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Exploring Safety Culture Maturity Models: A Systematic Review of Approaches, Assessment Elements, and Industrial Contexts

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Abstract

The rate of work accidents in various industrial sectors still shows an alarming trend, so efforts to improve safety culture are an urgent need. One of the strategic approaches used to encourage gradual improvement of safety culture is through the implementation of the *Safety Culture Maturity Model* (SCMM). This study aims to conduct a systematic literature review (SLR) of various SCMM models that have been used in the context of cross-sectoral organizations. Of the 58 articles screened, 17 articles met the criteria, including models, assessment elements, and industry contexts. The results of the study show that the Hudson model is the most widely used model due to its conceptual strength and flexibility in various industries. Other models, such as *Flemming* (*HSE model*), *DuPont Bradley Curve*, as well as the development of sector-specific models such as *Food Safety Culture Maturity* (FSCM), have also been found to be relevant according to organizational characteristics and the level of readiness of safety culture. Analysis of assessment elements shows that leadership commitment, safety communication, training, employee engagement, and risk management are the most dominant indicators used in measuring the level of maturity of safety culture. This study is expected to be an additional reference for practitioners and researchers in choosing appropriate and effective models for the transformation of safety culture in their organizations.

Keywords: *safety culture maturity model*, work safety culture, *systematic literature review*

INTRODUCTION

The number of work accidents in Indonesia continues to experience an increasing trend. In 2024, the number of work accidents in Indonesia reached 462,241 cases, an increase of 24.7% from the previous year. According to the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2021, work accidents are accidents that occur in an employment relationship, including accidents that occur on the way from home to work or vice versa, as well as diseases caused by the work environment. Work accidents have a very significant impact on companies; in addition to harming the workforce who are victims, work accidents also result in decreased productivity due to disruption of business processes, financial losses due to damage or loss of assets, and a negative impact on the company's reputation.

Work accidents can be caused by various factors. Choudhry (2014) found that unsafe behavior is a common cause of work accidents. Supardi (2021) stated that unsafe employee actions can cause injuries in the workplace, where 85% of injuries are caused by unsafe actions. Many accident investigations in various industries point to safety culture factors (Chib & Kanetkar, 2014). The term *safety culture* was first used after the nuclear power plant accident at *Chernobyl* in 1986. Based on an investigative report from the *International Nuclear Safety Advisory Group* (*INSAG*) of the *International Atomic Energy Agency* (*IAEA*), poor safety culture was identified as one of the factors causing the worst work accident in history.

Several previous studies have shown the positive influence of safety culture on safety performance through effective accident reduction and improved safety

performance indicators (Kalteh et al., 2019). Morrow et al. (2014), who conducted research on the nuclear power industry in the US, found an empirical relationship between safety culture and safety performance. Safety culture has been recognized as one of the key determinants in preventing work accidents and improving safety performance. Although many organizations have implemented safety management systems, the development of a safety culture is often slow, difficult to measure, and unsustainable. This is due to the complexity of organizational culture as well as the challenge of internalizing safety culture values at all levels of employees.

One of the approaches developed to emphasize the improvement of safety culture in organizations is through the *Safety Culture Maturity Model* (*SCMM*) (Ayob et al., 2022). SCMM is a tool to assess the extent to which the safety culture has been formed and developed, as well as to provide guidance in increasing the level of maturity of the safety culture. Models such as the *DuPont Bradley Curve*, *Hudson's Safety Culture Ladder*, and *HSE Model – Flemming* have been widely used in various industrial sectors.

However, the diversity of models and the contexts in which they are applied raise questions about the effectiveness and suitability of each model. There has not been a systematic review update that comprehensively compares the various SCMMs, analyzes their key elements, and evaluates their implementation in different industry sectors. Therefore, a systematic study is needed to synthesize the existing scientific evidence in order to provide a clear picture of the SCMM models.

This study aims to fill this gap by conducting a systematic literature review (*SLR*) of various SCMM models that have been developed and used in organizational contexts. Through this analysis, it is hoped that a better understanding of each model can be obtained. In addition, the results of this study are expected to serve as a reference in selecting or developing a model of safety culture maturity that is appropriate and in accordance with the characteristics of the organization, as well as in compiling the elements of the assessment.

RESEARCH METHODS

This study analyzed the *Safety Culture Maturity Model* using a systematic literature review method. Only empirical or theoretical studies that discussed the safety culture maturity model and were published between 2010 and 2025 were included. In the initial stage, articles were identified through searches of journal databases on *Scopus*, *Web of Science* (WoS), and *PubMed*. The keywords used were "safety culture maturity," "safety maturity model," "safety culture," and "organizational safety." In addition, the selection of journal types was limited to articles and/or reviews only. A total of 58 articles were found, but there were 11 duplicates, resulting in 37 articles.

