Safety Science 181 (2025) 106698

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/safety

Redefining health, risk, and safety for occupational settings: A mixed-methods study

Nektarios Karanikas *, Haroun Zerguine

School of Public Health and Social Work, Faculty of Health, Queensland University of Technology, Kelvin Grove, Queensland, Australia

A B S T R A C T

Clear and specific definitions are essential in Occupational Health and Safety (OHS) practice and research, guiding the development of methods, tools, and metrics for effective management. However, there remains a lack of consensus within the field when defining health, risk, and safety. This study addresses this gap by proposing comprehensive definitions of these constructs based on the combination of empirical data from workshops conducted at a major construction company in Australia with literature from various disciplines. The qualitative analysis of participant responses and thematic coding of definitions from various disciplines revealed diverse perspectives on health, risk, and safety, highlighting the need for context-specific definitions tailored to different organisational levels. Hence, this study recommends simplified, summarised, and comprehensive definitions of these constructs to enhance clarity and consistency in OHS communication and practice. These definitions aim to foster a shared understanding and improve the effectiveness of OHS initiatives across different contexts. The paper also discusses several theoretical, practical, and ethical implications these definitions may have for researchers, practitioners, and policymakers regarding the scope of health, risk, and safety, their relationships, and the validity of related constructs such as risk assessment and safety performance. Finally, our study advocates a shift from mainly approaching OHS as a business objective towards viewing it more as a positive duty and public health area.

1. Introduction

Clear and specific definitions are crucial in practice and research. They provide guidance for creating methods, tools, and metrics needed to design, implement, test, and assess constructs (Flowerdew, 1992). As such, commonly and agreeably defining fundamental Occupational Health & Safety (OHS) constructs should be a precondition of any OHS management initiative as this would affect the focus workers, managers and organisations (Susca, 2018). However, Balderson (2016) suggests that organisations often focus on safety without a clear definition or understanding of what it actually means or how to achieve the desired safety outcomes. Furthermore, Manuele (2013) argues that the struggle for OHS to be recognised as a distinct profession can be partially attributed to the lack of consensus within the field on the definitions of key constructs (e.g., health, risk, safety).

The challenges and varying perspectives regarding OHS-related definitions are not new, centring predominately around safety. Decades ago, Rochlin (1999) and Slovic (1992) observed that safety is a construct that attracts more judgements than clear definitions. Further, Rochlin (1999), while observing that safety remained an ongoing intersubjective construct and impossible to measure directly, suggested shifting from a negative approach to safety (e.g., absence of accidents) or a reflexive approach (e.g., error avoidance or risk control) to a more positive construct. Similarly, Hollnagel (2014a) challenged definitions that portray safety as the absence of accidents and injuries. He claimed the latter are not direct, use opposition to define a position and define safety as an epiphenomenon (i.e., something emerging but not effectual) rather than a tangible phenomenon. As such, Hollnagel (2014a) proposed to study safety by focusing on situations when things go right instead of when something goes wrong.

Following his position above, Hollnagel (2014b) defined safety as a dynamic event as opposed to the definition of safety as a dynamic non-event by Weick (1987). However, Haavik et al. (2019) observed that Hollnagel's definition, derived from the Resilience Engineering paradigm, centres on processes, whereas Weick's emphasis is on outcomes and aligns more with the High Reliability Organisations paradigm. Consequently, Haavik et al. (2019) concluded that Hollnagel's approach is "… essentially not doing much more than playing with words". Likewise, Karanikas and Zerguine (2024) concluded that the divergent and highly dissimilar safety definitions found in principal books about 'new safety paradigms', as also elaborated in the review by Cooper (2022), support the observations by Rochlin (1999). These reviews highlight that safety remains an immaterial construct subject to diverse interpretations.

Differing opinions on safety undoubtedly contribute to stimulating debate and broadening knowledge. Hence, in order to map the diversity

* Corresponding author.
E-mail address: nektarios.karanikas@qut.edu.au (N. Karanikas).

https://doi.org/10.1016/j.ssci.2024.106698
Received 22 August 2024; Received in revised form 30 September 2024; Accepted 10 October 2024
Available online 18 October 2024

Table 1
Indicative health definitions.

Health definitions and elements	Citations
Health as a state of the individual	
A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.	(WHO, 1948)
Social, emotional and cultural wellbeing of the community in which each individual achieves their full potential.	(Boddington & Räisänen, 2009; NASWP, 1989; Pearson et al., 2020)
A disease-free condition.	(Saracci, 1997)
Experience of physical and psychological wellbeing.	(Card, 2017)
Fullness of life by integrating body, mind, and spirit.	(Bradley et al., 2018)
Spiritual balance and harmony with the environment and the community.	(Bautista-Valarezo et al., 2020)
Health as an ability/capability of the individual to:	
Adapt and self-manage.	(Canguilhem, 1978; Huber et al., 2011)
Satisfy needs and cope or adapt to the environment.	(WHO, 1986)
Work, love and sleep.	(Pledger, 2011)
Work, socialise and be independent.	(Gessert et al., 2015)
Flourish and recover.	(Misselbrook, 2016)
React to all kinds of environmental events.	(Leonardi, 2018)
Satisfy life demands.	(Bircher, 2020)
Health as an individual trait	
Strength to be.	Credited to Deitrich Bonhoeffer cited in Marty (2011)
Physical and mental energy and strength.	(Fogel et al., 2012)
Health as a combined individual state, ability and/or outcome	
Wealth, relationships, coherence, fitness, and adaptability.	(Davies, 2009)
Life control with support by systems, environments and policies.	(Shilton et al., 2011)
Equilibrium within the environment and the capability and possibility of one living their own spirituality.	(Charlier et al., 2017)

of perspectives on health, safety, and risk from an ecological viewpoint, the following section presents definitions from various disciplines beyond the scope of OHS. This deliberate choice acknowledges that regulators, workers, managers, OHS professionals, and others involved in occupational activities are part of a broader environment where terms like health, risk and safety, which are often discussed together as interdependent concepts, are also used in different domains, such as public safety, financial risk, military and healthcare systems.

The definitions found in professional and academic literature presented in the next section are largely based on the personal experiences, backgrounds and understandings of the respective authors and are often not supported by field research. However, as mentioned above, different definitions within an organisation or across systems, industries, and regions can be counterproductive. In response to those challenges, to the best of the authors' knowledge, this is the first empirical study in the occupational context to propose definitions of health, risk and safety as interrelated terms based on combining field data with insights from academic and professional publications across various disciplines. As such, this work bridges theory and practice though reconciling current knowledge and positions with empirical insights and challenging various theoretical perspectives in OHS.

2. Definitions in the literature

It is noted that a systematic review of the literature was beyond the scope of this study. Therefore, the lists of the definitions provided in this section can be classified as an overview (Grant & Booth, 2009) and are not an exhaustive collection of sources and definitions. While recording definitions from the literature, we categorised them based on the ontological and epistemological perspectives of the respective authors (e.g., how they approach the construct and what traits they attribute to it).

Interestingly, although the construct of 'health' has been explored across various disciplines, we could not locate definitions in OHS-specific literature. Table 1 presents publications that defined health in the contexts of public health, including policy, promotion and communication, and medicine, health services and Indigenous health. The World Health Organisation's definition (WHO, 1948) is the one most frequently found in the literature. According to Larsen (2022), the WHO's health definition was a collaborative effort involving multiple stakeholders aiming to redefine health beyond traditional medical perspectives. The same authors observe that the WHO's definition of health has become key in contemporary moral philosophy. Nonetheless, various scholars (e.g., Hafen, 2016; Leonardi, 2018) criticise the dominant WHO definition because it:

- proposes unattainable health standards,
- is neither operational nor measurable to inform health standards,
- conflates scientific assessments with moral and political arguments,
- does not acknowledge that low wellbeing does not always mean poor health,
- blurs symptoms, impact factors and consequences of health,
- fosters the pathologisation of unfavourable mental states.

The Alma-Ata declaration responded to some of the concerns about the WHO's health definition by redefining health as the highest possible level (WHO, 1978). Furthermore, Brook (2017) recommended expanding the WHO's definition by including the terms acceptance and tolerance. Nevertheless, several agencies and authors view health not only as a state but also as an ability or capability, a property of the individual, and an outcome. This underscores the complexity and multifaceted nature of health, suggesting that a single definition that fully captures all its dimensions has not yet emerged. However, the literature reviewed emphasises the importance of a broader understanding of health that includes non-physical aspects.

Regarding the 'risk' construct, various disciplines have approached it from different angles (Table 2). Most of the publications reviewed defined risk with references to probabilities and consequences, but not consistently. Nonetheless, it seems that decades-old definitions highlighting risk as a measure of the probability and severity of adverse events (e.g., Lowrance, 1976), have significantly influenced subsequent perspectives. In general, the exploration of risk definitions across diverse disciplines shows a variety of perspectives on understanding risk within different contexts, as also noted in the work by Aven (2016).

Several decades ago, Fischhoff et al. (1984) discussed the difficulties in creating a single definition of risk. They presented 13 different viewpoints and recognised that different disciplines have different ways of understanding risk. This picture can be possibly attributed to how risk is perceived, its dynamic nature and the influences by emotional, social, and cognitive factors (Sjöberg, 2000), such as personality, experience, beliefs, age, gender, education level, knowledge, culture, and psychological context (e.g., Chionis & Karanikas, 2018; Chionis et al., 2022).

Regarding the 'safety' construct, the literature also approaches it from various view angles (Table 3). While noting that the international

Table 2
Indicative risk definitions.

