Designing safety interventions for specific contexts

Full Report

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1 Executive Summary

Workplace health and safety (H&S) is a significant global issue; around 500 million people are adversely affected by work-related injuries and illnesses each year, while the number of daily workplace fatalities runs into the thousands. One explanation for these alarming statistics may lie in the way safety interventions are introduced and implemented in different contexts.

A 'safety intervention' could be any physical artefact, process, procedure, skills, or specialist knowledge that restores, maintains, or strengthens safety (i.e., prevents or mitigates safety risks; influences culture and behaviours; improves health and wellbeing; ensures compliance with legal requirements). Misalignment between interventions and context increases the possibility of failure with adverse consequences. Where interventions 'fit' the context safety performance is high.

There is a clear requirement to minimise harm and maximise worker well-being in the workplace, a change that can be driven by the implementation of context-appropriate safety interventions. However, the degree to which organisations and occupational H&S researchers, and trainers contemplate contextualisation processes, and the variables that influence these processes, when sourcing, designing and implementing safety interventions is unclear and may account for the lack of success observed for some interventions.

In this report we attempt to address this knowledge gap and present the findings of our investigation into whether and how researchers, trainers, and organisations consider contextual factors in safety interventions.

The study comprised of three broad strands. Firstly, a comprehensive Rapid Evidence Assessment (REA) reviewed scholarly work published in peer-reviewed journals between 2011 and 2021; from an initial sample of 3,450 studies, 73 studies were included in the final review. Secondly, a screen of nationally and internationally recognised training materials, coupled with 12 semi-structured interviews with experienced trainers, was performed to determine how frequently safety courses considered context. Finally, further interviews with industry stakeholders were performed to identify both successful and unsuccessful interventions and to ascertain if context was a factor in outcomes.

We identified that training and education was the most frequently applied intervention, and training providers confirm that they believe appropriate consideration of context would increase the effectiveness of interventions. However, it was also clear that few courses consider the influence of context on the interventions or describe a framework whereby such contextualisation could occur. For example, interventions are often 'borrowed' from other organisations and are not adjusted to meet the specific needs of the new environment. This, coupled with the observation of a widespread failure of organisations to review the impact of their safety training in a continuous fashion and update and improve its implementation, suggests that there is a need for organisational level adjustments.

We, therefore, suggest that the following five recommendations are developed to improve the training of workplace H&S, and thus its implementation:

1. Organisations should begin considering the context of interventions as much as the intervention itself during implementation. This process can be assisted via the development of the processes detailed below.
2. Organisations, occupational safety and health (OSH) training providers, OSH institutions and agencies, and academia should develop guidelines that indicate key success factors (KSFs) for safety training effectiveness within the organisational context, and how these

KSFs can be achieved. These would consider organisational characteristics, trainee demographics and features of the intervention.

3. Organisations, OSH training providers, OSH institutions and agencies, and academia should develop guidelines for designing online safety training materials that consider context. This should consider aesthetics, usability and usefulness drawing on existing knowledge of technology acceptance.
4. Organisations, OSH training providers, OSH institutions and agencies, and academia should develop guidelines to produce immersive, interactive, digital content for contextually relevant safety training materials to meet growing demand.
5. OSH training providers, OSH institutions and agencies and OSH regulators should promote the need to review the benefits of safety training after the event and to review current understanding before re-training.

In addition, the field would benefit from further research to better describe methodologies and frameworks that will allow for efficient contextualisation of H&S interventions across a wide range of industries. These have been specified in a further set of 11 recommendations.

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2 Introduction

Globally, workplace fatalities number in the thousands per day. This number is compounded by daily workplace accidents and injuries, sometimes with life-changing consequences, and increased further by deaths due to work-related diseases[a]. With around 500 million people affected by work each year[b], workplace health and safety (H&S) has become a significant global issue, which forms part of the United Nations sustainable development goals[c].

One explanation for the figures above may lie in the poor introduction and implementation of specific safety interventions in particular contexts resulting in diminished effectiveness of the interventions and poor results [1]. Simply the wrong tool can be used in the wrong place. This draws attention to the importance of ensuring that safety interventions 'fit' the context in which they are applied to secure successful, that is safe, outcomes. Misalignment between interventions and context increases the possibility of failure with adverse consequences. When the characteristics of safety interventions and the context are aligned, safety performance could be improved.

Therefore, one of the challenges for safety professionals, or those responsible for workplace safety, is to better understand the relationship between their context and the safety interventions they deploy. Furthermore, it is essential to understand whether and how an externally sourced safety intervention needs to be modified to better fit their context and achieve the desired outcomes.

Anecdotally, safety interventions are often 'borrowed' or 'copied' from one setting where they have been successfully deployed to another, but not necessarily with the same positive outcome. Such 'borrowing' and variation in performance outcomes are consistent with the implementation of managerial practices more generally [2]. Røvik [3] noted that "… while everything is everywhere, it is also different everywhere, p.292". A perceivably common practice may be performed differently in different settings. Nevertheless, this variation may be subtle and not immediately obvious.

Checklists are an example of a safety intervention widely adopted across sectors [4]. Safety outcomes following the deployment of checklists, however, are not consistently and invariably high. While checklists have contributed significantly to safety in aviation, their contribution to safety in healthcare is variable and contested. Partly this is because checklists are interventions introduced in complex socio-technical systems and require careful attention to their design and the basic skills required to successfully implement them. Hence, checklists are used in different ways for different purposes in different sectors. For example, in aviation they play an integral part in guiding the dialogue and interactions between flight crews in critical flight phases such as departure and descent. By contrast, in the maritime industry they serve an audit function, providing evidence retrospectively that tasks were completed on the bridge prior to sailing by an officer operating alone[d].

Hence, global ambitions to minimise harm in the workplace and maximise worker well-being must be tightly coupled with the introduction of context-appropriate safety interventions so that they are implemented effectively and yield the desired outcomes. Failure to consider contextual differences may explain why the 'export' of safety interventions from one sector to

[a] WHO/ILO joint estimates of work-related burden of disease and injury, 2000-2016: global monitoring report. Geneva: World Health Organization and the International Labour Organization, 2021.
[b] https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249278/lang--en/index.htm (accessed 29 October 2021)
[c] UN SDG https://sdgs.un.org/goals
[d] Interviewee from case studies in this project

another is sometimes unsuccessful. However, the degree to which researchers and organisations contemplate contextualisation processes and the variables that influence these processes when designing and implementing safety interventions has not been explored systematically. Neither has there been a systematic exploration of Occupational Safety & Health (OSH) syllabuses to investigate the inclusion of contextualisation processes in training courses.

2.1 Objectives

The objectives of this work were, therefore, to:

1) Understand whether and how researchers, trainers, and organisations consider contextual factors in safety interventions, and
2) Use the conceptual framework proposed by Røvik [3] and presented in section 2.4 below to support the consideration of contextual factors with the goal of improving safety intervention effectiveness.

2.2 Research Methods

The above were achieved through four methods (detailed methods described in Appendix A):

1) Review research to identify contextual factors in the design and implementation of safety interventions;
2) Review published intervention studies to discover how safety interventions are contextualised and identify parameters that influence contextualisation;
3) Examine H&S syllabuses and training practice to reveal the extent to which those courses and their delivery support the contextualisation of safety interventions;
4) Provide case examples of successful and unsuccessful safety interventions through interviews with key industry stakeholders.

2.3 Theoretical background

This study draws on translation studies recognizing that ideas and models are social constructions [5] subject to interpretation and translation [6] as they are transferred in space and time [7]. Translation is the process whereby a general management idea is transferred and reinterpreted in a new setting [8]. These ideas and models are often stratified [9] and may not necessarily be singular. Rather, several different levels of an idea may be bundled together tightly. These bundles may contain core ideas operating at a programmatic/strategic level (e.g., aims and objectives) or a technical/operational level (e.g., formal and informal practices) [6]. Changes may be made at an operational level without necessarily changing the programmatic level ideas. Conversely, changes at the programmatic level may not inevitably change operational level practices. Also, a practice common to two settings may be enacted for different reasons. Furthermore, translation accepts that this transfer of an idea is not a 'friction-less' process, like diffusion, but change (transformation) is expected to occur in the translation process. This, therefore, implies that each translation is unique [10].

Translations may occur at different levels within the system [11]. Often this occurs at the 'field-level' (i.e., the sector or industry level) rather than the level of the organisation, where practices are translated and adopted by different business units within a company. Evidence suggests that ideas originating from outside a sector are more successfully embedded in a particular organisation within a particular sector when those ideas have been previously translated at the sector level prior to being received by the organisation [11]. 'Field level' translations occur, for example, at conferences and in workshops conducted by consultants and academics, and lead to sector 'best-practices'.

In practice, translation at the organisational level is mainly conducted by (senior) managers [10], who make the idea, "… relevant and understandable in the particular context of the adopting organisation" [11]. Often, managers are responsible for initiating organisational change in response to the occurrence of a safety incident by adopting new or amending existing safety practices. Nevertheless, other studies note that translation may be conducted by unions and governments, and, importantly for this study, trainers and consultants [10, Table 1].

Moreover, successful translation appears to be crucially dependent not on stable and invariant ideas but their 'interpretive viability' [12]. This provides different stakeholders in different contexts with the opportunity to work flexibly with the idea, allowing them to interpret the idea appropriately for their circumstances such that work activity is not constrained [13].

2.4 Design of conceptual framework

Røvik [3] developed an instrumental theory of translation, which we have captured diagrammatically in Figure 1. This conceptual model, which we used as a framework for this study, draws attention to the micro-processes of change explaining "… how actors apply various translation rules when de-contextualising practices in source units and contextualising representations of practice in recipient units" [3]. The model has two elements. First a decontextualisation process that takes the idea from the source and creates an abstract concept. This extracts the idea from its contextual wrapper but retains the relevant information that explains how the practice functions in its source context. The second element is a contextualisation process whereby the abstract concept is recontextualised to fit the recipient conditions. This may require the replacement of old practices in the recipient, the integration of the new practices with existing practices in the recipient or simple additions to the existing practices.

The ease with which a practice is decontextualised is a function of its complexity, its embeddedness, and its explicitness. Practices that are complex, deeply embedded in the context and tacit are the most difficult to decontextualise and therefore translate from source to recipient. As the level of complexity and embeddedness decrease and the idea becomes more explicit, decontextualisation becomes easier. Complexity is a function of the combination of technology and people. A technology with a clear-cut application is less complex, than one relying on a repertoire of human skills performed by different individuals. Practices that are concentrated can be easily identified and represented, making them easier to translate. Where they are dispersed and dependent on other practices to function, translation becomes more difficult. Furthermore, tacit practices are non-verbalised, non-codified and non-standardised. These need to be verbalised and made explicit before they can be translated.

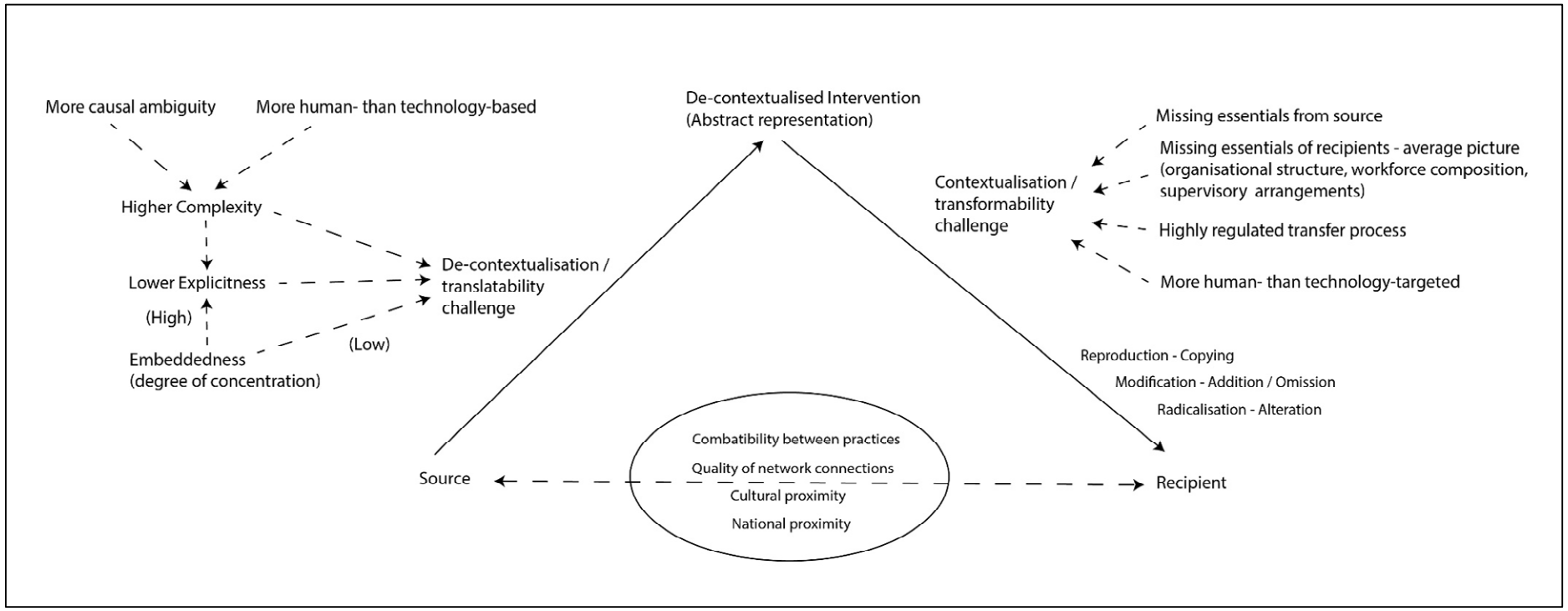

Figure 1: Conceptual framework for decontextualisation – contextualisation, based on Røvik [3]

Translation is guided by a set of 'editing' or 'translation rules' as ideas travel across space and time. The trajectory of these runs from copying, through modification to radical alteration. Copying attempts to achieve similar outcomes in the recipient as in the source by using the same intervention in the same way. Modifications can occur either by the addition of a few elements or by the omission of a few elements. These changes seek to achieve a better alignment between the intervention and the recipient's context. A radical alteration fundamentally changes the original idea. Such changes may be so radical that the new intervention in the recipient scarcely resembles the version in the source and the latter functions more as an inspiration rather a source of specific and concrete practice.

Differences between source and recipient create the 'space' within which the micro-processes of change can occur and influence the outcome of the translation process [11]. Where source and recipient show greater similarity, successful translation is more likely. Nevertheless, a variety of contextual factors that describe the source and recipient can influence this translation process. The original work highlights the need for national, cultural, and institutional proximity. Other contextual factors that regularly differ across organisations include culture, processes, demographics and criticality of OSH as part of the organisation's 'licence to operate' [14]. These may also impact translation success. Brown, Dahill [15] identified various structural and psychosocial factors that impact safety outcomes, including work over- or under-load, unclear communication, conflicting demands, and job insecurity.

Therefore, mastering this translation process is a key skill for effective change agents. Successful change is more likely when this translation process is performed competently [16]. 'Translation competence' requires clear knowledge and familiarity with the idea to be implemented, detailed understanding of the local practice where the new idea is being translated and an appreciation of the translation rules noted above.

Also, interventions vary, and this variety may also influence the ease of translation and the effectiveness of subsequent applications in a new context. Different categorisations of interventions are available. Focusing on human-artefact interactions, Karwowski [17] conceptualised interventions as functional, physical or process. Respectively, these represent human capabilities and limitations, interactions between humans and systems through workplace design, and process design and management. Alternatively, an organisational development perspective that seeks to create alignment between interventions and the successful achievement of organisational goals and improved performance adopts a different categorisation of interventions, namely Human process, Techno-structural, Human resource, and Strategic interventions[e]

In this study we consider interventions that impact organisational safety outcomes, including accident and injury rates, safety behaviours and worker wellbeing. To be inclusive, we define these safety interventions broadly. For example, 'Safety Intervention' could be any physical artefact, process, procedure, set of skills or specialist knowledge that restores, maintains, or strengthens safety (i.e., prevents or mitigates safety risks; influences culture and behaviours; improves health and wellbeing; ensures compliance with legal requirements).

[e] https://www.cipd.co.uk/knowledge/strategy/organisational-development/ (Accessed 29 October 2021)

3 Results & Findings

3.1 Health and Safety Publications

The Rapid Evidence Assessment (REA) of H&S publications and literature results were compiled into three datasets:

- AS – included all 73 studies (i.e., AS=NAI+API).
- NAI - for the 47 Not-Applied Intervention studies
- API - for the 26 Applied Intervention cases

Both NAI and API publications are considered for demographics, and contextual factors, with an in-depth breakdown of intervention data available in the case of Applied Intervention Cases in 3.1.3.

