonomics, and technical or engineering aspects of safety, such as specific tools, machinery, or protective equipment
Research context of the article is located in the manufacturing and processing sector in the forest-, paper- or pulp industry	Research context is mainly something different than the manufacturing sector of the forest-, paper- or pulp industry, for example, related fields such as forest management, forestry, logging or felling

Data analysis unfolds in two directions. The first is the descriptive statistical analysis, which approaches the preselected literature in a general way to provide a quantitative overview of the field. The descriptive statistical analysis examines, for example, countries, journals, journal categories, disciplines, and methodologies prevalent in recent workplace safety contributions.

From these descriptive statistical insights, conclusions are drawn about the current research status of the field, and possible future research avenues are derived. The basis for this analysis part is 60 preselected articles. The systematic literature review, on the other hand, examines the final 25 selected articles regarding their approach, research context, perspectives, assumptions, insights, and conclusions. While the descriptive statistical analysis provides a more general and quantitative overview of the field, the systematic literature review concentrates on thematic content as well as conflicts, agreements, and patterns in the literature. This is also the reason for taking a broader dataset for the descriptive statistical analysis and a narrower dataset for the systematic literature review.

RESULTS

Descriptive statistical analysis

Regarding the countries where most of the current articles' study environments were located (Figure 2 and Figure 3), one can see that international contributions, as well as articles with their study context located in Sweden, Ethiopia, Italy, South Africa, Thailand, the USA, and Turkey, were the most represented. Additionally, many articles were located in Canada, Denmark, France, Nigeria, and Spain. Thus, the field is highly international, with numerous contributions from Europe, Africa, Asia, and America. The field is quite diverse country-wise, with contributions from 20 single countries and four international articles in the last few years. The country where most research was conducted is Sweden, as 14 articles investigated safety culture co-creation topics in this country. This is especially interesting as the country with the following highest number, Ethiopia, had only five contributions, which is significantly lower. The high number of contributions about research located in Sweden could potentially be explained by a rich forest industry research tradition or the high societal and economic relevance of the Swedish forest industry. However, the current research landscape in general is characterized mainly by local embeddedness on the one hand and international connections on the other hand.

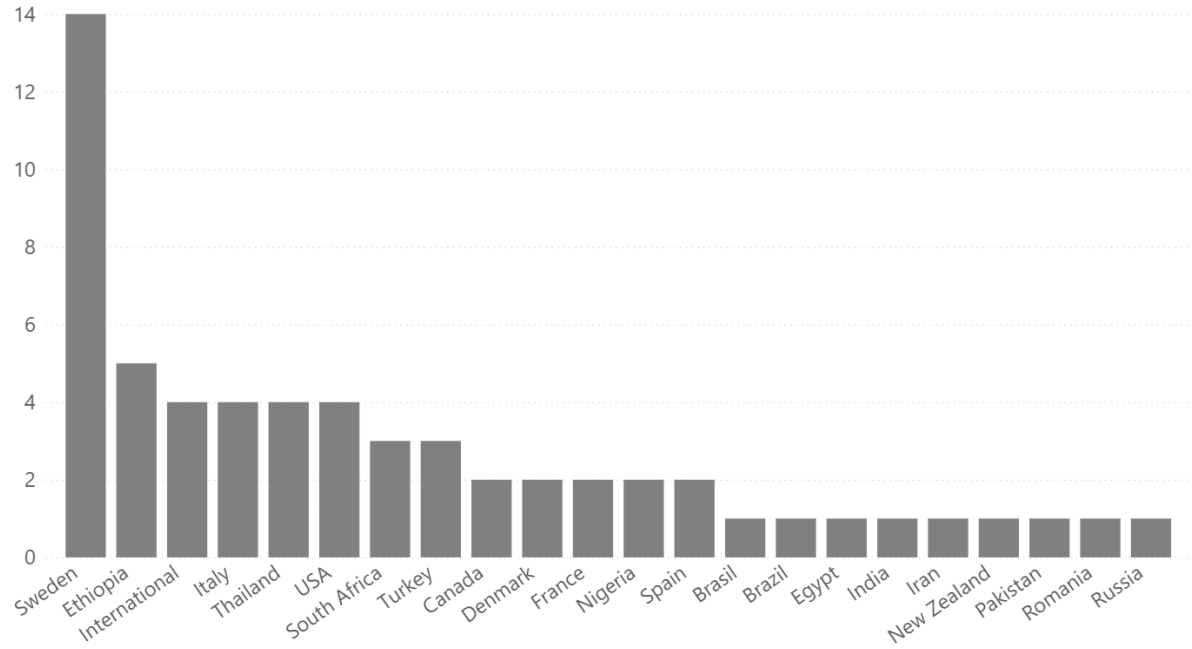

Figure 2. Number of contributions per country of study context.

Figure 3. Map of the number of contributions per country of study context.

Moreover, as seen in Figure 4, the number of publications in this field is growing. While 2016 had eight published articles, the years after have shown a slight decline in publication numbers. This trend changed in 2019 and onward, showing an increasing number of published articles. While

2018 had four publications, the year with the least number of contributions, fourteen articles were published in 2022, showing an increase of ten articles between 2018 and 2022. Although the quantitative scholarly interest in this topic has been growing, a decrease in publication numbers can be observed in 2023. Since the literature review was conducted in April 2024, this trend may reflect delays in the publication cycle rather than an actual decline. However, if this is not the case, this recent decline in publications in the field is concerning, considering the remaining importance of the topic and significant gaps in the field. Inquiries into the reasons for the initial rising but now declining academic interest in the topic of safety in the forest industry could shed some light on the underlying mechanisms that lead to this development.

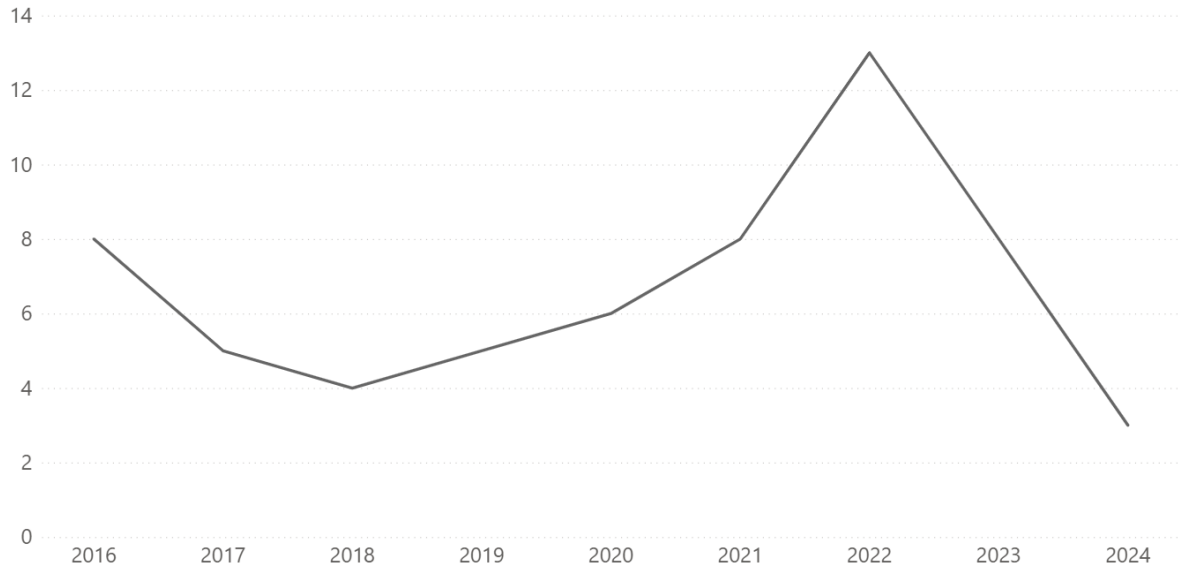

Figure 4. Number of publications per year.