The next stage involved screening by removing articles from the research database based on their suitability to the theme of the *Safety Culture Maturity Model* discussion. Studies that addressed only safety culture without a focus on maturity models were excluded to ensure topical and thematic relevance. Screening for compatibility was conducted by reviewing the title and abstract of each article, as well as access to full journal articles. This process yielded 23 articles relevant to the research theme.

In the final stage, the entire content of each article was assessed to determine whether it explained the stages of safety culture maturity, mentioned a model about safety culture maturity, and included the context of the industry and the results of its implementation. From this stage, 17 articles were obtained. From these 17 final articles, data were extracted, including basic information (author, year), the SCMM model used, elements in the model, and the application context.

RESULTS AND DISCUSSION

Adaptation and incorporation were carried out in several studies, such as by Behari (2018) which combined the Hudson Model with *the HSE model* from Flemming, *Process Safety Culture* from Parker et al., *DuPont Model* and other models to assess *Process Safety Culture Maturity* for Specialty Gas Companies. Chan, (2023) also combines the *Safety Culture Maturity Model* from Hudson with *Reason's Inter-dependent Sub-Cultures* to assess *Building Projects* in Hong Kong by adapting multilevel assessments according to the context of existing conditions in the construction sector, namely to *Client Safety Culture*, *Main Contractor Safety Culture* and *Subcontractor Safety Culture*.

Hudson (2001) proposes SCMM with an advanced stage of Westrum's concept by using two additional stages, namely reactive and proactive, and replacing the third stage of Westrum from bureaucratic to calculative (Figure 1).

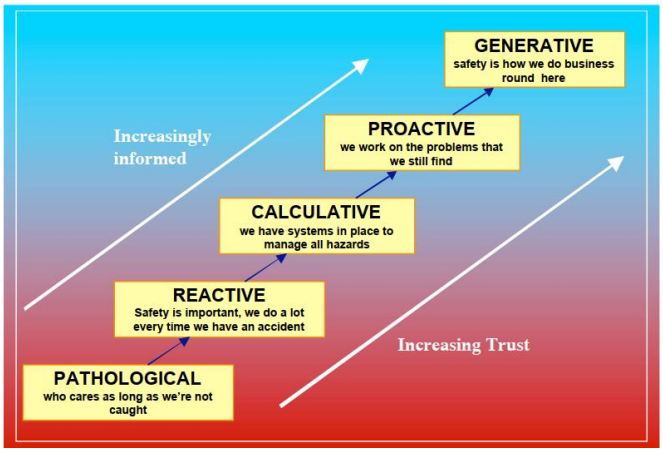

Figure 1. Hudson's Safety Culture Ladder
Source: Hudson (2001)

The model from Hudson was then complemented by Parker et al., (2006) with a framework that can be used to understand the maturity of an organization's safety culture. The framework consists of 11 *concrete* elements and 7 abstract elements, namely:

Table 1. Assessment Elements *of Hudson's Safety Culture Maturity Model*

"Concrete" Elements	"Abstract" Elements
Benchmarking, Trends & Statistics Audits & Reviews	Who causes accidents in the eyes of management?

"Concrete" Elements	"Abstract" Elements
Incident/Accident Reporting, Investigation & Analysis;	What happens after an accident? Is the feedback Loopbeing closed?
Hazard and Unsafe Act reports	How do safety meetings feel?
Work planning including PTW, Journey Management	Balance between HSE & Profitability?
Contractor Management	Is management interested in communicating HSE issues with the workforce?
Competency/Training	
Work-site Job Safety Techniques	Commitment level of the workforce and level of carefor colleagues.
Who Checks Safety on a day to day basis?	What is the purpose of procedures?
What is size & status of the HSE Department?	
What are the rewards of good safety performance?	

Source: Parker et al., (2006)

Hudson's SCMM model was developed from Hudson's research in the oil and gas industry with Shell, as well as real experience in developing safety cultures. Guldenmund (2007) considers that Hudson's model is very useful for organizations that want to drive cultural change systematically. Hudson's model can be used as a diagnostic tool through the assessment of the maturity stages of safety culture, identification of cultural gaps and creating safety intervention strategies based on the stages being undertaken. Hudson's model is also common and has been adapted in various industries such as mining (UK Coal), construction and even healthcare.