Risk definitions and elements	Notes	Context(s)	Citations
Risk as a product of probability and consequence features			
Event probability/ frequency and the potential negative consequences.	No reference to the likelihood or magnitude of consequences.	Systems safety and hardware and software safety engineering	(Ericson, 2011; Meulen, 2000)
Probability/ frequency of an event leading to negative consequences and its duration/ exposure.		Several/generic	(Meulen, 2000)
Probability/ frequency that an event will lead to negative consequences.		Public health	(Grima et al., 2021)
		Generic	(Rohrmann, 2008)
		Societal context	(Klinke & Renn, 2002)
Probability/ frequency of an event leading to negative consequences and the magnitude of those consequences.	No reference to the likelihood of the consequences.	International relations	(Pera, 2016)
		Defence sector	(Wall, 2009)
Probability/ frequency of negative consequences and their magnitude.	No reference to an initiating risk event.	Systems	Haimes (2009)
Risk as an outcome			
Effect of uncertainty on objectives.	Effect means any deviation from the expected.	Generic	(ASNZS, 2018b)
Negative consequences of an event.	No reference to other parameters such as likelihood, consequences and severity of events.	Psychosocial health and safety	(NSC, 2013)
		Corporate reputation	(Eckert, 2017)
		Travel risk	(Fang et al., 2022)
Risk as outcome parameters			
Probability distribution of different negative consequences.	No reference to an initiating risk event or the magnitude of the consequences.	Banking	(Drehmann & Nikolaou, 2013)
Magnitude of negative consequences.	No reference to an initiating risk event or the likelihood of the consequences.	Systems	(Huang et al., 2020)
Probability/ frequency of negative events.	No differentiation between risk and outcome events and no reference to magnitude.	Biotechnology and agriculture	(Desmond, 2017)
Risk as an ability			
Inability to recover from the negative consequences of an event.	–	Supply chains	(Heckmann et al., 2015)

Table 3
Indicative safety definitions.

Safety definitions and elements	Context(s)	Citations
State/set of conditions		
Absence of risk	Generic	(Hollnagel, 2008)
Presence of capacities, capabilities and competencies to ensure as many positive outcomes as possible.	Systems	(Conklin, 2016; Dekker, 2014b; Hollnagel, 2014b)
Absence of danger or conditions that can create risks.	Process engineering	(Sadeghi et al., 2015)
Freedom from danger, risk, or injury.	Software and hardware engineering	(Meulen, 2000)
	Generic	Public sources/ dictionaries cited in Cooper (2022).
Freedom from negative impacts on individuals, equipment, and the environment.	Systems	(DOD, 2000)
Shielded from physical harm or loss and free from unacceptable risks of mishaps.	Systems	(Ericson, 2011)
Condition of acceptable control over hazards and risks inherent to organisational activities.	OHS	(Balderson, 2016)
Result, output or impact (e.g., system outcomes or event consequences)		
No harmful outcomes.	Healthcare	(Simmons et al., 2016; Teuma Custo et al., 2019; WHO, 2024)
	Machine learning and artificial intelligence	(Varshney & Alemzadeh, 2017)
	Food quality	(de Araújo Gomes et al., 2023)
	Human-robot interactions	(Hu et al., 2016)
Outcome of top-down ethical responsibility.	Generic	(Dekker, 2014b)
Product/artefact workers create.	Generic	(Dekker, 2014a)
Ability, reflected in functions, processes, activities, etc.		
Control of recognised hazards to achieve an acceptable level of risk.	Systems	(Lack, 2001)
Series of activities to reduce or minimise risk under an epistemic uncertainty of harmful outcomes.	Systems	(Möller & Hansson, 2008)
Ability to succeed under both expected and unexpected conditions.	Generic	Hollnagel (2014a, 2014b)
Actively meeting complex care needs to achieve positive outcomes while reducing the risk of negative outcomes.	Healthcare	(Jones, 2016)
Feature (e.g., characteristic, property, attribute)		
Property arising from interactions and controllable through the enforcement of constraints.	Generic/systems	(Leveson, 2011)
Set of structural forms emerging from the interactions of human or material activities with the environment.	Generic	(Wang et al., 2019)

standard on OHS management systems does not define safety (ASNZS, 2018a), the definitions of safety we identified suggest various dimensions. These range from low-risk states and conditions to activities that aim to control hazards and create a safe environment. Broadly, these perspectives collectively emphasise that literature does not approach safety as a static condition but a dynamic, multifaceted concept requiring continuous effort and adaptation to protect individuals and systems from harm.

3. Methods

The research was conducted at Hutchinson Builders (HB), the largest privately owned construction company in Australia, with offices and projects across several regions and states. The company employs approximately 1,500 direct employees and has a network of over 10,000 subcontractors and suppliers, with over 14,000 individuals present at its job sites daily (HB, 2023). Considering that the construction sector globally experiences the negative impacts of high rates of accidents and injuries (Estudillo et al., 2024; Kang, 2024; Moreira et al., 2024), and

considering Australia's diverse workforce in terms of national, cultural and professional backgrounds (ABS, 2022), the specific company is deemed as adequately representative of a high-risk sector where ensuring OHS is expectedly a top priority.

The qualitative research for this study, involving face-to-face workshops with company staff, received approval from the ethics committee of the Queensland University of Technology (ethics approval number 7012). The researchers and company agreed to conduct several workshops with 10–12 participants each, aiming for representativeness and diversity by attracting personnel from different roles, departments, and regions. A liaison person at the company emailed all company staff, inviting them to express their interest in attending a workshop. The email summarised the project, outlined participation requirements, and assured confidentiality. The research team and company collaborated to ensure the invitation text met ethical research standards.

The liaison person worked with the researchers to categorise interested company employees into groups based on their organisational level and location. This strategy minimised disruptions, addressed balance power, and encouraged productive discussions (O.Nyumba et al., 2018; Sim & Waterfield, 2019). We conducted seven workshops, each lasting 1 to 1.5 h. Fifty-three (53) participants attended the workshops, with five to eleven participants per session. Of these participants, 45 identified as male and eight as female.

Participants had extensive industry experience, with a median of 20 years. The median tenure at the company was eight years, and the average experience in their respective job roles was six years. Participant roles included health and safety staff (n = 14), site managers and forepersons (n = 9), executives/directors and business unit leaders (n = 8), project, design and construction managers (n = 8), contract administrators (n = 7), other managers (e.g., commercial, compliance, business improvement, quality, social responsibility; n = 5), and preconstruction and technical support staff (n = 2).

Padlet, an online collaborative platform, was used to collect qualitative data. We invited participants to provide their definitions of health, safety and risk by answering on Padlet the questions: 'What is health?', 'What is safety?', and 'What is risk?'. After completing the activity, we projected all anonymised comments on the screen and discussed. The researchers shared definitions from the literature in section 2 to stimulate discussions. In each workshop, a researcher took notes on the overall topics discussed by participants without recording individual responses or personal information.

We exported the data from Padlet and analysed them thematically based on the groups within definitions and their elements presented in Tables 1, 2 and 3 above (e.g., whether safety is defined as a state, process, outcome or property). One author organised and coded the data, while the other one verified the consistency between the data and codes. After resolving any disagreements, we descriptively derived participants' views and perceptions. Of note, some participants submitted multiple responses, while others may not have answered the questions. This resulted in a variation between the number/percentage of some responses and the number of participants.

4. Results

4.1. Participant responses

The following subsections summarise the results of the qualitative analysis of the responses defining each OHS construct. We do not cite exact quotes from the dataset as per the clauses of the non-disclosure agreement with the company. Of note, we identified no similarities or patterns in the responses to the definitions of health, risk, and safety among the seven workshop groups.

4.1.1. Health

Of the 53 responses, the majority (25, 47.2 %) defined health as a state of overall wellbeing, encompassing physical, mental, and personal aspects. Additionally, 18.9 % of the participants described health simply as a general state or condition, focusing on both physical and mental aspects without mentioning wellbeing. Nine participants (17 %) defined health in different ways, such as being free from illness or unhappiness and having the ability to function properly. The remaining participants (n = 9, 17 %) considered both physical and mental aspects, as well as individual lifestyle and social activities, in their definitions.

Regarding the constituents of health, six participants (11.3 %) mentioned only physical health, while one participant referred exclusively to cognitive health. Nonetheless, 43.4 % of the respondents (n = 23) emphasised the combination of physical and mental aspects. Only a few participants (n = 4, 7.5 %) mentioned the emotional component of health along with mental and/or physical health aspects. Moreover, seven participants (13.2 %) associated health with performance. Notably, 19 participants (35.8 %) did not mention any specific health element in their definitions.

4.1.2. Risk

Participants' perspectives on risk revolved around the elements of risk potential, probability/likelihood, and severity/consequences, often in combination with each other and other risk-related constructs. More specifically, of the 53 responses recorded, 23 (43.4 %) combined potential with consequences, of which:

- three (3) in conjunction with the concept of exposure;
- three (3) together with the concept of risk assessment/perception;
- once in reference to actions with the potential to cause harm yourself;
- once together with the probability aspect.

The aspects of probability/chance and consequences were combined in 16 responses (30.2 %). Three (3) other responses (5.7 %) referred to the risk assessment process and risk level. The rest of the answers included a few references to elements stated separately or combined with others, such as inherent risk and activity combined with perception.

4.1.3. Safety

Of the 55 answers collected, the view of safety as a characteristic of an activity gathered the most responses (n = 23, 41.8 %). This was followed by the perception of safety as a state (n = 14, 25.5 %). Last, ten participants (18.2 %) defined safety as a process. The rest of the responses (n = 8, 14.5 %) viewed safety as an outcome, behaviour/attitude, a work/system characteristic, or a requirement.

The analysis of the responses revealed that participants also referred to the focus of safety (i.e., what safety is about), with two key themes emerging. First, when safety was seen as a state or outcome, it related to protecting health from harm or risk. Several participants described the aim of safety as ensuring no harm or risk to wellbeing. They emphasised the importance of minimising or eliminating potential dangers and hazards that may cause injury or illness.

Second, where safety was understood as an activity or a process, it was mostly associated with various elements of proactive risk management. Participants emphasised the need for risk assessment, control implementation, and effective communication to reduce risks. Last, a few other responses mentioned additional aspects related to safety, including necessary conditions, interactions with hazards, compliance with organisational systems and psychological safety.