Methodologically (Figure 5), most articles employ quantitative and mixed methods, while review and qualitative papers were less frequent, with only six contributions being review and qualitative articles. This dominance of quantitative approaches implies the risk that the field may rely too heavily on measurable insights, implying the risk of missing important intangible safety aspects. Due to the low numbers of qualitative and mixed-methods study designs, it can be argued that safety research in the forest industry tends to neglect intangible safety factors. Moreover, the lack of review and conceptual papers shows gaps in theoretical and conceptual development. These insights call for increased qualitative research to enrich the field with more diverse, wider, and

deeper contributions to paint a more complete picture of industrial reality. Additionally, more conceptual and review research is needed to advance the rich empirical insights in the field with theoretical development and rigor. Future research avenues could, therefore, revolve around applying qualitative and conceptual review approaches to create new research insights that complement the field with relevant contributions in areas that may have been under-researched in the past. These insights also call for more systematic reviews that thoroughly investigate and develop theoretical notions of workplace safety in the forest industry.

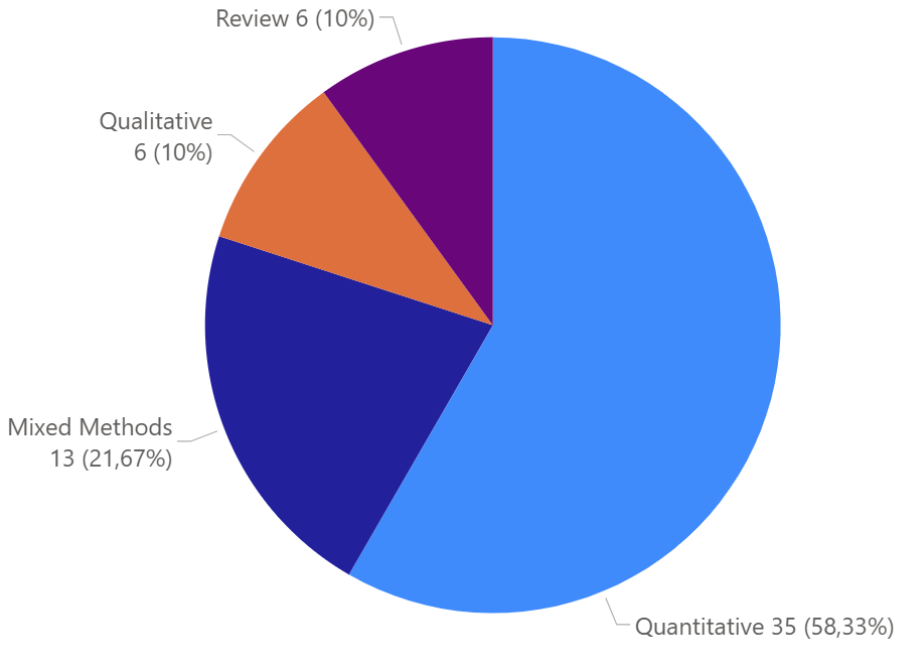

Figure 5. Number and percentage of contributions per employed methodology.

The fact that quantitative methods dominate the field, while qualitative approaches are less frequent, may also be due to the disciplines in which many articles are published (Figures 6 and 7). Articles were primarily published in journals from disciplines such as occupational health, medicine, and occupational safety. At the same time, the rest stem from multidisciplinary journals, as well as journals focusing on areas such as safety, technology, engineering, or forestry. Interestingly, apart from one contribution being published in the Scandinavian Journal of Management, journals from the fields of organizational, management, or business studies do not play a significant role in recent research on occupational safety in the forest industry. Therefore,

the field clearly lacks practical and theoretical contributions from management and business perspectives, although these disciplines and perspectives would help to deepen our knowledge about more intangible dynamics of safety culture co-creation, which is inherently more of a human factor than a technological or medical phenomenon. In this sense, management and business disciplines can add valuable insights on how to bridge the gap between the technical and human aspects of safety in a holistic manner. Because such perspectives are not yet present in workplace safety research, this gap provides another opportunity for future research, which could leverage organizational perspectives from business and management journals to improve our understanding of safety with additional theoretical and practical insights.

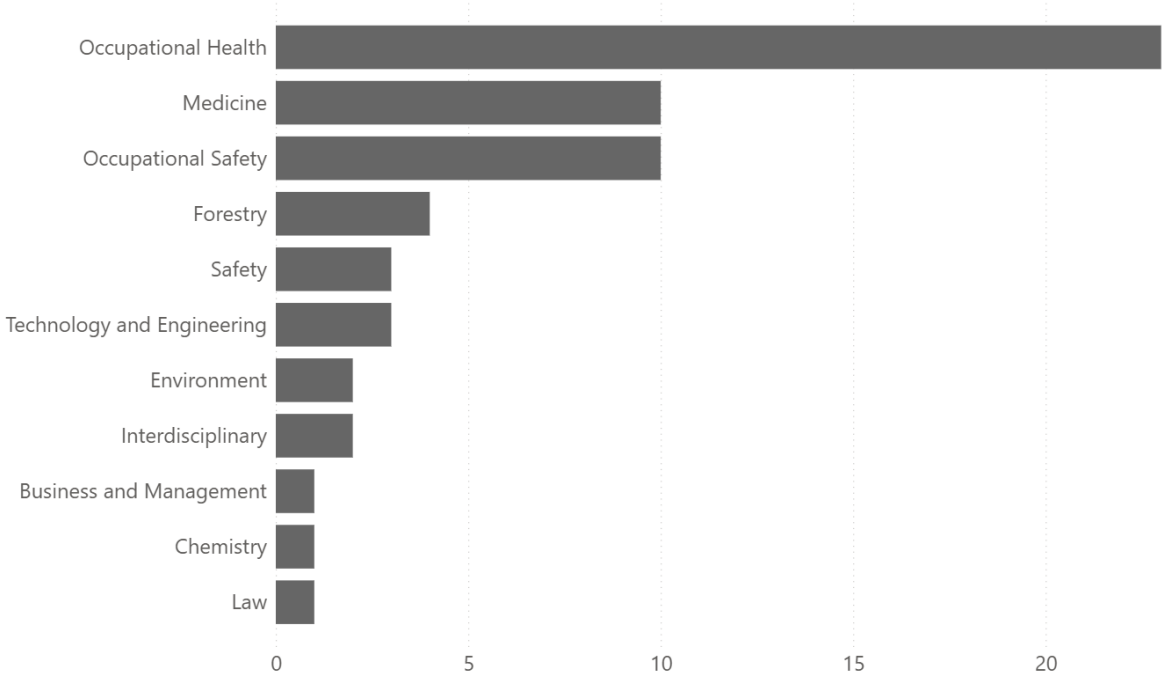

Figure 6. Number of contributions per journal category.

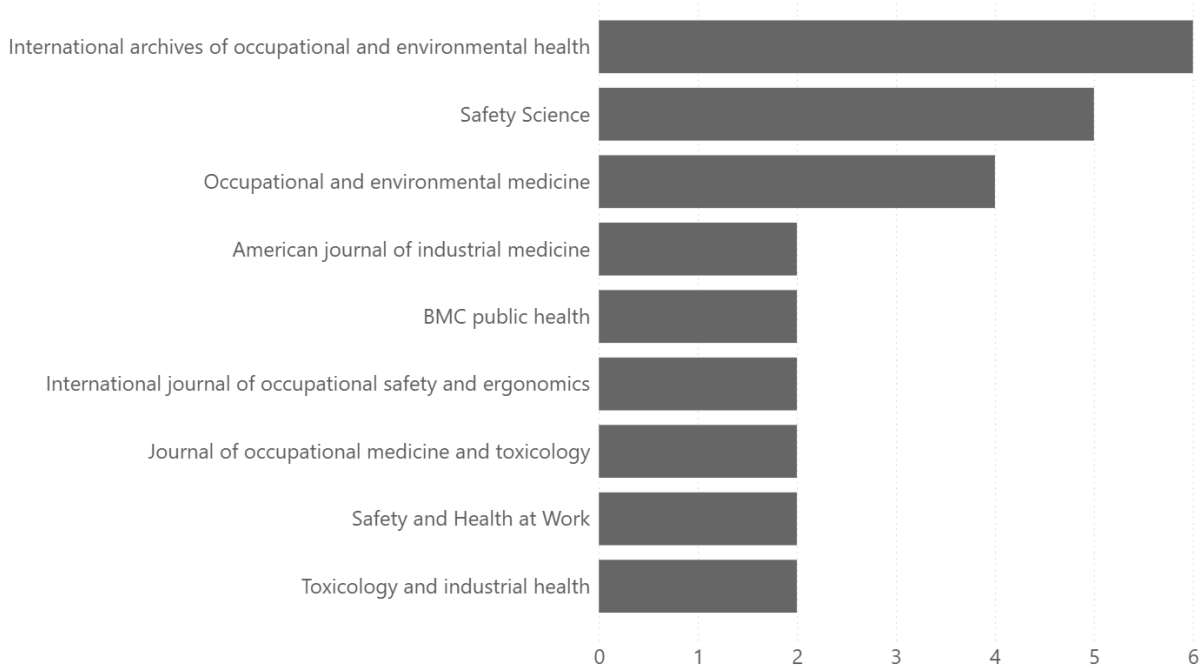

Figure 7. Journals with two or more relevant published articles.