While the model from Flemming was used by Sahri, et al., (2021) to assess *the Health and Safety Culture Maturity Level* at PT PAL (*Shipping Industry* Surabaya), Lee, S. (2019) to evaluate *safety culture* at *construction sites* and used by Zhang, et al., (2023) in his research on *safety culture maturity* evaluationfrom a real estate company. The Flemming model, better known as the HSE model, explains five levels of organization in an effort to improve safety culture, namely *emerging* (level 1), *managing* (level 2), *involving* (level 3), *cooperating* (level 4), and *continuously improving* (level 5).

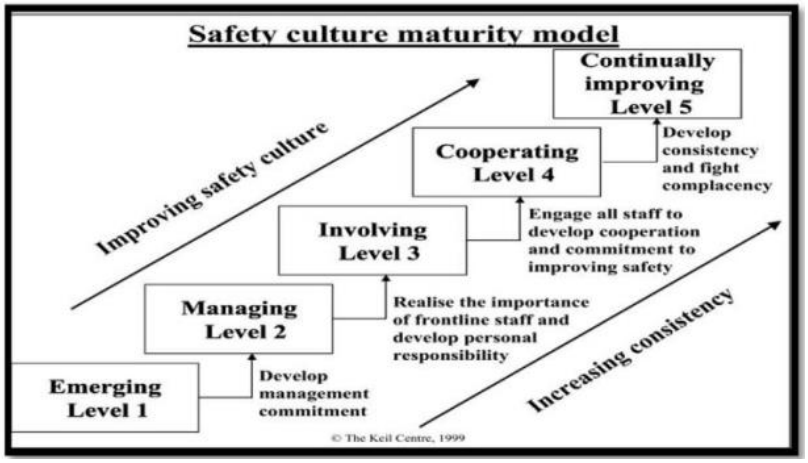

Figure 2. HSE Model from Flemming
Source: Ayob (2014)

In a study by Flemming (2004) that measured and increased cultural maturity in Petro-Canada, 10 (ten) elements of the SCMM assessment were used, namely

visibility of management commitment, *supervisor visible commitment*, *production pressures*, *organizational learning*, *job and safety communication*, *human and physical resources*, *rules and procedures*, *trust level*, *training* and *workforce involvement*. In the study by Sahri, et al., (2021) 10 similar elements were also used, while in the study from Zhang, et al., (2023) 7 (seven) assessment elements were used, namely *safety management system knowledge*, *publicity and education training*, *safety and management participation*, *staff safety awareness*, *staff safety knowledge and skills*, *co-workers behavior affect safety*, *responsibility and disciplinary punishment* but are not explained in the source article of this assessment element.

The Flemming model is an important part of the *Hearts and Minds* program developed by Shell with the Energy Institute and has been used >50 countries and adopted by hundreds of major companies in the energy, mining, construction and manufacturing sectors. The Flemming model is used by Shell, Petronas, Chevron, and other companies in the implementation of *the Hearts and Minds* program for the implementation of cultural change/transformation. However, Flemming requires organizations to have the following criteria before they can be used to assess SCMM, namely: having an adequate occupational safety management system; Most accidents are not caused by technical failures; comply with work safety laws and regulations; and using occupational safety to prevent accidents.

Research from Siuta, D. et al. (2022) used Bradley's SCMM to assess *the Safety Culture Maturity Level* in the energy industry in Poland. The Dupont Bradley curve consists of four levels that are used to identify the level of safety culture. The first level is *reactive* (safety is driven by natural instincts), the second level is *dependent* (safety is driven by management and based on the control of superiors), the third level is *independent* (driven by personal knowledge, commitment, and standards) and the last level is *interdependent* (driven by concern for others and teamwork).

