INTERNATIONAL JOURNAL OF SOCIAL HEALTH
https://ijsh.ph/index.php/rp
Volume 3 Number 6 June 2024

Literature Review of Indicators of Occupational Health and Safety Performance Evaluation Tools

First Mayro Annibaja Hutauruk[1]*, Doni Hikmat Ramdhan[2]
Universitas Indonesia, Depok, Indonesia[1,2]
Email: firstmayro@gmail.com[1], donihr_05@yahoo.com[2]

KEYWORDS

Occupational Health and Safety; Performance Evaluation Tools; Performance Indicators; Performance Measurement; Performance Tools; Evaluation Tools; Industry

ABSTRACT

Occupational health and safety (OHS) in the industrial world, especially in Indonesia, has become an increasing concern. Various efforts have been made, including developing and implementing laws, regulations, and standards to provide a framework for organizations to practice and enhance the prevention of work-related accidents and illnesses, aiming to place worker welfare at the center of production system design. However, the occurrence of some workplace accidents indicates that OHS performance evaluation still needs to be measured and improved. In this literature review, we outline the scope of research on performance evaluation and provide comments on the suitability of proposed instruments for industrial use. Methods: This study uses a systematic review design with the PRISMA (Preferred Reporting Items for Systematic Reviews & Meta Analyses) method. Information and data searches were conducted using databases from Science Direct, Elsevier, Scopus, and Google Scholar. The keywords used include occupational health and safety, performance evaluation tools, performance indicators, performance measurement, performance tools, evaluation tools, and Industry. This research allowed us to identify nine OHS performance evaluation tools. Our main conclusion is that field researchers have shown little interest in generalizing OHS performance evaluation instruments, and none of the nine tools studied can be appropriately applied to all industrial fields. The specificity of the industrial context has not attracted significant attention from many OHS researchers. Developing tools that offer a broader choice of performance indicators to OHS specialists intervening in industrial environments will significantly contribute to improving accident prevention in the workplace.

DOI:

Corresponding Author: First Mayro Annibaja Hutauruk*
Email: firstmayro@gmail.com

INTRODUCTION

Data from the Ministry of Manpower shows that the number of work accident cases in Indonesia in 2023 amounted to 370,747 cases, with around 93.83% occurring in wage recipients, 5.37% occurring in non-wage recipients, and 0.80% occurring in construction service participants. The trend of JKK and JKM claims on average, has continued to increase over the past five years. BPKS Employment data shows that the number of JKK claims in 2019 was 182,835 cases; Then, the number of claims continued to increase to 221,740 cases in 2020 and 234,370 cases in 2021. Furthermore, in 2022, the number of claims rose again to 297,725 cases. The number of work accident cases that submitted JKK claims reached 360,635 from January to November 2023. JKK claims usually occur in companies and plantations. As of November 30, 2023, BPJS Ketenagakerjaan has paid JKK for 360,000 claim cases

with a total value of IDR 2.79 billion and JKM for 121,000 claim cases with a total value of IDR 2.94 billion. Improving OSH performance is essential to reduce the number of occupational accidents. Some researchers describe this idea as the performance of management systems in relation to OSH (Tao, Yang, Qiu, & Reniers, 2020). For this study, two specific criteria were used to define OSH performance. The first criterion is that the business performs well if its OSH management is effective (Podgórski, 2015); (Liu, Chen, Cheng, Hsu, & Wang, 2014) (Sgourou, Katsakiori, Papaioannou, Goutsos, & Adamides, 2014) (Tao et al., 2020). The second criterion shows that OSH management is effective if it reduces or eliminates work-related injuries and illnesses in the short to medium term (Joas et al., 2015). Performance indicators are basically used to assess OSH performance. Measurements of elements that are considered important in a particular model are known as performance indicators (Bayramova, Edwards, Roberts, & Rillie, 2023). Reactive and proactive indicators are known (Rouat, 2019). Reactive indicators are usually used to assess K3 performance (Sinelnikov, Inouye, & Kerper, 2015). This makes it possible to assess the impact of actions taken to manage OSH (Tremblay & Badri, 2018a). The frequency of accidents and the severity index are the most widely used reactive indicators.