Co-authorship (Figure 8) unfolds in various independent clusters. In VOSviewer, the threshold of minimum accounts of authors was set to two to gain a complete picture of co-authorship. The two most prominent clusters with ten and eleven authors are followed by two smaller clusters of three authors. The two smallest clusters consist of one or two authors. Although close collaboration exists between authors, the connection between the clusters is not as developed. This is especially interesting because it has been shown earlier that the field is relatively international. For future research, this may imply that collaboration between different author clusters, countries, and disciplines can be increased to strengthen and deepen the research insights in the field with diverse and cross-cultural cooperation.

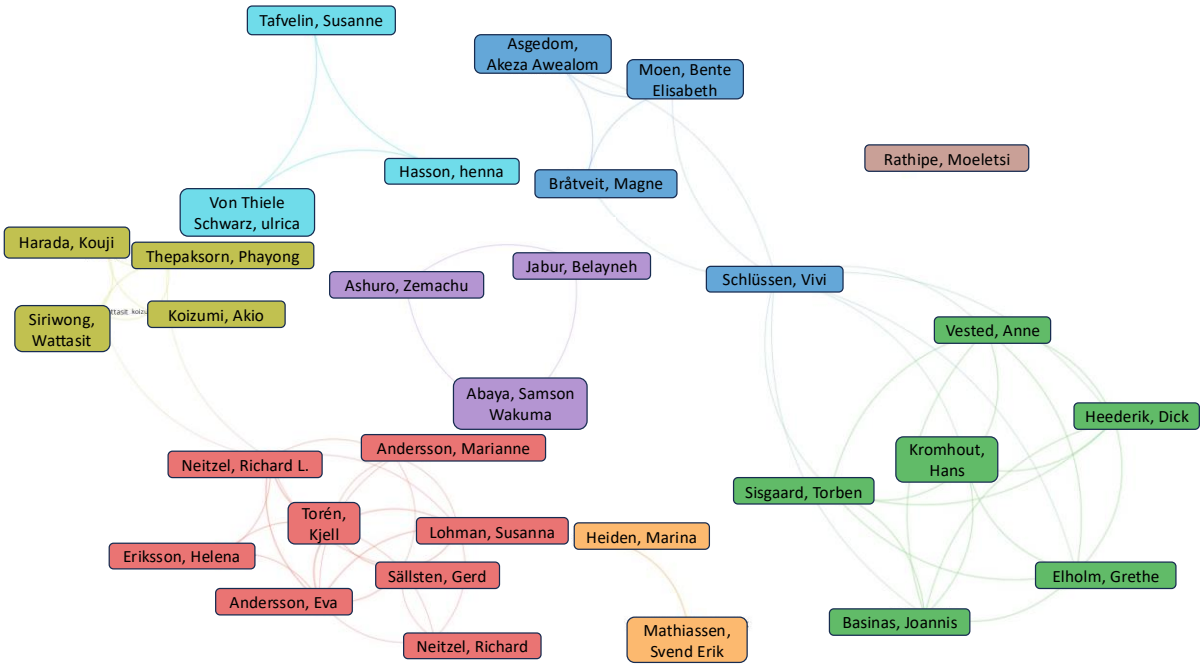

Figure 8. Co-authorship clusters.

Regarding the co-occurrence of keywords (Figure 9), two main clusters that are closely connected can be identified. The threshold was set to a minimum of five occurrences of each keyword to get a result of only the most important keywords. Three main clusters of keyword co-occurrence can be identified, evolving around occupational health with 23 occurrences, occupational exposure with 18 occurrences, and dust with 16 occurrences for the blue cluster. In general, most of the central and, therefore, often occurring keywords come from realms such as health, medicine, and quantitative methods. Keywords relevant and specific to the scope and aim of this review, such as safety, safety management, risk assessment, risk factors, and employment, played a relatively minor role, as they had fewer occurrences and fewer links to other keywords. Methodologically, the prevalence of keywords connected to quantitative methods, such as statistical analysis or regression analysis, showed once again the emphasis on quantitative methods. Interestingly, keywords such as safety culture, safety climate, collaboration, communication, or co-creation were absent. This again may illustrate a clear research gap in the realm of safety culture and co-creation in the forest industry.

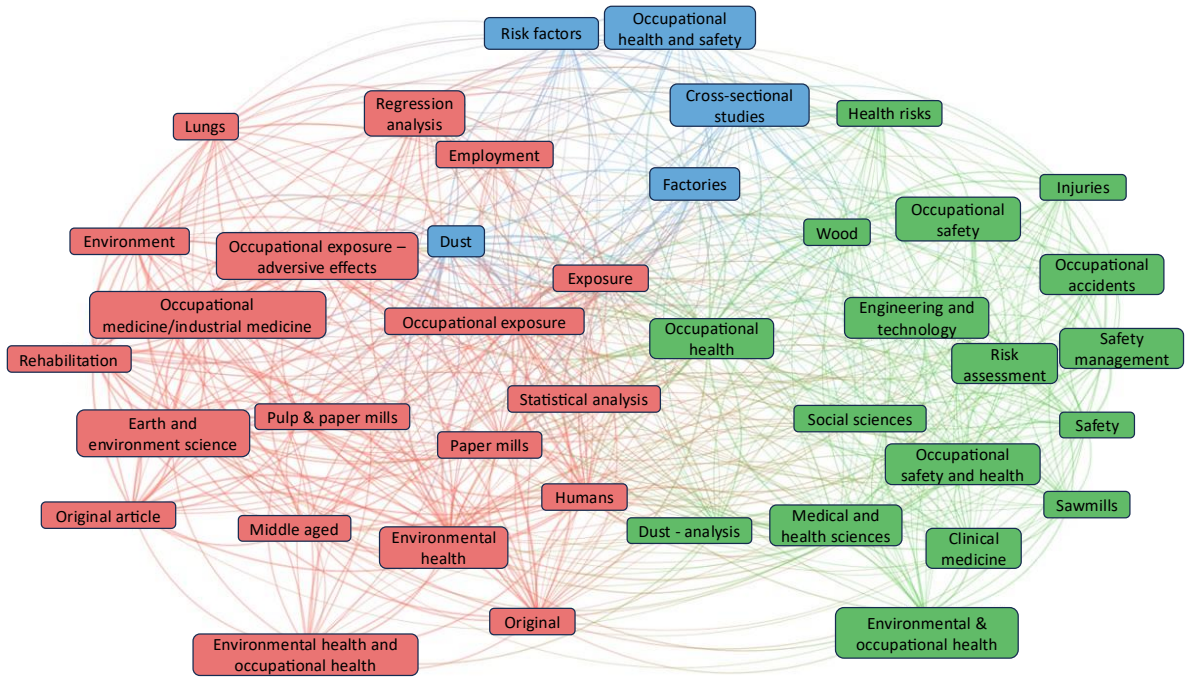

Figure 9. Co-word occurrence with a threshold of a minimum of six occurrences.

To sum up, the descriptive statistical analysis showed various gaps that provide multiple research avenues for future inquiry. First, as occupational health is the most researched topic, perspectives from medicine and health can be regarded as the most dominant field, also when considering keyword topics and thematic journal categories. Thus, although technology and medicine are invaluable and important topics to research in workplace safety, there is a gap in researching workplace safety in the forest industry from perspectives that concentrate on other topics. Future research avenues could therefore concentrate more on gaining a holistic picture of workplace safety that complements technical and medical perspectives on workplace safety factors. For example, future research in the field could aim to shed light on more intangible safety factors at different organizational levels, including varying organizational entities and stakeholders in a holistic and interconnected understanding. Moreover, the current focus on quantitative methods, which is related to the fields that are currently most dominant in the field, calls for more use of qualitative and review methods to mitigate the risk of missing important insights and to foster theory development further. Also, there is a gap concerning methodological and discipline diversity, which again poses a risk of a lack of insight into diversity and applicability across contexts. For this reason, journals and professionals from other disciplines, such as business and management studies, need to get involved in occupational safety research in the forest industry to

enrich the field with more diverse insights generated through a variety of methodologies and theoretical lenses. This can also be achieved by an increased utilization of cross-disciplinary collaboration, filling the gap of lacking multidisciplinarity and few collaborations across research traditions, fields, and sectors.