3.1.1 Information and demographics

The number of studies published each year varied from two in 2011 to 13 in 2019. Amongst the 47 NAI, 20 were cross-sectional, while 13 were opinion/review papers and 13 were non-comparative case studies. Most of the NAI collected qualitative data (n=15), followed by ordinal data from 12 studies and continuous data from eight. The API dataset included 12 uncontrolled pre-post intervention studies, six case studies, five randomised control trials and several other study types with lower frequencies. Data collected from API were mostly ordinal data (n=14), while six studies collected continuous data. Sample sizes varied greatly in the studies we reviewed. The sample size of targeted recipients or records collected in NAI ranged from 6 [18] to 12,959 [19] and in API ranged between 20 [20] to 1,784 [21].

Table A5 (Appendix A) presents the data regarding the demographics of the whole sample and separately for the NAI and API articles. Europe (n=26) and the Americas (n=22) were the regions where most of the studies took place. However, the distribution within the NAI and API subsets was somewhat inverted with more NAI articles coming from Europe (n=19, 40.4%) and most of the API publications coming from the Americas (n=11, 42.3%). All studies from the Americas were exclusively from the United States and Canada. In Europe, most of the AS (n=12) where carried out in Western Europe, followed by Northern Europe (n=9) and Southern Europe (n=4). Only four studies of the sample were conducted in Sub-Saharan Africa.

As presented in Table A6 (Appendix A), health services and construction were the industry sectors most studied with a total of 20 and 15 studies, respectively. The industry sector where the study was conducted was significantly associated with the NAI or API papers ($p = 0.04$, CI 99% 0.035-0.045). There were 12 studies conducted in the construction sector and 10 in the health services sector in the NAI category. Comparatively, in the API cases, the health services sector dominated the sample with 10 cases against three studies in the construction sector.

3.1.2 Contextual factors

The number of times different types of contextual factors derived from the studies, are presented in Table 1 (Note: the sum of the frequencies of the factors in the table exceeds the number of studies reviewed as each publication could refer to more than one factor). This section focuses on factors specifically considered in the organisational settings the studies targeted. The statistical tests did not show significant differences of the frequency of those contextual factors across (sub)regions and industry sectors.

Table 1: Contextual factors

Variables	n, (% of studies, % of all factors counted)		
	AS (N=73)	NAI (N=47)	API (N=26)
Psychosocial factors			
Communication	33 (45.2, 23.4)	21 (44.7, 20.4)	12 (46.2, 31.6)
Support from management	25 (34.2, 17.7)	21 (44.7, 20.4)	4 (15.4, 10.5)
Support from colleagues	24 (32.9, 17.0)	17 (36.2, 16.5)	7 (26.9, 18.4)
Workload	13 (17.8, 9.2)	13 (27.7, 12.6)	-
Role clarity	11 (15.1, 7.8)	8 (17.0, 7.8)	3 (11.5, 7.9)
Involvement in making decisions	10 (13.7, 7.1)	8 (17.0, 7.8)	2 (7.7, 5.3)
Influence over the way the job is done	5 (6.8, 3.5)	4 (8.5, 3.9)	1 (3.8, 2.6)
Organisational change management	3 (4.1, 2.1)	2 (4.3, 1.9)	1 (3.8, 2.6)
Conflicting demands	2 (2.7, 1.4)	2 (4.3, 1.9)	-
Job security	2 (2.7, 1.4)	2 (4.3, 1.9)	-
Not reported	13 (17.8, 9.2)	5 (10.6, 4.9)	8 (30.8, 21.1)
Absorptive capacity			
Cognitive factors	56 (76.7, 66.7)	37 (78.7, 63.8)	19 (61.5, 73.1)
Physical factors	9 (12.3, 10.7)	8 (17.0, 13.8)	1 (3.8, 3.8)
Emotional factors	9 (12.3, 10.7)	9 (19.1, 15.5)	-
Not reported	10 (13.7, 11.9)	4 (8.5, 6.9)	6 (23.1, 23.1)

3.1.2.1 Psychosocial Factors

The psychosocial factors considered varied widely amongst the studies. Across all the 73 studies reviewed, communication (n=33), support from management (n=25) and support from colleagues (n=24) were the most considered psychosocial factors, while conflicting demands (n=2) and job security (n=2) were the least considered factors. Furthermore, the extent of inclusion of or reference to psychosocial factors was not consistent across the two datasets (Figure 2).

In the NAI sample we identified all 10 psychosocial factors, the API sample considered seven of the 10 psychosocial factors, with workload, conflicting demands and job security not found in the API dataset. Thirteen of the 73 publications (five NAI and eight API publications) mentioned no psychosocial factor.

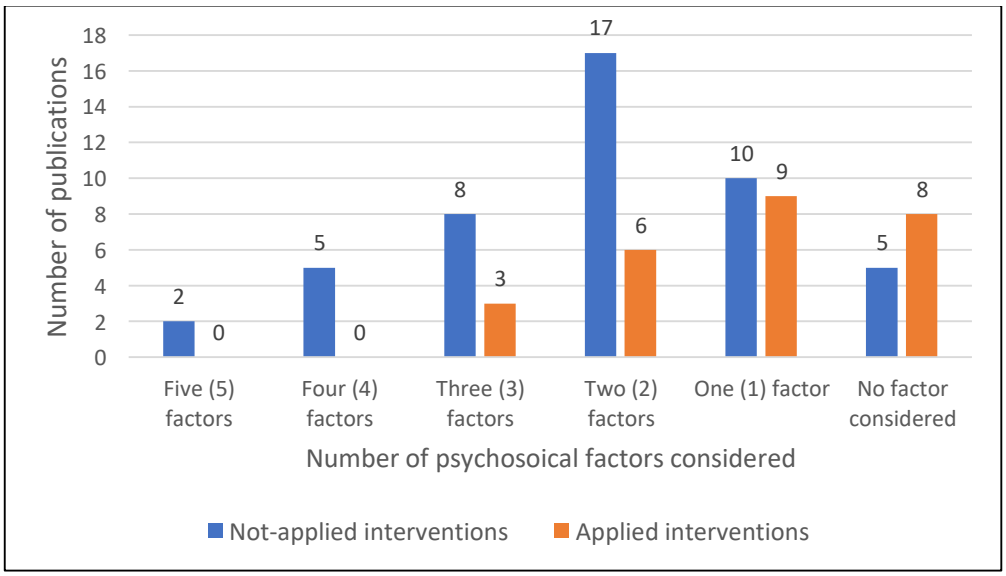

Figure 2: Number of psychosocial factors considered across publications

3.1.2.2 Absorptive Capacity

Cognitive factors were the most often considered (56 out of 73 studies), and only nine studies considered either emotional factors or physical factors. Only one of the 47 NAI considered all three factors [22]

Four NAI and six API articles did not include any reference to physical, cognitive, and emotional factors at all. Some NAI studies referred to additional parameters influencing participants' absorptive capacity, including religious and cultural beliefs [23-25]. One study stated project complexity, organisational complexity and contract management [26] and another study mentioned nationality [24] as factors influencing the absorptive capacity of participants. Other studies concluded that peer pressure [27] and team turnover [28] influenced absorptive capacity.

Amongst the API cases, none of them referred to more than one absorptive capacity factor, only one study considered physical factors [20], and most of the other studies (19 out of 26) considered cognitive factors only. When accounting for the missing datapoints, the frequency of absorptive capacity factors of recipients was significantly associated with whether the study was an intervention study or non-intervention study ($p = 0.05$, CI 99% 0.044-0.055). Across the sample, 78.7% of the NAI considered cognitive factors, 19.1% considered emotional factors and 17.0% considered physical factors. On the other hand, 61.5% of the API considered cognitive factors and only 3.8% considered physical factors, with emotional factors not found in any of the API cases.

3.1.3 Applied Interventions Studies (API)

3.1.3.1 Intervention Areas

Training or education was the most used intervention in the workplace with twelve of the 26 API using this method (Table 2). Communication was the second most frequently targeted area (n=5). However, if all individual risk-related interventions are aggregated, those interventions become the second most often cited area (n=7), and communication comes third.

Twenty-one of the API targeted one intervention area, and the other five studies employed more than one intervention. The study conducted by Haynes, Kramer [29] provided sun safety training as well as sun safety resources to outdoor workers. Guo, Goh [30] used goal setting along with feedback, training, reward, and punishment as interventions in the construction industry. Olson, Thompson [31] used goal setting along with education, self-monitoring, and social support as interventions in the health services sector. Senior management safety rounds, training for supervisors and online discussion forums were used as interventions in the health services by Bronkhorst, Tummers [32], while changing the triage process and adding extra staff were interventions used in the study by Balfour, Tanner [33].

Table 2: Intervention areas

Intervention areas	n (% of studies, % of all values counted)
Training/education	12 (46.2, 31.6)
Communication	5 (19.2, 13.2)
Risk control	3 (11.5, 7.9)
Behaviours	2 (7.7, 5.3)
Goals	2 (7.7, 5.3)
Rewards/awards	2 (7.7, 5.3)
Risk monitoring	2 (7.7, 5.3)
Culture	1 (3.8, 2.6)
Feedback	1 (3.8, 2.6)
Policy	1 (3.8, 2.6)

Intervention areas	n (% of studies, % of all values counted)
Punishment	1 (3.8, 2.6)
Risk assessment	1 (3.8, 2.6)
Risk management	1 (3.8, 2.6)
Safety management	1 (3.8, 2.6)
Self-monitoring	1 (3.8, 2.6)
Support	1 (3.8, 2.6)
Walk arounds	1 (3.8, 2.6)

3.1.3.2 Intervention Types

Sixteen studies reported functional interventions that targeted the purpose and role of persons and activity goals and outcomes (e.g., training, education, and communication-related interventions) (Table 3). Seven studies reported process interventions that targeted how the work is performed. Four studies reported physical interventions that targeted materials or the natural environment such as environmental conditions, infrastructure, equipment, tools, etc. Only one of these studies reported using both functional and physical interventions [21]. This study described the modification of sun safety policy and education through training as well as the provision of sun safety protection. Most of the interventions were more human than technology-oriented (88.5%).

Table 3: Intervention types

Intervention type	n (% of studies, % of all values counted)
Functional	16 (61.5, 59.3)
Process	7 (26.9, 25.9)
Physical	4 (15.4, 14.8)

3.1.3.3 Intervention Sources

Published studies and reports was the most frequent source of identifying interventions and/or informing the intervention design (n=11), followed by intervention initiatives sourced from knowledge from other industries (n=5) (Table 4). We identified only one study referring to two distinct sources, namely publicly available guidelines and training methods from various sources, and describing the implementation of an occupational safety programme with appropriate training methods in the education sector [34].

Table 4: Sources of interventions

Source of intervention	n (% of studies, % of all values counted)
Literature/studies	11 (42.3, 40.7)
Various industries	5 (19.2, 18.5)
Healthcare	2 (7.7, 7.4)
Manufacturing	2 (7.7, 7.4)
Aviation	1 (3.8, 3.7)
Food	1 (3.8, 3.7)
Government	1 (3.8, 3.7)
Internal practice	1 (3.8, 3.7)
Investigations	1 (3.8, 3.7)
Public information (presentations, guidelines)	1 (3.8, 3.7)
Training	1 (3.8, 3.7)

3.1.3.4 Intervention Method

Regarding the intervention mode, 12 studies regarded modifications (46.2%), 11 were radical interventions (42.3%) and three regarded reproductions of practices (11.5%) [34-36]. These three studies used the same programmes used in other industries to provide safety training to the targeted recipients; two of them regarded the education sector and one the healthcare industry.

3.1.3.5 Intervention Type

Excluding three API publications with no relevant information, in most of the cases, the intervention applied was 'new practice' for the recipients (n=17, 65.4%), and in six API (23.1%) the intervention regarded existing practice. Only three of the interventions were undertaken in collaboration between the source and the recipient. Of these, Karanikas, Obadimu [37] reported how they developed a safety award programme in a large aviation organisation at their request. Bull, Mason [38] reported a training program for Portuguese-speaking nurses in Mozambique that was modified in a collaboration between a hospital in the United Kingdom and a teaching hospital in Mozambique. Talbot, Wang [39] reported a collaborative effort within a large academic health centre to design a formalised system to improve safety of healthcare personnel. The remaining interventions (n=23) were undertaken on an ad-hoc basis.

3.1.3.6 Intervention Proximity

For 19 of the studies, it was not possible to detect information about the national proximity between source and recipient (e.g., no reference in the publication, the intervention was based on literature). Four of the studies (15.4%) were performed in the same country as the source [21, 37, 39, 40], while three studies (11.5%) were performed in a different country than the source [30, 33, 38]. Cultural proximity was indicated in 13 out of the 26 API and was almost evenly distributed between different (n=6, 23.1%), similar (n=7, 26.9%) and same (n=7, 26.9%) sectors and/or operations.

3.1.3.7 Intervention Outcomes

The three outcome types aimed and/or achieved were almost evenly distributed across the sample, with some precedence of OSH performance [OSH performance: n=12, 46.2%; Safe behaviours: n=11, 42.3%; Worker well-being, n=10, 38.5%]. No single study targeted all three outcomes, and only six API publications focused on two outcomes concurrently. Two studies aimed to improve both OSH performance and safe behaviours [41, 42]. Only one study aimed to improve OSH performance and worker wellbeing [29]. Three studies aimed to improve both safe behaviours and worker wellbeing [43-45]. Across the API sample, only one study reported a failed intervention [37].

3.1.3.8 Intervention De-Contextualisation

None of the API referred explicitly to the translation-transformation mode and translatability challenges at the source (Figure 1). Nevertheless, seven studies mentioned a variety of parameters affecting the design, implementation and outcomes of interventions. González-Formoso, Clavería [36] shared that some items of the original safety training source were difficult to interpret, Buller, Walkosz [21] recognised that the sun safety policies introduced relied on individuals to implement as they were not enforced, Guo, Goh [30] acknowledged that the behavioural-based interventions assumed linear relationships between system elements, and Bronkhorst, Tummers [32] noticed that the improvement of safety climate was somewhat difficult due to the reactive mindset of managers. Also, McDonald and Durso [46] recognised that task interruptions and high workload were counteracting the efforts to decrease attentional errors, Talbot, Wang [39] observed that the process improvement introduced was influenced by the limited time for decision-making and Randmaa, Mårtensson [47] expressed concerns that the intervention effectiveness would decrease due to lower adherence over time.

3.1.4 Intervention Limitations

Moreover, several studies mentioned limitations regarding the size and composition of the samples of targeted recipients or the timeframe and opportunities available to assess the intervention's effectiveness. Such limitations could not allow the generalisation of the results or afford high confidence in the outcomes measured. Other concerns expressed by various authors included incompatibilities between previous and new practices, which were realised retrospectively [37], diverse priorities [29] and reversion to past behaviours due to unsustainability of positive effects [30].

3.2 Health and Safety courses

Cumulatively, 319 of the 1,300 surveyed courses covered H&S topics (Figure 3). Approximately 20% of these H&S courses overall considered context (Figure 4). Nevertheless, there was considerable difference between providers. Some providers, for example NEBOSH, always considered context, while the courses delivered by OSHA and NSC rarely or never considered context (Figure 4). Between 25-50% of the courses provided by other providers considered context.

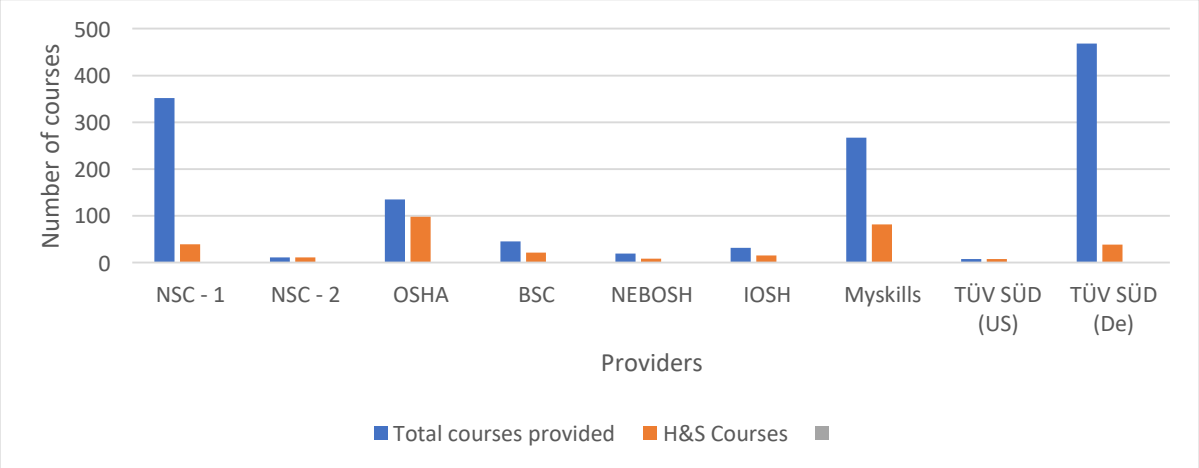

Figure 3: Courses considering H&S

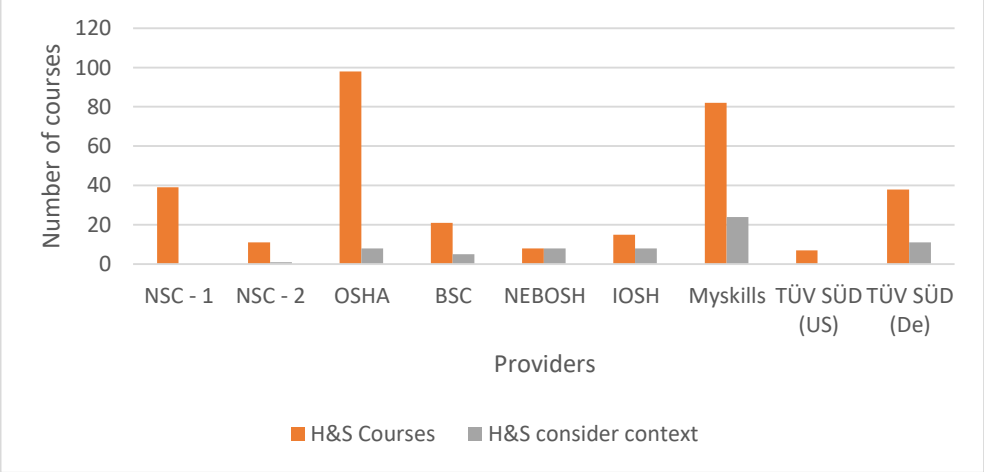

Figure 4: H&S courses considering context

None of the courses explicitly considered the processes of decontextualisation/contextualisation proposed by the conceptual model [3]. Nevertheless, evidence of the consideration of context in relation to a safety intervention was inferred from phrases, such as "*the application of knowledge to a work context*" (MySkills websites), or "*provide real-world information that can be immediately applied in the workplace*" (OSHA websites), or similar.