Part 2 discloses the methodology of our research, Part 3 discusses the results of a bibliographic search, Part 4 discusses the results and limitations of the study, and Part 5 provides conclusions. This study aims to demonstrate the strengths and limitations of the currently proposed tools for evaluating OSH performance.

Recent data from the Ministry of Manpower highlight a concerning trend: in 2023 alone, Indonesia witnessed a staggering 370,747 work accident cases. This figure underscores a pressing issue, with 93.83% of incidents impacting wage recipients, 5.37% affecting non-wage earners, and 0.80% involving participants in construction services. Moreover, the upward trajectory of JKK and JKM claims over the past five years paints a worrying picture. Starting at 182,835 cases in 2019, these claims escalated to 297,725 cases by November 2023, reflecting a persistent challenge in workplace safety. As of the end of November 2023, BPJS Ketenagakerjaan disbursed IDR 2.79 billion for 360,000 JKK claims and IDR 2.94 billion for 121,000 JKM claims, emphasizing the substantial economic impact of these accidents.

Addressing occupational safety and health (OSH) is crucial to mitigate these alarming statistics. Effective OSH management, defined as reducing or eliminating work-related injuries and illnesses, is paramount. This study examines various tools used to evaluate OSH performance, aiming to identify strengths and limitations in current methodologies. By doing so, it seeks to contribute to Indonesia's urgent need for enhanced workplace safety measures.

METHODS

This study uses the PRISMA (Preferred Reporting Items for Systematic Review & Meta-Analysis) method, which is carried out systematically by following the research stages correctly. First, the reading list is identified after a systematic search by keyword. The search for research articles relevant to this research topic was carried out using keyword collaboration: occupational health and safety; performance evaluation tools; performance indicators; performance measurement; performance tools; evaluation tools; Industry from Science Direct, Elsevier, Scopus, and Google Scholar. As for the inclusion criteria in the systematic review, the researcher used original studies related to topics that were not systematic study studies, quantitative studies using various study designs, international studies published in 2005-2023, and open access to studies. Researchers found 112 related studies that could be reselected using the PRISMA method.

To facilitate our analysis of existing tools and to see how they can be used in an industrial environment, In our analysis of the application of each of these tools, we refer to the following three criteria:

a) Content validity: it shows the extent to which the various components of the tool represent the concept being evaluated. Therefore, we sought to determine whether this tool could be used to evaluate eight elements that could contribute to the improvement of OHS. These elements are: (1) Planning, Review, Development of Policies and Procedures, (2) Organizational Management Arrangements, (3) Consultation Arrangements, (4) Contractors, (5) Hazard Identification and Risk

Assessment, (6) Preventive Measures, (7) Collection and Use of K3 Data, (8) Training (IKPEGBU, 2015).

b) Combination of the use of both types of indicators: To obtain an overall evaluation of the performance of OSH in industry, we expect this tool to include both reactive and proactive indicators (Ghahramani, Ebrahimi, & Hajaghazadeh, 2023; Jafari, Vosoughi, Abolghasemi, & Ebrahimi, 2020; Reiman & Pietikäinen, 2018; Rouat, 2019; Sinelnikov et al., 2015; Tremblay & Badri, 2018a; Versteeg, Bigelow, Dale, & Chaurasia, 2019).
c) Reliability, meaning that the tool tends to provide similar results from one evaluator to the next (Tremblay et al., 2018;). This important criterion is not always met (Jafari et al., 2020; Tremblay & Badri, 2018a). We were looking for a reliable tool because it was designed with indicators relevant to the evaluation of OSH performance in the company.

RESULTS and DISCUSSION

Tools - K3 Self-Diagnostics (Rouat, 2019)

The tool was developed in a study funded by IRSST (Institut de recherche Robert-Sauvé en santé et sécurité du travail). The aim was to evaluate the performance of OSH in manufacturing companies in Québec (Rouat, 2019). It is a questionnaire addressed to employees that consist of proactive indicators collected from the literature and given a score of 10 points based on the Likert scale. The tool uses a variety of workplace compliance indicators, as shown in Table 1.