Systematic literature review

The systematic literature review was divided into five sections. Each section was derived from thematic commonalities that were discovered in the literature, although there are, of course, also thematic overlaps between the sections. The subchapters consist of a table about key findings and safety culture co-creation topics covered by the reviewed literature in the respective thematic focus and of a short text that discusses and consolidates the findings from the table.

Safety culture co-creation in individual and subgroup risk awareness, attitudes, and behavior

On an individual level, essential safety culture co-creation factors such as safety behavior, risk perception, awareness and safety attitudes are influenced by certain individual and demographic characteristics, for example age, education, salary, personal protective equipment (PPE) usage, or level of experience. Similarly, work environment aspects shape safety behavior and safety attitudes of workers. For instance, workload, maintenance frequency, accident history, production goals and working hours affect safety culture co-creation circumstances on an individual level.

Table 3. Key topics and findings of literature about safety culture co-creation in individual and subgroup risk awareness, attitudes and behavior.

Reference	Safety culture co-creation topics	Key findings
Thepaksorn et al. (2018)	- Risk perception - Safety behavior - Work environment - Training and education - Risk management - Integration of individual needs with management and education measures	- Individual risk perception and the work environment play an essential role in safety behaviorp - Organizational health and safety management measures should consider specific subgroups' particular circumstances and needs - Risk perception and knowledge as antecedents for safe behavior in specific workforce groups
Ezinne et al. (2021)	- Role of management and organizational structures for individual safety behavior - Leadership commitment - Safety behavior - Demographics - Formalization - Rules and procedures - Safety investment	- Risky nature of the work makes organizational provision of PPE important for safety - Policies and programs must be developed to encourage employees to use the PPE - Employees of a younger age, with a lower salary, having less work experience and not using PPE are strongly associated with a higher prevalence of work-induced injuries
Asgedom et al. (2019)	- Knowledge, attitude, and practice of specific subgroups of workers - Safety differences between permanent and temporary workers - Safety behavior - Safety attitude - Knowledge sharing	- Employees generally know about hazards, effects on health, and preventive measures - Permanent employees show a more safety-conscious attitude and a higher usage of PPE, more vocational training, better knowledge of occupational risks and a more robust safety attitude than temporary employees - Experienced employees can have a role modelling effect in safety culture co-creation
Komut et al. (2020)	- Demographics - Importance of contextual factors such as competitiveness, work environment, and organizational structure for safety - Training and education - Safety investment - Rules and procedures	- Safety attitudes differ significantly with factors such as age, marital status, department, time of employment, and machinery maintenance frequency - Low education level and often changing workplaces negatively influence safety knowledge and behavior - Significant safety hazards include infrequent machinery maintenance and the non-provision of PPE, often caused by economic pressure
Girma et al. (2022)	- Differing individual preconditions and needs for safety - Training and education - Rules and procedures - Demographics - Leadership commitment	-Employees with less work experience, not having received health and safety training, with long working hours per week, and not using PPE have more injuries - - Ongoing training in the health and safety realm is crucial, together with PPE provision and monitoring of PPE use
Araújo-Vila et al. (2022)	- Active incorporation of demographic subgroups and their strengths in safety strategy - Knowledge sharing - Human resources and talent management - Work environment - Safety attitude	- Older employees provide experience, technical knowledge, problem-solving skills, better preparation for work tasks, and less stressful attitudes toward problems - To keep these skills, experiences, and knowledge so that younger employees as well as the organization, can benefit from them, it is vital to adapt job tasks and work environments to the needs of older employees.
Singh and Sekhon (2018)	- Continuous risk and safety management - Collaboration between different actors, levels, and institutions - Communication and dialogue - External stakeholders - Inclusivity - Work environment	- Effective and inclusive risk management is one of the most critical factors in improving safety - Risk management includes switching to alternative, less toxic materials, use of PPE, safety training, improvement of working environments, refinement of work methods, maintenance of equipment and machinery, implementation of appropriate emergency plans, increasing collaboration between industry and government, and raising awareness among all included actors.

To target these diverse needs and preconditions on an individual level, the active consideration of worker subgroups is a solution to managing safety attitudes, risk perception, and safety behavior. Worker subgroups form along factors such as experience and training levels, or being temporarily or permanently employed. Actively recognizing the different needs and safety characteristics of different worker subgroups allows for a relevant, effective, and targeted way. Management policies and programs, education and training interventions, accessible and equal provision of PPE, adapted work conditions or ongoing and engaging risk management are measures to support safety culture co-creation while considering differing preconditions and needs of a diverse workforce. Thus, safety culture co-creation depends on integrating individual characteristics and subgroup needs with organizational measures and work environment adaptation (Table 3).

The role of formalization, documentation, and compliance for safety culture co-creation

There is a certain degree of disagreement on whether higher degrees of compliance- and formalization-focused measures as part of safety management aid or hinder safety culture co-creation. On the one side, compliance-focused safety programs often fail because they neglect human behavior and individuality. On the other hand, formalization and control are among the most effective tools for safety management, enabling the monitoring of adherence to safety protocols and improving overall safety.

Table 4. Key topics and findings of literature about the role of formalization, documentation, and compliance for safety culture co-creation.

Reference	Safety culture co-creation topics	Key findings
King (2020)	- Formalization - Rules and procedures - Individual safety factors - Safety behavior	- Safety programs heavily based on compliance and control must naturally fail because they neglect the human-based elements of co-creating safety culture - Individuality and human behavior must be actively recognized when designing safety programs
Nnaji and Udokpoh (2023)	- Compliance and control for improving physical safety - Laws and policies - Training and education - Formalization - Documentation - Rules and procedures	- Injuries and hazards are often linked to specific work tasks - Occupational health and safety legislation needs to be further strengthened, and implementation should be increasingly monitored to improve compliance - Training about workplace hazards needs to be conducted continuously and frequently
Thepaksorn et al. (2017)	- Work environment - Communication and dialogue - Holistic and inclusive risk and safety management - Organizational structure	- Most important physical risks are dust, chemical and noise exposure - Need for an overarching action plan that incorporates different physical and non-physical safety aspects, levels, and departments of a production site
Rashid et al. (2022)	- Organization-wide communication and inclusion - Systematic risk management - Organizational structure and culture - Process hazard analysis revision and auditing - Formalization	- Process safety management implementation needs to be facilitated by sharing process safety management responsibility between departments - Importance of formalized co-creation in the form of leveraged communication and documentation to foster process safety culture
Poisson and Chinniah (2016)	- Technical lockout procedures and policies - Documentation and formalization - Safety behavior - Rules and procedures - Systematic risk management - Inclusivity - Communication and mutual feedback - Leadership style	- Lockout practices are often more developed than lockout policies and programs - Lockout procedures combined with task risk analysis and a revision of close-to-machine operations can help to reduce safety risks - Participatory and adaptive management systems to adapt safety lockout programs to operational reality - Audits, pictograms, and an integrated training and feedback system help to identify safety gaps, set up applicable safety policies, and support workers in improving their work safety
Rayner Brown et al. (2022)	- Process hazard analysis and hazard management through inherently safer design - Work environment - Risk management	- Solutions of inherently safer design include removing dangerous equipment, redesigning workplaces, and adjusting machinery for a safer production environment - Incident investigation and process safety management are valuable tools, especially in a collaboration context

However, there is an overarching agreement on the fact that formalization, documentation, compliance and procedure development work best when being integrated with aspects such as safety management, work environment, work realities and individual characteristics. In this sense, it is often proposed to link compliance and safety programs to ongoing training, collaboration, feedback loops, leadership and shared safety responsibility. Thus, formalization, documentation and compliance pose the risk of overlooking human factors. However, if combined with participatory, engagement and collaboration across teams, departments and hierarchies, these measures are effective modes of safety culture co-creation (Table 4).

