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Occupational health and safety management systems: a systemic approach

Sistemas de gerenciamento em saúde e segurança do trabalho: uma abordagem sistêmica

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Abstract – Risks are intrinsic to any human activity. Occupational Health and Safety Management Systems (OHSMSs) are mechanisms designed to mitigate risks, protect workers, and ensure productivity. This study aimed to support researchers' reflective analysis by examining scientific literature related to OHSMSs and identifying possibilities for future research with practical significance. Employing a qualitative approach, this systematic review was conducted using bibliographic procedures and action research. The intervention instrument *ProKnow-C* guided by a structured process from a constructivist perspective, was applied. A total of 3,130 studies were analyzed to select the bibliographic portfolio. The systemic analysis revealed that most articles neither demonstrate legitimacy nor consider companies' particularities. The paper advances theoretical knowledge of OHSMSs by assessing relevant studies in the field, identifying evolution patterns, and highlighting gaps. A research agenda is proposed to guide the development of future models. We conclude that the challenges of designing *ad hoc* OHSMSs and incorporating the decision-makers' knowledge throughout the process when addressed, have the potential to significantly contribute to the advancement of this field of knowledge.

Key words: Ergonomics; Occupational safety; Performance evaluation; Systematic review.

Resumo – *Os riscos são intrínsecos a todas as atividades humanas. Os sistemas de avaliação de desempenho de saúde e segurança no trabalho (SADSSTs) são mecanismos projetados para lidar com riscos, proteger os trabalhadores e garantir produtividade. Este estudo objetivou apoiar a análise reflexiva dos pesquisadores com base na literatura científica relacionada aos SADSSTs, identificando possibilidades de pesquisas futuras de importância prática. Com abordagem qualitativa, esta revisão sistemática foi desenvolvida com a adoção de procedimentos bibliográficos e pesquisa-ação. Foi utilizado o instrumento de intervenção ProKnow-C, um processo estruturado orientado pela perspectiva construtivista. Um total de 3.130 estudos foi analisado para a seleção do portfólio bibliográfico. A análise sistêmica revelou que a maioria dos artigos não apresenta legitimidade, nem considera as particularidades das empresas. O artigo avança no conhecimento teórico dos SADSSTs avaliando os estudos relevantes na área e identificando padrões de evolução e lacunas. Propõe-se uma agenda de pesquisa para orientar o desenvolvimento de modelos futuros. Conclui-se que o desenvolvimento de um SADSST ad hoc, não genérico e concebido com o conhecimento do decisor em todo o processo, permanece sendo um desafio e tem potencial para contribuir para o avanço deste campo do conhecimento.*

Palavras-chave: *Ergonomia; Segurança no trabalho; Avaliação de desempenho; Revisão sistemática.*

INTRODUCTION

Risk, whether physical, psychological, or financial, is inherent in any human activity. Risks are relentlessly involved in any business activity.[1] A zero-risk situation, or absolute and unconditional safety, does not exist.[2] To address the constant presence of this threat, occupational health and safety management systems (OHSMSs) are necessary. Safety management systems (SMSs) are integrated mechanisms in organizations designed to control risks that can affect workers' health and safety, and at the same time ensure the firm can easily comply with the relevant legislation.[3]

Occupational health and safety (OHS) is a pivotal field where performance evaluation can contribute significantly, given the absence of consensus on aspects such as definition, indicators, goals, measurement methods, evaluation, and correlation to efficiency. There is no commonly accepted OHS performance measurement method that can be simply used.[4] Such absence has an impact on workers' health due to the lack of instruments to support the management of the theme in the organization according to İnan, Gül.[5]

Information provided via performance indicators can be used to facilitate strategic health and safety management decision-making and the implementation of appropriate risk management actions on behalf of the organization.[6] A business that is attempting to improve its performance must not only put these elements in place but ensure that the measures are effective and efficient and provide adequate means of monitoring OHS.[7]

Accidents cost a lot of money not only in damage to the plant and claims for injury, but also in the loss of the company's reputation, workers' satisfaction, and productivity.[8] Investments in OHS have potential value for business and should be crucial to future competitiveness.[9] Thus, the implementation of OHSMSs has become a priority for many organizations[10] and has been implemented in numerous enterprises since the mid-1980s.[11]