4.2. Workshop discussions

Early discussions with participants about their responses and definitions in the literature indicated that OHS-related definitions should be adjusted for different levels within an organisation. This approach would ensure that lower organisational levels are not burdened with deciphering complex definitions. The latter should be considered in

Table 4
Health, Risk and Safety definitions in the OHS and public health contexts.

Construct	Definitions Simplified definition: Operational level (e.g., workers and supervisors)	Strategic level (e.g., senior managers and directors) Summarised definition: Tactical level (e.g., project and line managers)	Comprehensive definition: OHS staff, researchers and other subject matter experts.
Health	Physical, mental and emotional wellbeing.	Combined physical, mental and emotional wellbeing and capability in specific environments.	Combined physical, mental and emotional wellbeing and capability in environments comprising specific material[1] and immaterial[2] agents.
Risk	Potential for harm[3] on health.	Potential for harm[3] on health when (not) exposed to or/and (not) interacting with specific material[1] or immaterial[2] agents.	Potential for harm[3] on health:when (not) exposed to or/and (not) interacting with various material[1] and immaterial[2] agents of specific properties[4,] under relative capability to withstand single, concurrent and repetitive adversities[5] arising from those and other (non) exposures or/and (non) interactions.
Safety	Action(s) to control risks.	Action(s)[6] to eliminate or mitigate risks.	Action(s)[6] to eliminate or mitigate risks by: avoiding, reducing or withstanding harmful exposures to or/and interactions with various material[1] and immaterial[2] agents of specific properties[4] pursuing, strengthening or embracing necessary exposures to or/and interactions with various material[1] and immaterial[2] agents of specific properties[4].

[1] Material agents: physical, chemical, biological and technical/human-made (e.g., compounds, infrastructure, tools).
[2] Immaterial agents: incorporeal human interaction products generated directly (e.g., through body language, physical contact, conversation tone) and indirectly (e.g., through norms, rules, policies).
[3] Harm: can include (a) any effects on health regardless of type, severity, etc.; (b) unwelcome but still acceptable effects; (c) unacceptable but still tolerable effects; or (d) intolerable effects.
[4] Properties: agent properties (e.g., form, size, flow, density) and interaction/exposure parameters (i.e., frequency, duration and concentration).
[5] Capability to withstand single, concurrent or repetitive adversities: can be intrinsic (e.g., natural evolution characteristics, conditioning) and/or extrinsic (e.g., through technology, environment).
[6] Actions: these can (a) target the agents and their properties; (b) target the paths of exposures/interactions and their parameters; and (c) protect and strengthen the individual.

their entirety by technical/OHS experts. For example, OHS staff could use detailed definitions in their conversations and documentation of strategies, plans, and major initiatives. However, using these definitions directly with area managers, project managers, supervisors, or workers may not be the best option.

Similarly, definitions intended for tactical levels could be of medium complexity. Daily discussions among senior management and directors could involve medium-complexity definitions, while their decisions on OHS initiatives could use the most detailed versions. Participants agreed that job roles and system levels with greater influence on OHS resources and decisions should use more detailed definitions. This approach can enable senior levels to comprehend and tackle the broad scope of OHS to design and implement effective initiatives, programs, and risk controls.

On the other hand, participants supported a simpler wording for lower levels to ensure effectiveness. Although simplified definitions may not be as detailed, participants understood that changing OHS definitions across the organisation would necessitate modifying existing materials and communications. They agreed that using this approach would help maintain consistency when discussing health, safety, risks, and related topics at all levels of the organisation.

Also, most participants were unaware of the distinctions between mental/cognitive and emotional aspects of health during the discussions of their responses. The researchers used literature to explain the distinction between these aspects (Eich et al., 2000; Teasdale, 1996), even though the participants thought they were the same. The discussions with the workshop participants on the responses about risk also suggested occasional confusion between the constructs of hazard and risk, which sometimes they defined similarly. The researchers referred to definitions by international agencies and standards (ASNZS, 2018b; ICAO, 2018) to clarify to participants that, broadly, hazard is defined as a condition or object that can cause harm.

5. Definitions

Table 4 provides simplified, summarised and comprehensive definitions of health, safety and risk aimed at various organisational levels and roles, as suggested by the study participants. The definitions in Table 4 are based on:

- Simplified definitions: the workshop participant responses and discussions.
- Summarised definitions: extensions of the simplified definitions through post-workshop collaboration with company staff.
- Comprehensive definitions: further elaboration on the summarised definitions by the authors of this article. Those were based on the publications reviewed in section 2 above, additional literature cited in the discussion section below and their experience and knowledge.

Although the definitions were based on data from a workplace and literature from various disciplines, they address the three constructs more broadly in the public health context. Also, the levels and roles mentioned in Table 4 mean to function only as recommendations for the targeted audience per definition and can be extended beyond the workplace environment. For instance, in the wider community, the simplified versions could be used in communications with the public. Moreover, the notes in Table 4 explain each term while keeping a balance between being general and specific.

6. Discussion

6.1. Overall observations and limitations

Introducing definitions that are sufficiently specific to be meaningful yet flexible enough for diverse contexts can be challenging. In this study, we combined definitions from literature with insights from field research without any preconceived intent to compare, accept or reject existing definitions. While it was not a primary objective of the study, our proposal for three definition versions (i.e., simplified, summarised and comprehensive) for each of the three constructs during the workshop discussions highlights the necessity for such an approach. This aligns with literature suggesting that safety professionals must adapt their language for different audiences to achieve local coherence

(Laroche, 2020) and responds to calls for consistency within organisations to enable effective safety conversations and decision-making capacity (Susca, 2018).

As such, we argue that our interdisciplinary approach led to the formulation of more inclusive definitions, the fullest versions of which were suitably enriched with necessary terms and concepts, as discussed in the sections below. Of note, the differentiation we propose between simplified, summarised and comprehensive definitions in Table 4 could also correspond to the different education levels and other workforce background parameters across organisations. However, the distinctions in these definitions do not imply that they are designed for varying levels of intellectual capacity. Instead, these definitions can create a language that aligns with the different levels in the organisation. Using a simplified version should not exclude access of a work floor employee to a richer definition, especially when taking part in OHS reviews, strategic meetings, etc.

Interestingly, the diverse responses of the workshop participants resembled the diversity of the views expressed in the literature reviewed in section 2 of this paper, confirming that health, safety and risk remain considerably subjective constructs. Although it was outside the scope of this study to investigate how the participants formed their understandings of what those three constructs mean, we cannot exclude that their views had been shaped by accessible definitions (e.g., online sources, organisational and industry documents) which might have incorporated or been influenced by definitions mentioned in the literature. At the same time, in the absence of previous empirical research, the definitions proposed by several authors we cited in section 2 of this article could reflect a combination of their own understandings and the information collected during anecdotal professional and social discussions.

Admittedly, the study sample was drawn from a specific country, industry sector and company and might not represent all meanings of health, risk and safety in other workplaces and industry sectors. We also acknowledge the potential biases arising from the uneven distribution of our sample across genders and job roles. However, our objective was not to capture every possible understanding of these constructs on a global scale. Instead, we aimed to engage meaningfully with staff from this representative company in a high-risk sector to collaboratively develop definitions that resonate within that context. Nevertheless, the fact that the definitions we propose are informed by both empirical insights and interdisciplinary literature, it suggests their potential applicability in other occupational and public health settings.

The findings from our research and the definitions proposed suggest that it is arguably impossible to separate the constructs of health and risk from each other, the combined consideration of which justifies the constructs of safety and resilience/vulnerability. The construct of risk exists because variations in health are of interest. This, in turn, renders the safety and resilience/vulnerability constructs useful. If health changes were not of interest, the concepts of risk, safety, and resilience/vulnerability would not be necessary. On the other hand, safety and resilience/vulnerability are not necessary and inseparable constructs from health and risk. Risks of harm on health can always exist regardless of considering safety and resilience/vulnerability.

Also, besides explicitly mentioning material and immaterial health elements of individuals (i.e., physical, mental and emotional), by referring to external agents that are both material, which typically have clearly defined properties, and immaterial, which have mostly perceived properties, acknowledges both objective and subjective aspects of health. This, by extension, lends to the related constructs of risks and safety a multitude of objective and subjective elements, including the degree to which the potential for harm is known or presumed and whether the effectiveness of safety actions source from empirical knowledge or presumptions.

Last, our risk definitions do not refer to ‘malicious harm from thread agents’ or ‘unintentional harm from hazard agents’ that typically differentiate security from safety, respectively (Karanikas, 2018). However, in the public health and OHS contexts, the usefulness of this classification is rather limited to distinguishing between different traits of the risk (e.g., predictability) and types of actions to protect again risks. Our decision to omit ’intentionality’ aligns with recent suggestions to integrate safety and security in evaluations and programs (Boustras & Waring, 2020).

6.2. *Health definition*

In its simplified definition, health is approached as a state and refers to physical, mental, and emotional wellbeing, which aligns with prevalent views in the literature and combines the most frequent responses from our participants. Of note, our definition does not include the aspects of social and cultural wellbeing. Apart from not being expressed by the participants, the literature predominantly views those aspects as results of social interactions that can affect health, indicating that they are not distinct health constituents. For instance, harmony within a group, which can be experienced as social or cultural wellbeing, represents primarily an outcome emerging from the interactions of its members, which influences how these members feel, think, etc.

Also, we did not include spiritual wellbeing in the health definition for two reasons. The term did not emerge in our research and may not reflect common beliefs about afterlife and greater forces. Second, in literature, spirituality can refer to practices that help achieve health, connection, and purpose (Rowley, 2014; VonDras, 2019), whereas it can also represent the state of complete health (Peng-Keller et al., 2022). The above show it would be difficult to combine such divergent approaches in the definition of health.