Table 1.
Shows the Indicators of the IRSST Tool Used (Translated From (Rouat, 2019).

It	Information
1	Necessary means of protection are installed on machines and equipment
2	Preventive maintenance of equipment is carried out.
3	The Company owner provides the necessary personal protective equipment for the job.
4	Employers follow regulations regarding noise, air quality, and more.
5	The workplace is tailored to the characteristics of workers.
6	Employers implement safe work practices (such as lockout-tagouts, enclosures, etc.)

This diagnostic tool is simple and easy to use, and it only addresses the individual perspective of the worker. In addition, because it takes a considerable amount of time and effort to collect and process data, it is ineffective. Temporary irritation in the relationship between employees and management can affect the score. It is also made specifically for the printing industry, so there will be changes for other industries.

Tools - Organizational Performance Metrics (OPM, 2011)

To measure organizational performance, the Institute for Work and Health (IWH, Toronto) created a short questionnaire with eight proactive indicators (Table 2). These indicators were taken from a literature review and selected with the help of K3 experts. Regardless of size or industry sector, this scale applies to Canadian companies using the 5-point Likert scale.

Table 2.
Indicators used in OPM tools (Tremblay & Badri, 2018b)**.**

It	Information
1.	We conduct formal safety audits on a regular basis.
2.	Each staff member strives to improve OSH performance consistently.
3.	K3 is considered by companies to be as important as quality and production.
4.	The information needed to work safely is available to all employees and managers.
5.	Work is always involved in health and safety decision-making.
6.	The staff in charge of OSH has the authority to make changes that are deemed necessary.

7.	Those who work with safe working methods are recognized and encouraged to do so.
8.	To carry out safe operations, each staff member is equipped with the necessary personal protective equipment.

OPM is an easy tool and seems to be generalizable, but its limited indicators do not provide a complete and practical picture of a company's safety and health (OSH) performance or make it possible to find effective corrective actions. Results can vary depending on how the data is collected—in person, over the phone, or in a meeting—and there is plenty of room for subjectivity in assessing indicators

Tools - Total Safety Performance (TSP, 2014)

Total Safety Performance was created to assess the overall K3 performance of Taiwanese companies (Liu et al., 2014). The TSP questionnaire consists of twenty-five proactive indicators drawn from the literature and arranged in three dimensions: human, organizational, and technical (Table 3). They were assessed on a five-point Likert scale. Again, K3 professionals were involved in the creation of this survey. Three case studies were conducted at Taiwanese electronics factories to verify the devices.

Table 3.
Indicators included in TSP

Dimension	Indicators
Technical	Self-inspection
	Emergency plan
	Personal protective equipment
	Handling of hazardous materials
	Safety protection (including risk management)
	Risk analysis
Organization	Legislation and regulations
	Accident statistics and investigations
	Management commitment
	Organization and responsibilities
	Education and Training
	Subcontractor management
	Purchasing management
	Change management
	Licenses, work permits
	Communication
	Monitor the work environment
	Health check-up
	Security audit
	Planning review
	Progress review
	Follow-up review
Human	Employee participation
	Safe behavior
	Safety-oriented attitude

Tool 8 Fuzzy Comprehensive Performance Evaluation (HSE, 2015)

Fuzzy logic has been tested to consider the evaluation of different experts simultaneously (Li, Liang, Zhang, & Tang, 2015). The HSE tool consists of 29 proactive indicators (Table 4) selected using internal procedures at a large petrochemical company. This indicator is scored on a 5-point Likert scale.

Table 4.
29 indicators on HSE tools (Li et al., 2015)

It	Indicators
1	Leadership and commitment
2	Health, safety and environmental mission
3	Hazard identification, risk evaluation, and determination of critical control points
4	Legal obligations and other obligations
5	Purpose and objectives
6	Program
7	Organizational approach, obligations, resources, and documents
8	Resources
9	Skills, training, and sensitization
10	Communication, participation, and consultation
11	Documentation
12	Document monitoring
13	Structural integrity installation
14	HSE management of subcontractors and suppliers
15	Clients and products
16	Community and public relations
17	Licenses, work permits
18	Health at work
19	The production itself
20	Operational control
21	Change management
22	Emergency preparations and interventions
23	Output measurement and monitoring
24	Compliance evaluation
25	Deviations, corrective and preventive measures
26	Incident/accident management
27	Recording monitoring
28	Internal K3 audit
29	Managerial review