Notably, ergonomics has been integrated into OHSMSs. Health, Safety, Environmental, and ergonomics (HSEE) are essential concepts in today's industries for managers, as they contribute to providing a safe and healthful working environment for all workers and the public.[12,13]

OHSMSs also play a vital role in promoting workers' health programs. Understanding OHS key performance indicators enables decision-makers to devise more tailored and, consequently, more effective health promotion programs. Encouragingly, the number of employers investing in workers' health promotion programs is increasing because the companies' balance sheets demonstrate that healthy employees produce more and cost less.[14]

Given the significance of OHSMSs, it is crucial to understand what researchers have uncovered through scientific literature and how they interpret their findings. This knowledge is essential for identifying research gaps and fostering advancements in this field. Hence, this study poses the following research question: How are OHSMSs represented in the scientific literature?

The objective of this study is to systemically analyze the scientific literature on this subject. This will support researchers in reflective analysis and assist in identifying unexplored topics and opportunities for future research.

METHOD

This study was conducted utilizing bibliographic procedures and action research in accordance with Creswell[15] guidelines. The methodological procedures are categorized into three sections: the first outlines the intervention instrument, the second details the process of selecting the bibliographic portfolio (both theoretical and empirical), and the third elucidates the methods employed for data analysis.

Intervention instrument

ProKnow-C is a structured process that aims to develop knowledge in the researchers and transmit it through its analyses and contributions.[16] This knowledge enables a greater understanding of the topic which leads to critical analysis of the literature and identification of possible research gaps.[17] The instrument is continually updated and currently comprises (i) selection of the bibliographic portfolio (BP), (ii) bibliometric analysis, (iii) literature map, (iv) systemic analysis, and (v) formulation of research suggestions (Figure 1). For this study, the processes undertaken were (i) selection of the bibliographic portfolio (BP), (iv) systemic analysis, and (v) formulation of research suggestions.

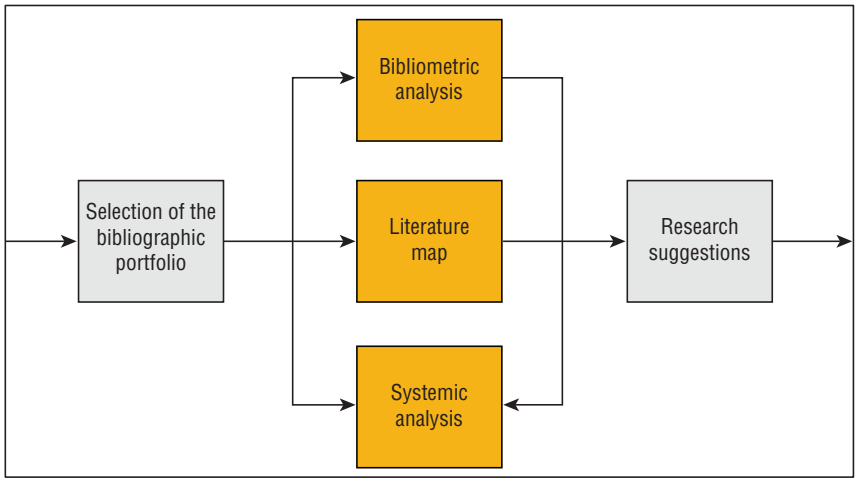

Figure 1. *ProKnow-C* macro-process[18].

Data collection procedures

The data collection was structured into four stages: (i) selection of the gross article database; (ii) application of redundancy, title, and scientific recognition filter; (iii) review of abstracts and application of potential scientific recognition filters; and (iv) thorough review of the remaining articles (Figure 2).

To select the gross article database, the authors defined the research axes, performance evaluation, and occupational health and safety, and identified corresponding keywords. These combinations were searched in the *Scopus* and *Web of Science* databases on 21 October 2021, without temporal delimitation, focusing on title, abstract, and keywords. This yielded 3,984 articles for the preliminary gross article database, 1,069 from *Web of Science,* and 2,915 from

Scopus. To ensure the selected keywords accurately represented the research topic, an adherence test was conducted. Five articles with relevant titles were selected and their keywords were analyzed for any potential additions. Any differing keywords encountered were context-specific to individual articles. Therefore, no new keywords were incorporated.