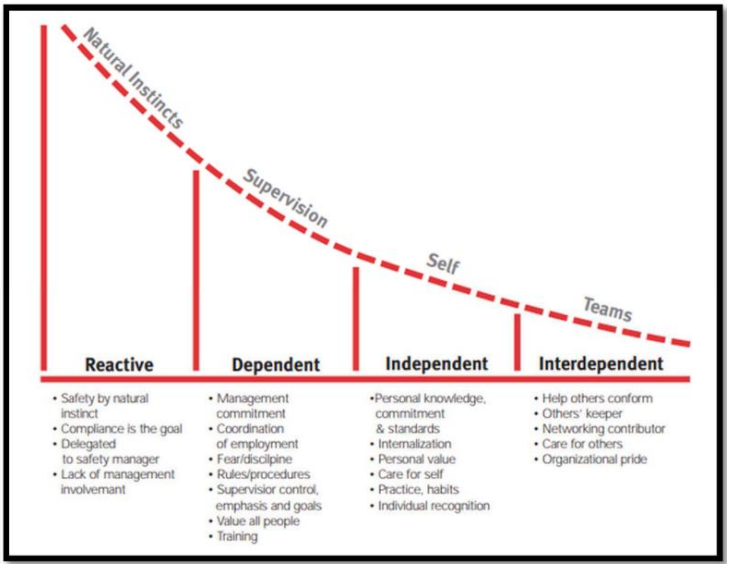

Figure 3. Dupont Bradley Curve
Source: Ayob (2014)

In their research, Siuta, et al., (2022) used elements such as: *leadership for safety, recognition and awards, communication and information flow, networking, personal knowledge and skills, care for yourself, loss of organization image, safety training, care for others, cost of proactive actions, organizational pride*.

The Dupont Bradley curve is often used in organizations that are just beginning to build a safety culture, mapping out the current position and providing a framework for the evolution of the culture. The Dupont Bradley curve is often used in programs such as *Behavior-Based Safety* (BBS) because it is easy to associate it with real actions in the field. This is supported by empirical evidence from research by Jasiulewicz-Kaczmarek et al., (2015) that the DuPont Bradley Curve is combined with BBS interventions through observation, feedback, and training to accelerate the transition of safety culture.

The development of *a safety culture maturity assessment model* is also carried out, such as Foster, P. & Hoult, S., (2013) who developed the *UK Coal Journey Model* for the coal mining industry in the UK. *The UK Coal Journey Model* is divided into 5 stages or levels, namely *basic – reactive – planned – proactive – resilient.*

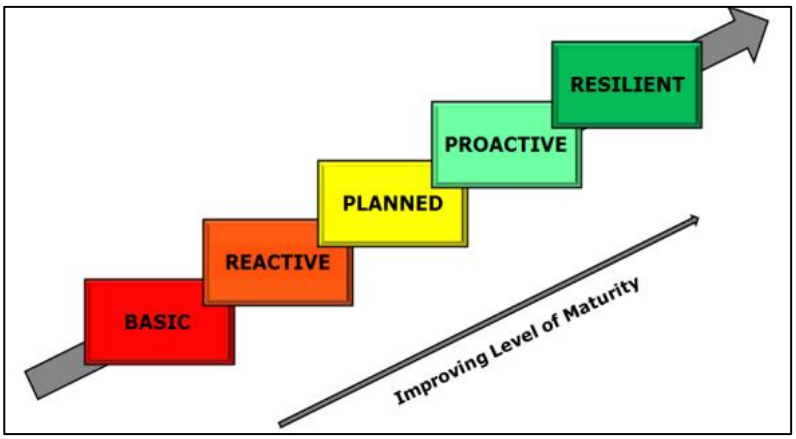

Figure 3. UK Coal Journey Model
Source: Foster, P., & Hoult, S., (2013)

There are 12 (twelve) elements used for the assessment of *safety culture maturity* using *the UK Coal Journey Model*, namely: *Leadership & Accountability, Policy & Commitment, Risk & Change Management, Legal Requirements, Objectives, Targets & Performance Measurement, Training, Competence & Awareness, Communication & Consultation, Control of Documents, Operational Controls, Emergency Procedures, Incident Investigation, Monitoring, Auditing & Reviews.*

Development was also carried out by McSweeney (2022), who developed the *Offshore Safety Culture Maturity Model* to assess *the safety culture* of the offshore exploration industry.