HSE tools are flexible as they can manage a wide range of user evaluations. In addition, the calculations are done automatically and reports are generated by the software, which saves a lot of time. Nevertheless, there are some unclear indicators of what to evaluate. The company that developed the principles may understand them, but it is unclear how commonly they can be applied. There is no clear data on what to do to prevent damage. This also applies to similar evaluations conducted by different entities at different times.

Tools - Monash University Organizational Performance Metrics (OPM-MU, 2016)

Monash University proposed a new tool to measure organizational performance (Shea, De Cieri, Donohue, Cooper, & Sheehan, 2016). It is based on a study conducted in 66 workplace environments

in medium to large companies in Australia. Its development is carried out in several stages. Proactive indicators of OSH were chosen, as described in the published article (Table 5), and then OSH performance tools were found in the literature. The results of the evaluation show that the original OPM tool developed by IWH is easier to use and simpler to use.

Table 5.
Proactive indicators are drawn from published research (Shea et al., 2016)

It	Indicators
1	K3 Responsibilities
2	Consultation and communication on OSH
3	Employee autonomy and involvement in OSH decision-making
4	Management commitment and leadership
5	Recognition and positive response to OSH efforts
6	K3 hierarchy structure
7	Risk management
8	OSH system (policies, procedures, practices)
9	Training, interventions, information, tools, and resources for K3
10	OSH inspections and audits in the workplace

The OPM-MU tool has undergone several significant changes compared to OPM (Tremblay & Badri, 2018b) as follows:

a) The percentage scale was replaced by a 5-point Likert scale;
b) Questions about perception were added to evaluate how OPM is associated with various elements of OSH;
c) Asking survey participants to say the number of incidents they were personally involved in;
d) Collect measurements used in the workplace in each organization;
e) The inclusion of reactive indicators.

OPM-MU is a simple measuring tool that can be used to check the status of early OSH in various industries. It can provide information about the quality of the OSH management system, but it has some limitations, such as not providing a complete or in-depth understanding of OSH in a company and is not suitable for small companies. Those who made it hope to improve it so that it is useful for comparative analysis of K3 status (Shea et al., 2016).

Tools - K3 Profile (2018)

Québec's forestry, pulp, and paper sector commissioned the creation of a tool called the "SST Profile" to assess OSH performance. This tool is based on several tools discussed in the literature and is specifically designed for small and medium-sized companies (Tremblay & Badri, 2018a). There are four dimensions of performance: organizational, technical, behavioral, and continuous improvement. There are also several thematic subcategories that include proactive indicators. Tables 7 and 8 provide a summary of the "SST Profile" structure.

Hypothesis Test

1) **Multiple Linear Regression Test**

The multiple linear regression test serves to measure the correlation of independent variables (x) with dependent variables (y). The following are the test results obtained:

Table 7.
Structure of "SST Profile"

Dimension	Organization	Technical	Behavior	Advanced Enhancements

Theme	Commitment from management	Locking/tagging	Supervisor	Advanced upgrades
	Risk identification, control	Personal protector of the device	Measures of discipline	
	Prevention programs	Tight space	Labor representatives	
	Training	Working at Height	Communication	
	Supervision of subcontractors	Hot environment		
		SIMDUT		
		Rescue in the forest		
		Manual felling		

Tool - Risk Management Maturity Measurement: Initial Model (2018)

To measure the maturity of risk management, it has been proposed to use only a few indicators found in the literature (Kaassis & Badri, 2018). First, the indicators are divided into four groups: risk management processes, organization and management, individuals, and finally, tasks and resources. Subsequently, the family is used with published models to create a better starting model for small and medium-sized businesses. Table 9 provides examples of indicators that are appropriate for risk management process groups.