3.2.1 Who Applies Content to Context?

The above suggests that during the courses referring explicitly or implicitly to context the delegates would consider how the new knowledge they had acquired during the course would, or could, be applied in their workplace. The TÜV SÜD websites emphasised this "practical application" of the new knowledge, and the use of case studies in the training materials. NEBOSH, in a couple of its courses, states that delegates will be able "*to apply knowledge to familiar and unfamiliar situations*", suggesting that this training may include some consideration of how the safety interventions work and how this might be affected by context. Moreover, NEBOSH also indicates that several other courses will be through practical application in the workplace. This might suggest that trainees are provided with decontextualised interventions that then they are expected to modify and apply to their context.

The examination of courses offered on these nine websites indicates that 70% of all the H&S courses that consider context were delivered as continuing profession development (CPD) (Table 5). Fourteen courses were either certificated programmes (in the US) or earned certificate-level awards, and five were awarded diplomas (Table 5).

Table 5: Types of awards available from H&S courses that consider context

	CPD	Certificate	Diploma	Degree
NSC (combined)	1	0	0	0
OSHA	0	7	0	1
BSC	3	1	1	0
NEBOSH	2	4	2	0
IOSH	7	1	0	0
MySkills	21	1	2	0
TÜV SÜD De	11	0	0	0

3.3 Health and Safety trainers' interviews

3.3.1 What is the aim/purpose of the safety training? Is context important?

Two respondents raised this vital prior question, "what is the aim/purpose of the training or learning?". Is training the best or only way of tackling the presenting safety issue?

In some cases, training is an end in itself. It simply demonstrates to a third party that an organisation has responded to a particular issue. That aside, it is important to identify whether the training is to provide knowledge and skills or to support implementation, application, or organisational change. The latter demands a consideration of context; the former may not. However, interviewees felt that context was generally overlooked, or at best left implicit rather than being made explicit.

> *"…we assume people think about context – but they don't".*

> *"One of the things that I find so frustrating is actually when people don't recognise the context that they are in, and that that has an impact on what's going on".*

One reason for the failure to consider context is because training is used as a vehicle to communicate and deliver information that needs to be remembered rather than to provide the skills required to interpret the information in different settings.

Nevertheless, the interviewees were unanimous in their view that consideration of context was important in safety training and that it would make a difference to safety outcomes:

> "*Absolutely it makes a difference*"

> "*This is definitely a definite yes*".

But there was an important note of caution: "*Intuitively, you say yes, don't you? But I've got no evidence to the contrary*".

3.3.2 Where does a consideration of 'contextualisation' occur in safety training?

None of the key informants discussed the processes of de-contextualisation/contextualisation identified by Røvik [3]. Nevertheless, they clearly indicated that considerations of context occur at two points in the delivery of training. The first point is in the design stage. This is particularly important for In-Company Programmes. The second point occurs during the delivery of the materials in class, where trainers draw on the experiences of delegates or on their own examples. This is prevalent on Open Programmes hosting delegates from different organisations, where there is "*lots of context on the fly*". Similar discussion of 'war stories 'may also occur during the delivery of In-Company programmes too; in some cases, this may be an integral part of the design.

Consideration of context can also be influenced by the approval process surrounding the development of the course or programme. Those involved in this process have a profound influence on the content and the delivery of the materials. In some cases, courses may be designed only by learning and development professionals without reference to H&S professionals. In other settings, courses may or may not have industrialists approving the content to evaluate the relevance of the materials for practitioners participating in the course.

The respondents acknowledged the need to adapt and modify training materials, or even to create new materials to meet the needs of the client organisation, and to consider their context:

> *"So, your aspect of context is really fundamental in that. And the mistake to go to a client is to say, we think you should have this*".

The interviewees recognised that H&S training programmes trigger organisational change, and the consideration of context needs to be supported for the benefits of the training to be realised. Collectively the respondents indicated they considered the following factors when developing training materials for In-Company programmes.

- Relevant international/national guidance or regulatory frameworks
- Nature of the company's business
- Previous experience of incidents in the company
- Current strategic circumstances (*e.g.,* ongoing change programmes)
- Risk profile of the company
- Operational systems and procedures and processes
- Maturity of the H&S management system
- Company language
- Company values
- Competence and capability of those attending
- Design and support for action plan arising from the training

Standardisation of materials allows quality control of the materials that are used and ensures a known content. However, the interviewees believed "off-the-shelf" courses rarely consider context. A critique of e-learning modules made by several interviewees was that they were standardised and prevented a consideration of how the materials might be applied in context. Interviewees also noted that e-learning also precludes questions, which promotes understanding for the learner, and reduces the chance of application subsequently. It is worth noting that two interviewees in the case examples drew attention to the need to develop digital interactive and immersive H&S materials to engage employees, because this is their normal experience.

Some trainers, particularly from professional bodies, were strong advocates for the use of case studies. These allowed delegates to be involved in the unfolding decision making that led to the outcome illustrated in the case study. Others drew attention to the need for more immersive, interactive, and digital content in training materials.

Interviewees provided several explanations for why context was not an important consideration in the purchasing or provision of training products. These reflect the role and knowledge of the person responsible for the purchasing decision, the characteristics of the providers and the perceived value to the student of the training. The reasons given were:

- Those purchasing training are often seeking the cheapest option rather than the most effective option.
- The person involved with the selection and choice of training often has little knowledge of the products being purchased or the setting to which they will be applied.

  > *"It's one size fits all because of budget constraints or whatever, that's the way it's delivered".*

- Training providers sell generic materials to complete a transaction.

  > *"Do training providers take context into account? No, because most training providers are generic"*

  > *"I know for a fact that some H&S consultants will go in and deliver generic training, and that's it, job done"*

- Some national awarding bodies have strict guidelines on the content of the materials and the methods of delivery of training, which makes adaptation difficult or even impossible.
- Purchasers of training are often seeking nationally/internationally recognised qualifications. This builds CVs, making the award holders more marketable.

3.3.3 Trainer Influence on Contextual application

> *"It's not just the design. It's also which trainer we send out is important"*

Some respondents drew attention to the valuable contribution the trainer makes to the success of the training, and to the contextualisation of the training materials. They identified the following set of skills and attributes that characterise successful trainers.

- Competent and experienced
- Responsive and able to pick up on cues in class
- Able (and permitted) to adapt materials to suit interests, capabilities, and requirements of the delegates
- Appropriate 'fit' between delegates and trainer, e.g., similar demographic
- Relevant industry experience – "*the smell, the noise, the feeling in an industry*"

3.3.4 Review of Effectiveness

A significant issue with most training, not only H&S training, is the failure to review the training after the event with the participants and to ask the simple question: "what did you learn?" This could then be followed up by a demonstration of how this learning has been applied in practice, for example, with a test six-months later.

Interviewees were curious to know, "*why [organisations] buy training and not check to see if it works?*" Part of the response to this question returns to the opening consideration of the purpose and aims of safety training.

3.3.5 Important contextual factors influencing safety interventions

The contextual factors identified by interviewees could be clustered into ten themes. Five of these were single topic themes, for example organisational culture, leadership, or management (Table 6). These dominant themes were noted regularly by more than half, and sometimes all, of those interviewed. Others, such as drivers of the intervention, intra-organisational relationships, and internal support for intervention emerged from the aggregation of less frequently reported themes (Table 7). Once combined, these aggregated themes were reported by up to half of the interviewees, with the 'degree of internal support' mentioned by all interviewees.

3.3.5.1 Organisational culture

The culture of the organisation was universally considered to be an important contextual factor determining the effectiveness of an intervention. Respondents drew attention to the difference between those pursuing the minimum requirements and those seeking best practice. This was also manifest in whether individuals were able to speak up about safety issues and without adverse consequence. Safety maturity was not a function of organisational size.

3.3.5.2 Leadership

The behaviours of the senior managers within the organisation towards safety was seen as critical and without their commitment and support it is likely to fail. This extends through the organisation to anyone with leadership responsibilities, including supervisors. It is important

that leaders are visible and are engaged with the workforce, listening to their concerns and open to suggestions.

3.3.5.3 Management

Managers also need to be committed to the intervention and engaged with the delivery. In large organisations with a sizable cadre of middle managers support for a safety intervention can be easily diluted, even if the senior management team is very supportive. Managers also need to be technically competent and able to understand the issues on the shopfloor.

3.3.5.4 Competence of employees

Individuals undertaking the specific safety training should be knowledgeable and skilful operatives capable of deploying the intervention effectively. It was also noted that capability referred not only to the ability to understand what was required but also to be physically capable of performing the task.

3.3.5.5 Individual-level attributes

A range of individual-level factors were identified that enable or hinder the successful implementation of a safety intervention. Some of these were demographic factors, for example education level. Others included psycho-social factors such as morale and resentment. Motivation to engage with the new intervention and how this could be engendered was also important.

3.3.5.6 Driver of the intervention

Five more minor themes were aggregated to create this theme. The drivers for the adoption of an intervention vary but include:

- responding to regulatory requirements, perhaps following receipt of an improvement notice,
- responding to data that indicates a need for a change,
- a sense of insecurity and experiencing the need 'to do' something,
- exposure of hazards that need a response,
- an experience of a recent near-miss, actual incident, or even fatality.

3.3.5.7 External Environment

Three aspects of the external environment were noted to influence the effectiveness of safety interventions. These were the national culture, legal/regulatory context, and the existence of external standards. National cultures influence beliefs about H&S and attitudes towards safety practices that affect the adoption of safety interventions. Raising safety concerns in the workplace may be inconsistent with life experience beyond the workplace, for example restricting the work on flatbed lorries may be inappropriate where it is acceptable to ride to work on the roof of a bus. Local legal or regulatory requirements determine what is required and what is acceptable. Understanding these before attempting to make safety interventions will result in a more successful outcome. Similarly, the pursuit of external standards, including ISO standards, can influence the successful adoption of safety interventions.

3.3.5.8 Characteristics of the business

Some interviews commented on characteristics of a business that may affect the successful implementation of a safety intervention. These included:

- the size of the organisation, whether it was a multi-national or an SME;
- the presence or absence of a unionised workforce. They can be "*a very important influencer*";

- private or public sector. This makes a noticeable difference in terms of the ease of procurement of interventions to support safety;
- the involvement of third-party contractors in the work processes.

3.3.5.9 Intra-organisational relationships

Relationships between different groups within an organisation, particularly where they are adversarial, can influence the adoption and effectiveness of a safety intervention. Differences are commonly seen between the headquarters of an organisation and sites or subsidiaries geographically distant from the main office. Differences are also seen between groups within an organisation, for example between professionals and managers. Tensions here can affect adoption of a new practice. Better relationships are encouraged by two-way, open communication that encourages the development of trust, which "*comes in on a tortoise and goes out on an antelope*".

3.3.5.10 Degree of internal support for intervention

Several important enablers and barriers internal to the organisation were identified which affect effective safety interventions. The availability of resources (including time) to support the development and deployment of the intervention is a crucial factor. This is particularly important in large multi-site organisations where the cost of deploying a new intervention may be high, and where other initiatives may also exist. Potentially these may be in conflict. This is critically connected to the complexity of the intervention being deployed. Large complex interventions require more resource generally. Other immediate priorities within the business can influence the effectiveness of an intervention. A down-turn in the industry requiring a focus on performance output or the shedding of staff can distract from effectively deploying a safety initiative. Moreover, other organisational change initiatives compete for resources, especially at the front-line, making it challenging to effectively deliver any of the initiatives.

The source of the intervention also determines whether it will be effectively implemented. A top-down mandated approach is likely to be less successful than one that is co-designed by the workforce and 'owned' by those who must implement it. Furthermore, success is affected by the reporting line of the originators of the initiative; for example, does H&S have a direct reporting line to the board?

Successful implementation of the intervention is more likely if the new intervention aligns with existing processes and procedures. This requires the interaction between the H&S professionals in the organisation with those responsible for the operational processes in the organisation. The existence of silos precludes this, making failure more likely.

Table 6: Contextual factors (dominant themes) influencing effectiveness of safety interventions.

Dominant Theme	Illustrative quotes
Organisational culture	*It sounds lazy, but obviously culture is the golden bullet (MPH).* *Understanding that the environment in which someone is working will determine what action they are likely to take in any given scenario … whether it is the cultural environment that they're in, in how they're encouraged, supported, do they have that level of psychological safety to be able to speak up (TK).*
Leadership	*I would get a sense of where the leadership are in terms of attitudes and behaviours towards safety (DN)* *There are so many other factors that have to be considered, such as what's the leadership's stance on [safety interventions] (AH)* *there are some things that will influence whether it's likely to be more or less effective, for example, you might have a top – a senior leadership team that is supportive or you might have a senior leadership that isn't supportive (ZG)*
Management	*the resistance comes a bit further down, once you start hitting those middle managers who are less convinced about the need for the intervention or whether it's going to work (DN)* *I remember also a case where people said, well, the most important danger in my job is my boss. So, then you have to do something about the boss, or you have to start communicating with the boss and it is also important that the people and the boss develop a new kind of conversation among them. It may take quite some time before it happens So, yeah, that is also context (GZ)*
Competence of employees	*we need to stop just looking at people's technical abilities as well and start looking at their other skill sets that they've got when we're promoting people into certain positions at work (MPH)* *Generally, the most important is employees' competence level. You know, occupational health and safety training, you can't just throw it into your company and say, okay, fine, because competence level between, let's say, a manager and supervisor and, let's say, for floor staff are totally different (TW)*
Individual attributes	*Demographic. Male/female, educated/uneducated (HB)* *It is around people being decisive when they need to be, but also realizing when they need to listen, and having that level of self-awareness. And so, when you see people realise that actually self-awareness is going to help them through this if it happens to them, that can be really quite useful. (TK)*

Table 7: Contextual factors (aggregate themes) influencing effectiveness of safety interventions

		Illustrative quotes
Aggregate themes	**Sub-themes**	
Driver of the intervention	Reason	*Has there just been a recent fatality or an injury that makes this a more well-received piece of information that you're trying to do, and what's really the motivation behind the company doing it? Is it cost? is it regulatory? is it humanitarian? What is the motivation? (AH)*
	Incident	
	Pressure	*she was under a lot of pressure from her manager to get something out there as quickly as possible. And I think that's the reality a lot of the time (PW)*
	Hazards	*So, you need to know within a workplace, what is somebody exposed to, that could either impact on health on work or work on health. And then advise simple example noise, noise, benzene, many different things (RM)*
External environment	National culture	*what is fundamental is actually to understand the country and their culture and religious behaviours (TW)*
	Legal/Regulatory context	*Also, what's the regulatory territory that you're in, as well, because obviously, with any intervention that you do, you will have to keep an eye on what your country regulatory is saying about in terms of guidance, laws, or codes of practice. Also, in fact, actually industry standards as well (DN)*
	External standards	
Characteristics of the business	Size	*I think with smaller organisations, they sort of pick and choose, and borrow and get and '-ize' it to their organisation as far as [the] words around things that are specific to [their] industry, but maybe not necessarily around specific needs or competence or outcomes, at least (JD)*
	Union/non-union	*The Trade Unions are in context are very important influencer. And you ignore them at your peril. (RM)*
	Public/private	*then there's the third bit, which is the discretionary spend, what's nice to have. And dependent upon whether its public sector/private sector or anything, their outlook on what that is, is completely different (RM)*
Intra-organisational relationships	HQ-Site relations	*So how you can build capability in that particular site, which is in line with the corporate culture, the corporate view and vision and it may be the other way around as well because maybe the corporate is doing really, really like not so well or their safety culture doesn't show really big commitment towards safety, but they have really brilliant sites. And then it's the opposite. (ZG)*
	Group – sub-group	*the social interactions in the group that can also be important. Sometimes there is a strong subculture in a group. It is difficult to influence by leaders even (GZ)*
	Employee relations	*of course, ultimately, it's about what's the relationship then with the employees, the organisational relationship with the employees. That's quite the key as well. (DN)*
	Trust	*I think those interpersonal relationships between team members is absolutely critical to have that positive, not negative, or toxic, resulting in eroding of trust, lack of support, those sorts of things (TK)*
	Communications	*having a leadership team who will listen, being a listening organisation (MPH)*