The summarised definition expands the health construct by combining physical, mental, and emotional aspects. This aligns with literature highlighting the interconnectedness of those three health elements (Collins et al., 2010; Ekkekakis & Cook, 2013; Mohiyeddini, 2013). Also, the summarised definition extends wellbeing by incorporating the concept of ’capability’, which combines ideas from literature and workshop results that see health as both a state and an ability. While not explicitly defined as such in the literature, capability in our health definition represents the combination of capacity (i.e., the physical, cognitive and emotional potential) and ability to use, mobilise, transform, etc. the available capacity to decide and act. Hence, in the summarised definition, simply ‘being well’ is insufficient to be considered healthy. The ability to use one’s wellness to decide and perform tasks is also important. From that perspective, ‘being well’ does not mean someone has, by default, the physical, cognitive and emotional ability to perform.

Moreover, the summarised definition of health considers the context through referring to the term ‘specific environments’. This agrees with the viewpoints discussed in the literature, which see health as a relative concept rather than an absolute condition. Under this lens, someone can be healthy in one environment but unhealthy in another. For example, someone who is healthy at sea level might have trouble adjusting to high-altitude areas and experience symptoms like headaches, nausea, and difficulty breathing. Another person who is healthy in a moderate climate might experience health issues in extreme climates (e.g., someone used to a cool climate might suffer from heat exhaustion in a hot environment).

Last, by referencing any combination of material and immaterial agents, the full definition of health accounts for any type of natural, technical, and social environments. A material agent could be anything that carries physical energy; under this category, from the perspective of biology, humans are material agents. Immaterial agent is an experienced outcome emerging from exposures and interactions of social nature, meaning between humans and their artefacts. Although the case of direct interactions and exposures is what literature commonly covers (e.g., communication, teamwork, leadership, consultation), in this study, we approach other human-made artefacts as indirect means of interaction. For example, when complying with a procedure, a worker

indirectly interacts with its authors, approvers, etc.

Notably, by considering the entire array of material and material environmental constituents, the comprehensive definition of health also embeds cultural and social health elements included in some health definitions listed in section 2 above. A person might thrive in a close-knit community where social interaction and support are accessible. However, if the same individual moves to a society where individualism is highly valued and there is less emphasis on community, they might experience loneliness or isolation, which can negatively impact health. Similarly, in a work environment that values a balance between work and personal life, an individual might maintain good health. However, in a work culture that encourages long working hours and high demands, the same individual might experience stress, anxiety, depression, etc.

6.3. Risk definition

In its simplified version, risk is linked to harm to health. The broad term 'harm' refers to negative impacts on any physical, mental or emotional aspects and abilities to mobilise them, which could have cascading negative effects on overall wellbeing and capability. Hence, 'harm' collectively incorporates literature references and most participant responses regarding negative consequences, impacts, adverse events, etc. Admittedly, the focus on negatives does not entirely align with the approach of the respective international standard ISO 31000, which suggests risks also relate to positives and opportunities (ASNZS, 2018b), but it matches the public health and OHS contexts.

Moreover, when comparing our simplified risk definition (i.e. "Potential for harm on health") with the one in the ISO standard (i.e., "Effect of uncertainty on objectives"), the former is arguably more workable. Specifically, the terms 'potential' in our definition and 'uncertainty' in ISO 31000 imply 'possibility' and are intangible constructs. However, our definition provides context to the concept of 'potential' and connects it with the experience of harm, while the standard's definition employs the intangible concept of 'uncertainty' as a cause or effect. The latter contradicts the argument that an incorporeal construct cannot have a material effect conceptually and practically (Dekker & Hollnagel, 2004).

Further, the respective explanatory note in Table 4 refers to a conceptual range of perceived harm from 'any effects on health' to 'intolerable effects' to acknowledge that harm in general and in public health can have different meanings over time and across different contexts (e.g., personal, social, regional/national, organisational) (Cohen, 2018; Morris, 2015). Therefore, the construct of risk in our definition is coupled with the type and magnitude of the unwanted outcome of interest or concern. Hence, the outcome does not constitute an evaluation parameter of risk levels, as in some definitions presented in section 2 above.

Instead, harm is contextual and not uniform. Whatever is just unwelcome today or by a specific community or system might be unquestionably intolerable tomorrow or by another community or system. This approach also aligns with public health and epidemiology practice and research, whereby the interest is in the 'risk of' developing a particular disease, health condition, etc. because of an exposure, or the 'risk of' specific outcomes (e.g., chronic pain, fatality) because of developing a disease.

Furthermore, the impact of any outcomes, the spread of the risk and other parameters related to the risk level, which we discuss in section 6.5 below, can guide resource allocation. Still, these variables do not affect the meaning of risk as a potential for any harm or harm of particular seriousness. Moreover, the term 'potential' in the summarised definition also reflects the uncertain and changing nature of risk, as stated in section 2. It corresponds to harm under specific circumstances, contrary to the terms 'possibilities' and 'probabilities' that carry connotations of absolute or relative chance of an eventuality, respectively, and can be more open to interpretations.

Besides, the summarised risk definition specifies harm by considering the role of environmental elements. It broadens the scope of 'harm' to include effects attributed to the presence of harmful agents or lack of necessary agents. As such, this perspective accommodates (a) effects generated through harmful exposures and interactions, addressed by disciplines like occupational hygiene, fire safety, process safety, food/product safety, etc., and (b) cases when someone could also be deprived of necessary exposures and interactions, typically covered by domains such as positive psychology, environmental health, human factors and ergonomics, etc.

For instance, worker health can be impacted because of exposure to asbestos and while carrying a heavy object without any supports or mechanical aids, but also when the same worker does not have access to enough water or does not have opportunities to socially interact with peers. In that sense, the concepts of harmful and necessary agents do not always represent the extremes of a spectrum of the same agent, but also distinct references to the effects of specific agents. For example, good and poor food quality belongs to the same spectrum of quality of the 'food agent' and correspond to beneficial and harmful exposures, respectively. Still, someone can suffer from the lack of food, regardless of its quality. In this case, someone starving could even consume food that is knowingly of low quality because not consuming any type of food, regardless of quality, could have more immediate implications than the effects of poor quality food.

The example above can extend to several material and immaterial agents. It highlights how the summarised risk definition includes both negative and lack of positive aspects and promotes understanding risk within its context. Next, the comprehensive definition of risk provides more specific information, considering individual characteristics and avoiding binary judgments of agents. The comprehensive definition acknowledges that the same agents can be both useful and useless and can have different impacts. It all depends on several agent and path parameters (e.g., size, magnitude, density, composition, frequency, duration) and the receiver's traits.

Indeed, the disciplines mentioned above support that some exposures with and interactions with agents traditionally carrying connotations of 'harmful' might be still necessary for health (e.g., zinc and sodium, criticism and conflict) or work (e.g., use of chemicals) under particular properties, but could prove harmful if escaping the respective properties' envelope. Likewise, agents often labelled as 'necessary' can have negative impacts if their properties are not suitably managed (e.g., sunlight and water, social media and physical exercise). Hence, the definition of risk does not refer to the term hazard but refers to agents under specific (non)exposure or (non)interaction conditions. When those conditions are satisfied and create the potential for harm, the agents can be labelled as hazards.

Moreover, the comprehensive definition of risk considers all the above relative to the capability of individuals to withstand single, several and repetitive adversities generated through the (lack of) exposures and interactions. In literature, this capability is named resilience when approached as a positive ability to survive in adverse environments, or vulnerability when it is viewed as a deficit and weakness to endure such conditions. As such, we view resilience and vulnerability as the opposite ends of the capability spectrum to withstand adversities in a specific environment and time: Resilience = 1-Vulnerability.

Besides, the comprehensive definition does not refer to a uniform capability regardless of the environment, but places capability within the scope of particular (non) exposures and interactions. The classification of this capability in the explanatory notes of Table 4 as intrinsic (e.g., natural evolution characteristics, conditioning to specific tasks) and extrinsic (e.g., through technology, environment) accords with respective literature about resilience.

Intrinsic resilience, in general and in different contexts, represents the capability to withstand current and new adversities following adaptation to previous ones (Denyer, 2017; Richardson, 2002; Ye et al., 2021). It becomes necessary only when one is not merely interested in

health state changes (e.g., back-pain) but also their impact on individuals and groups, systems, etc. (e.g., magnitude and frequency of back-pain outcomes, such as absence from work and sense of uselessness) and variations over time and across comparable entities. In this sense, intrinsic resilience becomes a natural and organic property and determines the difference between maximum and actual impacts on the health of particular individuals at a specific time point or period.

Extrinsic resilience represents leveraging technical and human resources available in the environment (e.g., workplace, organisations) to enhance the capability to withstand adversities (e.g., Crane, 2017; de los Reyes et al., 2022). Different from intrinsic resilience, extrinsic resilience is not embedded as an inextricable characteristic of the individual. It provides additional defence capabilities, such as giving workers protective gear to prevent them from being exposed to harmful substances. Likewise, when a retail organisation provides training to salespeople on how to handle difficult customers, it is a type of external resilience.

Of note, none of the risk definitions in Table 4 adopts the probability-consequences pair, which literature uses in different versions and combinations, and was also often stated in the responses collected during the workshops. Conversations with workshop participants and subsequent discussions with the company revealed that referencing probabilities, consequences and their parameters does not define risk, but may indicate its level. This position is already reflected in industry practices using matrixes with scales of likelihood and severities to assess risk levels and not to define risks (e.g., Bao et al., 2022). Similarly, systems engineering uses calculations of probabilities of outcomes of particular magnitude to evaluate the criticality of risks, but they do not define the latter. For instance, according to airworthiness standards, there must be no higher than 10^{-9} likelihood of a catastrophic event (FAA, 1982).

6.4. Safety definition

The simplified definition of safety as 'action(s) to control risks' denotes that safety is deliberate and visible, reflecting the concept of 'positive duty' (Bianca, 2023; Leigh, 2013). As such, safety is positioned between the agents whose presence (or absence) give rise to risks and the individuals whose health must be protected. In this sense, labelling or perceiving something as safe or safer, does not guarantee the absence of risks. 'Being safe' does not literally mean there is no risk, as there is no environment entirely free of risks (Beck, 1992; Reese, 2008; Woods, 2011).