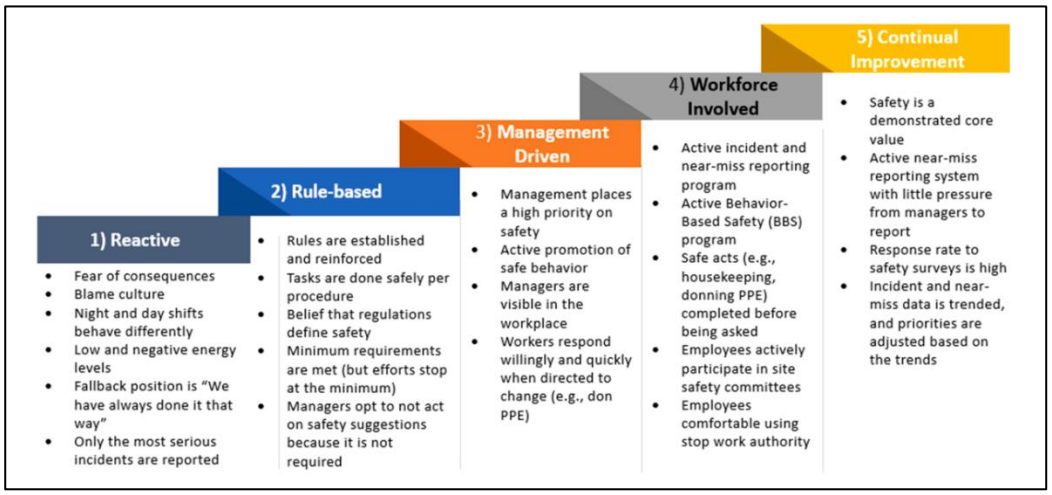

Figure 4. ***Offshore Safety Culture Maturity Model***
Source: McSweeney (2022)

The *Offshore Safety Culture Maturity Model* assessment uses 9 (nine) elements of safety culture identified by the *Bureau of Safety and Environmental Enforcement* (BSEE, 2013) as the regulator of the US offshore oil and gas industry, namely *Leadership, Hazard and Risk, Accountability, Work Processes, Improvement, Raising Concerns, Communication, Respectful Environment, and Inquiring Attitude.*

In other sectors, Fourar, et al., (2021) developed a quantitative PSCMM (*Patient Safety Culture Maturity Model*) to assess *patient safety culture* in the healthcare industry. This assessment uses the HSOPSC (*Hospital Survey on Patient Safety Culture*) questionnaire which consists of 12 dimensions, namely: *Teamwork Within Units, Supervisor/Manager Expectations & Actions Promoting Patient Safety, Organizational Learning—Continuous Improvement, Management Support for Patient Safety, Overall Perceptions of Patient Safety, Feedback and Communication About Error, Communication Openness, Frequency of Events Reported, Teamwork Across Units, Staffing, Handoffs and Transitions, Nonpunitive Response to Error.*

Quite interesting is the development of *Food Safety Culture Maturity* (FSCM) by Jespersen, L. et al., (2016) to assess cultural maturity in the food safety sector. Follow-up research was developed by Jespersen, L. et al., (2019) and Spagnoli, P., et al. (2024) to look at the impact and relationship of *Food Safety Culture* maturity on economic gains. There are 5 (five) levels of maturity in *Food Safety Culture Maturity* developed from the research of Jespersen, L. et al., (2016), namely stage 1 (*doubt*), stage 2 (*react to*), stage 3 (*know of*), stage 4 (*predict*) and stage 5 (*internalize*). Meanwhile, the *Food Safety Culture Maturity assessment* consists of 5 (five) capability areas, namely: *Perceived Value, People System, Process Thinking, Technology Enabled, Tools and Infrastructure*.

In terms of assessment elements, there are ten elements that are most used in cross-model and industry SCMMs, namely:

Table 2. Ten Most Frequently Used Elements in SCMM

No.	Assessment Elements	Frequency of Occurrence	Article/Journal Number
1.	*Leadership / Management Commitment*	10	3, 5, 17, 7, 8, 11, 12, 15, 10, 4
2.	*Safety Communication*	9	1, 2, 5, 7, 6, 12, 15, 13, 11
3.	*Training & Competence / Education*	8	3, 5, 17, 11,12, 10, 15, 16
4.	*Organizational Learning / Feedback*	6	1, 2, 5, 6, 10, 15
5.	*Risk & Hazard Management*	5	1,17, 15, 16, 7
6.	*Employee Involvement / Participation*	5	5, 3,12, 10, 11
7.	*Accountability / Responsibility*	4	17, 7, 11, 12
8.	*Incident Reporting / Investigation*	4	17, 6, 9, 11
9.	*Organizational Values & Culture*	3	15, 16, 12
10.	*Safety Management System / Documentation*	3	17, 8, 9

Source: Processed Researcher

The frequency of the emergence of these elements demonstrates global consistency about the importance of organizational leadership, training, communication, and learning as the key pillars of a mature safety culture.