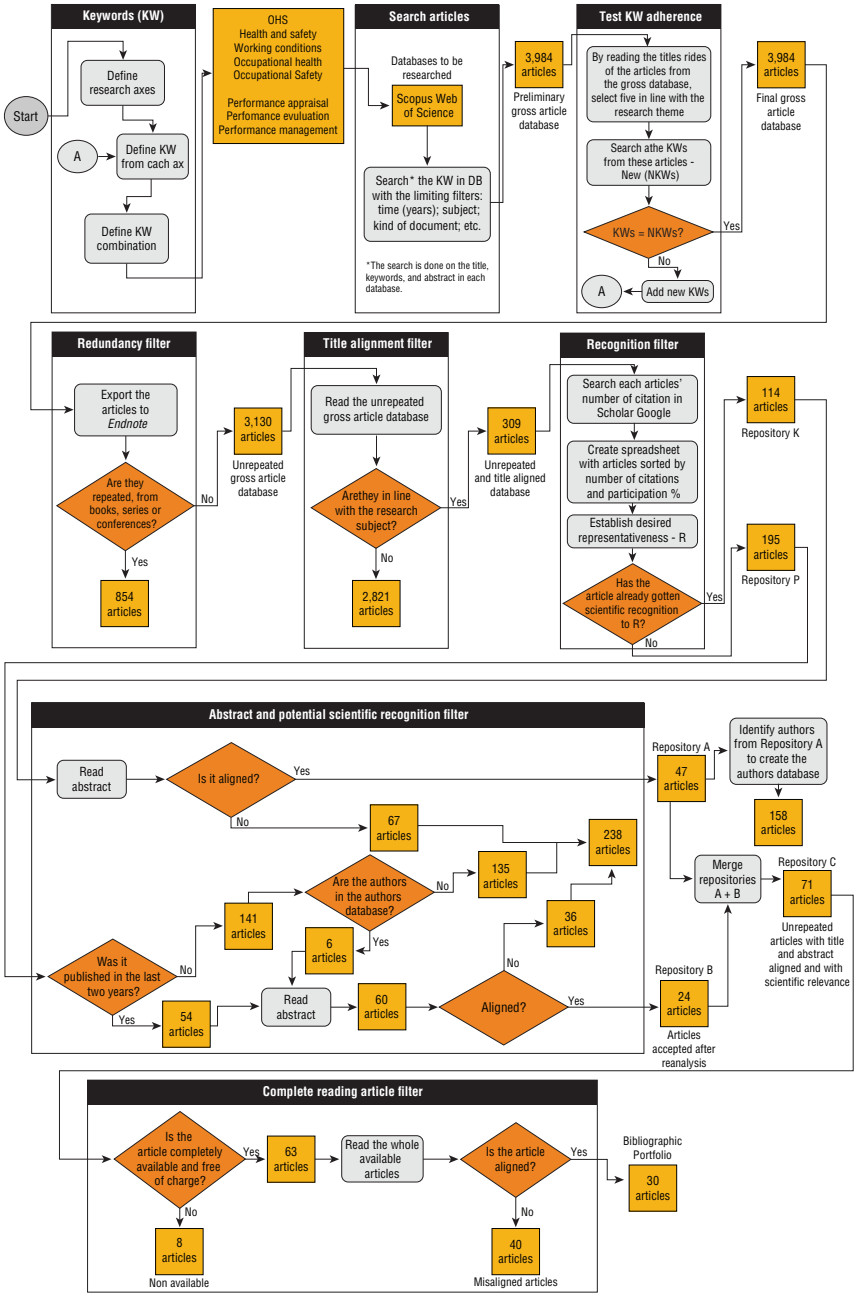

Figure 2. Data Collection Procedure.

Subsequently, the redundancy, title, and scientific recognition filter process was performed. For data management purposes, all article data were imported into the *Endnote X9* bibliographic manager, including details like titles, authors, abstracts, journal and institution names, and keywords. Duplicates, book publications, chapters, series, and conference papers were excluded, leaving

3,130 articles in the unrepeated gross articles database. Any articles with titles that did not align with the research focus were removed, reducing the count to 309 articles.