Instead, 'being safe' means there is some degree of protection against risks. Labelling something as 'safe' does not mean there would be no risks of harm to health under any possible condition. Rather, it refers to the degree to which mechanisms exist to protect against specific risks and the extent to which individuals can withstand any foreseeable (residual) risks under specific conditions and assumptions. When those conditions change and assumptions are not longer valid, giving rise to new or changed risks, safety then means to action on those risks and bringing back the object, system, etc. to a 'safe' state. Hence, the simplified definition already accommodates suggestions that safety should be approached as a phenomenon (Hollnagel, 2014a). The specific action areas in the summarised definition align with public health and epidemiology literature (Caron, 2022; Celentano et al., 2024; Landesman & Burke, 2021) and can target agents/sources, transmission paths and receivers under the options to eliminate or mitigate risks or self-protect.

Of note, an 'action' in our safety definitions differs from an 'intervention' because the latter implies a broader context where an action is taken to influence a situation, and it can often involve a third party. An 'action' is more specific to the act itself and does not necessarily imply the involvement of a third party. Therefore, the distinction between 'action' and 'intervention' lies in the roles of the parties dealing with risks. For example, although donning personal protective equipment (PPE) and other worker-reliant actions (e.g., implementing safety procedures) are typically named as safety controls, this is true only from the perspective of the worker who 'actions' them. When using PPE, a worker actions on the path between the substance and the route of exposure (e.g., eyes or skin).

However, when providing PPE and instructions, an organisation does not action on the risk directly. Instead, it 'intervenes' to increase the extrinsic resilience of workers by providing them with resources to use during work to avoid harmful exposures/interactions (e.g., through following procedures) or protect themselves (e.g., through using protective equipment). Similarly, safety training and education are important for helping workers to deal with risks (Alston & Millikin, 2018; Santios et al., 2022), but cannot be classified as controls from the organisational perspective, despite suggestions to the contrary (Cooper, 1995). In such cases, organisations only provide the resources the workers can use to fend for themselves against risks.

The approach above aligns also with legislation in several western-culture countries that have traditionally spearheaded developments in safety. For example, according to the Model Regulations in Australia (SWA, 2024), if elimination is not possible, substitution of hazards, isolation from hazards and engineering controls are listed as the principal options from the hierarchy of controls (Morris & Cannady, 2019; NIOSH, 2016), stating that "The duty holder…. BY DOING one or more of the following…". These three options denote the concepts of actioning at the risk source (i.e., elimination and substitution) and the path (i.e., isolation and engineering).

Then, the specific Regulations mention that any residual risk (i.e., level of harm that actions cannot reduce to an acceptable level) could be further reduced by implementing administrative measures (e.g., modify the way work is performed) or, least preferably, by providing training or PPE. Those two options denote that the organisation as a duty holder does not 'action' directly but 'intervenes' by providing staff with the resources to 'action' safety, including the means to control risks (e.g., instructions for avoiding dangerous areas or using tools specifically designed for the task) and withstand adversities (e.g., use of protective equipment and opportunities to maintain physically and mentally rested). In turn, 'actioning safety' also renders workers as duty holders, as they are supposed to comply with any reasonable instructions of the employer.

Next, the comprehensive safety definition classifies interventions as either 'preventing negatives' or 'seeking positives'. This classification reconciles perspectives about whether safety links to dynamic events or non-events and whether it corresponds to negatives or positives (Hollnagel, 2014b; Weick, 1987). Therefore, while safety maintains the connotation of 'protection from/against', it regards managing exposures to and interactions with not only harmful agents but also necessary ones with different combinations and properties.

6.5. Theoretical implications

When considering the definitions and explanations above about the three constructs, it can be argued that *'changes to health are a measure of risk'* and *'changes to risk are a measure of safety'*. A statement that interconnects health, risk and safety could be:

'Health is influenced by risks moderated by safety'.

As a combination of state and ability, health cannot perform as it does not have the ability to do anything. States do not perform because they refer to a specific condition or status of an individual or system at a particular time-point or period. Individuals and systems can perform. Hence, health as a dynamic and contextual state and ability can only be compared between individuals in the same environment, for an individual over time or in different environments, etc. This position of 'relative health' also accommodates criticisms of various authors against the notion of 'absolute health', as presented in section 2 above.

Similarly, as risk is an incorporeal construct, it cannot perform either. However, as mentioned in section 6.3, risk can be assigned levels, the evaluation of which should address the whole spectrum of

parameters included in the comprehensive risk definition. Thus, when combining principles of ergonomics that predominantly deal with interactions and of occupational hygiene that mostly focus on exposures, the risk level in a specific context could be a function of parameters of the:

1. potency of agents (e.g., size, form, composition, density),
2. path (i.e., frequency and duration of exposures/interactions),
3. dose per unit of time (i.e., concentration of agents and the area exposed/interacting), and
4. capability to withstand adversities (i.e., context-specific and single, concurrent or repetitive).

The risk variables above regarding for agents that are not strictly harmful or beneficial can have relative ranges, such as minimum and maximum dose values. The risk level should also consider how multiple agents can interact and affect each other. Nonetheless, all the above, which admittedly involve complex parameters and relationships but can reduce risk determinism and biases, are not always explicit and visible in current professional and organisational practice and training. This situation allows for over-simplified approaches to risk in public and workplace contexts (Ruiz-Tagle et al., 2022; Steen et al., 2024).

Likewise, as safety, according to our definition, is a construct representing collectively actions with a particular aim, it cannot perform. Individuals, equipment and systems perform actions, but actions do not perform. As such, '*safety is performed and does not perform*'. Executing a task safely signals the implementation of one or more actions from a set of others, where the 'safety' ones aim to control risks. Consequently, the constantly debated concept and construct of safety performance (Karanikas, 2016) and the currently suggested lagging and leading indicators (e.g., Hammond et al., 2023; ICMM, 2021; Niu et al., 2023; OECD, 2014) might be misleading. Besides, considering actual outcomes can be deterministic and not representative of the degree to which the persons involved in events had controls over their systems (Karanikas & Nederend, 2018).

Negative consequences like accidents, injuries and damages usually result from the actions of individuals, teams and systems. None of the latter work to produce safety, which is considered a non-functional requirement in systems engineering and co-exists with several others like quality, reliability, efficiency, etc. Indeed, events like accidents are negative when seen through the lens of individual or system health, but they do not comprise safety outcomes. They remain individual or system outcomes.

Hence, rates of accidents, serious injuries, etc. can be signs and indicators of a system's performance, but not metrics of safety performance. Nevertheless, system outcomes related to safety could be analysed and processed when statistically controlling for other concurrent system requirements and outcomes (e.g., quality and productivity) under the reality of the finite pool of resources and competing priorities (Hollnagel, 2009; Zahraei & Teo, 2017). A system could cause worker injuries because of productivity pressures but enjoy noticeable profitability as another consequence of those pressures.

Also, in safety management programmes, activities such as risk assessments, safety audits and investigations, certifications and safety training, are regularly used to form leading indicators. However, as per the arguments in section 6.4 above, those are mostly interventions and not actions. For instance, although audits and investigations can reveal system flaws and strengths, this does not translate directly and always into risk control actions. The number and quality of such interventions can be useful from a programmatic and management viewpoint, but they represent activity indicators and not safety performance.

When safety management interventions lead to safety actions, it could show how effective the interventions are, nevertheless, it does not correspond to safety performance. This case could represent safety management performance, but not safety performance. The positions above support the urge to distinguish between 'safety work' and 'safety of work' (Rae & Provan, 2019) and between 'safety business' and 'safety of business' (Karanikas & Zerguine, 2024).

Instead of safety performance, we propose using the terms 'relative safety level' and 'relative safety effectiveness'. Relative safety level is the degree of current protection relative to the maximum practicable protection within a particular context. This evaluation concept is helpful for organisations and legislative compliance as it aligns with the principle of 'reasonably practicable' used by safety regulators. Considering that if safety measures are not in place, risks could become uncontrollable, relative safety effectiveness is the change to the level of risk before and after implementing controls.

6.6. Practical implications

Our proposed definitions have several practical implications for OHS practitioners and policymakers. First, the multi-level definitions (i.e., simplified, summarised, and comprehensive) could provide a common language for OHS practitioners, managers, and workers across different organisational levels. This standardisation could improve communication and reduce misunderstandings about health, risk and safety concepts. However, organisations and professionals may resist adopting new definitions, especially if they have been using existing concepts for a long time. Overcoming inertia and changing ingrained habits can be difficult. To support this, existing policies, procedures, OHS training programs, etc. may need to be updated to reflect these new, more nuanced definitions, a process that could prove time-consuming and costly.

Furthermore, the proposed comprehensive definition of risk, which includes both material and immaterial agents, could lead to more holistic risk assessment frameworks. Practitioners might need to revise their risk assessment tools to account for a broader range of factors, including psychosocial risks that are often overlooked. Furthermore, the proposed definitions might influence how organisations allocate resources for OHS. For example, recognising the importance of both intrinsic and extrinsic resilience in risk could lead to more balanced investments in both individual and organisational capabilities. On the other hand, the broader definitions proposed might lead to unintended consequences, such as over-reporting of risks or excessive caution, which could impact productivity or innovation. Also, the recognition of individual differences in capability to withstand adversities in the risk definition may lead to ethical dilemmas about how to fairly allocate resources and support among workers with different resilience levels.

Policymakers could also use these definitions as a basis for developing clearer and more precise and comprehensive OHS regulations. For example, our definition of health that includes physical, mental, and emotional aspects could encourage policies that address all these dimensions equally. Moreover, adopting these definitions at the policy level can promote a unified terminology across industries and regions. This consistency can facilitate better compliance and enforcement of OHS standards. Equally crucial, the more comprehensive definitions proposed could have legal implications, potentially expanding what is considered under an employer's duty of care, particularly regarding mental and emotional health.

Additionally, our discussion on the implications for safety performance measurement suggests a need to revise and redefine key performance indicators in OHS. However, developing new metrics and measurement tools that accurately reflect these more comprehensive definitions could be complex, especially for less tangible aspects like emotional health or immaterial risk factors. Nevertheless, this necessity and the interconnectedness of health, risk and safety could encourage more collaboration between OHS, human resources, and other disciplines and organisational departments. Even further, the alignment of our definitions with public health concepts could facilitate better integration of occupational and public health strategies.