Degree of internal support for the intervention	Resources	*Are there sufficient tools of our or other things available, resources available to bring the change that is needed etc.? (GZ)*
	Competing priorities	*there are competing priorities at the supervisory level in particular, that's where it becomes a lynchpin and a stopping point. So, understanding what else the organisation is trying to do simultaneously (AH)*
	Origin of intervention	*what happens more often than not is that interventions are designed from the top-down and not from the bottom-up, and we need to get better at designing interventions with involvement from the people at the lower levels, because we'll end up with much better sustainable interventions (DN)*
	Alignment with processes	*I think another one of the issues that we have in terms of our interventions, they tend to be separate processes, as opposed to maybe trying to integrate your intervention with existing processes in a business (DN)*
	Safety's position	*It's all very lovely to say, you know, you have the power to stop the plant. And I get a lot of people telling me that in the training courses, I say okay that's great, when was the last time someone did it? Well, they have never done it. Well, why do you think they have the power to do it then if they've never done it? (TK)* *So, if we're training someone on a particular safety topic and that safety function within that organisation reports to a vice-president or to the CEO, you're probably going to have a better chance of that being implemented than if that safety person is a lower-level person or perhaps reports into HR or into finance, for example (AH)*

Eight of these ten different contextual factors indicated in the two previous tables operate at different levels in the organisational system to influence adoption of interventions. They also align to three different forms of fit required to ensure a practice or intervention is adopted successfully by an organisation. Technical fit refers to the compatibility of the intervention with existing technologies, while cultural fit refers to the alignment with existing cultural values, beliefs, and practices. Political fit refers to, "the degree to which implicit or explicit normative characteristics of a diffusing practice are compatible with the interests and agendas of potential adopters" [48]. Table 8 summarises how these different contextual factors might influence the adaptation and adoption of a safety intervention in a new organisation. Individual level attributes and drivers of the intervention are not included in the table.

Table 8: Where and how contextual factors influence the adaptation and adoption of safety interventions (based on Ansari, Fiss [48]).

Fit Characteristics	Intra-Organisational	Organisational	Supra-Organisational
Technical	Management Competence of employees	Public/ Private Sector[3] Size of organisation[3]	Regulatory Context[4] External Standards[4]
Cultural	Leadership Management	Organisational Culture	National Culture[4]
Political	Leadership Management	Organisational relationships[1] Support for Intervention[2]	Legal Context[4] Union/non-Union[3]

[1]Includes: Group-Subgroup, HQ-Site, Employee relations. [2] Includes: resource availability, competing priorities, alignment with processes, safety's position. [3]Contributes to Characteristics of the business. [4]Part of external environment.

3.4 OSH Intervention Cases

Details of the 17 cases from the key informant interviews are provided in Appendix G. All cases were from the private sector and come from different industrial sectors ranging from safety-critical industries, like oil and gas, and high hazard operations, like construction and shipping, to service organisations such as retail. As the variety of industrial sectors rendered any detailed comparisons challenging, through reflective conversations between the researchers we distilled the salient features of each study. In the following subsections, we have synthesised the findings from a cross-case comparison of these features.

3.4.1 Triggering conditions

Overall, the interventions were triggered by one of three different conditions, and the cases have been arranged in response to these triggers. None of the triggers was a response to a report following an investigation by an external agency. The three triggering conditions were:

i. **Reaction to unacceptable levels of incidents and claims within the organisation.** Five cases (1-5) in different sectors (food manufacturing, retail, telecoms, energy, and construction) reported actual safety-related events or adverse safety occurrences within the company that were perceived to be sufficiently serious to merit attention and action.

ii. **Proactive strategic interventions from within the organisation** that either directly or indirectly influence organisational safety. Three cases (6,7,8) in different sectors (construction, utilities, and private provider of public services) reported a cultural transformation within the organisation driven by a dissatisfaction with current safety culture and ways of working. Two other cases (9,10) in two different sectors (oil and gas and utilities) reported interventions triggered by non-safety related strategic decisions made by

the senior management team with the expectation that these will be implemented across the organisation.

iii. **Responses to drivers external to the organisation to improve organisational safety**. Two cases (11, 12) from the oil and gas sector reported the pervasive influence of an investigation report of an accident at another company in the same sector. Similarly, normative expectations within the oil and gas sector of HAZOP reviews drove changes in cases 13 and 14. The three cases from the maritime sector (15,16, 17) reported sector-wide views as revealed by NGOs and insurance companies and may indicate field-level instead of organisational-level translations.

3.4.2 Intervention types

In these cases, the interventions can be categorised as *functional, physical or process*. Most interventions were either wholly (n=6) or partially (n=7) functional focusing on improving capabilities and competence through training. One intervention was solely physical relating to the design of work (case 5). Three cases (13,14,15) were solely process interventions, where process design and management practices were adjusted. Strategic interventions (cases 6-10) were considered to combine all three intervention types.

Interventions in each of the cases demonstrated variable levels of complexity, reflecting the extent of interaction between people and technology and the causal ambiguity [3]. In some case examples, for example the introduction of manual handling training (cases 1-2), there was a clear connection between the deployment of the intervention and an improvement in safety performance. In other cases (e.g., 4 and 12), this connection was less certain, although assumed. Several of the cases, for example 9 and 10, also required the interaction between people and technology, which increases complexity. Except for those cases in the maritime industry (15-17), interventions in all other cases were developed and deployed by a single individual or a small group of individuals, even if the subsequent reach throughout the organisation was extensive. This suggests these interventions all displayed low levels of embeddedness [3]. Also, the interventions in all cases had high levels of explicitness [3]. They were normally documented (codified and explicit) and standardised for universal application.

3.4.3 Source of intervention

Interventions were typically initiated, developed, and deployed without reference to the experience of other organisations. Although the types of interventions in many cases resembled those reported widely in safety literature [49, 50], their specific origin was rarely clear. This suggests that copying was uncommon. Most interventions were either modified to fit local circumstances or were new practices. However, the interventions in cases 1, 2, 13 and 14, followed the individual key informants as they changed employers. They had successfully deployed an intervention in the first organisational setting and sought to introduce it in the second setting, but, at the time of interview, with apparently less success. However, even these interventions were modified between settings and not copied.

In each case, the intervention was deployed from a central position within the organisation. This was often either the main organisational headquarters (e.g., cases 11-12 about the development of a competence assessment framework in the oil and gas sector), or the headquarters of a division or business unit (e.g., case 6 regarding a strategic intervention in a construction company). The field-level interventions triggered by the industry trade bodies or the insurers in the maritime industry (cases 15-17) were accepted by the companies.

3.4.4 General organisational context of case examples

Only cases 1 and 3 had fewer than 250 employees, and only one of these is classified as a Small and Medium-Sized Enterprise. The other is the production line of a single factory of a

global branded food manufacturer. All other cases involved organisations with large employee numbers, more than 10,000. Those in Oil and Gas typically have more than ca. 70,000 employees worldwide and may be considered very large. The sectors and scale of the businesses represented in the cases reflect mature industries and well-established organisations. The exceptions are cases 3 and 10, where the key informants described the respective organisations as young (less than 20 years old).

3.4.5 Outcomes

The outcomes following the application of the interventions varied. The cases, particularly those that respond to the first triggering condition, unacceptable levels of incidents or claims, often reported a pre- and a post-state. Approximately 40% of the interventions were reported to have a successful outcome and for about 40% of the other interventions the response was variable. Regarding the latter, the intervention was adopted successfully in some parts of the business but not in others (e.g., cases 6, 9 and 14). In other cases, for example those in the maritime sector, it was too soon to tell. In the remaining approximately 20% of cases, interventions were wholly unsuccessful and key informants pursued a different approach subsequently (e.g., case 8).

In four of the five cases responding to incidents or claims the interventions were either considered successful or were considered likely to be successful by the key informants. In cases 1 and 3, success was closely associated with small size and supportive and engaged staff. In larger organisations (cases 2 and 4), pilot testing indicated likely success, or it was deemed ‘too soon to tell’. Organisational operations in these cases had not always followed a procedure prior to the ones introduced, or the previous procedure was not deemed ‘fit-for-purpose’ and needed to be replaced. The new procedures and processes needed to be rolled out and embedded.

Case 5, which deployed sensors on cranes to prevent them colliding with each other and buildings, appeared unsuccessful because the sensors were switched off. The key informants suggested that this was because of the perceived slowing of work by operators, which was unacceptable to those working under time pressure and tight financial margins. When actual data on the impact of sensors on the speed of operations became available, showing no loss of productivity, the sensors were reluctantly accepted and turned on.

3.4.6 Key factors influencing outcomes

Success with process/physical interventions driven by organisational strategy or normative expectations were more successful where the interventions were capable of being integrated into existing processes. In case 10, the use of the software tool was designed into the practices required to fulfil the task, rather than being an additional ‘extra’ task as in case 9, which yielded only partial acceptance. The benefit of this additional task in case 9 was questioned and adoption was consequently patchy, even though it was supported.

In case 13, the ‘command and control’ culture required that the HAZOP review process were adopted. It was integrated into the standard operating procedures of the organisation following intense and robust scrutiny by the board. There was no questioning about the appropriateness of this approach, which became a standardised practice across the whole organisation. This contrasts with the situation in case 14 where there was no consistent overarching culture in the organisation, and divisions and business units operated almost independently of headquarters control. Frequent staff turnover and continuous organisational change further eroded the consistency of operations within the organisation allowing people to selectively choose what they did.

Strategic interventions aimed directly at improving safety had variable success. In case 7, the safety culture transformation was considered entirely successful. A small, centralised organisation with a supportive CEO and executive board, and access to resources in terms of budget and staff, ensured a successful transformation. In contrast, the attempt to replicate the transformation in a larger decentralised organisation failed (case 8). The key informant suggested that the lack of commitment and budget support by the executives, a small central safety team and no line management control over safety staff in the business units were barriers to success. More success was obtained in the decentralised division located away from the headquarters of a construction company (case 6). The backing of the division's general manager and the small team sizes in each of the 12 units within the division allowed some success in some teams with the implementation of new ways of working based on changes in values. Identifying local team-specific champions together with 'permission' to make local adaptations encouraged success.

Functional interventions that encouraged the development of competence assessment frameworks also encountered mixed success. In the same oil and gas company the response to the intervention developed by the headquarters and rolled out across the business was variable (cases 11 and 12). Where a champion for the framework engaged with each of the managers in a business to allow units to tailor the approach to better suit their circumstances, a successful outcome was achieved (case 13). Implementation of the same competence assessment framework met less success in a much greater number of smaller locations driven by a production agenda rather than a safety agenda (case 14). Furthermore, the lack of ownership was considered by the key informant a critical difference. Competence frameworks and best practice guidelines were developed by trade associations, NGOs, and insurers in the maritime sector (cases 15-17), but their effects were not clearly observable.

A summary of the prominent success factors and barriers identified across all cases are reported per intervention type in Table 9.

Table 9: Common success factors and barriers associated with each intervention type identified from 17 case examples across sectors.

Intervention Type	Common Success Factors	Common Barriers
Functional	• Small organisational units • Supportive CEO/Senior Management team • Local champion	• Safety not a priority
Process	• Supportive CEO/Senior Management team • Mandated adoption • Employee commitment to organisation	• Local autonomy • Dispersed business units
Physical	• Small organisational units • Less mature organisations • Engage and support workforce with adoption	• Negative perception of value of technology • Increased workload; additional task • Perception of delaying work
Strategic (Incorporation of all three above)	• Small organisational units • Supportive CEO/Senior Management team • Centralised decision-making • Resource availability	• Small team delivering change • Decentralised organisation • Locally independent units • Limited resources
Field	• Influential third parties in sector aware of need for change • Wide reach of third parties • Pressure to adopt changes	

4 Discussion

4.1 Health and Safety Publications

In general, the numbers of publications about Not-Applied Interventions (NAI, n=47) and Applied Interventions (API, n=26) suggest that theoretical concepts and pilot applications outnumber significantly full-scale studies in real-world settings.

This means it is almost twice as likely to find studies discussing contextual factors in general terms as case studies of actual interventions in a given setting. Although this difference could be partially attributed to the nature of Rapid Evidence Assessments (REAs), since we used a common search string and applied the same screening criteria, the possibilities of missing publications from any of the NAI or API categories remains equal. Hence, even if the numbers above do not fully represent the whole set of safety intervention studies published, their relative frequency of 26 APIs vs 47 NAIs can be claimed as valid.

The above could be attributed to the fact that some NAIs did not mature enough to the level of full implementation, or they were deployed but failed. The first presumption is indirectly

supported by the fact that we did not identify API and NAI studies on the same interventions. It is also possible that the authors directly published the actual implementation and did not perceive the necessity or did not have the resources to share any conceptual approaches and their trials. Nevertheless, notably, only one API shared a failed intervention, which confirms the effects of publication and outcome reporting biases of sharing strong and confirmatory results [51-53].

4.1.1 Study demographics

The differences regarding the study types between the NAI and API datasets were expected since most of the former did not include actual interventions and focused more on the introduction of concepts and pilot/small-scale test cases. The prevalence of uncontrolled pre-post intervention studies in the API cohort can be justified by the difficulty to design and run case-control and randomised controlled trials in real-world settings along with possible human research ethical considerations. Nonetheless, the diversity, along with the highly variant sample sizes suggest that the findings of this project should not be viewed as conclusive.

Based upon analysis by Merigó, Miranda [49] and Wang, Chen [54] we can be confident the regions of the publications we reviewed seem to represent the overall trend of safety-related publications. The difference between the percentages of regions for the API and NAI publications, where the Americas prevailed in the former and Europe in the latter, could be attributed to some form of publication bias or national cultural elements. Regarding the latter, for example, Rice, Daouk-Öyry [55] acknowledged that whereas most healthcare team training programmes were developed in the USA, it is imperative to understand the interplay between national culture and team dynamics and incorporate the values of different cultures into team training to create more effective interventions.

Furthermore, Zotzmann, van der Linden [56] found that countries, cultural values, and personality dimensions are related to an individual's error orientation, the latter defined as the attitude and behaviour toward dealing with, communicating about, and learning from errors. Employees working in the USA reported the highest mean levels on error orientation [56], which could indirectly explain the more frequent API publications in this region. Additionally, works in other fields, such as medicine and conservation biology and ecology, have recognised that the geographical region could play a role in various aspects such as reporting of positive/negative outcomes [57], actual or perceived impact and significance of the study's subject [58] and available research resources [59].

The relatively increased frequency the healthcare and construction sectors were studied in both API and NAI can be explained by the combination of their workforce sizes and rate/prevalence of workplace incidents and accidents. Considering the countries and regions where most of the publications focused, in the US, healthcare and construction rank as the 2nd and 9th largest sector respectively out of 19 industries[f], with construction presenting the highest number of worker fatalities[g]. In Europe, the healthcare sector is the 3rd largest employer and construction ranks 6th out of 17 industries[h], but construction suffers from the highest number of fatal accidents at work[i]. Especially in the UK, human health and social work comprise the largest employer, and construction ranks 7th out of 16 sectors[j]. Construction in the UK had the

[f] https://www.bls.gov/emp/tables/employment-by-major-industry-sector.htm

[g] https://www.bls.gov/charts/census-of-fatal-occupational-injuries/number-and-rate-of-fatal-work-injuries-by-industry.htm

[h] https://skillspanorama.cedefop.europa.eu/en/dashboard/employed-population-occupation-and-sector?year=2019&country=EU&occupation=#1

[i] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Accidents_at_work_statistics#Number_of_accidents

[j] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentbyindustryemp13

highest number of fatalities in 2020-21[k], and healthcare and social workers reported the highest rate of work-related illnesses and non-fatal injuries[l]. In Australia, healthcare and social assistance is the largest employer amongst 19 sectors, with the construction industry positioned in the 4th place[m]. The latter sector in the 3rd highest in worker fatalities and disease and injury claims, whereas the healthcare industry ranks 1st in the number of serious claims[n].

Moreover, apart from the figures presented above, other differences between and within industry sectors might influence the degree to which they share interventions through publications. For instance, the study by Olsen and Aase [60] showed that the safety climate level and safety performance were generally higher in the petroleum sector than healthcare in Norway, which could indicate that the latter sector might feel the need to share lessons from interventions more frequently as a means to contribute to safety improvements across the sector.