Table 3. Data Extraction Table

Yes	Author (Year)	Study Title	Model SCMM	Assessment Elements	Industry Context
1	Chan, E. (2023)	A Multi-Level Safety Culture Maturity Model for (New) Building Projects in Hong Kong	Reason's Inter-dependent Sub-Cultures and Hudson's Safety Culture Maturity Model with multilevel assessment adaptation	*Safety Communication, Learning from Incidents, Care and Respect, Risks and Hazards Management*	New buildin g constru ction in Hong Kong
2	Filho, A.P.G., et al. (2010)	A Safety Culture Maturity Model for Petrochemical Companies in Brazil	Hudson's Model	Information, Organisational Learning, Involvement, Communication and Commitment	Petroch emical industr y in Brazil
3	Liana, D., et al. (2022)	A self-assessment model for hospital safety culture maturity	Hudson's Model	Management commitment, Safety communication, Rules and procedures, Enabling environment, Personal involvement, Safety training	Hospita ls (Indone sia)
4	Behari, N. (2018)	Assessing Process Safety Culture Maturity for Specialty Gas	A combination of HSE models, Process Safety Culture (Parker) and Hudson's models, DuPont	Human factor, process safety audits, leadership behavior, operational process safety risks	Special gas operati on

Yes	Author (Year)	Study Title	Model SCMM	Assessment Elements	Industry Context
		Operations: A Case Study	Model, and others.		
5	Sahri, M. et. al. (2021)	Assessment of Health and Safety Culture Maturity Level in the Shipping Industry in Surabaya	Flemming's Model	Management commitment and visibility, Communication, Productivity versus safety, Learning organization, Safety resources, Participation, Shared perceptions about safety, Trust, Industrial relations and job satisfaction, Training	Shipping industry in Surabaya
6	Fourar, Y.O. et al. (2021)	Contribution of PCA/K-means Methods to the Mixed Assessment of Patient Safety Culture	Development of quantitative PSCMM (Patient Safety Culture Maturity Model)	According to the HSOPSC (Hospital Survey on Patient Safety Culture) questionnaire with 12 dimensions: Teamwork Within Units, Supervisor/Manager Expectations & Actions Promoting Patient Safety, Organizational Learning—Continuous Improvement, Management Support for Patient Safety, Overall Perceptions of Patient Safety, Feedback and Communication About Error, Communication Openness, Frequency of Events Reported, Teamwork Across Units, Staffing, Handoffs and Transitions, Nonpunitive Response to Error	Healthcare industry
7	McSweeney, K. (2022)	Development of a Comprehensive Multi-Component Toolkit for Offshore Safety Culture Assessment	Offshore Safety Culture Maturity Model	Leadership, Hazard and Risk, Accountability, Work Processes, Improvement, Raising Concerns, Communication, Respectful Environment, Inquiring Attitude	Offshore industry
8	Phusavat, et al. (2015)	Enterprise Development Through the Safety Culture Maturity Model	Hudson's Model	Leadership and commitment, Policy and strategic objectives, Organisation, resource and documentation, Evaluation and risk management, Planning and operational	Oil and gas industry

Yes	Author (Year)	Study Title	Model SCMM	Assessment Elements	Industry Context
				control, Monitoring and Measuring, Audit and review	
9	Rocha, R. et al. (2024)	Framework for the Assessment of the Safety Culture in the Oil and Gas Industry	Hudson's Model	Benchmarking, trends and statistics, audits and incident and accident investigations and analyses, hazard and unsafe act reporting, work planning, contractor management	Offshore oil industry
10	Jespersen, L. et al. (2016)	Measurement of Food Safety Culture Using Survey and Maturity Profiling Tools	Food Safety Culture Maturity Model (FSCM)	Perceived Value, People System, Process Thinking, Technology Enabled, Tools and Infrastructure	Food and beverage industry
11	Judith, D. et al. (2022)	Methodology for the Determination of a Process Safety Culture Index and Safety Culture Maturity Level in Industries	DuPont Bradley Curve	Leadership for safety, Recognition and awards, Communication and information flow, Networking, Personal knowledge and skills, Care for yourself, Loss of organization image, Safety training, Care for others, Cost of proactive actions, Organizational pride	Energy industry in Poland
12	Zhang, F. et al. (2023)	Research on the Maturity Evaluation Model of Enterprise Safety Culture	Flemming's Model	Safety management system knowledge, publicity and education training, safety and management participation, staff safety awareness, staff safety knowledge and skills, co-workers' behavior affect safety, responsibility and disciplinary punishment	Real estate companies
13	Kirkegaard, M. L. et al. (2020)	Risk Perceptions and Safety Cultures in the Handling of Nanomaterials in Academia and Industry	Hudson's Model	Communication, Cooperation, Benchmarking, Safety practices, Leadership	Academia and industries that deal with nanomaterials
14	Lee, S. (2019)	Safety Culture Evaluation Model at Construction Site	Flemming's Model	Elements: Leadership, communication, training, incident reporting; Stage: Not explained in detail	Construction industry