Last, the redefined fundamental concepts of health, risk, and safety can have additional ethical implications, mainly in cases the intent and

content of the proposed definitions is not well understood. For instance, the more comprehensive definition of health, including mental and emotional aspects, may lead to increased monitoring of workers' well-being. This can raise ethical questions about privacy and the extent to which employers should be involved in employees' personal health matters. The more nuanced definitions might also highlight the increased risks faced by certain groups (e.g., those with pre-existing health conditions or lower resilience). This could generate ethical challenges about how to protect vulnerable workers without discrimination.

Also, the definition of safety as "actions to control risks" might lead to debates about the balance between organisational control and individual autonomy. There could be a potential ethical tension between protecting workers and respecting their right to make their own decisions about risk. Moreover, the proposed definitions might shift the perceived balance of responsibility for health and safety between employers and employees. This could raise ethical questions about accountability and blame in the event of incidents. Importantly too, the definitions, particularly of health, might not align with all cultural perspectives, creating ethical considerations about imposing potentially Western-centric concepts globally.

7. Conclusions

While metaphors can help simplify complex ideas and engage the audience, clear and commonly understood definitions are paramount in the OHS and public health context. Such definitions can instil a shared language and drive individual, team, organisational, industry, and regulatory efforts. The current study constructed definitions of health, safety, and risk by combining empirical research with academic and industry literature to promote a more inclusive and comprehensive understanding of these three interrelated terms. The above, together with the discussion of the theoretical, practical and ethical implications of our study, renders this research a unique contribution to knowledge and practice and advances the field of OHS.

The varied definitions from our study participants in a construction company align with the diverse definitions found in the literature reviewed in this article. As such, the reality of different understandings of health, safety and risk would not be flagged as exceptional and organisation-specific, but rather as common across industry and society. Nonetheless, our study findings reaffirm the intricate interplay between health, risk and safety, summarised as *'health is influenced by risks moderated by safety'*.

Furthermore, both the definitions provided by the study participants and the ones proposed in this work lean more towards viewing safety as a public health area rather than a business/management objective (Karanikas & Tyson, 2022). Through this lens, safety is not a system or business outcome but a duty and responsibility to protect health. The above also accord with the fact the OHS is one of the very few disciplines whose name includes the context (Occupational risks), the aim (Health protection) and the means (Safety actions).

In addition, this paper provides definitions that can be customised for communication needs in organisations. It suggests using simplified, summarised, and comprehensive versions at different levels within the organisation. This approach can help promote a clear and consistent understanding of health, risk, and safety across different levels of systems. It can facilitate better collaboration between different stakeholders, including workers, managers, OHS professionals, and regulators and lead to more effective and coordinated efforts to improve workplace health and safety.

Moreover, in this article, we briefly present some implications the proposed definitions bring, challenging current approaches to safety management and performance measurement. In general, our definitions provide a resolution to opposing views on health, risk and safety and arguably align with the spirit and intent of 'positive duty' in current legislative provisions and requirements in western-culture countries. Nevertheless, the proposed definitions acknowledge that there are objective and subjective aspects, which add multiple dimensions to those three constructs.

Our definitions can be revised and customised to fit specific contexts, and we invite researchers and industry professionals to make adjustments and extend the concepts we proposed when discussing above the theoretical implications of this study. We argue it is imperative for scholars and industry to transition from typical business-focused concepts to adopting epidemiological approaches in evaluating health, safety, and risk in workplaces and communities. Furthermore, these proposed definitions can encourage and enlighten the re-examination of health, risk, and safety s in various domains like systems engineering.

CRediT authorship contribution statement

Nektarios Karanikas: Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Haroun Zerguine:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation.

Funding

This paper is partially based on a report produced for a commercial research project funded by Hutchinson Builders, Australia (Karanikas & Zerguine, 2023).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

ABS. (2022). *Employment in the 2021 Census*. Australian Bureau of Statistics. Retrieved 12 July 2024 from https://www.abs.gov.au/articles/employment-2021-census.

Alston, F., Millikin, E.J., 2018. Workforce Training on Hazard Recognition and Control. In *Industrial Hygiene : Improving Worker Health Through an Operational Risk Approach*. Taylor & Francis Group, pp. 113–130.

ASNZS. (2018a). *Occupational health and safety management systems – requirements with guidance for use (AS/NZS ISO 45001:2018)*. Standards Australia & Standards New Zealand.

ASNZS. (2018b). *Risk management - Guidelines (AS/NZS ISO 31000:2018)*. Standards Australia & Standards New Zealand.

Aven, T., 2016. Risk assessment and risk management: Review of recent advances on their foundation. Eur. J. Oper. Res. 253 (1), 1–13. https://doi.org/10.1016/j.ejor.2015.12.023.

Balderson, D., 2016. Safety Defined: A Means to Provide a Safe Work Environment. Prof. Saf. 61 (5), 63–68.

Bao, C., Li, J., Wu, D., 2022. Risk matrix : rating scheme design and risk aggregation. Springer.

Bautista-Valarezo, E., Duque, V., Verdugo Sánchez, A.E., Dávalos-Batallas, V., Michels, N. R.M., Hendrickx, K., Verhoeven, V., 2020. Towards an indigenous definition of health: an explorative study to understand the indigenous Ecuadorian people's health and illness concepts. Int. J. Equity Health 19 (1), 101. https://doi.org/10.1186/s12939-020-1142-8.

Beck, U., 1992. Risk society : towards a new modernity. Sage.

Bianca, M., 2023. Respect (at) Work: Continuing developments to prevent workplace sexual harassment. WORKPLACE REVIEW 11 (4), 196–200.

Bircher, J., 2020. Meikirch model: new definition of health as hypothesis to fundamentally improve healthcare delivery. Integr Healthc J 2 (1), e000046.

Boddington, P., Räisänen, U., 2009. Theoretical and practical issues in the definition of health: insights from Aboriginal Australia. J Med Philos 34 (1), 49–67. https://doi.org/10.1093/jmp/jhn035.

Boustras, G., Waring, A., 2020. Towards a reconceptualization of safety and security, their interactions, and policy requirements in a 21st century context. Saf. Sci. 132, 104942. https://doi.org/10.1016/j.ssci.2020.104942.

Bradley, K.U., Goetz, T., Viswanathan, S., 2018. Toward a Contemporary Definition of Health. Mil Med 183 (suppl_3), 204–207. https://doi.org/10.1093/milmed/usy213.

Brook, R.H., 2017. Should the Definition of Health Include a Measure of Tolerance? JAMA 317 (6), 585–586. https://doi.org/10.1001/jama.2016.14372.

Canguilhem, G., 1978. On the Normal and the Pathological. Springer, Dordrecht. https://doi.org/10.1007/978-94-009-9853-7.