Influences of identity, informal relations and leadership on safety culture co-creation

Interpersonal relations, leadership, individual identity and group identity greatly influence safety culture co-creation. Individual and group identities concerning safety are shaped horizontally and vertically in relation to peers and to management. As this affects acceptance and perception of safety measures, failing to align safety measures with workers identity and work reality and missing the opportunity to involve workers in safety program design can lead to resistance among workers.

Table 5. Key topics and findings of literature about the influences of identity, informal relations, and leadership on safety culture co-creation.

Reference	Safety culture co-creation topics	Key findings
Arbin et al. (2021)	- Identity and peer dynamics - Risk and safety perception - Engagement - Safety attitudes - Communication and dialogue - Inclusivity - Interpersonal relations - Vertical and Horizontal safety mechanisms	- Workers resist health and safety programs because the program fails to address the employees' work identity - Workers define their identity vertically in relation to other hierarchies and horizontally with their peers - When health and safety programs come from management and trade unions, these mechanisms lead to the workers resisting the program - Formally and informally involving employees in the safety program and fostering a mutual dialogue about workplace safety helps to avoid this problem
Mattson Molnar et al. (2019)	- Leadership commitment and style - Safety-specific leadership - Vertical safety mechanisms - Communication and dialogue - Safety behavior - Interpersonal relations	- Safety-specific leadership is a leadership construct inspired by transactional and transformational leadership. - Leadership that emphasizes safety continuously has a positive effect on individual safety behavior. - Communication and acting as a role model are crucial in this type of leadership
Tafvelin et al. (2019)	- Influence of disagreement and agreement between workers and leaders for safety - Safety behavior - Safety attitude - Mutual feedback - Communication and dialogue - Leadership style and commitment - Engagement and inclusivity	- The extent to which leaders and followers agree on the level of safety leadership is an important mechanism for understanding and influencing overall safety culture - Perceptual distance between leaders and followers also has consequences for feedback processes - Leadership training should incorporate feedback tools and processes - Followers' self-efficacy in intervening against unsafe work practices is higher when disagreeing with their leaders about safety as followers claim informal responsibility for their and colleagues' safety

Agreement or disagreement between leaders and followers on safety behavior and measures plays an important role in equal collaboration and feedback when designing said safety measures and programs, especially when it comes to training interventions and safety behavior of leaders. Workers are, for example, more prone to intervene against unsafe practices when they disagree with their leader's safety behavior, suggesting that informal responsibility for safety may shift to employees in such cases. Thus, leaders are crucial to safety culture co-creation as they can foster and initiate open communication, and as they act as safety behavior role models through safety-specific leadership. Whether in relation to leadership, individual identity, or group dynamics, employee involvement, feedback tools and processes and mutual dialogue are key components of safety culture co-creation (Table 5).

The relation between competitiveness and safety in internal and external safety culture co-creation

Safety is not only a cost or obligation for companies, but it is also one of the most important factors for competitive strength. When seeing safety from a human resource management, corporate social responsibility, and sustainability perspective, it has the potential to contribute to more stable and resilient production, leading to ethical, social, and economic value creation. Human resource management thus plays a key role in fostering collaboration between managers, workers, agencies, health representatives, researchers, and financiers. With that, human resource management contributes to important safety culture co-creation factors such as dialogue, engagement, and transparency not only within the organization, but also with external stakeholders. Such multi-stakeholder collaboration aiming at safety across and beyond an organization including industry, communities, government and the workforce strengthens sustainable development, social responsibility and legitimacy.

Table 6. Key topics and findings of literature about the relation between competitiveness and safety in internal and external safety culture co-creation.

Reference	Safety culture co-creation topics	Key findings
Almanza Floyd et al. (2024)	- Competitive environment - Corporate social responsibility - Sustainability - External stakeholders - Human resource management - Safety strategy - Safety investment - Risk management	- The most relevant criterion for competitive strength is health and safety, and the most essential competitive indicator is human resources management - Integration of these factors happens through social sustainability and responsibility -"Classic" competitiveness factors such as raw materials, new markets, or environmental regulations play only a minor role - Ignoring or underestimating the social sphere can be counterproductive for economic success and stability
Baumgart et al. (2023)	- Competitive environment - Safety behavior - Training and education - Safety and risk management	- Positive association between productivity and safety - Practical PPE use among workers can be facilitated by investing in modern equipment and training employees, which has, in turn, a significant effect on productivity
Ulvenblad and Barth (2021)	- Co-creation in developing formal human resources management practices concerning safety and health - Formalization - Knowledge sharing - Human resource management - Inclusivity and engagement - Communication and dialogue - Feedback	- Co-creation consists of collaboration between unit representatives, managers, working agencies, key persons from the workforce, business health representatives, researchers, and financiers - The co-creation process is driven by co-creation activities that benefit from dialogue, access, risk, transparency, and openness to consolidate processes - Co-creation can, therefore, be a valuable tool to achieve functioning and efficient human resources management processes and safety
Morozov et al. (2021)	- Co-creation within and between stakeholders and organizations - Health and safety as most important corporate social responsibility factor - External stakeholders - Communication and dialogue - Laws and policies	- Companies achieve legitimacy, improve stakeholder relationships, ensure sustainable development, and incorporate social responsibility through interaction between local communities, government, and business - The most critical aspect of social responsibility is the behavior of companies towards their workforce to ensure health and safety - Collaboration between industry, municipalities, legislation and workforce enables social responsibility
Best et al. (2021)	- Influence of psychosocial factors and stress on wellbeing, health and safety at work - Work environment - Organizational structure and culture - Interpersonal relations - External stakeholders - Competitive environment - Sustainability and corporate social responsibility	- Mental health and psychosocial wellbeing are crucial factors for workplace health and safety - Psychosocial factors and stress can focus on work content and work context - The importance of taking a holistic perspective on safe work environments manifests in linking safety to competitive advantage and sustainability - Expanding safety management to communities, external stakeholders, and interpersonal relations beyond the workplace improves psychosocial work conditions

In this sense, safety culture co-creation within and beyond organizational entities helps to improve physical and psychosocial working conditions by leveraging laws, industry standards, and best practices. When involving internal as well as external actors, safety culture co-creation can yield measurable return on investment, reframing safety from a cost to a driver of productivity and stability. Thus, holistic safety culture co-creation addressing physical and psychosocial safety can produce economic, social, and environmental benefits (Table 6).

Safety culture co-creation in safety training and interventions

In this sense, co-creative interaction and collaboration between individual staff members and organizational entities is key when it comes to training, as safety culture co-creation is not only the outcome of safety training, but also the basis for designing, conducting, and evaluating interventions. Diverse and inclusive participation and engagement of workers and management, as well as integrating internal factors (attitudes, behavior) with external factors (equipment, procedures), is both the starting point and result of safety culture co-creation in training and interventions.

Table 7. Key topics and findings of literature about safety culture co-creation in safety training and interventions.

Reference	Safety culture co-creation topics	Key findings
Tehrani et al. (2018)	- Interventional role of training for co-creating a health, safety, and environment culture - Training and education - Organizational culture - Safety attitude - Engagement and inclusivity - Communication and dialogue - Sustainability	- Training programs that are tailored to the needs of the employees and organization have a significant positive effect on health, safety, and environmental awareness and attitude, staff capability, and health and safety reporting - Although training interventions are often comprehensive and resource-demanding, it is a highly effective tool to achieve holistic safety learning - Effective training interventions depend on a thorough understanding of the employees' health, safety, and environmental culture
Cil and Gedik (2022)	- Safety interventions mediating between formal and informal safety aspects - Training and education - Safety behavior - Safety attitude - Risk perception - Organizational and work environment factors	- Understanding risk-taking behavior plays a crucial role to develop effective safety interventions to reduce occupational accidents and injuries - Organizational and workplace factors such as PPE usage, safety training, working conditions, and safety climate significantly affect employees' risk-taking behavior - Individual factors, such as risk perception, play only a minor role in influencing workers' risk-taking behavior
Hedlund et al. (2016)	- Increase of safety motivation through interventions - Training and education - Engagement and motivation - Safety attitude - Leadership	- At the enterprise and individual levels, safety motivation changed significantly after conducting safety training interventions - For a significant change effect of safety training, the number of training occasions, the engagement of the decision makers, the overall degree of participation, and the relevance to the primary target group are important
Dankachatarn et al. (2023)	- Safety interventions for influencing workers' safety behavior through safety attitudes and perception of control - Training and education - Engagement and motivation - Safety behavior - Safety attitude - Interplay of individual and organizational external and internal safety factors	- Employers and organizations must establish policies and practices to foster positive safety attitudes and perceived behavioral control - Attitudes and perceived behavioral control are influenced by the interplay of individual and organizational factors, fostering worker and management participation - The key to improved safety outcomes is to combine internal factors, such as skills, attitudes, and behavior, with external factors, such as procedures and equipment