To assess the scientific significance of these articles, citation counts were extracted from *Google Scholar*. Each article's citation percentage was calculated relative to the entire set. The desired representation rate (R) was set at 26 or more citations. Out of the 309, 114 articles met or exceeded this criterion, accounting for 88% of all citations, and were cataloged in repository K. The remaining 195 articles were grouped into repository P named unrepeated articles with titles aligned and with the potential to have scientific recognition.

Abstracts of the 114 articles from repository K were reviewed, and 47 were considered aligned. These unrepeated articles, with aligned titles and abstracts and confirmed scientific relevance compose repository A. This repository had contributions from 158 distinct authors, leading to the creation of an authors' database.

Repository P was bifurcated based on publication date: 54 were recent (published within the last two years) and 141 were older. Of the older articles, six had authors listed in the authors' database. The abstracts of these six, along with the 54 recent ones, were reviewed, resulting in 24 articles considered aligned and cataloged in repository B to be reanalyzed.

Repository C combined the articles from A and B, gathering 71 unique articles with relevant titles, abstracts, and confirmed scientific significance. Of these, 63 were freely accessible in full. After a comprehensive reading, 30 articles that aligned with the study's objectives were chosen to establish the final bibliographic portfolio for this research (Table 1).

Table 1. Bibliographic Portfolio.

#	Title	Year	Authors
1	Relation between occupational safety management and firm performance	2009	B. Fernandez-Muniz, J. M. Montes-Peon and C. J. Vazquez-Ordas
2	The effects of job characteristics and working conditions on job performance	2007	E. Kahya
3	Worker productivity, and occupational health and safety issues in selected industries	2003	A. A. Shikdar and N. M. Sawaqed
4	Measuring operational performance of OSH management system - A demonstration of AHP-based selection of leading key performance indicators	2015	D. Podgorski
5	British directors' perspectives on the impact of health and safety on corporate performance	2001	C. Smallman and G. John
6	Management of health, safety and environment in process industry	2008	N. J. Duijm, C. Fiévez, M. Gerbec, U. Hauptmanns and M. Konstandinidou
7	Merging strategic safety, health and environment into total quality management	1995	M. Rahimi
8	Occupational health and safety and the balanced scorecard	2003	K. Mearns and J. I. Håvold
9	Exploring the relationship between safety culture and safety performance in U.S. nuclear power operations	2014	S. L. Morrow, G. Kenneth Koves and V. E. Barnes
10	The effect of integrated management system on safety and productivity indices: Case study; Iranian cement industries	2012	N. Hamidi, M. Omidvari and M. Meftahi
11	Safety performance evaluation of Indian organizations using data envelopment analysis	2011	G.S. Beriha and B. Patnaik
12	The occupational safety and health scorecard - A business case example for strategic management	2009	B. Köper, K. Möller and G. Zwetsloot

Table 1. Continued...

#	Title	Year	Authors
13	Exploring the state of health and safety management system performance measurement in mining organizations	2016	E. J. Haas and P. Yorio
14	Safety management systems: A broad overview of the literature	2018	Y. L. Li and F. W. Guldenmund
15	Evaluation of an occupational health and safety management system performance measurement tool II: Scoring methods and field study sites	2002	C. F. Redinger, S. P. Levine, M. J. Blotzer and M. P. Majewski
16	Assessment and improvement of integrated HSE and macroergonomics factors by fuzzy cognitive maps: The case of a large gas refinery	2013	S. M. Asadzadeh, A. Azadeh, A. Negahban and A. Sotoudeh
17	Prioritization of OHS key performance indicators affecting business competitiveness – A demonstration based on MAUT and Neural Networks	2019	E. O. B. Nara, D. C. Sordi, J. L. Schaefer, J. N. C. Schreiber, I. C. Baierle, M. A. Sellitto and J. C. Furtado
18	A model of analysis of the occupational safety and health system in the production system	2019	B. Vranješ and M. Todić
19	Assessment of occupational health and safety performance evaluation tools: State of the art and challenges for small and medium-sized enterprises	2018	A. Tremblay and A. Badri
20	Evaluation of occupational health and safety key performance indicators used in healthcare sector	2018	A. Y. Korkusuz, U. H. Inan, Y. Ozdemir and H. Basligil
21	Safety metrics of performance for small and medium-sized enterprises-case study	2018	L. Kotek, A. Nosek and V. Bartos
22	A multiple attribute decision model to compare the firms' occupational health and safety management perspectives	2017	U. H. Ínan, S. Gül and H. Yilmaz
23	Total Safety Management: Principles, processes and methods	2017	T. Kontogiannis, M. C. Leva and N. Balfe
24	A new framework for HSE performance measurement and monitoring	2017	P. Amir-Heidari, R. Maknoon, B. Taheri and M. Bazyari
25	Key factors identification and dynamic fuzzy assessment of health, safety and environment performance in petroleum enterprises	2017	L. Yan, L. Zhang, W. Liang, W. Li and M. Du
26	Performance assessment of human resource by integration of HSE and ergonomics and EFQM management system: A fuzzy-based approach	2017	M. Sadegh Amalnick and M. Zarrin
27	How Productive Is Workplace Health and Safety?	2017	I. S. Buhai, E. Cottini and N. Westergaard-Nielsen
28	A neuro-fuzzy algorithm for assessment of health, safety, environment and ergonomics in a large petrochemical plant	2015	A. Azadeh, M. Saberi, M. Rouzbahman and F. Valianpour
29	An adaptive algorithm for assessment of operators with job security and HSEE indicators	2014	A. Azadeh, M. Rouzbahman, M. Saberi and F. Valianpour
30	Performance assessment and optimization of HSE management systems with human error and ambiguity by an integrated fuzzy multivariate approach in a large conventional power plant manufacturer	2012	A. Azadeh, A. H. Farmand and Z. J. Sharahi