Card, A.J., 2017. Moving Beyond the WHO Definition of Health: A New Perspective for an Aging World and the Emerging Era of Value-Based Care. World Medical & Health Policy 9 (1), 127–137. https://doi.org/10.1002/wmh3.221.
Caron, R.M., 2022. Population health, epidemiology, and public health : management skills for creating healthy communities, (2nd ed.). Health Administration Press.
Celentano, D. D., Szklo, M., Farag, Y. M. K., & Gordis, L. (2024). *Gordis epidemiology* (Seventh edition ed.). Elsevier.
Charlier, P., Coppens, Y., Malaurie, J., Brun, L., Kepanga, M., Hoang-Opermann, V., Correa Calfin, J.A., Nuku, G., Ushiga, M., Schor, X.E., Deo, S., Hassin, J., Hervé, C., 2017. A new definition of health? An open letter of autochthonous peoples and medical anthropologists to the WHO. Eur. J. Intern. Med. 37, 33–37. https://doi.org/10.1016/j.ejim.2016.06.027.
Chionis, D., Karanikas, N., 2018. Differences in Risk Perception Factors and Behaviours amongst and within Professionals and Trainees in the Aviation Engineering Domain. Aerospace 5 (2), 62. https://doi.org/10.3390/aerospace5020062.
Chionis, D., Karanikas, N., Iordan, A.-R., Svensson-Dianellou, A., 2022. Risk perception and communication factors in aviation: Insights from safety investigators. J. Risk Res. 1–16. https://doi.org/10.1080/13669877.2022.2038246.
Cohen, A.J., 2018. Toleration and Freedom from Harm : Liberalism Reconceived. Taylor & Francis Group.
Collins, D., Abbott, A., Richards, H., 2010. Psychology for physical performance. Elsevier.
Conklin, T., 2016. Pre-Accident Investigations : Better Questions - an Applied Approach to Operational Learning, (1st ed.). Taylor & Francis Group.
Cooper, M.J., 1995. Training as a risk control measure. Ind. Commer. Train. 27 (11), 26–29. https://doi.org/10.1108/00197859510100266.
Cooper, M.D., 2022. The Emperor has no clothes: A critique of Safety-II. Saf. Sci. 152, 105047. https://doi.org/10.1016/j.ssci.2020.105047.
Crane, M.F., 2017. Managing for resilience : a practical guide to individual wellbeing and organizational performance. Routledge.
Davies, P. G. (2009). Why the Definition of Health Matters. *BMJ: British Medical Journal*, *338*(7687), 124-124. http://www.jstor.org/stable/20511784.
de Araújo Gomes, A., Azcarate, S.M., Špánik, I., Khvalbota, L., Goicoechea, H.C., 2023. Pattern recognition techniques in food quality and authenticity: A guide on how to process multivariate data in food analysis. TrAC Trends Anal. Chem. 164, 117105. https://doi.org/10.1016/j.trac.2023.117105.
de los Reyes, E. J., Blannin, J., & Mahat, M. (2022). Building Academic Resilience: Lessons for Academics and Institutions. In M. Mahat, J. Blannin, C. Cohrssen, & E. J. de los Reyes (Eds.), *Academic Resilience* (pp. 123-135). Emerald Publishing Limited. doi: 10.1108/978-1-80262-387-120221008.
Dekker, S., 2014. Safety Differently : human factors for a new era. CRC Press.
Dekker, S., Hollnagel, E., 2004. Human factors and folk models. Cogn. Tech. Work 6 (2), 79–86. https://doi.org/10.1007/s10111-003-0136-9.
Dekker, S. (2014a). *The field guide to understanding 'human error'* (Third edition. ed.). Ashgate.
Denyer, D., 2017. Organizational Resilience: A summary of academic evidence, business insights and new thinking. BSI and Cranfield School of Management. https://www.cranfield.ac.uk/-/media/images-for-new-website/som-media-room/images/organisational-report-david-denyer.ashx.
Desmond, E., 2017. Risk definition and the struggle for legitimation: a case study of Bt cotton in Andhra Pradesh. India. *Journal of Risk Research* 20 (1), 135–150. https://doi.org/10.1080/13669877.2015.1042504.
DOD. (2000). *System Safety, MIL-STD-882E*. Department of Defence.
Drehmann, M., Nikolaou, K., 2013. Funding liquidity risk: Definition and measurement. J. Bank. Financ. 37 (7), 2173–2182. https://doi.org/10.1016/j.jbankfin.2012.01.002.
Eckert, C., 2017. Corporate reputation and reputation risk. J. Risk Financ. 18 (2), 145–158. https://doi.org/10.1108/JRF-06-2016-0075.
Eich, E., Kihlstrom, J.F., Bower, G.H., Forgas, J.P., Niedenthal, P.M., 2000. Cognition and Emotion. Oxford University Press. https://doi.org/10.1093/oso/9780195113334.001.0001.
Ekkekakis, P., Cook, D.B., 2013. Routledge handbook of physical activity and mental health. Routledge.
Ericson, C.A., 2011. Concise encyclopedia of system safety : definition of terms and concepts. Wiley.
Estudillo, B., Carretero-Gómez, J.M., Forteza, F.J., 2024. The impact of occupational accidents on economic Performance: Evidence from the construction. Saf. Sci. 177, 106571. https://doi.org/10.1016/j.ssci.2024.106571.
Faa, 1982. System Design Analysis. Advisory Circular 25–1309.01. Federal Aviation Administration, USA.
Fang, K., Fan, J., Yu, B., 2022. A trip-based network travel risk: definition and prediction. Ann. Oper. Res. https://doi.org/10.1007/s10479-022-04630-6.
Fischhoff, B., Watson, S.R., Hope, C., 1984. Defining risk. Policy Sci. 17, 123–139.
Flowerdew, J., 1992. Definitions in science lectures [Article]. Appl. Linguis. 13 (2), 202–221. https://doi.org/10.1093/applin/13.2.202.
Fogel, S.C., Calman, L., Magrini, D., 2012. Lesbians' and Bisexual Women's Definition of Health. J. Homosex. 59 (6), 851–863. https://doi.org/10.1080/00918369.2012.694768.
Gessert, C., Waring, S., Bailey-Davis, L., Conway, P., Roberts, M., VanWormer, J., 2015. Rural definition of health: a systematic literature review. BMC Public Health 15, 378. https://doi.org/10.1186/s12889-015-1658-9.
Grant, M.J., Booth, A., 2009. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Info. Libr. J. 26 (2), 91–108. https://doi.org/10.1111/j.1471-1842.2009.00848.x.
Grima, S., Hamarat, B., Özen, E., Girlando, A., Dalli-Gonzi, R., 2021. The Relationship between Risk Perception and Risk Definition and Risk-Addressing Behaviour during the Early COVID-19 Stages. Journal of Risk and Financial Management 14 (6), 272. https://doi.org/10.3390/jrfm14060272.
Haavik, T.K., Antonsen, S., Rosness, R., Hale, A., 2019. HRO and RE: A pragmatic perspective. Saf. Sci. 117, 479–489. https://doi.org/10.1016/j.ssci.2016.08.010.
Hafen, M., 2016. Of what use (or harm) is a positive health definition? J. Public Health 24 (5), 437–441. https://doi.org/10.1007/s10389-016-0741-8.
Haimes, Y.Y., 2009. On the Complex Definition of Risk: A Systems-Based Approach. Risk Anal. 29 (12), 1647–1654. https://doi.org/10.1111/j.1539-6924.2009.01310.x.
Hammond, D.M., King, A.L., Joe, M., Miller, J.R., 2023. Understanding the relationship between safety culture and safety performance indicators in U.S. nuclear waste cleanup operations. Saf. Sci. 166, 106241. https://doi.org/10.1016/j.ssci.2023.106241.
Hb., 2023. We are Hutchies. Hutchinson Builders.
Heckmann, I., Comes, T., Nickel, S., 2015. A critical review on supply chain risk – Definition, measure and modeling. Omega 52, 119–132. https://doi.org/10.1016/j.omega.2014.10.004.
Hollnagel, E., 2008. Risk + Barriers = Safety? Saf. Sci. 46, 221–229.
Hollnagel, E., 2009. The ETTO Principle: Efficiency-Thoroughness Trade-Off: Why Things that Go Right Sometimes Go Wrong. Ashgate.
Hollnagel, E., 2014a. Is safety a subject for science? Saf. Sci. 67, 21–24. https://doi.org/10.1016/j.ssci.2013.07.025.
Hollnagel, E., 2014b. Safety-I and safety-II : the past and future of safety management. Ashgate.
Hu, N., Li, C.-S., Wang, L.-F., Hu, L., Xu, X.-J., Zou, Y.-P., Hu, Y., Shen, C., 2016. Intelligent monitoring-based safety system of massage robot. J. Cent. South Univ. 23 (10), 2647–2658. https://doi.org/10.1007/s11771-016-3326-3.
Huang, W., Shuai, B., Zhang, R., Xu, M., Xu, Y., Yu, Y., Antwi, E., 2020. A New System Risk Definition and System Risk Analysis Approach Based on Improved Risk Field. IEEE Trans. Reliab. 69 (4), 1437–1452. https://doi.org/10.1109/TR.2019.2942373.
Huber, M., Knottnerus, J. A., Green, L., Horst, H. v. d., Jadad, A. R., Kromhout, D., Leonard, B., Lorig, K., Loureiro, M. I., Meer, J. W. M. v. d., Schnabel, P., Smith, R., Weel, C. v., & Smid, H. (2011). How should we define health? *BMJ*, *343*, d4163. doi: 10.1136/bmj.d4163.
Icao, 2018. Safety Management Manual. In *Doc. 9859*, 4th ed. International Civil Aviation Organization, Montreal, Canada.
Icmm, 2021. Health and Safety Performance Indicators - Guidance. International Council on Mining and Metals.
Jones, S., 2016. Alternative perspectives of safety in home delivered health care: a sequential exploratory mixed method study. J. Adv. Nurs. 72 (10), 2536–2546. https://doi.org/10.1111/jan.13006.
Kang, L. (2024). Examining the relationship between construction fatalities and the construction economy in China: a three-decade analysis. *Engineering, Construction and Architectural Management*, *ahead-of-print*(ahead-of-print). doi: 10.1108/ECAM-09-2023-0920.
Karanikas, N., 2016. Critical Review of Safety Performance Metrics. Int. J. Bus. Perform. Manag. 17 (3), 266–285.
Karanikas, N., 2018. Revisiting the relationship between safety and security. International Journal of Safety and Security Engineering 8 (4), 547–551. https://doi.org/10.2495/SAFE-V8-N4-547-551.
Karanikas, N., Nederend, J., 2018. The controllability classification of safety events and its application to aviation investigation reports. Saf. Sci. 108, 89–103. https://doi.org/10.1016/j.ssci.2018.04.025.
Karanikas, N., Tyson, L., 2022. Occupational health and safety (OHS) and integrated management: A desktop-based review across higher education OHS, business and general management courses in Australia. *Australian Universities'*. Review.
Karanikas, N., Zerguine, H., 2023. Advancing Occupational Health and Safety in Context: Mapping of the Literature. Queensland University of Technology.
Karanikas, N., Zerguine, H., 2024. Are the new safety paradigms (only) about safety and sufficient to ensure it? An overview and critical commentary. Saf. Sci. 170, 106367. https://doi.org/10.1016/j.ssci.2023.106367.
Klinke, A., Renn, O., 2002. A New Approach to Risk Evaluation and Management: Risk-Based, Precaution-Based, and Discourse-Based Strategies1. Risk Anal. 22 (6), 1071–1094. https://doi.org/10.1111/1539-6924.00274.
Lack, R.W., 2001. The dictionary of terms used in the safety profession, (4th ed.). American Society of Safety Engineers.
Landesman, L.Y., Burke, R.V., 2021. Landesman's public health management of disasters : the practice guide, (5th ed.). American Public Health Association.
Laroche, H. (2020). The Languages of Safety. In B. Journé, H. Laroche, C. Bieder, & C. Gilbert (Eds.), *Human and Organisational Factors: Practices and Strategies for a Changing World* (pp. 105-110). Springer International Publishing. doi: 10.1007/978-3-030-25639-5_12.
Larsen, L.T., 2022. Not merely the absence of disease: A genealogy of the WHO's positive health definition. Hist. Hum. Sci. 35 (1), 111–131. https://doi.org/10.1177/0952695121995355.
Leigh, H., 2013. Corporate crime and officer liability under WH&S legislation now in harmony : but will it please the ear of the indemnified and insured? Company and Securities Law Journal 31 (7), 437–456.
Leonardi, F., 2018. The Definition of Health: Towards New Perspectives. Int. J. Health Serv. 48 (4), 735–748. https://doi.org/10.1177/0020731418782653.
Leveson, N., 2011. Engineering a Safer World: Systems Thinking Applied to Safety. MIT Press.
Lowrance, W.W., 1976. Of acceptable risk : science and the determination of safety. William Kaufmann Inc.
Manuele, F. A. (2013). Defining the Practice of Safety. In F. A. Manuele (Ed.), *On the Practice of Safety* (pp. 27-42). John Wiley & Sons, Inc. doi: 10.1002/9781118574683.ch2.