Yes	Author (Year)	Study Title	Model SCMM	Assessment Elements	Industry Context
15	Jespersen, L. et al. (2019)	The Impact of Maturing Food Safety Culture and a Pathway to Economic Gain	Food Safety Culture Maturity Model (FSCM)	Values and Mission, People Systems, Consistency, Adaptability, Risks and Hazards	Food and beverage industry
16	Spagnoli, P., et al. (2024)	The Relationship between Food Safety Culture Maturity and Cost of Quality: An Empirical Pilot Study in the Food Industry.	Food Safety Culture Maturity Model (FSCM)	Food safety management system (riskiness of the context, level of control activities, level of assurance activities), human–organization (leadership, communication, commitment, resources, and risk awareness), human–individual (compliance, participation, motivation, knowledge, stress, and burnout)	Food & beverage industry (Europe)
17	Foster, P. & Hoult, S. (2013)	The Safety Journey: Using a Safety Maturity Model for Safety Planning and Assurance in the UK Coal Mining Industry	UK Coal Journey Model	Leadership & Accountability, Policy & Commitment, Risk & Change Management, Legal Requirements, Objectives, Targets & Performance Measurement, Training, Competence & Awareness, Communication & Consultation, Control of Documents, Operational Controls, Emergency Procedures, Incident Investigation, Monitoring, Auditing & Reviews	Coal mining industry in the UK

Source: Processed Researcher

CONCLUSION

The results of this systematic literature review demonstrated that the *Safety Culture Maturity Model* (SCMM) has been rapidly developed and widely adopted across various industry sectors, including oil and gas, construction, health, food, and manufacturing. Among the 17 studies reviewed, there was considerable diversity in both the theoretical models and assessment elements utilized, with *Hudson's Safety Culture Maturity Model* emerging as the most commonly applied due to its strong theoretical foundation and adaptability. *Flemming's Model*, particularly as part of the *Hearts and Minds* program, was also frequently used for organizations with existing safety management systems seeking to enhance worker engagement, while the *DuPont Bradley Curve* proved effective for organizations at the early stages of safety culture transformation. Across all models, core elements

such as leadership commitment, safety communication, training, and organizational learning were identified as critical for assessing and advancing safety culture maturity. This review provides valuable academic and practical insights for selecting or developing contextual SCMM models and designing safety culture evaluation tools. For future research, it is suggested to conduct longitudinal studies to evaluate the long-term effectiveness of different SCMM models in various industrial contexts.

REFERENCES

Ayob, A. N., Hassan, C. R. C., & Hamid, M. D. (2014). Safety culture maturity measurement methods: A systematic literature review. *Journal of Loss Prevention in the Process Industries*, *80*. https://doi.org/10.1016/j.jlp.2022.104846

Behari, N. (2018). Assessing process safety culture maturity for specialty gas operations: A case study. *Process Safety and Environmental Protection*. https://doi.org/10.1016/j.psep.2018.09.007

Chan, E. (2023). A multi-level safety culture maturity model for (new) building projects in Hong Kong. *HKIE Transactions, 30*(1), 95–105. https://doi.org/10.1080/1023697X.2023.2167517

Chib, S., & Kanetkar, M. (2014). Safety culture: The buzzword to ensure occupational safety and health. *Procedia Economics and Finance, 11*, 130–136. https://doi.org/10.1016/S2212-5671(14)00183-1

Choudhry, R. M. (2014). Behavior-based safety on construction sites: A case study. *Accident Analysis & Prevention, 70*, 14–23. https://doi.org/10.1016/j.aap.2014.03.007

Flemming, M. (2004). Safety culture maturity model. *SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production*. https://doi.org/10.2118/86761-MS

Foster, P., & Hoult, S. (2013). The safety journey: Using a safety maturity model for safety planning and assurance in the UK coal mining industry. *Transactions of the Institution of Mining and Metallurgy, Section A: Mining Technology, 122*(1), 20–29. https://doi.org/10.1179/1743286312Y.0000000027

Fourar, Y. O., et al. (2021). Contribution of PCA/K-means methods to the mixed assessment of patient safety culture. *International Journal of Health Governance*. https://doi.org/10.1108/IJHG-02-2021-0013

Filho, A. P. G., Andrade, J. C. S., & Marinho, M. M. O. (2010). A safety culture maturity model for petrochemical companies in Brazil. *Safety Science, 48*(5), 615–624. https://doi.org/10.1016/j.ssci.2010.01.015