Systemic analysis procedure

Systemic analysis provides support, coherence, and reasoning for model construction decisions in social contexts and has been carried out in multiple ways.[19] It is a scientific process aiming to enrich the literature via a critical review of the selected BP, based on a theoretical affiliation, in order to identify gaps and research gaps and opportunities. Adopting a theoretical affiliation is essential to determine how the context will be observed and which intrinsic attributes will be assessed.

Analysis falls on the investigation of the presence of these characteristics, and how they are presented, according to Marafon, Ensslin.[20] As highlighted by Ensslin, Giffhorn,[21] performance evaluation is the process of building knowledge

in the decision-maker, (1) about a specific context (2) proposed for evaluation, discerned by their perception (3) through activities that identify, organize, (4) measure, and (5) integrate the facets for its management, (6) to visualize the repercussions of interventions and their management (added numbering to denote the origin of the lenses). These six lenses specifically: 1. approach; 2. singularity; 3. process of objective identification; 4. measurement; 5. indicator integration; 6. learning and improvement as delineated by Valmorbida, Ensslin,[22] guided the perspective for the articles' critical evaluation.

Regarding the initial lens, models can be classified as (i) normative, (ii) descriptive, (iii) prescriptive, or (iv) constructive. The origins and interpretations of these terms are elaborated in Roy[23] and Dias and Tsoukiàs.[24] Concerning model utilization, the analysis evaluates if the model is generic or specific. For harmony between the methodology to create the model and its application, models guided by normative and descriptive strategies should be applied to a generic context, whereas those underpinned by the prescriptive or constructive strategies should pertain to specific settings.

The subsequent lens examines the model's singularity, focusing on the decision-makers' role and the physical environment. The third lens identifies if the objectives incorporated in the PE models acknowledge the need for the decision maker's knowledge. The fourth lens analyzes if the model aptly measures the objectives, allowing the identification of each indicator's benchmark levels. The fifth lens investigates the synergy between objectives and indicators, based on the decision-maker's preferences and whether they permit a holistic and systemic evaluation of organizational performance. Ultimately, the sixth lens evaluates if the articles use the information elicited by the models to manage tasks and enhance the context.

RESULTS

Each empirical article underwent a systemic analysis to address the research question, with the findings summarized in Table 1. The analysis encompassed several lenses, including Harmony, Singularity, Legitimacy, Compliance with Measurement Theory, Integration Activity with Decision-Makers Perception, and Utility of the PE Model for Management and Improvement.

In terms of Harmony, most articles adhered to a descriptive approach, with the constructivist approach being the least utilized (10%). Regarding the context, the proportion of specific contexts (52%) slightly outnumbered generic ones (48%), resulting in 81% of articles displaying alignment between the model and the utilized context.