Table 9.
Risk management process maturity indicators

Indicator Categories	Measurement
Identify OSH risks	Number of hazards identified
	Number of incident reports filed
	Number of inspections carried out
	Number of people trained to identify hazards
OSH risk estimation and evaluation	The number of estimates and evaluations carried out and validated
	Number of risks identified per risk level
Preventive and corrective actions	Number of recommended precautions and remedies
	Number of effective preventive measures and remedies (verified and validated)
	Number of precautions per hazard type (e.g., narrow spaces, height, etc.)
	Number of prioritized corrective actions per hazard type (e.g., high or low severity)
	Number of new hazards reported after the implementation of preventive measures and remedies
Risk characterization	Correlation between proactive and reactive indicators
	The amount of potential hazard (with low or high severity, etc.)
	The number of hazards per specific category (e.g., narrow spaces, heights, etc.)
Monitoring and review	Number of new evaluations of OSH risks
	Effectiveness of corrective actions implemented

Tools - Measurable Proactive Indicators of Risk Management Maturity (2019)

The literature has compiled the right proactive indicators for use in small to medium-sized chemical companies in China. These indicators are divided into four groups: operations, management, individuals, and resources and technology (Sun, Liu, & Yuan, 2019). There are also other indicators that are known to vary based on risk. To assess the measurability of the proposed indicators, the sixteen participating companies were divided into two groups based on work accident records over the previous 24 months. Table 10 shows operation-based indicators.

Table 10.
Operation-based OSH indicators that can be used in small to medium-scale chemical companie

Code	Indicator Categories	Measurement Examples
1	Hazard identification	Number of hazards identified
		Number of inspections focused on chemical safety
		Number of inspections that focus on work-related risks
		Number of people trained to identify hazards
2	Risk estimation and evaluation	Number of estimates and re-evaluations carried out
		Risks are identified per level or category
3	Prevention and corrective action	Number of recommended precautions and remedies
		Number of preventive/remedial measures that are considered effective
		The number of precautions per hazard type (e.g. enclosed spaces, sparks, etc.)
		Number of new hazards reported after the implementation of preventive measures and remedies
4	Risk characterization	Correlation of proactive and reactive indicators
		The number of potential hazards sorted by severity
		The number of hazards based on a specific category (e.g., enclosed spaces, altitude, etc.)
5	Follow-up and investigation	Number of new risk evaluations
		Effectiveness and efficiency of corrective actions implemented

Managers can get a basic picture of their business's risk management maturity by using proactive, measurable indicators. This study shows that companies that diligently implement proactive risk management strategies can reduce the rate of occupational accidents. Since the proposed indicators aim to show the risk management maturity of small and medium-sized Chinese chemical companies, it is still unclear how much can be generalized. This type of company tends to be large by Canadian standards.

Tool - K3 Management Evaluation (2019)

Based on a review of the literature used to design the 7 tools above, Taiwan's food industry was selected to conduct an evaluation of K3 performance (Cheng, Lin, Liou, Hsiao, & Liu, 2019). Using the Delphi technique, experts were asked for their opinions on six indicators that were omitted: emergency intervention, purchasing policy, change management, safety communication, prevention management, and safety behavior. In addition, 25 K3 management problems that were not previously addressed were also found. The 28 key indicators, 25 of which are used for tool 7, are divided into three categories of OSH factors: technical, organizational, and human. Table 11 displays three additional indicators.

Table 11.
Additional key indicators regarding OSH performance

K3 Factor	Key Performance Indicators

Organization	Preventive management practices
	Employee protection measures
Human	Security enhancement program

The framework for the performance assessment of safety and health management systems was developed using SafetyMAP Australia's audit criteria as a foundation and supplemented with additional criteria identified in the occupational health and safety management literature. In addition to the elements of emergency response procedures, health promotion and monitoring of the work environment were not assessed by IKPEGBU and were not used as assessment criteria from the results of the formulation of the assessment framework above, but in his research, the information was still collected.