Also, differences in the structures of different industry sectors could influence whether they perceive the value and urgency of publishing safety intervention cases instead of sharing those only internally through professional bodies and agencies. As Lindøe, Engen [61] observed, the petroleum industry is dominated by a limited number of big enterprises whereas the coastal fishing industry has large numbers of small fishing boats, low degree of formal organisation, high degree of personal freedom and a tradition to engage in risky activities. On the other hand, maritime enjoys some form of self-regulation through classification societies [61]. Although our data did not show considerable differences in the numbers of publications targeting those sectors, the small sample size yielded cannot guarantee conclusive results.

4.1.2 Recipients' contextual factors

The inclusion of psychosocial factors in the NAI and API publications did not present any observable trend, and the frequencies those factors were considered within each dataset could be rather viewed as random than systematic. The fact that in about 18% of the publications there was no reference to such factors and most of the NAI and API studies addressed only a few psychosocial factors could be alarming and indicative of underappreciation of their importance. Undoubtedly, it is a positive sign that communication, management and collegial support and workload parameters were addressed in many publications as several books, industry standards, and even legislation, view those factors as crucial in OSH management [62-72].

However, the sufficient coverage of communication, management and collegial support should not justify the exclusion or underrepresentation of other psychosocial parameters. Adequate organisation-wide support, worker consultation and role clarity are important but alone might not lead to successful interventions. Overall, the findings create the impression that interventions are more imposed on workers than created with their actual involvement. This means that management could communicate and support changes but not actively allow workers to influence how any intervention would impact their work.

Especially regarding job security, several studies over time and across industries have shown effects of precarious employment on risk perception and safety behaviours, compliance and participation [73-75], increased vulnerability to injuries [76], mental health [77] and overall employee

[k] https://www.hse.gov.uk/statistics/fatals.htm

[l] https://www.hse.gov.uk/statistics/industry/

[m] https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp2021/Quick_Guides/EmployIndustry

[n] https://www.safeworkaustralia.gov.au/statistics-and-research/statistics/disease-and-injuries/disease-and-injury-statistics-industry

performance [78]. Therefore, this factor can influence the degree to which a safety intervention will be accepted and realised by the targeted workforce. Although for the API publications we cannot exclude the case they included only workers with permanent employment status, we expected job security to have been addressed more frequently in NAI studies, most of which were about conceptualising and introducing safety interventions.

Similarly, the factor of competing demands, which was not present in API publications and appeared with a very low frequency in NAI papers, has been flagged in the literature for decades as influential on the priorities individuals set under different settings in domains such as public safety [79], agriculture [80] and healthcare [81, 82]. Notably, a survey of 1,375 workers across 33 organisations from the USA and Italy revealed that organisational-level production pressure climate exacerbated the positive relationship between workload and risky safety behaviours [83]. Moreover, change management and employee participation in influencing the way jobs tasks are executed and safety management is applied, factors which were underrepresented in the sample, have been mentioned in several publications as essential organisational approaches to gaining worker buy-in and enhancing the effectiveness and sustainability of interventions [84-89].

Regarding the frequency to which cognitive, physical, and emotional factors appeared in the publications reviewed, it can be claimed that the picture reflects expectations and perceptions related to their possible influence and visibility. Although it would be unsafe to argue that the change agents in the intervention studies did not appreciate the importance of all the three categories of factors, the relative overemphasis on individual cognitive parameters is justified by the intervention areas targeted. Education and communication, which were collectively found in 17 out of the 26 API and represented 44.8% of all interventions, aim mainly at developing cognitive skills (e.g., awareness, decision making, evaluation). The same applies to other interventions such as policies, self-monitoring programmes and risk management. In turn, this could explain the lower concentration on physical factors, possibly under the assumption that all workers were physically able and healthy to participate in cognition-focused interventions.

However, regardless of the intervention area, emotions regulate and drive mental and physical responses, and, at the same time, are shaped through cognition and physiology under a continuous interplay [90, 91]. The absence of emotional factors from API studies and their low frequencies in NAI publications could be possibly attributed to where emotions are perceivably positioned in the operational envelope and when their effects are considered. For instance, in the hospitality sector, Zhang, Xie [92] examined the interrelationship between negative emotions, safe behaviours and corporate social responsibility in response to COVID-19 measures. Mou and Lin [93] investigated whether negative emotions develop after exposure to food safety information and result in changes of risk perception and prevention actions. In the aviation industry, Causse, Dehais [94] showed that a failure to execute a go-around was associated with temporary impairment of rational decision-making due to the negative emotional consequences attached with the go-around. In the same industry sector, Catino and Patriotta [95] investigated how the interaction of cognition, emotions, and safety culture influence the detection, reporting, and analysis of errors.

Moreover, the findings from an experiment in a virtual construction environment suggested that emotional responses to the construction hazards did not affect hazard identification performance but modulated risk evaluation and decision-making [96]. In the context of emergency response, Lu, Yang [97] illustrated the relationships between several environmental emergencies and their effects on the emotional state of the rescuers involved. In summary,

the studies mentioned above suggest a proactive inclusion of emotional factors in the design and deployment of interventions might not be perceived as a necessity or priority.

Moreover, although the studies we reviewed were independent and not part of the same projects, the above could indirectly suggest that the transition from concepts and tests to real-world applications under constraints might lead to narrower consideration of absorptive capacity elements. Also, we could not exclude the case that the API studies followed unpublished concepts and trials during which the change agents considered more factors than the ones included in the final API publications. Nevertheless, overall, the results show a lack of holistic approaches to human capacity and capability drivers, and, possibly, low organisational maturity, with only one NAI study addressing cognitive, physical, and emotional factors concurrently. The lack of a holistic and systems approach is also evident by the outcomes applied intervention studies aimed and measured. According to the results, no API study targeted concurrently OSH performance, safe behaviours, and worker wellbeing and only six out of the 11 publications aimed at two outcomes, whereas all three are interconnected.

4.1.3 Applied interventions

The fact that training was the intervention area in about half of the API sample suggests its appreciation. However, together with most of the other intervention areas, suggests a focus on lower levels of the widely accepted concept of the hierarchy of risk controls: elimination, substitution, engineering, administration, and personal protection [98-101]. Training, communication and feedback, safety and risk management tools, rewards and punishment, behaviours, culture, and support, all constitute controls at the administrative level. This suggests that controls of higher order, which are more effective as they rely less on human performance, were not covered by the intervention studies.

The picture above aligns with findings from studies where administrative controls prevailed over elimination, substitution, and engineering. For example, Turner, Amyotte [102] analysed 277 recommendations from 30 incidents between 2001 and 2018 in Contra Costa Health Services, California, and classified 75% of the corrective actions as administrative and 14% as passive or active engineering, with only 8% targeting system redesign. In an earlier study, the analysis of 63 reports, studies, and bulletins from process incident investigations by the U.S. Chemical Safety Board showed elimination through design counted for 36% of the risk reduction measures, 22% were classified as passive and active engineering, and procedural safety was introduced as a measure in 42% of the sample [103].

In the aviation sector, the analysis of 625 recommendations included in the investigation reports published by four agencies concluded that only 11% of the sample regarded suggestions for elimination, substitution and engineering controls with the rest 89% of the recommendations aiming procedures, training, policies, strategies, etc. [104]. Interestingly, in the same domain, a survey with the participation of 42 professionals with safety-related roles revealed that the participants almost uniformly perceived administrative controls as more effective than other measures [105], contrary to the concept of the hierarchy of controls.

The results from the REA and the somewhat different findings from the studies discussed above could be attributed to several organisational factors. The work by Hudson, Schill [106] explored how the principles of the hierarchy of controls included in the NIOSH Total Worker Health guidelines were implemented among seven organisations. They found that elimination, substitution, and redesign controls were commonly used and trialled, and education was often discussed as a method to complement other controls. However, leadership, culture, available resources, access to information and the implementation process (e.g., implementation climate, readiness for implementation) were the determinants of control choices and their

success or failure [106]. Similarly, the study by Karanikas [105] found that aviation professionals acknowledged the relative vulnerability of administrative controls, but attributed the focus on the latter to pressures from authorities, who ask for more and better procedures, and the decreased feasibility to implement technical controls due to their cost.

However, transformative changes associated with the reduction of injuries and fatalities mostly include technical interventions that physically supress hazards, reduce risk exposure or improve responses to incidents (e.g., seatbelts and ABS in vehicles, fall prevention, metal fire escapes, explosion-proof lighting, roll-over cages, gas detectors, elimination of asbestos and passive smoking). Notably, in the studies reviewed, training and education, which are mainly transactional behavioural interventions, do not visibly appear as complementary to physical/technical interventions. This, along with the results showing that most intervention were imposed and not performed under a collaborative approach, could be an indication of emphasis on controlling workers through behavioural interventions and a lack of focus on structural weaknesses and other system improvement opportunities.

The fact the interventions reviewed were mainly sourced from published studies and reports could be attributed, on one hand, to the natural tendency of academic authors to derive ideas from previous publications, and, on the other hand, a possible tendency of the industry to import ideas and be tempted by the "new" rather than learning from inside and scoping the problem space [107]. Nonetheless, the prevalence of the specific intervention sources might also explain the low frequency of reproduced practices and higher percentages of radical and modified interventions. Journals typically accept and publish studies that offer new scientific insights and do not merely share the application of established practices from one setting to another. Hence, as reproduction-type interventions could be seen as mandatory (e.g., compliance with standards and requirements) and might not present scientific interest, we cannot claim the distribution of the three interventions modes in our sample reflects the industry reality.

4.2 Health and Safety Training

Overall, only one in five of the H&S training courses considers context, and it is unclear how they consider context because details on the websites were few. Often, they refer simply to the application of knowledge in a particular context. This process of ***application*** may not require abstraction (decontextualisation) but only contextualisation, or neither. Moreover, it is not clear where this process is tutor-led (i.e., facilitated by a knowledgeable other) or student-led (i.e., based on self-reflection, and perhaps unaided).

4.3 Health and Safety Trainer's Interviews

Training is a common safety intervention. However, its purpose is often ambiguous, and its effects are rarely evaluated. Safety training generally fails to consider context, although in the trainer interviews all interviewees unanimously agreed that this would be beneficial. When it does occur, it may occur during the design (and a checklist of important contextual factors was provided), or during the delivery of the training. The latter requires trainers with appropriate skills. Interviewees identified a set of 10 contextual factors that they considered to be influential in the successful implementation of safety interventions. These factors align adequately with the ones we considered in the analysis of studies during the REA.

4.4 OSH Intervention Cases

Seventeen different intervention cases were analysed, mainly from large and mature private sector organisations. Interventions were triggered within the organisation either reactively, in response to an incident, or proactively, at the suggestion of the senior managers. They were also triggered externally to the organisation. The interventions in most cases were functional,

focusing on improving the capabilities and competences of employees, confirming the prevalence of such interventions in the research reviewed during the REA. Typically, these interventions displayed low levels of embeddedness and high levels of explicitness. Moreover, they were initiated, developed, and deployed without reference to other organisations. This suggests not only that some local modification of the intervention occurred, but also that copying was rare. Interventions to improve safety can be implemented both successfully and unsuccessfully. Approximately 20% of the cases identified in these interviews were unsuccessful, and the outcome of some of the remainder was uncertain.

5 Conclusions

This work has demonstrated the need to consider context to deliver effective and impactful H&S interventions. To summarise, safety practices are reported often 'borrowed' from other organisations which have demonstrated a positive impact. However, contextual differences between organisations, sectors or sites are often overlooked leading to poor performance of 'borrowed' interventions. It is therefore key that OSH professionals and practitioners consider both the type of intervention and the wider context in which that intervention exists. This process should be continuous and should evolve over time to match the needs of the environment. We identified six key themes during the study that should be addressed to improve outcomes.

The literature review showed that training and education was the most frequently applied intervention. Importantly, all interventions represented administrative controls, contrary to the concept of hierarchy of controls. Although exact reproductions of practices were not frequently published, this was attributed to the practice to share scientific works communicating some type of innovation. Furthermore, **the analysis revealed missed opportunities to learn from both successes and failures in real-world settings**. There are considerably more studies about early-stage, pilot-tested or concept-stage OSH interventions than real-world, full-scale implementation of interventions and an absence of published cases of unsuccessful implementation of safety interventions. There were interventions where psychosocial factors were not mentioned. When those were mentioned, they did not cover the whole range of the factors. Additionally, the emotional capacity of recipients of the interventions was rarely considered. Many publications referred to 1 or 2 capacity factors, suggesting a lack of a holistic approach to physical, cognitive and emotional capacity of workers to accept and realise interventions.

Our search through the websites of several nationally and internationally important providers of safety training indicates that **few courses consider the influence of context on the interventions being trained.** Moreover, the courses focus on the application to a work context and appear not to consider the process of decontextualisation. Furthermore, it is not evident who does the application, where and with what support.

Our conversations with H&S trainers confirmed their belief that considerations of context would make a difference to the effectiveness of safety interventions in organisations. Complementing the findings of a recent review [108], this emphasises the importance of trainers fully understanding the characteristics of the organisation and the needs of the audience, in order for training to be successful and the benefits realised. This requires in-depth consideration of the organisation where the intervention will be applied, and an appreciation of the demographic characteristics of the trainees. These will require modification of the content of training programmes to fit the audience needs better and ensure greater engagement.

An important, but surprising, observation is the widespread failure of organisations to review the benefit of safety training, and to discover what employees have learnt at a time interval after the training. This might imply that training is done to meet an organisational requirement, for example to demonstrate to a third party that training has occurred, rather than to enhance the skills of the employees.

The analysis of the 17 OSH intervention cases showed that **organisations manage rather than remove the risks** by pursuing safety improvements from the base of the 'hierarchy of controls' rather than the apex. Furthermore, the safety interventions shared through those cases characteristically were highly explicit and had low levels of embeddedness. These features may have contributed to their apparent effectiveness. Interestingly, most of these interventions originated from within the organisation. There was little evidence that interventions were 'borrowed' from elsewhere. They were also modified to a greater or lesser extent, rather than directly copied. This also aligns with the findings from the literature review.

6 Recommendations

In combination the conclusions from the review of H&S training courses and interviews with H&S trainers lead to the following recommendations both for future work and immediate practical application:

1. Organisations should begin considering the context of interventions as much as the intervention itself during implementation. This process can be assisted via the development of the processes detailed below.
2. Organisations, OSH training providers, OSH institutions and agencies, and academia should develop guidelines that indicate key success factors (KSFs) for safety training effectiveness within the organisational context, and how these KSFs can be achieved. These would consider organisational characteristics, trainee demographics and features of the intervention.
3. Organisations, OSH training providers, OSH institutions and agencies, and academia should develop guidelines for designing online safety training materials that consider context. This should consider aesthetics, usability and usefulness drawing on existing knowledge of technology acceptance.
4. Organisations, OSH training providers, OSH institutions and agencies, and academia should develop guidelines to produce immersive, interactive, digital content for contextually relevant safety training materials to meet growing demand.
5. OSH training providers, OSH institutions and agencies and OSH regulators should promote the need to review the benefits of safety training after the event and to review current understanding before re-training.

In addition, the field would benefit from further research to better describe methodologies and frameworks that will allow for efficient contextualisation of H&S interventions across a wide range of industries. These have been specified in a further set of 11 recommendations.

1. Analysis of non-academic safety intervention publications, such as industry and government reports to gain a more complete picture of whether and how context influences safety interventions.
2. Extension of similar research to other safety fields, such as process, food, fire, operational, etc. safety.
3. Investigation of whether and how the whole range of psychosocial factors and physical, cognitive and emotional capacities of workers are included as parameters of organisation changes, OSH education and training, and professional practice.
4. Development of competence of OSH professionals in organisational change management.

5. Investigation of the sources of new safety interventions within organisations, and the extent to which they borrow from other settings. This may build on the previous work on knowledge and information sources funded by the Institution of Occupational Safety and Health [109].
6. Investigation of how interventions are modified in organisations to develop practical guidelines on how this may be achieved more effectively, by considering published approaches and frameworks [110-112].
7. Development of a more extensive portfolio of case studies from different geographies, sectors, organisational sizes and regulatory regimes to support safety training, with an equal representation of 'failed' interventions.
8. Investigation of what 'success' or 'effectiveness' means for different stakeholders, and over what time scale this is assessed, to develop measures of success appropriate to different intervention types serving different purposes.
9. Enrichment, development and testing of the conceptual model of translation underpinning this work to derive practical guidelines on how to deliver each phase of the model.
10. Consideration of the potential for applying alternative research methods to identify important contextual conditions and where and how these affect safety outcomes.
11. As this study focused on 'context', further work could investigate the 'translation process', seeking to understand the mechanisms by which interventions cause their effects, and how these mechanisms interact with context to generate observed outcomes.

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159. Lohse GR, Leopold SS, Theiler S, et al. Systems-based safety intervention: Reducing falls with injury and total falls on an orthopaedic ward. *Journal of Bone and Joint Surgery - Series A* 2012; 94: 1217-1222. DOI: 10.2106/JBJS.J.01647.