The analysis performed on singularity revealed that 48% of the studies did not identify the decision-makers; 33% did identify them but did not involve them in model development, and a mere 19% were collaboratively built with the decision-maker. Concerning the physical context, a majority of models (62%) were adapted for the organization, while the minority (38%) were built for the organization. Consequently, a significant portion of the articles (62%) did not exhibit singularity, while 19% did, and 19% presented partial singularity.

Legitimacy was determined based on two criteria: i) the incorporation of the decision-maker's knowledge throughout all stages, and ii) the identification of the objectives is fully based on the decision-maker's values. Half of the studies did not consider the decision-maker's knowledge; 42% did throughout the entire process, and 8% in at least one stage. In relation to identification and

criteria, the majority (45%) did not acknowledge the values and preferences of the decision-maker; 27% were entirely aligned with the values and perceptions of the decision-maker; 19% were partially aligned, and 9% were externally defined but validated by the decision-maker. Considering these results, 33% of the studies were considered legitimate, while 67% were deemed illegitimate.

The fourth lens revealed that a significant majority of the articles successfully measured the objectives, employing 0% nominal, 28% ordinal, 61% interval, and 11% ratio scales. Remarkably, 89% of the articles complied with measurement theory.

Regarding the fifth lens, 62% of the articles permitted the integration of the indicators, while 33% did not. 5% were not applicable as they were not formulated with the decision-maker's perception. Therefore, it was not possible to evaluate them. Among those subject to evaluation, in 67% of the studies integration was performed without the involvement of decision-makers to identify the reference levels that are essential to classify the necessary integration rates to move from the lower to the higher reference level. 77% provided a holistic view of performance and both partial and global results; 15% only presented global results; and 8% exclusively offered a holistic performance view. 67% of the articles were descriptive or graphical and did not use cardinal reference levels (benchmark); 25% were descriptive or graphical and used cardinal reference levels; 8% were solely descriptive; and none only used cardinal reference levels or were exclusively graphical.

The sixth lens indicated that half of the studies graphically or numerically presented diagnoses, explaining the strengths and weaknesses; 25% did it generically; 25% did not present any diagnosis, and none textually presented strengths and weaknesses together with graphical or numerical data. Among studies that diagnosed the current situation, 39% did not offer a process for improvement actions; 22% suggested performance improvement without a presented process; 22% identified and ranked actions within a presented process; and 17% identified and suggested actions within a process. Only 22% of the articles, a relatively low proportion, ranked the improvement actions (Table 2).

Table 2. Systemic Analysis Results.

Lens 1: Harmony		
Approach	Constructive	10%
	Normative	14%
	Prescriptive	24%
	Descriptive	52%
Context	Generic	52%
	Specific	48%
Result	Harmony	81%
	Disharmony	19%
Lens 2: Singularity		
Decision-makers	Not identified	48%
	Identified, but did not take part in the development of the whole model	33%
	Take part in the development of the entire model	19%
Context	Adapted to the organization	62%
	Built for the organization	38%
Result	Singular	19%
	Partially	19%
	Not singular	62%

Table 2. Continued...

Lens 3: Legitimacy		
Knowledge Recognition	Decision-makers' knowledge is not valued in all stages of the process	50%
	Decision-makers' knowledge is valued in at least one stage	8%
	Decision-makers' knowledge is valued in all stages	42%
Identification of the objectives or criteria	Not based on the decision-makers' values and preferences	45%
	External but the decision-makers validate it.	9%
	Partially based on the decision-makers' values and preferences	19%
	Fully based on the decision-makers' values and preferences	27%
Result	Legitimated	33%
	Illegitimate	67%
Lens 4: Measurement Compatibility		
Performs Measurement	Yes	86%
	No	14%
Scale Type	Nominal	0%
	Ordinal	28%
	Interval	61%
	Ratio	11%
Result	Compatible	89%
	Incompatible	11%
Lens 5: Integration		
Decision makers participation	Yes	33%
	No	67%
How	Holistically, partially, and with the global result	77%
	Holistically	8%
	Only global result	15%
Presentation	Descriptively or graphically using reference levels	25%
	Descriptively or graphically without reference levels	67%
	Cardinally using reference levels	0%
	Graphically	0%
	Descriptively	8%
Result	Enables integration of indicators	62%
	Did not enable integration of indicators	5%
	Not applicable (did not perform measurement)	33%
Lens 6: Management		
Diagnostics presentation	Graphically or numerically explaining weaknesses and strengths	50%
	Textually explaining weaknesses and strengths	0%
	Graphically or numerically	0%
	Not shown	25%
	Generic	25%
Process for improvement	Not presented	39%
	Not presented but suggestions are given.	22%
	Only presented	0%
	Presented and actions explained	17%
	Presented, actions explicated and ranked in order of importance	22%