One of the most important safety culture co-creation forums is safety training interventions, as tailored training programs significantly improve safety awareness and attitudes, safety capability, and incident reporting activity. Safety training and similar interventions have the power to increase the motivation to act safely and to enhance safety attitudes and safety behavior, depending on the frequency of the intervention, decision-maker engagement, participation level, and relevance of the training content to the target group. The basis for effective safety training is a genuine and deep understanding of the organization's and workforce's existing safety culture to tailor interventions to the needs, realities and goals of the target group. This can be done by including the workforce in the developing training programs and instances through holistic communication, feedback, and dialogue (Table 7).

DISCUSSION AND CONCLUSIONS

The presented observations from the descriptive statistical analysis reveal the current status of the field, as well as various gaps that provide multiple avenues for future research inquiry. First, as occupational health is the most researched topic, perspectives from medicine and health can be regarded as the most dominant field, also when considering keyword topics and thematic journal categories. Thus, although technology and medicine are invaluable and important topics to research in workplace safety, there is a gap in researching workplace safety in the forest industry from perspectives that concentrate on other topics. Future research avenues could therefore concentrate more on gaining a holistic picture of workplace safety that complements technical and medical perspectives on workplace safety factors. For example, future research in the field could aim to shed light on more intangible safety factors at different organizational levels, including varying organizational entities and stakeholders in a holistic and interconnected understanding. Moreover, the current focus on quantitative methods, which is related to the fields that are currently most dominant in the field, calls for more use of qualitative and review methods to mitigate the risk of missing important insights and to foster theory development further. Also, there is a gap concerning methodological and discipline diversity, which again poses a risk of a lack of insight into diversity and applicability across contexts. For this reason, journals and professionals from other disciplines, such as business and management studies, need to get involved in occupational

safety research in the forest industry to enrich the field with more diverse insights generated through a variety of methodologies and theoretical lenses. Business and management could, for example, show how technical and physical safety factors can be integrated with more intangible and fluctuating human safety aspects in a holistic way that reflects the dynamic and complex reality of safety culture co-creation. This can also be achieved by an increased utilization of cross-disciplinary collaboration, filling the gap of lacking multidisciplinarity and few collaborations across research traditions, fields, and sectors.

As shown in the systematic literature review, thematic insights are diverse, but show emphasis on safety culture co-creation factors that are present in several contributions. One of those is that safety culture co-creation has many faces, as it is present in complex, dynamic, and varying organizational aspects. Safety culture co-creation happens in personal relationships, ways of working together, psychosocial work conditions, organizational culture, as well as individual and group identities, attitudes, perceptions, behaviors, practices, and knowledge. Yet, all these safety culture co-creation facets in the forest industry seem to have a common ground: holistic safety culture co-creation permeates all hierarchical levels, departments, and stakeholders, and it even has the capacity of expanding to stakeholders outside of the organization, for example municipalities, communities, unions, competing firms, or policy makers. It is also important to note that holistic safety culture co-creation is a key factor for promoting and implementing safety in behavioral and cultural dimensions that root deeper than measurable safety outcomes. Safety culture co-creation can therefore be regarded as an anticipating safety factor that indirectly and intangibly influences measurable safety outcomes. Also, safety culture co-creation is found to have an impact on not only safety performance, but also competitiveness, productivity, and external relations.

Based on the findings of the systematic literature review, a conceptual model (Figure 10) of the current state of research on safety culture co-creation can be developed. In the model, safety culture co-creation is depicted as occurring horizontally, from individuals and subgroups to teams and departments, as well as vertically, through top-down and bottom-up processes between leaders and employees. Additionally, there are organizational, individual, contextual, and interventional factors that influence horizontal and vertical safety culture co-creation. Organizational factors are understood as factors that are embedded in organizational structures, leadership, and steering, such as investments in safety through the appropriate allocation of resources, the definition and

development of internal safety rules and procedures, or specific leadership styles and leadership commitment that support safety culture co-creation. Individual factors entail aspects that can be located more on the employee level, which also includes individuals in management and leadership. There, individual behaviors, perceptions, and attitudes towards safety, individual traits such as motivation, engagement, and proactivity, but also demographic preconditions, as well as identity in relation to peers and to other hierarchical levels, play a crucial role in safety culture co-creation. Moreover, contextual factors influence safety culture co-creation from a wider perspective, for example in surrounding conditions such as the competitive environment, external stakeholders, policies and laws or national culture, but also physical and psychosocial work environment aspects as well as sustainability and social responsibility notions are important to acknowledge here. Lastly, interventional factors mean specific activities and tools that have the potential to actively facilitate and enable safety culture co-creation. In this realm, interventions such as holistic, cross-organizational and cross-hierarchical communication, dialogue and feedback, systematic and continuous risk and safety management as well as training and education as effective forums of knowledge and information exchange are regarded as most important based on the findings of current research. It needs to be noted that the stated factors have an influence on all directions and kinds of safety culture co-creation mechanisms and processes that are illustrated in the center of the model. Thus, it is important to bear in mind that safety culture co-creation is understood as a dynamic, complex, and holistic phenomenon that spans not only the whole organization with all its formal and informal entities, but also relates to and is altered by external factors. This makes safety culture co-creation a valuable tool for sustainably, inclusively and holistically improving safety performance through accident prevention on an organizational cultural level.

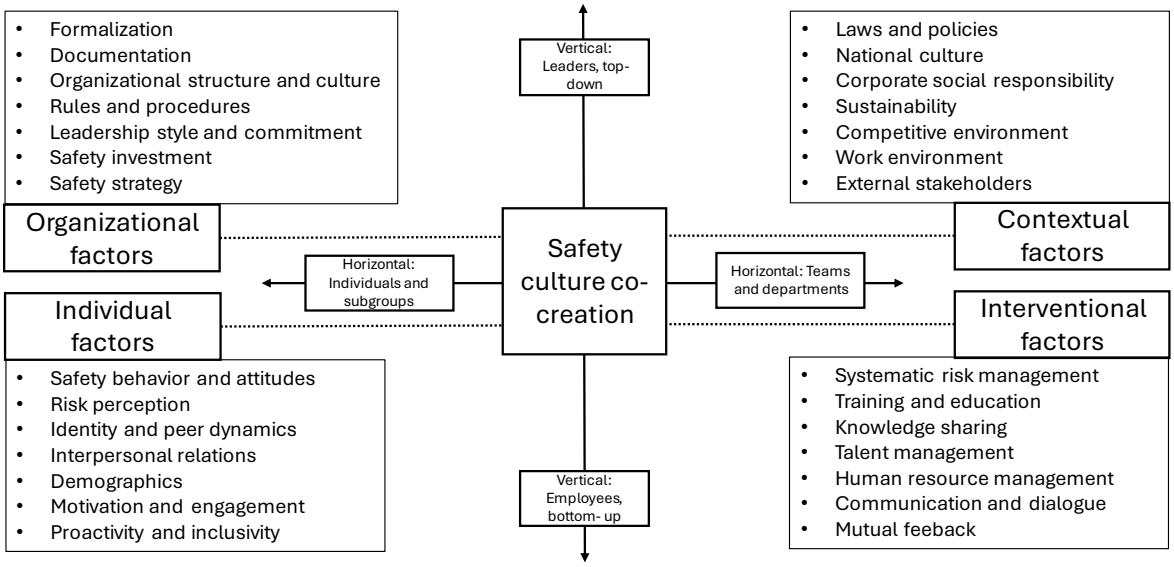

Figure 10. Conceptual model of safety culture co-creation based on the systematic literature review.