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research – An evaluation. *Safety Science, 45*(6), 723–743. https://doi.org/10.1016/j.ssci.2007.04.006

Hudson, P. (2001). Safety management and safety culture: The long, hard and winding road. https://doi.org/10.2118/68660-MS

Jasiulewicz-Kaczmarek, M., Drobińska, E., & Antosz, K. (2015). Improving safety culture through the implementation of the DuPont Bradley Curve. *Management and*

Production Engineering Review, 6(4), 49–56. https://doi.org/10.1515/mper-2015-0047

Jespersen, L., Griffiths, M., MacLaurin, T., Chapman, B., Wallace, C. A., & Ball, B. (2016). Measurement of food safety culture using survey and maturity profiling tools. *Food Control, 66*, 174–182. https://doi.org/10.1016/j.foodcont.2016.01.030

Jespersen, L., Griffiths, M., Wallace, C. A., & Thomassen, G. (2019). The impact of maturing food safety culture and a pathway to economic gain. *Food Control, 98*, 106–115. https://doi.org/10.1016/j.foodcont.2018.10.019

Kalteh, H. O., Mortazavi, S. B., Mohammadi, E., & Salehi, M. (2019). The relationship between safety culture and safety climate and the safety performance of Iranian petrochemical industry workers. *Heliyon, 5*(3), e01252. https://doi.org/10.1016/j.heliyon.2019.e01252

Kirkegaard, M. L., Hansen, S. F., & Baun, A. (2020). Risk perceptions and safety cultures in the handling of nanomaterials in academia and industry. *Journal of Nanoparticle Research, 22*(3), 1–19. https://doi.org/10.1007/s11051-020-04773-7

Lee, S. (2019). Safety culture evaluation model at construction site. *Journal of the Korean Society of Safety, 34*(6), 1–9. https://doi.org/10.14346/JKOSOS.2019.34.6.001

Liana, D., Hardiyanti, D., & Dewi, A. R. (2022). A self-assessment model for hospital safety culture maturity. *National Public Health Journal, 17*(2), 67–74. https://doi.org/10.21109/kesmas.v17i2.5801

McSweeney, K. (2022). Development of a comprehensive multi-component toolkit for offshore safety culture assessment. *Journal of Safety Research, 80*, 70–82. https://doi.org/10.1016/j.jsr.2021.10.004

Morrow, S. L., Koves, G. K., & Barnes, V. E. (2014). Exploring the relationship between safety culture and safety performance in U.S. nuclear power operations. *Safety Science, 69*, 37–47. https://doi.org/10.1016/j.ssci.2014.02.022

Parker, D., Lawrie, M., & Hudson, P. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551–562. https://doi.org/10.1016/j.ssci.2005.10.004

Phusavat, K., Anussornnitisarn, P., Helo, P., & Sureephong, P. (2015). Enterprise development through the safety culture maturity model. *Industrial Management & Data Systems, 115*(7), 1208–1231. https://doi.org/10.1108/IMDS-11-2014-0350

Rocha, R., Duarte, F., Lima, F. P. A., & Campos, M. (2024). Framework for the assessment of the safety culture in the oil and gas industry. *Safety Science, 167*, 106157. https://doi.org/10.1016/j.ssci.2023.106157

Sahri, M., Hartono, & Saptomo, G. S. (2021). Assessment of health and safety culture maturity level in the shipping industry in Surabaya. *Journal of Occupational Safety and Health, 18*(3), 121–134. https://doi.org/10.20473/jkk.v18i3.2021.121-134

Spagnoli, P., Defalchidu, L., Vlerick, P., & Jacxsens, L. (2024). The relationship between food safety culture maturity and cost of quality: An empirical pilot study in the food industry. *Food Control, 153*, 112556. https://doi.org/10.1016/j.foodcont.2023.112556

Stuart, D., Kukfisz, B., Kuczyńska, A., & Mitkowski, P. T. (2022). Methodology for the determination of a process safety culture index and safety culture maturity level in industries. *Energies, 15*(9), 3104. https://doi.org/10.3390/en15093104

Supardi, S., Chandrarin, G., & Sunardi. (2021). The role of safety leadership and safety culture in improving safety performance. *East African Scholars Journal of Economics, Business and Management, 4*(3), 55–62.

Zhang, F., Wu, X., & Guo, Y. (2023). Research on the maturity evaluation model of enterprise safety culture. *International Journal of Environmental Research and Public Health, 20*(1), 287. https://doi.org/10.3390/ijerph20010287