DISCUSSION

The findings reveal several critical insights into the current state of empirical studies in the field. A significant majority of studies under the Harmony lens employ a descriptive approach and are aligned with their contexts, but the use of a constructivist approach remains minimal. The higher incidence of specific context studies suggests a tendency towards more tailored research.

According to Ensslin, Dezem,[25] to be considered singular, the study must be built with the participation of the decision-maker and aimed at reaching the organization's goals. If one of the requirements is not met, the result will be a partial singularity. There will be no singularity when both aspects are absent. These requirements are partially or fully achieved in a majority of articles, although

with a notable proportion not meeting the criteria for singularity. This highlights a potential gap in the involvement of decision-makers, a vital component for ensuring the study's relevance and applicability to organizational goals.

The result of the third lens signals the model´s legitimacy, according to Landry and Banville.[26] The concept of legitimizing a model refers to the social code, in which the perspective of individuals is considered. The model is, thus, legitimate or illegitimate, according to the perception of these individuals. Signaling social identity focuses on an internal stakeholder group and claims that staff members or potential job applicants assess the attractiveness of an organization based on its human resource/OHS initiatives.[8] The fulfillment of these criteria results in the legitimacy of the studies according to Thiel, Ensslin.[27] The legitimacy of the models, based on these criteria, shows that a significant number of studies are considered illegitimate.

Most of the studies do not have the full participation of the decision-makers, which may result in ineffective systems. This raises questions about the extent to which decision-maker's knowledge and values are incorporated, and the implications of this for the effectiveness of the systems developed. The decision-maker's contribution must start from the design of the system. As emphasized by Amir-Heidari,[28] the first step in the design of health, safety, and environmental (HSE) performance measurement systems is creating an expert team with deep knowledge and experience in the field of HSE and KPIs. The inadequate participation of decision-makers can result in ineffective systems, underscoring the importance of involving an expert team from the design phase.

The fourth lens assumes the indicators and scales comply with the measurement theory, in terms of mathematical operations and statistical analysis according to Stevens.[29] The compliance with measurement theory is generally high, indicating a sound basis for the majority of studies. However, the variety in the types of scales used and the integration of indicators suggests diversity in approaches to measuring objectives and presenting a holistic view of organizational performance. The differences in descriptive, graphical, and cardinal presentations also reflect varied methodologies in conveying results.

The fifth lens analyzes if the mathematical model contemplates the integration activity with the perception of the decision-makers. This way it allows a systemic and holistic vision of the organization's performance as a whole to support management. The resulting information signals the presence of decision-makers' support and the constructivist vision. The basis of a performance evaluation model is to create knowledge in decision-makers for them to identify, evaluate, and improve what is important in a specific context.

The analysis under the sixth lens brings attention to the utility of the information obtained by the PE model in managing activities and suggesting improvements. It was checked if and how the studies diagnose the current situation. The varied presentations of diagnoses and the low proportion of articles ranking improvement actions point to opportunities for enhancing the utility of these studies in practical settings. The emphasis on offering hierarchical improvement actions aligned with established objectives is crucial for providing actionable insights for decision-makers.

The findings from the analysis present a multifaceted view of the current research landscape, revealing both strengths and areas for improvement. The insights generated made it possible to present a research agenda, thus answering the research question and achieving the objectives of the present investigation.

The fact that most models analyzed in this study were not singular may influence their effectiveness. The inherent difficulty in making effectiveness determinations is that such determinations are unique to each organization.[30] A system must be designed to measure tangible and intangible parameters in a specific context and sometimes even in distinct sites of the same organization. It seemed reasonable to monitor safety performance and disseminate examples of good practice at a site level rather than across the organization, where learning processes could perhaps become too generalized for site-specific problems.[31]

It was observed that there is not an established model of success for each type of company, although, the adoption of appropriate methodologies can contribute favorably to increasing the probability of developing an effective system. Therefore, after the systemic analysis based on six lenses, a research agenda (Figure 3) is suggested as an opportunity for the future development of OHS evaluation models.