Practical implications

Practical applications manifest in the need for practitioners to define, develop, and implement horizontal and vertical safety culture co-creation processes and practices under constant and active recognition of the organizational, individual, contextual, and interventional factors that greatly influence safety culture co-creation as a tool for improving safety performance and accident prevention. Practitioners can also benefit from leveraging the power of interventions to facilitate and enable safety culture co-creation. Especially collaboration and communication, but also training, as well as feedback and knowledge sharing, can be used by practitioners in safety culture co-creation, because it creates a common sense of workplace safety as the basis of safety culture, which in turn measurably improves safety performance. For example, intervention programs and training events could be co-designed and -conducted by management and the workforce jointly to ensure relevancy and applicability of the training contents and format. This would also foster peer-to-peer knowledge exchange and communication among the workers, which are essential for safety culture co-creation. Moreover, safety culture co-creation can be improved when recognizing that safety culture co-creation is no one-way street, but rather a dynamic and inclusive dialogue that happens vertically and horizontally within an organization, but also in relation to external factors and stakeholders. In this sense, audits, reporting schemes, policies or procedures could be redesigned to forums for worker participation and engagement so that these aspects not only are a

duty to the workforce, but also a way of interacting with each other and of actively shaping the safety work of the organization. Managers would also benefit from such participatory risk assessments and feedback loops because of a probably higher degree of acceptance of safety measures, resulting ultimately in increased safety levels. The insights of this study can be applied to a variety of manufacturing industries with a need of improving safety performance beyond measurable safety factors, making this review valuable for practitioners from a wide range of industries in the manufacturing sector seeking to prevent accidents sustainably and effectively.

Theoretical contribution and future research

This review contributes in different, unique ways to the academic discourse about safety in the forest industry. First, as a review, it advances the conceptual understanding of the topic by capturing the current state of research in the field. This is especially valuable, as the field is dominated by empirical and quantitative contributions with a lack of qualitative and review designs. The review, therefore, adds theoretical advancement by providing unique insights into the under-researched field of intangible safety factors in the forest industry, because the field mostly concentrates on tangible technical and medical safety aspects. Moreover, a co-creation perspective is employed for understanding safety culture formation in the forest industry. This combination of a review research design, a co-creation lens on safety culture, a focus on intangible safety factors, and the forest industry context has not been applied before in the field, making the insights of this review novel and relevant for a variety of audiences active in accident prevention and safety performance in a manufacturing context. The review advances not only the field conceptually by proposing a conceptual model that provides insights into how safety culture is co-created, but it also provides future research avenues and a valuable tool to practically improve safety performance.

As co-creation is identified to be a relevant and interesting umbrella term for certain intangible safety factors, future research could unfold in critically conceptualizing and empirically exploring safety culture co-creation between internal and external forest industry stakeholders. Another future research avenue opens in further investigating the complex and dynamic interplay between management and workers to better understand the chances and challenges of top-down, bottom-up, and cross-sectional safety culture co-creation. Leaving the current state of research behind, which concentrates mostly on details rather than the holistic picture. Future research could also

further investigate the relationship between sustainability, human resource management, and social responsibility in relation to occupational safety. This would tie the field more to an overall societal perspective, opening possibilities for researching not only safety culture co-creation within organizations but also between institutions from the public and private sectors to improve safety in collaboration.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

CONFLICTS OF INTEREST

The authors confirm there are no conflicts of interest.

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APPENDIX A

Overview of articles for descriptive statistical analysis.

Reference	Title	Journal
Abdelsalam et al. (2022)	Toward Autonomous Vehicles and Machinery in Mill Yards of the Forest Industry: Technologies and Proposals for Autonomous Vehicle Operations	IEEE access
Almanza Floyd et al. (2024)	Competitiveness and sustainability in the paper industry: The valorisation of human resources as an enabling factor	Computers & industrial engineering
Andersson et al. (2020)	Lung function and paper dust exposure among workers in a soft tissue paper mill	International archives of occupational and environmental health
Araújo-Vila et al. (2022)	The Age Factor in the Analysis of Occupational Risks in the Wood Industry	Healthcare
Arbin et al. (2021)	Explaining workers' resistance against a health and safety programme: An understanding based on hierarchical and social accountability	Safety Science
Asgedom et al. (2019)	Knowledge, attitude and practice related to chemical hazards and personal protective equipment among particleboard workers in Ethiopia: A cross-sectional study	BMC public health
Asgedom et al. (2020)	Exposure to inhalable dust, endotoxin and formaldehyde in factories processing particleboards from eucalyptus trees in Ethiopia	Environmental and Occupational Health Practice
Baumgart et al. (2023)	Analysis of work safety from the perspective of sizing and use of EPIs in a sawmill in the state of Mato Grosso	Diversitas Journal
Best, T. et al. (2021)	Stress, psychosocial factors and the New Zealand forest industry workforce: Seeing past the risk of harm to the potential for individual and organisational wellbeing	New Zealand Journal of Forestry Science

Borz et al. (2021)	Performance of small-scale sawmilling operations: A case study on time consumption, productivity and main ergonomics for a manually driven bandsaw	Forests
Carles et al. (2016)	O44-1Pestipop: a french generic job-exposure matrix for use in epidemiological studies on occupational exposure to pesticides	Occupational and environmental medicine
Cil & Gedik (2022)	Research on factors affecting the risk-taking behaviour of personnel working in the forest products sector	International journal of occupational safety and ergonomic
Comberti et al. (2018)	Large occupational accidents data analysis with a coupled unsupervised algorithm: The S.O.M. k-means method. An application to the wood industry	Safety
Dankachatarn et al. (2023)	Effects of safety interventions toward workers' behaviours using the theory of planned behaviour in the rubber wood processing industry	International journal of occupational safety and ergonomics
Das (2024)	Adverse Health Effects and Perceived Musculoskeletal Pain in the Sawmill Workers of West Bengal, India	Toxicology and industrial health
Elsaidy & Mahmoud (2020)	Prevalence of Noise Induced Hearing Loss among Employees at Wood Industry in Damietta Governorate	International journal of medical arts
Emanuelli et al. (2016)	A case-case study on sinonasal cancer prevention: Effect from dust reduction in woodworking and risk of mastic/solvents in shoemaking	Journal of occupational medicine and toxicology
Eriksson et al. (2021)	Cardiovascular mortality in a Swedish cohort of female industrial workers exposed to noise and shift work	International archives of occupational and environmental health
Ezinne et al. (2021)	Occupational ocular injuries and utilization of eye protective devices among sawmill workers in the ojo local government area of lagos state, Nigeria	Vision

Ghelli et al. (2021)	Oxidative stress induction in woodworkers occupationally exposed to wood dust and formaldehyde	Journal of occupational medicine and toxicology
Girma et al. (2022)	Occupational Injuries and Associated Factors Among Small-Scale Woodwork Industry Workers in Hawassa, Southern Ethiopia: A Cross-Sectional Study	Environmental health insights
Hedlund et al. (2016)	Safety motivation at work: Evaluation of changes from six interventions	Safety Science
Heiden et al. (2019)	Trunk and upper arm postures in paper mill work	Applied ergonomics
Jabur et al. (2022)	Chronic respiratory symptoms and lung function parameters in large-scale wood factory workers in Addis Ababa, Ethiopia: a comparative cross-sectional study	International archives of occupational and environmental health
Khedher et al. (2016)	P024Occupational exposure to endotoxin and lung cancer risk: results of the icare study	Occupational and environmental medicine
King (2020)	The Hazards of COMPLIANCE-DRIVEN SAFETY PROGRAMS	Professional safety
Komut et al. (2020)	Occupational health and safety awareness in wood, wood products and mushroom production sector in Turkey	Turkish Journal of Forestry
Leso et al. (2017)	Occupational chemical exposure and diabetes mellitus risk	Toxicology and industrial health
Mathiassen et al. (2023)	Cost and statistical efficiency of posture assessment by inclinometry and observation, exemplified by paper mill work	PloS one
Mattson Molnar et al. (2019)	Leading for Safety: A Question of Leadership Focus	Safety and Health at Work
Michael & Gorucu (2020)	Analysis of forklift and pallet jack injuries in wood-related industries	Forest products journal