Appendix A: Detailed methodology

Health and Safety Publications

We conducted a comprehensive Rapid Evidence Assessment (REA) review of the literature to identify the contextual factors considered in theory and empirical research, the reference to parameters affecting contextualisation and the effectiveness of achieving desired outcomes when considering contextual variables. To ensure a systematic, transparent and reproducible approach, we followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [113].

Eligibility criteria

Since the adoption of safety interventions can be described and evaluated using a wide variety of approaches and designs, we included publications of all study designs (e.g., experimental, and observational, randomised, and non-randomised) and data types (e.g., qualitative, and quantitative). Also, we did not apply any inclusion/exclusion criteria regarding industry sectors and geographical regions represented. As we sought recent accounts of safety-related publications that reflect current practice and settings while discussing context-related variables, only studies that were published since January 2011 were included.

To ensure the information provided represented formal evaluation and review, we included scholarly work published in peer-reviewed journals. No unpublished studies or grey literature such as reports from the industry, professional bodies, or governmental agencies, were included. Only articles with their full-text available online and written in English were considered. Table A1 presents the inclusion and exclusion criteria applied.

Table A1: Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
Peer-reviewed publications (journal articles and conference papers)	Unpublished material Theses, dissertations, technical/industry/government reports, trade magazine articles, books, and chapters
Full text published in English	Full text published in languages other than English
Published between 1-1-2011 and 30-6-2021	Published before 2011 and as from July 2021
Full text available online	Full text not available online
Occupational Safety and Health	Other safety and health areas (e.g., patient safety, public health)

Identification and selection of studies

We constructed an inclusive search strategy encompassing both research questions on the bibliographic databases of Medline (via PubMed), APA PsycArticles (via EBSCOhost), Web of Science and Scopus (Table A2). The search was constructed by information specialists and review experts of the Queensland University of Technology (QUT). After the initial pilot testing the search strategy, the results were discussed with the researchers from Cranfield University and appointed personnel of LRF. Subsequently, the search strategy was adjusted to improve sensitivity and specificity in accordance with the scope of this study.

Table A2: Search strategy used on all platforms

No.	Search
	TITLE KEYWORDS
S1	Safety
S2	"case study" OR interven* OR program* OR strateg* OR polic* OR plan* OR develop* OR 49nvestin* OR modif* OR transform* OR method* OR pract* OR 49nvest* OR action* OR project* OR scenario* OR schem* OR system* OR approach* OR adapt* OR adopt* OR analys*
S3	S1 and S2
	TOPIC KEY WORDS (TITLE & ABSTRACT)
S4	(change OR cross* OR implement* OR appl* OR *design* OR 49nvest* OR plan* OR translat* OR adapt* OR adopt*)
S5	(context* OR situation* OR setting) AND (factor* OR aspect* OR parameter* OR variable* OR criter*)
S6	(identif* OR diagn* OR find* OR select* OR consid* OR contempl* OR examin* OR explor* OR stud* OR specif* OR defin* OR determ* OR indic* OR analys* OR analyz* OR evaluat* OR 49nvesting*)
S7	S4 and S5 and S6
	FINAL STRING
S8	S3 and S7

The strategy produced a listing of over 5,000 hits (Table A3). We collated all the records from the database searches, imported them into EndNote (X8.0.1) software and removed the duplicates. Then, we screened the titles and abstracts of the remaining articles, identified publications that fulfilled our inclusion criteria and fell within the scope of the review and downloaded their full text. The researchers were overly inclusive at this stage and, if in doubt, a publication was left in the dataset. Any disagreements were resolved by a joint evaluation of each manuscript and further consultation with the QUT Chief Investigator (NK) and Co-Investigator (PB) appointed for the design and execution of the REA. It is noted that NK has postgraduate qualifications and long industry and academic experience in safety management and PB has expertise in systematic literature reviews. At this stage, we excluded publications that did not entirely match the inclusion criteria and REA's scope, and we recorded the exclusion reasons. Studies that fulfilled the inclusion criteria and were evaluated as within scope were included in the full analysis and synthesis.

Table A3: Database search results (1-7-2021)

Index	Hits
Medline (via PubMed)	1,323
APA PsycArticles (via EBSCOhost)	5
Web of Science (incl. MEDLINE, Current Contents Connect, KCI-Korean Journal Database, Russian Science Citation Index and SciELO Citation Index)	2,662
Scopus	1,285
Total	**5,275**
Duplicates removed	**1,826**
Final count	**3,449**

Where a study shared only part of an intervention (e.g., only evaluation results), we checked the list of references to identify whether any other publication included more details about the specific intervention.

All eligible studies were then categorised into two groups. The first group Not-Applied Intervention studies (NAI) contained studies that discussed context in safety interventions but did not explain or describe how the interventions were implemented in the workplace.

The second group of studies Applied Intervention (API) contained applied safety interventions where the context was also considered.

For example, an article could refer to context when introducing a new safety risk management approach. If this work included a survey to sense the comprehension of the new approach but did not test its actual application, it was categorised as a Not-Applied Intervention study (NAI). If the article included an applied case of this approach, it was classified as an Applied Intervention study (API).

In addition to the 3,449 studies returned by the initial search after removing duplicates (Table A2), an additional study was identified through citation lists. Following the initial title and abstract screening, 2,880 articles were excluded. The review of the abstracts of the remaining 570 articles resulted in the exclusion of 410 articles. The excluded studies either reported irrelevant interventions and/or outcomes, did not report any intervention or contextual factors, or were not human or occupational studies. After reviewing the full text of 160 studies, we included a total of 73 studies in the final review, of which 47 were NAI and the remaining 26 studies were API cases. The flow of information across the various stages of the REA is shown in Figure A1.

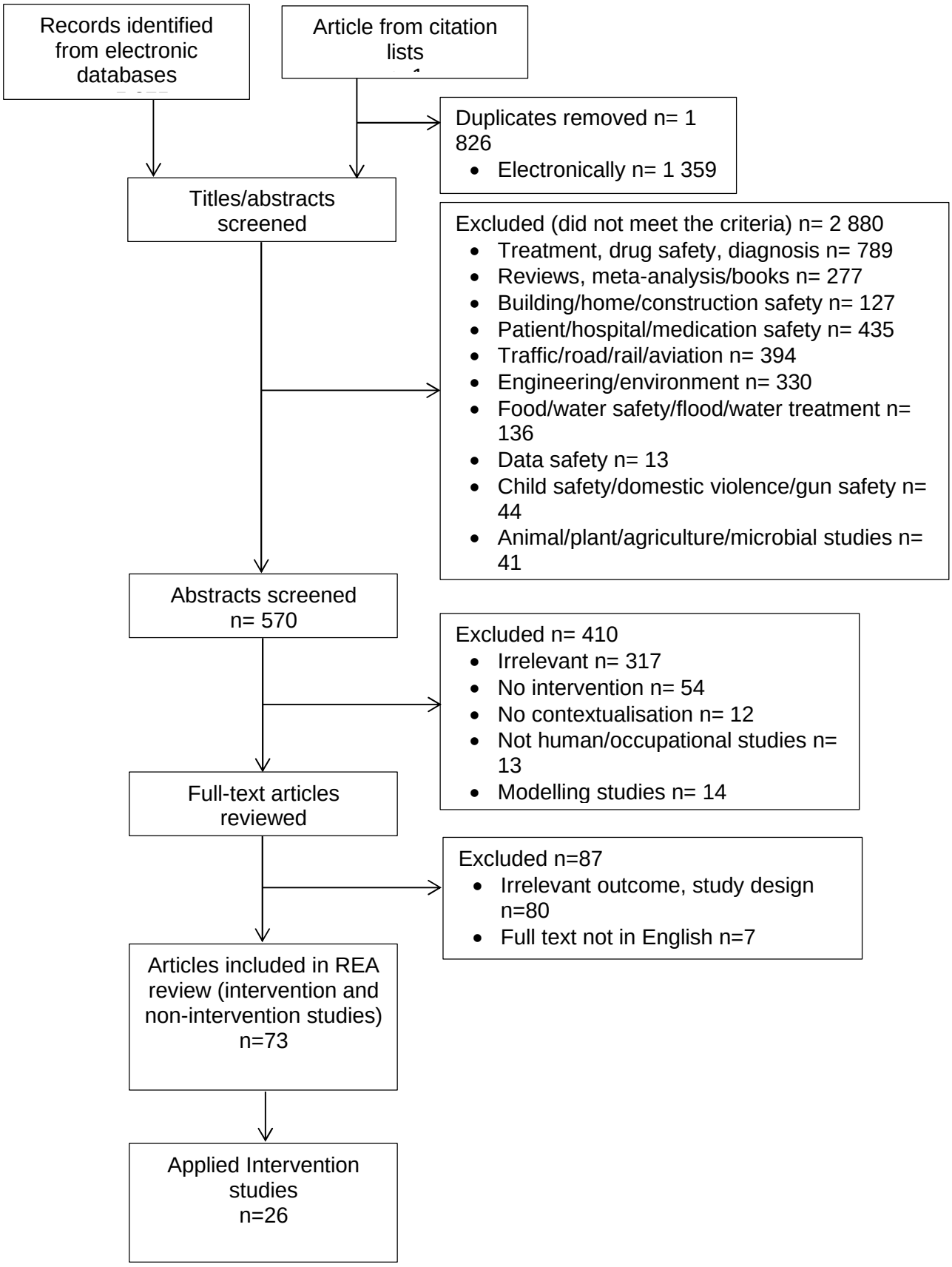

Figure A1: PRISMA flow diagram for study inclusion

Data extraction and analysis

Given the nature of a REA is to explore the current evidence base and not derive causal relationships or epidemiological evidence, we did not assess the risks of biases or quality of reporting. Data were extracted for all studies that met the inclusion criteria. We constructed data extract forms, properly tailored to meet the requirements of this REA. During this phase, we developed definitions and used standard classifications for the data items and ensured they were applied consistently. This was achieved through several iterations as the data extraction process progressed. Information that was unclear or disagreements in interpretation were resolved through discussion amongst the QUT researchers. Appendix B presents the variables, values and definitions used in the data extraction form.

Regarding the whole sample, we extracted information about the region and subregion where each study was conducted, year of publication, study design, types of data collected, sample size, industry sector(s) addressed, and contextual factors considered. The latter included:

Psychosocial Factors

Psychosocial factors which represented variables of the internal organisational context: workload, conflicting demands, role clarity, involvement in making decisions, influence over the way the job is done, organisational change management, job security, communication, support from management and support from colleagues. The list was created based on the works of Brown, Dahill [15], Sujan [114] and Sujan [115] and information from EU-OSHA[o].

Absorptive Capacity Factors

Absorptive capacity factors which reflected the opportunity of the intervention recipients to understand, accept, assimilate, and action the intervention objectives, details, and expectations. Due to the nature of REA, we adopted the general categories of *physical factors* (e.g., manual skills, anthropometrics, physical condition, and health), *cognitive factors* (e.g., knowledge, experience) and *emotional factors* (e.g., feelings, trust, motivation) as proxies to record whether individual absorptive capacity was considered.

Specifically for the intervention studies, we considered the ***intervention type*** (i.e., physical, process or functional), intervention area (e.g., training, communication, policy), source of intervention, intervention mode (i.e., reproduction/copying, modification/adaptation, radicalisation/alteration), national and cultural proximity between sources and recipients, outcomes aimed and achieved, and translatability and transformability challenges met, as outlined in Figure 1 and defined in more detail in Appendix B.

The QUT research associate (SRK), who holds a PhD and has experience in systematic reviews, extracted the data from the included studies and entered the data in the entry forms in Microsoft Excel. NK independently checked the data, compared entries and any differences were discussed until we reached an agreement. Any disagreements were resolved through discussions with PB. Where the publications did not include information about the variables of interest, the respective fields were noted as missing datapoints. The data collected about intervention areas and sources as well as proximity between sources and recipients were coded in mutually exclusive categories to allow a basic descriptive analysis.

The data collected were transferred from Excel to SPSS v.26 and subjected to frequency analysis of the variables recorded for the whole sample and per subset of NAI and API studies. Furthermore, we explored possible variations by conducting Fisher exact tests. Chi-square tests were not possible to perform as the initial screening of the data showed the assumptions of this test were violated in most cases due to highly uneven distributions of the sample.

[o] https://osha.europa.eu/en/themes/psychosocial-risks-and-stress

Moreover, to increase the accuracy of the statistical results, we selected the SPSS option of Monte Carlo simulation with 10,000 samples and 99% confidence interval.

The statistical significance level was set to α=0.05 and the null hypotheses across all tests was of no significant variation. Table A4 presents the pairs of variables included in the statistical tests. Those were decided based on the frequencies per value of each variable. When the distributions of the values within each variable where highly skewed (e.g., most of the frequencies concentrated on a very limited number of variable values), we contemplated those statistics would not produce meaningful results.

Results from the statistical tests are reported only for the cases of statistically significant variations. Where not reported, the tests performed between the variables shown in Table A4 did not return statistically significant findings. In addition to the Tables with findings included in the following subsections, Appendixes C and D present the basic characteristics of the NAI and API articles respectively.

Table A4: Variables included in the statistical tests per data set.

Dependent variables	**Independent variables***				
	Intervention study (NAI or API)	**Major regions**	**Subregions**	**Industry sectors**	**Intervention mode**
Intervention study (NAI or API)	-	AS	AS	-	-
Industry sectors	AS	AS, NAI, API	AS, NAI, API	-	-
Psychosocial factors	AS	AS, NAI, API	AS, NAI, API	API	API
Absorptive capacity	AS	AS, NAI, API	AS, NAI, API	-	-
Practice at the recipient before intervention	-	API	API	API	-
Cultural proximity	-	API	API	API	API
Intervention mode	-	API	API	API	-
Intervention type	-	API	API	API	API
Targeted outcomes	-	API	API	API	API
* AS: All studies; NAI: Not-Applied Intervention studies; API: Applied Intervention studies					

Demographic information

Table A5: Regions and subregions

Variables	**n (%)**		
	AS (N=73)	**NAI (N=47)**	**API (N=26)**
Regions			
Europe	26 (35.6)	19 (40.4)	7 (26.9)
America	22 (30.1)	11 (23.4)	11 (42.3)
Asia	14 (19.2)	10 (21.3)	4 (15.4)
Oceania	7 (9.6)	5 (10.6)	2 (7.7)

Variables	n (%)		
	AS (N=73)	NAI (N=47)	API (N=26)
Africa	4 (5.5)	2 (4.3)	2 (7.7)
Sub-regions			
Northern America	22 (30.1)	11 (23.4)	11 (42.3)
Western Europe	12 (16.4)	8 (17.0)	4 (15.4)
Northern Europe	9 (12.3)	8 (17.0)	1 (3.8)
South-eastern Asia	8 (11.0)	6 (12.8)	2 (7.7)
Australia and New Zealand	7 (9.6)	5 (10.6)	2 (7.7)
Southern Europe	4 (5.5)	3 (6.4)	1 (3.8)
Sub-Saharan Africa	4 (5.5)	2 (4.3)	2 (7.7)
Western Asia	3 (4.1)	1 (2.1)	2 (7.7)
Southern Asia	2 (2.7)	2 (4.3)	-
Eastern Asia	1 (1.4)	1 (2.1)	-
Northern Africa	-	-	-
Latin America and the Caribbean	-	-	-
Central Asia	-	-	-
Eastern Europe	-	-	-
Melanesia	-	-	-
Micronesia	-	-	-
Polynesia	-	-	-
Not specified	1 (1.4)	-	1 (3.8)

Table A6: Industry sectors

Industry sectors	n (%)		
	AS (N=73)	NAI (N=47)	API (N=26)
Health services	20 (26.7)	10 (20.4)	10 (38.5)
Construction	15 (20.0)	12 (24.5)	3 (11.5)
Transport (civil aviation; railways; road transport)	7 (9.3)	5 (10.2)	2 (7.7)
Other	7 (9.3)	7 (14.3)	-
Education	4 (5.3)	1 (2.0)	3 (11.5)
Various	4 (5.3)	3 (6.1)	1 (3.8)
Food; drink; tobacco	3 (4.0)	2 (4.1)	1 (3.8)
Oil and gas production; oil refining	3 (4.0)	2 (4.1)	1 (3.8)
Public service	2 (2.7)	-	2 (7.7)
Shipping; ports; fisheries; inland waterways	2 (2.7)	2 (4.1)	-
Transport equipment manufacturing	2 (2.7)	-	2 (7.7)
Utilities (water; gas; electricity)	2 (2.7)	2 (4.1)	-
Agriculture; plantations; other rural sectors	1 (1.3)	-	1 (3.8)
Basic metal production	1 (1.3)	1 (2.0)	-
Chemical industries	1 (1.3)	1 (2.0)	-
Textiles; clothing; leather; footwear	1 (1.3)	1 (2.0)	-
Commerce	-	-	-
Financial services; professional services	-	-	-
Forestry; wood; pulp and paper	-	-	-
Hotels; tourism; catering	-	-	-
Mining (coal; other mining)	-	-	-
Mechanical and electrical engineering	-	-	-

Industry sectors	n (%)		
	AS (N=73)	NAI (N=47)	API (N=26)
Media; culture; graphical	-	-	-
Postal and telecommunications services	-	-	-

Health and Safety Training

Health and Safety Training Courses

Nine websites from seven nationally and internationally recognised training providers from four countries were selected for a review of their respective courses (Table A7). Eight of these providers offered courses in English. Only the content of courses provided by TÜV SÜD are delivered in German; this provider was chosen to decrease selection bias and to utilise the language skills of one research team member who is a native German speaker.