Marty, M.E., 2011. Dietrich Bonhoeffer's letters and papers from prison : a biography. Princeton University Press.
Meulen, M. J. P. v. d. (2000). *Definitions for Hardware and Software Safety Engineers*. Springer London. doi: 10.1007/978-1-4471-0471-1.
Misselbrook, D., 2016. Aristotle, Hume and the goals of medicine. J Eval Clin Pract 22 (4), 544–549. https://doi.org/10.1111/jep.12371.
Mohiyeddini, C., 2013. Emotional relationships: types, challenges, and physical/mental health impacts. Nova Science Publisher's Inc.
Möller, N., Hansson, S.O., 2008. Principles of engineering safety: Risk and uncertainty reduction. Reliab. Eng. Syst. Saf. 93 (6), 798–805. https://doi.org/10.1016/j.ress.2007.03.031.
Moreira, F.G.P., Pereira de Oliveira, C., Farias, C.A., 2024. Workplace accidents and the probabilities of injuries occurring in the civil construction industry in Brazilian Amazon: A descriptive and inferential analysis. Saf. Sci. 173, 106449. https://doi.org/10.1016/j.ssci.2024.106449.
Morris, M.B., 2015. Public Health and Harm Reduction : Principles. Nova Science Publishers, Incorporated, Perceptions and Programs.
Morris, G.A., Cannady, R., 2019. Proper Use of the Hierarchy of Controls. Prof. Saf. 64 (08), 37–40.
Naswp, 1989. A national Aboriginal health strategy. National Aboriginal Strategy Working Party, Department of Aboriginal Affairs, Canberra.
NIOSH. (2016). *Hierarchy of Controls*. https://www.cdc.gov/niosh/topics/hierarchy/.
Niu, Y., Fan, Y., Li, Y., 2023. Safety performance measurement in collectivized oil companies in China: Contribution of leading indicators to lagging indicators. J. Loss Prev. Process Ind. 83, 105090. https://doi.org/10.1016/j.jlp.2023.105090.
NSC. (2013). Psychological health and safety in the workplace — Prevention, promotion, and guidance to staged implementation. In: National Standard of Canada.
O.Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution, 9*(1), 20-32. doi: 10.1111/2041-210X.12860.
Oecd, 2014. Guidance on Developing Safety Performance Indicators For Industry. OECD Publishing. https://doi.org/10.1787/9789264221741-en.
Pearson, O., Schwartzkopff, K., Dawson, A., Hagger, C., Karagi, A., Davy, C., Brown, A., Braunack-Mayer, A., on behalf of the Leadership Group guiding the Centre for Research Excellence in Aboriginal Chronic Disease Knowledge, T., & Exchange, 2020. Aboriginal community controlled health organisations address health equity through action on the social determinants of health of Aboriginal and Torres Strait Islander peoples in Australia. BMC Public Health 20 (1), 1859. https://doi.org/10.1186/s12889-020-09943-4.
Peng-Keller, S., Winiger, F., Rauch, R., 2022. The spirit of global health : the World Health Organization and the 'spiritual dimension' of health, 1946–2021. Oxford University Press.
Pera, J., 2016. Etymology of the definition of risk in international relations. The Research Perspective. *Horyzonty Polityki* 7 (21), 119–140. https://doi.org/10.17399/HP.2016.072104.
Pledger, G. (2011). A working definition of health. *BMJ: British Medical Journal*, *343* (7821), 436-436. http://www.jstor.org/stable/23051984.
Rae, A., Provan, D., 2019. Safety work versus the safety of work. Saf. Sci. 111, 119–127. https://doi.org/10.1016/j.ssci.2018.07.001.
Reese, C.D., 2008. Occupational health and safety management : a practical approach, (2nd ed.). CRC Press.
Richardson, G.E., 2002. The metatheory of resilience and resiliency. J. Clin. Psychol. 58 (3), 307–321. https://doi.org/10.1002/jclp.10020.
Rochlin, G.I., 1999. Safe operation as a social construct. Ergonomics 42 (11), 1549–1560. https://doi.org/10.1080/001401399184884.
Rohrmann, B., 2008. Risk Perception. A Conceptual Appraisal. University of Melbourne, Risk Attitude, Risk Communication, Risk Management.
Rowley, J.M., 2014. Power of Positive Fitness : Maximizing Physical. A C U Press, Mental and Spiritual Health.
Ruiz-Tagle, A., Lopez-Droguett, E., Groth, K.M., 2022. A novel probabilistic approach to counterfactual reasoning in system safety. Reliab. Eng. Syst. Saf. 228, 108785. https://doi.org/10.1016/j.ress.2022.108785.
Sadeghi, L., Mathieu, L., Tricot, N., Al Bassit, L., 2015. Developing a safety indicator to measure the safety level during design for safety. Saf. Sci. 80, 252–263. https://doi.org/10.1016/j.ssci.2015.08.006.
Santios, N. D. d., Lago, E. M. G., Albuquerque Neto, H. C., Gusmão , A. D., & Cruz, F. M. d. (2022). Organizational factors for risk control: Comparison between face-to-face and remote training methods. Analysis of the performance of workers working in the construction of electrical networks. *Research, Society and Development.* doi: 10.33448/rsd-v11i3.26398.
Saracci, R., 1997. The World Health Organisation Needs to Reconsider Its Definition of Health. *BMJ*. Br. Med. J. 314 (7091), 1409–1410. http://www.jstor.org/stable/25174539.
Shilton, T., Sparks, M., McQueen, D., Lamarre, M.-C., Jackson, S., 2011. Proposal for new definition of health. BMJ 343, d5359. https://doi.org/10.1136/bmj.d5359.
Sim, J., Waterfield, J., 2019. Focus group methodology: some ethical challenges. Qual. Quant. 53 (6), 3003–3022. https://doi.org/10.1007/s11135-019-00914-5.
Simmons, S.F., Schnelle, J.F., Sathe, N.A., Slagle, J.M., Stevenson, D.G., Carlo, M.E., McPheeters, M.L., 2016. Defining Safety in the Nursing Home Setting: Implications for Future Research. J. Am. Med. Dir. Assoc. 17 (6), 473–481. https://doi.org/10.1016/j.jamda.2016.03.005.
Sjöberg, L., 2000. Factors in Risk Perception. Risk Anal. 20 (1), 1–12. https://doi.org/10.1111/0272-4332.00001.
Slovic, P., 1992. Perception of risk: Reflections on the psychometric paradigm. In: Krimsky, S., Golding, D. (Eds.), Social Theories of Risk. Praeger, pp. 117–152.
Steen, R., Norman, J.E., Bergström, J., Damm, G.F., 2024. Dark knights: Exploring resilience and hidden workarounds in commercial aviation through mixed methods. Saf. Sci. 175, 106498. https://doi.org/10.1016/j.ssci.2024.106498.
Susca, P.T., 2018. The Business Value of a Common Safety Language. Prof. Saf. 63 (3), 18–21. https://www.proquest.com/docview/2010639999.
SWA. (2024). *Model Work Health and Safety Regulations*. Safe Work Australia. https://www.safeworkaustralia.gov.au/doc/model-work-health-and-safety-regulations.
Teasdale, J.D., 1996. The relationship between cognition and emotion: the mind-in-place in mood disorders. In: Clark, D.M., Fairburn, C.G. (Eds.), Science and Practice of Cognitive Behaviour Therapy. Oxford University Press, pp. 67–94. https://doi.org/10.1093/med:psych/9780192627254.003.0004.
Teuma Custo, P., Teuma Custo, R., Buttigieg, S., 2019. The Relationship Between Safety Climate and Performance in Intensive Care Units: The Mediating Role of Managerial Safety Practices and Priority of Safety [Original Research]. Front. Public Health 7. https://doi.org/10.3389/fpubh.2019.00302.
Varshney, K.R., Alemzadeh, H., 2017. On the Safety of Machine Learning: Cyber-Physical Systems, Decision Sciences, and Data Products. Big Data 5 (3), 246–255. https://doi.org/10.1089/big.2016.0051.
VonDras, D.D., 2019. Better Health through Spiritual Practices : A Guide to Religious Behaviors and Perspectives That Benefit Mind and Body. Libraries Unlimited. https://doi.org/10.5040/9798400617737.
Wall, K.D., 2009. Thinking about Risk: Definition, Assessment, and Management. The Armed Forces Comptroller 54 (3), 8.
Wang, Y., Jin, Z., Deng, C., Guo, S., Wang, X., Wang, X., 2019. Establishment of safety structure theory. Saf. Sci. 115, 265–277. https://doi.org/10.1016/j.ssci.2019.02.013.
Weick, K.E., 1987. Organizational Culture as a Source of High Reliability [Article]. Calif. Manage. Rev. 29 (2), 112–127. https://doi.org/10.2307/41165243.
Who, 1948. Preamble to the Constitution of the World Health Organization. World Health Organization.
Who, 1978. Declaration of Alma-Ata. Primary Health Care. World Health Organization, Geneva, Switzerland.
Who, 1986. The Ottawa Charter for health promotion, In. World Health Organization, Geneva, Switzerland.
WHO. (2024). *Global patient safety report 2024*. World Health Organization. https://iris.who.int/bitstream/handle/10665/376928/9789240095458-eng.pdf.
Woods, M., 2011. Risk management in organizations an integrated case study approach. Taylor and Francis.
Ye, W., Strietholt, R., Blömeke, S., 2021. Academic resilience: underlying norms and validity of definitions. Educ. Assess. Eval. Account. 33 (1), 169–202. https://doi.org/10.1007/s11092-020-09351-7.
Zahraei, S.M., Teo, C.-C., 2017. Optimizing a supply network with production smoothing, freight expediting and safety stocks: An analysis of tactical trade-offs. Eur. J. Oper. Res. 262 (1), 75–88. https://doi.org/10.1016/j.ejor.2017.02.045.