K3 performance evaluation tools are often based on reactive indicators (e.g., frequency or severity of work accidents). Although simple to measure, this type of indicator provides little useful information for identifying K3 deficiency (Versteeg et al., 2019). Researchers are starting to turn their attention to proactive indicators (e.g., the percentage of employees who receive K3 training, and frequency of workplace inspections) as a way to get more useful evaluations. This shows the efficiency of the prevention process in a business and even identifies problems before they cause accidents. Therefore, proactive indicators are an important source of OSH information. However, its use is still largely unexplored in the scientific literature (Ghahramani et al., 2023; Rouat, 2019; Tremblay & Badri, 2018b).

The strengths and weaknesses of these two types of indicators show that there is no one type of indicator that provides precise and reliable performance measurements (Ghahramani et al., 2023). To get a complete evaluation, the two types must be used simultaneously. By triangulating these things, we can not only get an overall and realistic picture of the situation but also identify needs (Ghahramani et al., 2023). Information obtained from one type of indicator can confirm or add value to information obtained from another indicator. In summary, performance indicators, both reactive and proactive, each have strengths and weaknesses.

Several observations emerged from the comparison of these nine K3 performance evaluation tools. First of all, the Tool - Total Safety Performance (Liu et al., 2014), the Tool - Fuzzy Comprehensive Performance Evaluation (Li et al., 2015) and the Tool - K3 Profile (Tremblay & Badri, 2018a) showed that it had met the components of eight elements that could contribute to the improvement of K3. These elements are: (1) Planning, Review, Development of Policies and Procedures, (2) Organizational Management Arrangements, (3) Consultation Arrangements, (4) Contractors, (5) Hazard Identification and Risk Assessment, (6) Preventive Measures, (7) K3 Data Collection and Use, (8) Training.

None of the selected tools use reactive indicators. Where the K3 Tool – Profile has the most complete indicator with 94 measurable proactive indicators while the K3 independent Diagnostic Tool – has a simple indicator that the use of the tool needs to be measured by an OHS expert. In the observation of the nine tools, none of the tools had a reactive indicator.

Tools - Total Safety Performance (Liu et al., 2014), Tools - Fuzzy Comprehensive Performance Evaluation (Li et al., 2015) and Tools - K3 Profile (Tremblay & Badri, 2018a) show that tools have a diversity of indicators, have a broad vision of K3 performance, are very effective and practical for comparative studies and Simple and user-friendly for the industry.

CONCLUSION

In conclusion, evaluating occupational health and safety (OSH) performance is crucial for enhancing workplace conditions and operations. This assessment is supported by a range of tools designed to monitor progress and measure the effectiveness of preventive measures in industries prone to physical risks. The review of literature from 2005 to 2023 highlights several key evaluation tools, emphasizing their content validity, use of indicators, and reliability. While both reactive and proactive indicators offer insights into OSH status and performance, combining these approaches provides a more comprehensive view. Tools like Total Safety Performance, Fuzzy Comprehensive Performance Evaluation, and K3 Profile demonstrate effectiveness in improving occupational health and safety through elements such as policy development, hazard assessment, and training. As global demographics

evolve, ensuring safer work environments becomes increasingly critical, necessitating robust monitoring systems tailored to today's workforce challenges. Despite advancements, ongoing incidents underscore the need for reliable OSH evaluation tools to meet regulatory standards and achieve safer workplaces effectively.

REFERENCES

Bayramova, A., Edwards, D. J., Roberts, C., & Rillie, I. (2023). Constructs of leading indicators: A synthesis of safety literature. *Journal of Safety Research*, 85, 469–484. Retrieved from https://doi.org/10.1016/j.jsr.2023.04.015

Cheng, S.-Y., Lin, K.-P., Liou, Y.-W., Hsiao, C.-H., & Liu, Y.-J. (2019). Constructing an active health and safety performance questionnaire in the food manufacturing industry. *International Journal of Occupational Safety and Ergonomics*.

Ghahramani, A., Ebrahimi, M., & Hajaghazadeh, M. (2023). Development and psychometric evaluation of an occupational health and safety performance tool for manufacturing companies. *Heliyon*, 9(6).

IKPEGBU, M. A. (2015). Implementation Of Occupational Safety And Health Management System In Reducing Ergonomic Risk Among Certified And Uncertified Automotive Industry Workers.