Table A7: Websites of national and international providers of H&S training **screened for courses that consider context.**

Country	Provider	Websites
United Kingdom	British Safety Council	https://www.britsafe.org/training-and-learning/find-the-right-course-for-you/all-health-safety-and-environmental-training-courses/
United Kingdom	Institution of Occupational Safety and Health (IOSH)	https://iosh.com/training-and-skills/iosh-training-courses/
United Kingdom	NEBOSH	https://www.nebosh.org.uk/qualifications/
United States	National Safety Council (NSC)	https://nsc.puresafety.com/Ondemand/Home https://www.nsc.org/safety-training/workplace/develop-exceptional-safety-practitioners
United States	Occupational Safety and Health Administration (OSHA)	https://www.osha.gov/otiec/degreeprograms/bydegreelevel#by_degree
Australia	National Careers Institute	https://www.myskills.gov.au/Courses/Search?keywords=safety&distance=25
Germany	TÜV SÜD	https://www.tuvsud.com/en-us/services/training/e-learning-courses https://www.tuvsud.com/de-de/store/akademie/online-trainings

The nine websites were accessed and searched between 3 August and 1 October 2021. The resulting list of courses from each site was then screened to exclude courses that were not directly relevant to H&S (e.g., forensics, environmental management, storm water specialist) or that were very specific or technical (e.g., display screen equipment training, stress awareness, personal protective equipment overview, modern day slavery).

The details available for the remaining courses were next screened explicitly for processes of contextualisation/decontextualisation using suitable keywords (Table A8). These keywords relate to the processes and context of translation or transformation [3] and were combined in a single string. The application of the string to each of these remaining individual course webpages highlighted relevant areas. Reading the highlighted sections enabled us to infer whether the courses offered training in the proposed processes of

decontextualising/contextualising safety interventions, or whether they considered how the safety interventions could be applied in the workplace, implying that context may influence application.

Table A8: List of key words used to screen websites of training providers.

English	German
Adapt (for: Adaptation / -ing)	Anpass (Anpassen, Anpassung)
Translat (for: Translation / -ing)	Anwend (Anwenden, Anwendung)
Transform (for: Transformation / -ing)	Umsetzung (Umsetzen, Umsetzung)
Modif (for: Modification / -ying)	Ànder (Abändern, Abänderung, Umändern,
Adjust (for: Adjustment / -ing)	Umändernung, Ändern, Änderung,
Appl (for: Application /-ying)	Verändern, Veränderung)
Amend (for: Amendment / -ing)	Modifizier (Modifiziern, Modifizierung)
Develop (for: Development /-ing)	Variier (Variiern, Variierung)
Alter (for: Alter -ing)	Angleich (Angleichen, Angleichung)
Copy (for: Copy and Copying)	Abstimm (Abstimmen, Abstimmung)
Replicat (for: Replicate and Replicating)	Verwend (Verwenden, Verwendung)
Duplicat (for: Duplicate and Dupliating)	Űbernehmen
Transfer (for: Transfer and Transfering)	Übernahme
Change	Entwick (Entwickeln, Entwicklung)
Context	Arbeit (Erarbeiten, Ausarbeiten)
Situation	Nachmachen
Environment	Nachbild (Nachbildung, Nachbilden)
Setting	Reproduzieren
	Űbertrag (Űbertragen, Űbertragung)
	Abwand (Abwandeln, Abwandlung)
	Kontext
	Umfeld
	Sachverhalt
	Umstand
	Arbeitsstelle
	Umgebung
	Arbeitsplatz
	Spezifisch
	Fachgebiet
	Praxis

Health and Safety Trainer's Interviews

Twelve semi-structured interviews were conducted with key informants selected on a convenience basis from the network of contacts available through the project steering group. The sample included university lecturers, independent consultants and senior figures in internationally recognised training providers and specialist professional bodies working in the UK, USA, Australia, the Netherlands, and Malaysia. Three of the key informants worked for providers whose websites we had searched (see Section above). There were five female and seven male participants with training expertise in both process and occupational safety. Collectively, the interviewees had experience mostly in the private sector across a wide range of industries including construction, oil and gas, manufacturing, pharmaceuticals, and entertainment. They had been delivering training from certificates through to master's degrees and had extensive experience in delivering CPD courses for organisations to both front-line employees and senior management.

An interview protocol (Appendix E) was shared with interviewees in advance to allow them preparation time and to secure considered responses. Interviews were conducted online via Zoom, recorded and transcribed. Eleven interviews lasted between 41 and 59 minutes, and one extended to 1.5h. Responses to each question were collated. The factors that influence the design and successful implementation of safety interventions were initially free-coded. These free codes were then aggregated together into themes. The latter were then classified into one or more of the three elements (technical, cultural, political) that influence effective adaptation (or 'fit') to context and operate at different levels in the organisational system [48]. The findings below synthesise the responses to the different questions across the interviewees (identifiable by their initials).

OSH Intervention Cases

Seventeen semi-structured interviews were conducted with key informants from seven private sectors, including oil and gas, construction, maritime and retail, predominantly working in English speaking countries (UK, US, and Australia). An interview protocol (Appendix F) was developed through consultation between members of the research team and Lloyds Register Foundation, and it was shared in advance with the interviewees. This allowed them to identify examples prior to the conversation. Interviews were conducted online via MS-Teams or Zoom, recorded and transcribed. The interviews lasted between 27 and 63 minutes, averaging 53 minutes.

The transcripts were analysed, and the data from each transcript were re-written in a structured format aligning with the elements of the conceptual model (Figure 1). These summary documents were then used as the basis for structuring the reporting of each of 17 key informant interviews. From each interview we identified the following elements to create a case:

- Background or trigger: the motivation for the intervention.
- Intervention: the intervention applied in a particular case.
- Target population: the characteristics of the population targeted by the intervention.
- Organisational setting for intervention: the contextual background to the organisation in which the intervention was applied.
- Key factors for outcome: the determinants of the outcome of the intervention.
- Outcome: the stated level of success of the intervention.

Appendix B: Variables used in the data extraction form

CATEGORY	VARIABLE	EXPLANATION	CODES & VALUES
Study information	Major region	Major geographical region from where data was collected as per the classification by the United Nations (https://unstats.un.org/unsd/methodology/m49/)	AF - Africa AM - America AS - Asia EU - Europe OC - Oceania
	Subregion	Sub-region from where data was collected as per the classification by the United Nations (https://unstats.un.org/unsd/methodology/m49/)	SR1 - Northern Africa SR2 - Sub-Saharan Africa SR3 - Latin America and the Caribbean SR4 - Northern America SR5 - Central Asia SR6 - Eastern Asia SR7 - South-eastern Asia SR8 - Southern Asia SR9 - Western Asia SR10 - Eastern Europe SR11 - Northern Europe SR12 - Southern Europe SR13 - Western Europe SR14 - Australia and New Zealand SR15 - Melanesia SR16 - Micronesia SR17 - Polynesia
	Industry sector	The sector where the study was performed as per the classification by the International Labour Organisation (https://www.ilo.org/global/industries-and-sectors/lang--en/index.htm)	IS1 - Agriculture; plantations; other rural sectors IS2 - Basic metal production IS3 - Chemical industries IS4 - Commerce IS5 - Construction IS6 - Education IS7 - Financial services; professional services IS8 - Food; drink; tobacco IS9 - Forestry; wood; pulp and paper IS10 - Health services

CATEGORY	VARIABLE	EXPLANATION	CODES & VALUES
			IS11 - Hotels; tourism; catering IS12 - Mining (coal; other mining) IS13 - Mechanical and electrical engineering IS14 - Media; culture; graphical IS15 - Oil and gas production; oil refining IS16 - Postal and telecommunications services IS17 - Public service IS18 - Shipping; ports; fisheries; inland waterways IS19 - Textiles; clothing; leather; footwear IS20 - Transport (civil aviation; railways; road transport) IS21 - Transport equipment manufacturing IS22 - Utilities (water; gas; electricity) *Added by the research team:* *IS23 - Other* *IS24 - Various*
	Study design	The design(s) employed in the study reviewed [116].	RCT - Randomised controlled trial COH - Cohort (prospective, retrospective) CAC - Case-control (prospective, retrospective) CROSS - Cross-sectional ECO - Ecological CASE - Case study (non-comparative) MIX - Mixed PPI - Pre-post intervention (uncontrolled, repeated measures) QUAL – Opinion/review (no systematic data collection, review of studies or documents) CON - Controlled study (non-randomised trial)
	Data type	The type(s) of the data collected in the study reviewed	QUAL - Qualitative NOM - Nominal ORD - Ordinal DIS - Discrete CON - Continuous MIX - Mixed

CATEGORY	VARIABLE	EXPLANATION	CODES & VALUES
			OTH - Other NA - Not applicable
Intervention demographics	Physical intervention	The intervention targeted materials/natural environment of the workplaces with the intent to improve safety. These included environmental conditions, infrastructure, equipment, tools, etc.	YES/NO
	Process intervention	The intervention targeted how the work is performed (flow, nature, duration, order, etc. of activities).	YES/NO
	Functional intervention	The intervention was about the purpose and role of persons, goals, and outcomes of activities, etc. This category included everything not falling under the physical and process categories above.	YES/NO
	Intervention area	Details of the intervention components as described by the authors	Text
	Intervention source	The source(s) of practice or knowledge	Text; Noted as 'N/A' when study is first of its kind
	Intervention recipient	The recipient(s) of the intervention	Text
	Intervention mode	• Reproduction: the intervention is a copy of the original practice/knowledge • Modification: the intervention is modified with addition(s) or omission of the original practice/knowledge • Radicalisation: the intervention is significantly altered	Reproduction, Modification, Radicalisation
Similarity factors considered	Compatibility between new and old practices at the recipient	If the practice has been used in the recipient organisation before	EXISTING/NEW/NOT MENTIONED

CATEGORY	VARIABLE	EXPLANATION	CODES & VALUES
	Source-recipient connections	The intervention is (a) enforced by regulation/law or (b) collaborative between source and recipient or (c) designed when needed (ad hoc)	ENFORCED/COLLABORATIVE/AD HOC/NOT MENTIONED
	Source-recipient cultural proximity	**Same:** exactly same sector and operations **Similar:** when the operations/sector are similar but not necessarily the exact same (e.g., both the food services industry and dairy milk industry must ensure food quality) **Different:** no similarity between sectors/operations (e.g., the manufacturing industry and health services sector)	Text description, noting NOT MENTIONED (whether they considered the proximity), N/A (No source at all)
	Source-recipient national proximity	Same or different geographical regions, where mentioned.	Text description, noting NOT MENTIONED/N/A (when the intervention is new and no source info available)
	Other	Other similarity factors described in the study but not included in the categories above	Text
Recipient contextual factors considered	Psychosocial factors	Reference to psychosocial factors from the list on the right. The list was created based on the works of Brown, Dahill [15], Sujan [114] and Sujan [115] and https://osha.europa.eu/en/themes/psychosocial-risks-and-stress	PF1 - Workload PF2 - Conflicting demands PF3 - Role clarity PF4 - Involvement in making decisions PF5 - Influence over the way the job is done PF6 - Organisational change management PF7 - Job security PF8 - Communication PF9 - Support from management PF10 - Support from colleagues
	Absorptive capacity	Factors shaping the capacity of change of the recipients during and after the intervention	• Physical factors (e.g., age, sex, anthropometrics) • Cognitive factors (e.g., knowledge, skills, motivation) • Emotional factors (e.g., trust, interest, anger, satisfaction)
	Other	Further information about the recipient context that the study identified as being relevant	Text description

CATEGORY	VARIABLE	EXPLANATION	CODES & VALUES
Outcomes aimed/achieved	Adoption	The degree to which the intervention was adopted by the target population	FULL (80-100%)/PARTIAL (40-79%)/LOW (<40%)/NOT MENTIONED
	OHS performance	Any measurement of OHS processes or outcomes through leading or lagging indicators	YES/NO/PARTIALLY/NOT AIMED
	Safe behaviours	Any measurement of the extent to which behaviours changed (e.g., compliance, teamwork, change of work practices)	YES/NO/PARTIALLY/NOT AIMED
	Worker wellbeing	Any assessment of changes in physical, cognitive, and emotional capabilities and wellness	YES/NO/PARTIALLY/NOT AIMED
	Other	A description of other outcomes that were aim or achieved not included in the above categories	Text description
Translatability challenges met	Complexity factors/degree	• The more a desired practice is based on a technology component with a clear-cut application, rather than on context-specific human skills, the less complex it is. • Practices that depend on a strong human component and a low/unclear technology component are more complex. • Causal ambiguity - the more ambiguous and complex the relationships between observed results and underlying practices, the harder to translate.	YES (text)/NO/NOT MENTIONED
	Explicitness factors/degree	Explicit knowledge is verbalised, codified, well-articulated	YES (text)/NO/NOT MENTIONED
	Embeddedness factors/degree	The extent to which the knowledge and capabilities of a practice are anchored in its intra- or inter-organisational context	YES (text)/NO/NOT MENTIONED
	Other	Any other challenges mentioned but not falling in the categories above	Text description

CATEGORY	VARIABLE	EXPLANATION	CODES & VALUES
Transformability challenges met	Missing essentials (source)	Limitations of the source	YES (text)/NO/NOT MENTIONED
	Missing essentials (recipient)	Limitations of the recipient	YES (text)/NO/NOT MENTIONED
	Regulated transfer process	Whether the intervention was subject to a prescribed/enforced process	YES (text)/NO
	More human- than technology-targeted	Whether the intervention appears more aiming at influencing people than implementing new technology	MORE HUMAN/MORE TECHNOLOGY
	Other	A description of other challenges met in transforming the practice/knowledge but not mentioned in the categories above	Text description

Appendix C: Not-applied intervention (NAI) studies

Citation	Major region	Sub-region	Industry sector(s)	Study type(s)	Data type(s)	Sample size
Bracco, Masini [117]	EU	SR12	IS22	CASE		
Jang, Lee [118]	AS	SR7	IS10	CROSS	ORD	311
Morgan, Curcuruto [23]	EU	SR13	IS20	CROSS	ORD	620
Ryan, Golightly [119]	EU	SR13	IS20	QUAL		
[120]	EU	SR13	IS5	QUAL	QUAL	43
Murad, Jamian [121]	AS	SR7	IS15	CROSS	ORD	41
Akhter, Rutherford [122]	AS	SR8	IS19	QUAL	QUAL	14
[123]	AS	SR9	IS10	CROSS	ORD, DIS	1317
Ceccacci, Matteucci [124]	EU	SR12	IS23	CASE	QUAL	8
Deepak and Mahesh [125]	AS	SR8	IS5	CROSS	CON	210
Grill, Nielsen [126]	EU	SR11	IS5	MIX	CON	468
Huang, Tsai [127]	AS	SR7	IS10	CROSS	CON	394
Huggins and Scheepers [128]	AF	SR2	IS3, IS23	CROSS	CON	396
Lee and Lunn [129]	AS	SR7	IS6	CROSS	CON	350
Lingard, Zhang [130]	OC	SR14	IS5	CROSS	CON	73
[131]	EU	SR11	IS10	QUAL	QUAL	9
Winge, Albrechtsen [26]	EU	SR11	IS5	QUAL	OTH	12
Dahl and Kongsvik [132]	EU	SR11	IS15	CROSS	ORD	5712
Micheli, Cagno [22]	EU	SR12	IS24	CASE	NOM	58
Stiles, Ryan [133]	EU	SR13	IS5	QUAL	QUAL	21
Zaheer, Ginsburg [134]	AM	SR4	IS10	CROSS	CON	185
Gao, Chan [24]	AS	SR7	IS5	CROSS	ORD	587
Joss, Dupré-Husser [18]	OC	SR14	IS24	CASE	QUAL	6
Shen, Ju [135]	AS	SR6	IS5	CROSS	ORD	292
Chapman and Thompson [136]	OC	SR14	IS23	QUAL	-	-
Liu, Han [137]	AM	SR4	IS5	CASE	-	-
Nordström, Goerlandt [138]	EU	SR11	IS18	CROSS	ORD	25
Twaalfhoven and Kortleven [139]	EU	SR13	IS2	CASE	QUAL, ORD	23 (QUAL), 64 (ORD)
Edwards, Davey [25]	OC	SR14	IS20	CASE	QUAL	20