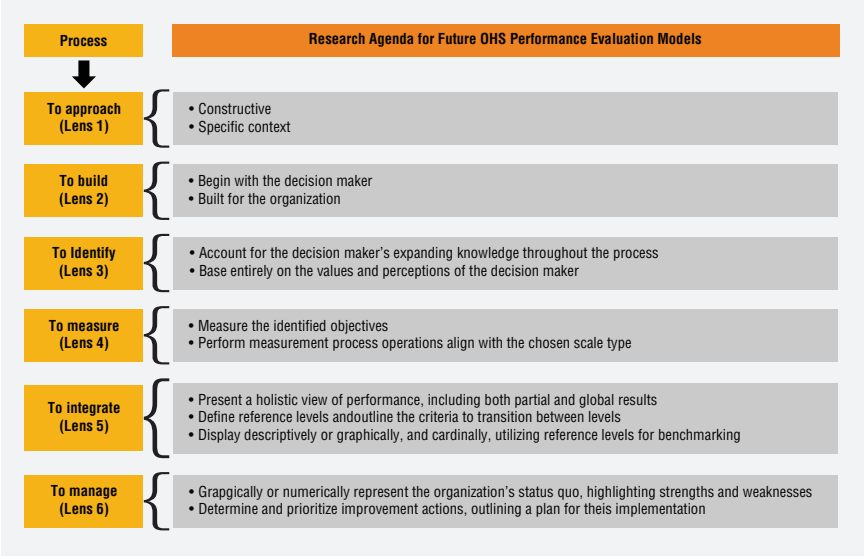

Figure 3. Research agenda for the development of OHS Evaluation Models.

CONCLUSION

This meticulous study has provided a comprehensive consolidation of how Occupational Health and Safety Management Systems (OHSMSs) are portrayed in the current scientific literature. Through this study, researchers have gained insights into a fragment of the literature, enabling the formulation of a research agenda aiming to guide the development of customized OHSMS for each organization.

Research related to performance management in OHS is likely to expand knowledge in the field. However, this expansion should happen towards the evolutionary direction, meaning that contributions should be built upon what is considered the most advanced stage. The noticeable gap in decision-maker involvement and the inconsistency in model legitimacy highlight critical areas where the alignment of theoretical frameworks with practical necessities can be significantly enhanced. These insights contribute to a more profound understanding of the field, illuminating areas where further exploration and development are essential.

Management of OHS, like any other form of management, is an organizational practice. Studying organizations is part of social science and is not merely an extension of safety engineering. Social science must effectively work with 'soft' data. Consequently, there is not a one-size-fits-all effective model to guarantee the success of OHSMSs, as effectiveness varies from one company to another. While there are numerous ways to define organizational effectiveness, a universally accepted definition remains intangible. If the interpretation of effectiveness changes, it also changes the factors influencing it, and subsequently, what affects performance.

However, it should not be ignored that many countries impose legal obligations on how employers measure and manage OHS. Thus, the voluntarily developed singular systems must comply with legal OHS regulations. Both regulation-governments and market-based standards must be included and the system designs, along with their interaction, must be holistically tested.

Ultimately, by identifying areas of potential improvement and emphasizing the necessity of a tailored approach to OHSMS, this study contributes to the advancement of occupational health and safety practices. The research advocates for the design of singular systems, factoring in the organizational context and informed by decision-makers. They may have general guidelines but should be tailored in accordance with each organization's particularities. Singular systems, developed with the knowledge of decision-makers and specifically crafted for the organizational context, are crucial. In doing so, it emphasizes a holistic and more impactful approach to OHS, ensuring both compliance with legal regulations and commitment to enhancing worker safety and well-being.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

Ethical approval from a Research Ethics Committee (CEP) is not required for studies analyzing aggregated and anonymized data, such as literature review articles.

Conflict of interest statement

The authors have no conflicts of interest to declare.

Author Contributions

Conceived and designed experiments: ARPM, JLN; Performed experiments: JLN; Analyzed data: JLN, SRE; Contributed with reagents/materials/analysis tools: JLN, SRE; Wrote the paper: ARPM, JLN, SRE. All authors read and approved the final version of the manuscript.

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