Jafari, H., Vosoughi, S., Abolghasemi, J., & Ebrahimi, H. (2020). Development and validation checklist for the health, safety and environment management system auditing in the Surface Mines. *Iran Occupational Health*, 17(1), 1098–1108.

Joas, A., Knudsen, L. E., Kolossa-Gehring, M., Sepai, O., Casteleyn, L., Schoeters, G., … Joas, R. (2015). Policy recommendations and cost implications for a more sustainable framework for European human biomonitoring surveys. *Environmental Research*, 141, 42–57. Retrieved from https://doi.org/10.1016/j.envres.2014.10.012

Kaassis, B., & Badri, A. (2018). Development of a preliminary model for evaluating occupational health and safety risk management maturity in small and medium-sized enterprises. *Safety*, 4(1), 5.

Li, W., Liang, W., Zhang, L., & Tang, Q. (2015). Performance assessment system of health, safety and environment based on experts' weights and fuzzy comprehensive evaluation. *Journal of Loss Prevention in the Process Industries*, 35, 95–103. Retrieved from https://doi.org/10.1016/j.jlp.2015.04.007

Liu, Y., Chen, J., Cheng, S., Hsu, M., & Wang, C. (2014). Evaluation of safety performance in process industries. *Process Safety Progress*, 33(2), 166–171.

Podgórski, D. (2015). Measuring operational performance of OSH management system – A demonstration of AHP-based selection of leading key performance indicators. *Safety Science*, 73, 146–166. Retrieved from https://doi.org/10.1016/j.ssci.2014.11.018

Reiman, T., & Pietikäinen, E. (2018). Patient safety indicators as tools for proactive safety management and safety culture improvement. In *Patient Safety Culture* (pp. 183–204). CRC Press.

Rouat, S. (2019). L'utilité de la formation dans la prévention des risques psychosociaux au travailprévention des risques psychosociaux, santé au travail, formation, ressources psychosociales. Les effets d'une formation aux RPS sur le développement des ressources psychosociales. *Perspectives Interdisciplinaires Sur Le Travail et La Santé*, (21–1).

Sgourou, E., Katsakiori, P., Papaioannou, I., Goutsos, S., & Adamides, E. (2014). A holistic framework for safety performance evaluation. *Occupational Safety and Hygiene II*, 75–79.

Shea, T., De Cieri, H., Donohue, R., Cooper, B., & Sheehan, C. (2016). Leading indicators of occupational health and safety: An employee and workplace level validation study. *Safety Science*, 85, 293–304. Retrieved from https://doi.org/10.1016/j.ssci.2016.01.015

Sinelnikov, S., Inouye, J., & Kerper, S. (2015). Using leading indicators to measure occupational health and safety performance. *Safety Science*, 72, 240–248. Retrieved from https://doi.org/10.1016/j.ssci.2014.09.010

Sun, J., Liu, C., & Yuan, H. (2019). Evaluation of risk management maturity: measurable proactive indicators suitable for Chinese small and medium-sized chemical enterprises. In *IOP Conference Series: Earth and Environmental Science* (Vol. 242, p. 042006). IOP Publishing.

Tao, J., Yang, F., Qiu, D., & Reniers, G. (2020). Analysis of safety leadership using a science mapping approach. *Process Safety and Environmental Protection*, 140, 244–257. Retrieved from https://doi.org/10.1016/j.psep.2020.04.031

Tremblay, A., & Badri, A. (2018a). Assessment of occupational health and safety performance evaluation tools: State of the art and challenges for small and medium-sized enterprises. *Safety Science*, 101, 260–267. Retrieved from https://doi.org/10.1016/j.ssci.2017.09.016

Tremblay, A., & Badri, A. (2018b). Assessment of occupational health and safety performance evaluation tools: State of the art and challenges for small and medium-sized enterprises. *Safety Science*, 101, 260–267. Retrieved from https://doi.org/10.1016/j.ssci.2017.09.016

Versteeg, K., Bigelow, P., Dale, A. M., & Chaurasia, A. (2019). Utilizing construction safety leading and lagging indicators to measure project safety performance: A case study. *Safety Science*, 120, 411–421. Retrieved from https://doi.org/10.1016/j.ssci.2019.06.035