Morozov et al. (2021)	Social responsibility of business at the enterprises of the forest industry	E3S Web of Conferences
Negash et al. (2023)	Assessment of paper dust exposure and chronic respiratory symptoms among paper factory workers in, Ethiopia; a comparative cross-sectional study	BMC pulmonary medicine
Neitzel et al. (2020)	A semi-quantitative job exposure matrix for dust exposures in Swedish soft tissue paper mills	American journal of industrial medicine
Neitzel et al. (2022)	Dust Exposures in Swedish Soft Tissue Paper Mills	Annals of work exposures and health
Nnaji & Udokpoh (2023)	Identification of Immediate and Remote Health Hazards and the Need for Health Hazard Assessment in the Nigeria Sawmill Industry	Indonesian Journal of Social and Environmental Issue
Poisson & Chinniah (2016)	Managing risks linked to machinery in sawmills by controlling hazardous energies: Theory and practice in eight sawmills	Safety Science
Rashid et al. (2022)	Process safety management and process hazard analysis implementation progress in Pakistan chemical process industries	Process safety progress
Rathipe & Raphela (2022a)	Assessment of Occupational Exposure to Noise among Sawmill Workers in the Timber Processing Factories	Applied artificial intelligence
Rathipe & Raphela (2022b)	Evaluation of occupational exposure to wood dust among sawmill workers within the Gert Sibande District Municipality, South Africa	Annals of Agricultural and Environmental Medicine
Rathipe & Raphela (2023)	Hearing loss and respiratory health symptoms among large-scale sawmill workers of the timber processing factories within the Gert Sibande District Municipality: a comparative cross-sectional study	BMC public health
Rayner Brown et al. (2022)	Application of Process Hazard Analysis and Inherently Safer Design in Wood Pellet Production	ACS omega

Schell-Busey (2023)	Do extralegal variables impact the post-inspection process of the occupational safety and health administration?	Crime, law, and social change
Singh & Sekhon (2018)	Need for Risk Management and Regular Occupational Health Safety Assessment Among Workers of Developing Countries	Global journal on quality and safety in healthcare
Soranso et al. (2023)	Biomechanical analysis of wood processing work in tropical forest regions: A study in Midwest Brazil	Journal of occupational and environmental hygiene
Spinelli et al. (2017)	Postural risk assessment of mechanised firewood processing	Ergonomics
Sritharan et al. (2016)	Natural resource-based industries and prostate cancer risk in Northeastern Ontario: a case–control study	Occupational and environmental medicine
Tafvelin et al. (2019)	Leader-team perceptual distance affects outcomes of leadership training: Examining safety leadership and follower safety self-efficacy	Safety Science
Thepaksorn et al. (2019)	Occupational noise exposure and hearing defects among sawmill workers in the south of Thailand	International journal of occupational safety and ergonomics
Thepaksorn et al. (2018)	Relationship Between Noise-Related Risk Perception, Knowledge, and the Use of Hearing Protection Devices Among Para Rubber Wood Sawmill Workers	Safety and Health at Work
Thepaksorn et al. (2017)	Job safety analysis and hazard identification for work accident prevention in para rubber wood sawmills in southern Thailand	Journal of Occupational Health
Tehrani et al. (2018)	Interventional Role of Training in Promotion of Health, Safety and Environment Culture in Wood Industries	International journal of occupational hygiene
Top et al. (2016)	Comparison of practices related to occupational health and safety in microscale wood-product enterprises	Safety Science

Torén et al. (2023a)	Cancer incidence among workers in soft paper mills: A cohort study	American journal of industrial medicine
Torén et al. (2023b)	Occupational exposure to noise and dust in Swedish soft paper mills and mortality from ischemic heart disease and ischemic stroke: a cohort study	International archives of occupational and environmental health
Ulvenblad & Barth (2021)	Liability of smallness in SMEs – Using co-creation as a method for the 'fuzzy front end' of HRM practices in the forest industry	Scandinavian journal of management
Vested et al. (2016)	O26-4Inverse associations between occupational organic dust exposure and incidence of chronic obstructive pulmonary disease (copd) - healthy worker survivor bias?	Occupational and environmental medicine
Vested et al. (2021)	Dust exposure and the impact on hospital readmission of farming and wood industry workers for asthma and chronic obstructive pulmonary disease (COPD)	Scandinavian journal of work, environment & health
Westberg et al. (2016)	Inflammatory markers and exposure to airborne particles among workers in a Swedish pulp and paper mill	International archives of occupational and environmental health
Wójcik-Fatla et al. (2022)	Timber-colonizing gram-negative bacteria as potential causative agents of respiratory diseases in woodworkers	International archives of occupational and environmental health

APPENDIX B

Overview of articles for systematic literature review.

Reference	Title	Journal
Almanza Floyd et al. (2024)	Competitiveness and sustainability in the paper industry: The valorisation of human resources as an enabling factor	Computers & industrial engineering
Araújo-Vila et al. (2022)	The Age Factor in the Analysis of Occupational Risks in the Wood Industry	Healthcare
Arbin et al. (2021)	Explaining workers' resistance against a health and safety programme: An understanding based on hierarchical and social accountability	Safety Science
Asgedom et al. (2019)	Knowledge, attitude and practice related to chemical hazards and personal protective equipment among particleboard workers in Ethiopia: A cross-sectional study	BMC public health
Baumgart et al. (2023)	Analysis of work safety from the perspective of sizing and use of EPIs in a sawmill in the state of Mato Grosso	Diversitas Journal
Best et al. (2021)	Stress, psychosocial factors and the New Zealand forest industry workforce: Seeing past the risk of harm to the potential for individual and organisational wellbeing	New Zealand Journal of Forestry Science
Cil & Gedik (2022)	Research on factors affecting the risk-taking behaviour of personnel working in the forest products sector	International journal of occupational safety and ergonomic
Dankachatarn et al. (2023)	Effects of safety interventions toward workers' behaviours using the theory of planned behaviour in the rubber wood processing industry	International journal of occupational safety and ergonomics
Ezinne et al. (2021)	Occupational ocular injuries and utilization of eye protective devices among sawmill workers in the ojo local government area of lagos state, Nigeria	Vision

Girma et al. (2022)	Occupational Injuries and Associated Factors Among Small-Scale Woodwork Industry Workers in Hawassa, Southern Ethiopia: A Cross-Sectional Study	Environmental health insights
Hedlund et al. (2016)	Safety motivation at work: Evaluation of changes from six interventions	Safety Science
King (2020)	The Hazards of COMPLIANCE-DRIVEN SAFETY PROGRAMS	Professional safety
Komut et al. (2020)	Occupational health and safety awareness in wood, wood products and mushroom production sector in Turkey	Turkish Journal of Forestry
Mattson Molnar et al. (2019)	Leading for Safety: A Question of Leadership Focus	Safety and Health at Work
Morozov et al. (2021)	Social responsibility of business at the enterprises of the forest industry	E3S Web of Conferences
Nnaji & Udokpoh (2023)	Identification of Immediate and Remote Health Hazards and the Need for Health Hazard Assessment in the Nigeria Sawmill Industry	Indonesian Journal of Social and Environmental Issue
Poisson & Chinniah (2016)	Managing risks linked to machinery in sawmills by controlling hazardous energies: Theory and practice in eight sawmills	Safety Science
Rashid et al. (2022)	Process safety management and process hazard analysis implementation progress in Pakistan chemical process industries	Process safety progress
Rayner Brown et al. (2022)	Application of Process Hazard Analysis and Inherently Safer Design in Wood Pellet Production	ACS omega
Singh & Sekhon (2018)	Need for Risk Management and Regular Occupational Health Safety Assessment Among Workers of Developing Countries	Global journal on quality and safety in healthcare

Tafvelin et al. (2019)	Leader-team perceptual distance affects outcomes of leadership training: Examining safety leadership and follower safety self-efficacy	Safety Science
Tehrani et al. (2018)	Interventional Role of Training in Promotion of Health, Safety and Environment Culture in Wood Industries	International journal of occupational hygiene
Thepaksorn et al. (2017)	Job safety analysis and hazard identification for work accident prevention in para rubber wood sawmills in southern Thailand	Journal of Occupational Health
Ulvenblad & Barth (2021)	Liability of smallness in SMEs – Using co-creation as a method for the 'fuzzy front end' of HRM practices in the forest industry	Scandinavian journal of management