Citation	Major region	Sub-region	Industry sector(s)	Study type(s)	Data type(s)	Sample size
Flach, Carroll [140]	AM	SR4	IS8, IS22	QUAL	-	-
Kvorning, Hasle [141]	EU	SR11	IS5, IS20	CASE, CROSS	QUAL	24 (QUAL), 295 (CROSS)
Pekovic [19]	EU	SR13	-	CROSS	-	12959
Goode, Salmon [142]	OC	SR14	IS20	QUAL	QUAL	27 workers, 35 managers
Kolar, Atchison [143]	AM	SR4	IS23	CROSS	CON, DIS	118 women, 116 clients
Liebman, Juarez-Carrillo [144]	AM	SR4	IS8	QUAL	QUAL	37
McGuinness and Utne [145]	EU	SR11	IS18	CASE	-	-
Bahari and Clarke [146]	AS	SR7	IS23	CROSS	ORD	325
Basil, Basil [147]	AM	SR4	IS5	CROSS	ORD	212
Chambers, Mustard [148]	AM	SR4	IS10	CASE	-	-
Kushniruk, Borycki [149]	AM	SR4	IS10	CASE	-	-
[150]	EU	SR13	IS10	COH	ORD	284
Chandrasekaran and Mishra [28]	AM	SR4	IS23	CROSS	ORD	28
Furber, Duncan [27]	AF	SR2	IS5	CASE	QUAL	12
Lilleston, Reuben [151]	AM	SR4	IS23	QUAL	QUAL	40
Reiman and Pietikäinen [152]	EU	SR11	IS24	QUAL	-	-
Charles, McKee [153]	EU	SR13	IS10	CASE	QUAL	144
Taylor, Dy [154]	AM	SR4	IS10	QUAL	QUAL	22

Appendix D: Applied intervention (API) studies

Citation	Major region	Sub-region	Industry sector	Study type	Data type	Sample size	Intervention details	Intervention source	Intervention recipient
Ledo, Hettinga [41]	AF	SR2	IS1	PPI	ORD	107	Food safety and hygiene training	Food service settings	Dairy farmers
Marquardt, Hoebel [42]	EU	SR13	IS21	PPI	ORD	81	Crew Resource Management (CRM) Training	High risk industries such as aviation, nuclear power, offshore oil and gas and medicine	Assembly-line workers of an automotive manufacturer
Dusenberry and Robinson [35]	AM	SR4	IS6	CON	ORD	215	Targeted training to increase psychological safety of teams	Training in several industries	Students (n=144) from 3 universities
Hasanzadeh, Polys [155]	AM	SR4	IS5	CASE	MIX	33	Mixed-reality environment	Immersive environment (IE) safety-enhancement systems used in several industries (military and aviation)	Students with one year experience in the construction industry
Karanikas, Obadimu [37]	EU		IS20	CASE	N/A	1 organisation	Safety award programme (SAP)	Aviation industry	All staff of the organisation
Buller, Walkosz [21]	AM	SR4	IS7	RCT	OTH	1784	Sun safety policy and education	Local government organisations in a western US state	Local government workers in public safety, public works and parks and recreation

Citation	Major region	Sub-region	Industry sector	Study type	Data type	Sample size	Intervention details	Intervention source	Intervention recipient
González-Formoso, Clavería [36]	EU	SR12	IS10	RCT	ORD DIS	138	Training in patient safety	Hospital	27 tutors, 26 residents in primary health care
Bronkhorst, Tummers [32]	EU	SR13	IS10	PPI	ORD	1323	Senior management safety rounds, training for supervisors, online discussion platform	Safety climate concept	693 employees and 37 supervisors working in 46 teams
Guo, Goh [30]	AS	SR7	IS5	CASE	QUAL	1 project	Goal setting, feedback, training, reward, punishment	Behaviour-based safety (BBS) program in various industries	Contractor of a Mass Rapid Transit (MRT) tunnelling project
Haynes, Kramer [29]	AM	SR4	IS24	CASE	QUAL	12 workplaces	Training and providing sun safety resources to the workplace	Literature	OHS Leads from 12 workplaces including nine municipalities and three electrical utility companies
Rodrigues, Vale [34]	EU	SR13	IS6	PPI	ORD	301	Occupational Safety Programme (OSP) in secondary and vocational schools	Previous guidelines; Training programs	142 students of secondary schools and 157 of vocational schools
Ward, Vaughn [156]	AM	SR4	IS6	RCT	CON NOM ORD	553	Health campaign	Literature	553 childcare staff from 56 centres in central North Carolina

Citation	Major region	Sub-region	Industry sector	Study type	Data type	Sample size	Intervention details	Intervention source	Intervention recipient
Balfour, Tanner [33]	AM	SR4	IS10	PPI	CON	1 organisation	Changing the triage process and adding additional staff	Auto-manufacturing industry	A freestanding behavioural health facility or Crisis Response Centre
Bull, Mason [38]	AF	SR2	IS10	PPI QUAL	ORD	87	Training for nurses to correctly calculate medication doses using calculators	Hospital in the UK	87 Portuguese-speaking hospital nurses in Mozambique
Haghighi, Taghdisi [157]	AS	SR9	IS15	PPI CON	ORD	90	Safety Culture Promotion Intervention Program (SCPIP)	Literature	45 operation personnel
Juárez-Carrillo, Liebman [43]	AM	SR4	IS8	PPI	DIS	836	Safety and health curriculum	Literature	Spanish-speaking workers from 67 farms in Wisconsin
Zohar, Werber [40]	AS	SR9	IS10	RCT	ORD	445	Supervisor feedback	Manufacturing companies	10 Head nurses, 232 nurses/13 departments
Newnam and Oxley [45]	OC	SR14	IS17	CASE	ORD	Large government agency	Four half day group-based development sessions conducted once a month over 4 months	Literature	Supervisors (n=36) of work-related drivers

Citation	Major region	Sub-region	Industry sector	Study type	Data type	Sample size	Intervention details	Intervention source	Intervention recipient
Ochsmann, Noll [20]	EU	SR13	IS21	COH	CON	20	Evaluate the effects of three different pairs of safety shoes	Literature	20 male workers from the automotive industry; no history of foot pain, no injury, no pain, or disorders of the lower extremities and back in last 6 months
[31]	AM	SR4	IS10	RCT	ORD	149	Education, goal setting, self-monitoring, social support	Literature	Home care workers
McDonald and Durso [46]	AM	SR4	IS20	PPI	CON	28	Behavioural intervention to shift conductors' attention back to post-completion step at the time the error is likely to occur; training	Literature	28 undergrad students from Georgia Tech
Lee, Lee [158]	AS	SR7	IS5	CASE	OTH	2	Real-time location-based construction labour safety management system that tracks and visualises workers' locations in real time and sends early warnings to endangered workers	Literature	2 case studies of construction workers

Citation	Major region	Sub-region	Industry sector	Study type	Data type	Sample size	Intervention details	Intervention source	Intervention recipient
Randmaa, Mårtensson [47]	EU	SR11	IS10	CON	ORD	169	Implementation of a communication tool Situation-Background-Assessment-Recommendation (SBAR); training course	High-risk organisations, including healthcare	Staff at anaesthetic clinics
Talbot, Wang [39]	AM	SR4	IS10	PPI	CON	1 organisation	A formalised system for an improved waiver process	A paper-based process in the same organisation	A large academic health centre
Lohse, Leopold [159]	AM	SR4	IS10	PPI	CON DIS	1 ward of a hospital	Several interventions were implemented that revolved around minimising unassisted movement of patients	Previous adverse event database was evaluated, and two common high-risk factors were identified	All patients from an orthopaedic ward of a large academic hospital
Newnam, Lewis [44]	OC	SR14	IS10	PPI	ORD	105 nurses and 22 supervisors	Safety information exchange between driver and supervisor	Literature	Community-oriented nurses who drive at least once a week for occupational purposes and their supervisors

Appendix E: Semi-Structured Interview Protocol for Training Providers

Questions

1. Please could you briefly describe your experience of delivering training in Occupational Safety and Health.

2. In your training
    - Do you consider how context might influence the performance of these interventions?
    - Do you consider whether the interventions might need to be changed in some way to be effective?

3. ***IF YES (to Q2)***: Where it is considered, why does this occur?
    - Is this consideration of 'contextualisation' included in the formal design (curriculum) of the training courses you offer? OR does it 'happen' (through discussion/conversation) informally during the training event?
    - What contextual factors do you consider in the design of the training course? Or during the training event? Why these in particular?

4. ***IF NO (to Q2)***: Where it is not considered, please explain why you think this is the case?
    - Would it make a difference to the people you train if it were considered? Why?

5. As far as you are aware, to what extent does H&S training take account of contextual influences?
    - Why do you think this is the case?
    - Can you provide some examples of where it does and where it does not?

6. Based on your experience, do you think it would make a difference to organisational safety outcomes (such as OSH performance, safety behaviours) if contextualisation was considered in training on particular safety interventions? Why?

7. Based on your experience, what are the contextual factors someone should consider when designing and implementing a safety intervention? Why these?

8. Based on your experience, what are the most important aspects of organisational context that influence the effectiveness of safety interventions? Why? How?

Appendix F: Semi-Structured Interview Protocol for Case Studies

Pre-work for Interview

Ask respondents to identify a safety intervention, which they have taken from one context and applied in at least one other work contexts/settings, possibly with different results.

Where a 'Safety Intervention' is defined, for example as a physical artefact, a process or procedure, or a set of skills or specialist knowledge that restores, maintains, or strengthens safety (i.e., prevents or mitigates safety risks; influences culture and behaviours; improves health and wellbeing; comply with legal requirements).

Interview Questions

1) Please describe the safety intervention.

2) Please describe the organisational context from which the intervention was sourced

3) Please describe the organisational context in which the intervention was applied

4) To what degree was the safety intervention changed to fit the new context?

5) Was the difference in the effectiveness of the intervention between the two settings a surprise? Why (not)? How do you explain any difference in the effectiveness of the safety intervention between the two contexts?

6) As a result of this experience have you/the organisation you work for, changed the processes for implementing safety interventions in new settings? How? (Give some examples)

7) Have you received any training or guidance on how to contextualise safety interventions? Where? When? From whom?

8) Based on these experiences do you think it would be helpful if there were some guidelines on how to implement safety interventions effectively in new contexts? Why(not)? What should they include?

9) From your perspective, why are/were some interventions more effective in some settings than in others, in general?

Appendix G: Case details

Table G1: Cases where interventions were reactive driven by incidents and claims

	Case 1	Case 2	Case 3	Case 4	Case 5
Intervention type	**Functional**	**Functional**	**Functional**	**Functional / Process**	**Physical**
Sector	**Food Manufacturing**	**Retail**	**Telecoms**	**Energy**	**Construction**
Background / Trigger	High value of compensation claims (£m) and incidents	Poor manual handling top cause of accidents	Series of accidents and near-fatalities	Vicious cycle of repeating events and responses	Collision of cranes with buildings and each other
Intervention	Manual handling training: bespoke videos to demonstrate practice, ongoing coaching support	Manual handling training: bespoke videos to demonstrate practice, ongoing coaching support	Development of test site to assess competence of new recruits	Revised approach to delivering 'standard interventions' to ensure understanding	Installation of camera/sensors on cranes to allow safe segregation of work
Target population / Organisation population	200 employees in production lines on single site.	83k employees across multiple stores in UK.	New recruits in SME (ca. 150 staff)	Large enterprise	Large multi-national company. *c.* 13k employees globally High-profile construction projects.
Organisational setting for intervention	Engagement of H&S staff with workforce.	Silo'd H&S team. Directors not involved in safety before the intervention. Bureaucratic processes	Telecoms is a competitive market for labour. Allegedly competent staff. Small start-up with immature safety management systems	Creation of new business within large global company.	Competing priorities and time pressure. Small financial margins. Inertia – always done it this way; no need for technology. Confident in competence
Key Factors for outcome	Staff engagement and ownership. Relevance to task. Small scale.	Place of H&S management in organisation (reporting lines). Large size and scale.	Limited budget so needed to develop in-house capability. Small organisation. Supportive CEO.	New entity. Opportunity to avoid "*repeating the same old same old*".	Perceived work organisation discomfort. Perceived slowing of pace of work.

		Non-enforced manual handling procedures		Create senior management commitments with consequences. *"Create meaningful training that was engaging and understandable"* Make interventions 'inclusive'; integrate into existing operations.	
Outcome	No claims.	Some success in pilot studies but too soon to tell	No incidents in 9 months	Repeats declining, Buy-in. Too soon to tell.	Disable sensors and cameras. Revert to old ways of working. **N.B.** Real-time data allows challenge to perception and re-introduction of sensors.

Table G2: Cases where proactive strategic interventions directly or indirectly influenced safety interventions

	Case 6	**Case 7**	**Case 8**	**Case 9**	**Case 10**
Intervention type	**Functional / Process / Physical**	**Functional / Process / Physical**	**Functional / Process / Physical**	**Functional / Process / Physical**	**Functional / Process / Physical**
Sector	**Construction**	**Utilities**	**Private provider of public services**	**Oil and Gas**	**Utilities – Power & Water**
Background / Trigger	Personal dissatisfaction with current safety performance	Personal dissatisfaction with safety management	Personal dissatisfaction with safety management	Strategy to achieve transparency of data reporting through digitalisation	Strategy to achieve transparency of data reporting through digitalisation
Intervention	Annual 'State of the Nation' address with a new challenge to safe work practices	Safety culture transformation	Safety culture transformation	Deployment of software tool for capturing and reporting incidents.	Deployment of software tool for capturing and reporting incidents.
Target population	c. 350 employees across division	*c* 2k employees	*c* 14k employees in the region	*c.* 11k employees globally	3k employees across locations in MENA region
Organisational setting	Decentralised division located away from HQ. 12 units within division.	Small, centralised organisation.	Large, decentralised global organisation with regional offices	Mature organisation operating across >30 locations internationally.	Young utility supplier. SMT demand digital reporting.
Key Factors	Arms-length from HQ (no opposition). Supportive (albeit uninformed) general manager Small team sizes. Create ownership locally with unit champions. Adapt to their language.	CEO supportive. Executive board supportive. Budget/resource available. New H&S team.	Small safety team (4 people). Safety staff in business units reporting lines to business unit heads. No board involvement. No budget.	Implemented on top of existing SMS. Increased workload on site. Budget but no enthusiasm. Generic support from vendor.	Technology used to drive processes; fully integrated into design. Weekly meetings with vendor to solve problems. Online resources/guides created locally to support use.
Outcome	Variable success of embedding new work	Successful transformation –	Unsuccessful. Change to safety	Mixed acceptance	Widespread adoption

	practices across interventions and sites.	engagement statistics improving.	governance programme.		

Table G3: Cases where interventions in the organisation were driven by sector level expectations.

	Case 11	**Case 12**	**Case 13**	**Case 14**
Intervention type	**Functional**	**Functional**	**Process**	**Process**
Sector	**Oil & Gas**	**Oil & Gas**	**Oil & Gas**	**Oil & Gas**
Background / Trigger	Longford explosion report raised issue of competence of workforce	Longford explosion report raised issue of competence of workforce	Industry norm	Industry norm
Intervention	Development of competence assessment framework	Development of competence assessment framework	Periodic HAZOP review	HAZOP review introduced
Target population	*c.* 86k employees worldwide	*c.* 86k employees worldwide	*c.* 71k employees worldwide	*c.* 70k employees worldwide
Organisational setting	Deployed in *c.* 1000 airports globally.	Deployed in *c.*40k retail filling stations.	Mature organisation operating globally. Organisational stability. 'Command and control' culture. Robust board level scrutiny of proposals.	Mature organisation operating globally, with effectively independent business units. Continuous organisational change.
Key Factors	Hazard aware setting. Hierarchical structure with limited span.	Production/sales orientation. Organisational structure creates 'fiefdoms'	Trust competence of people in role. Enforced compliance.	Limited control from HQ over local operations. Recruitment from outside the business brings new attitudes. Variable trust in competence of people in role.
Outcome	Favourable business unit culture – ownership. Small size and scale of operations relative to the organisation size. Champion for approach.	Push-back, no ownership. Production not safety culture. Large scale – many small, dispersed locations.	Standardised practice – Universal adoption	Localised adoption and incorporation in upstream operations. Less acceptance downstream.

Table G4: Cases where interventions were driven by other organisations in the wider sector

	Case 15	**Case 16**	**Case 17**
Intervention type	**Process**	**Functional / Process**	**Functional**
Sector	**Shipping**	**Shipping**	**Shipping**
Background / Trigger	Member companies of trade association recognise need for sector-wide improvements	Member companies of NGO recognise need for sector-wide improvements	High volume of personal injury claims
Intervention	Revision of best practice guidelines incorporating human factors elements through trade association	Promotion of Behavioural Competencies and Verification framework to train and assess skills	"Good catch" programme emphasizing personal responsibility for safety
Target population	All member companies	All member companies	All Protection & Indemnity club members
Organisational setting	Large shipping companies. Multi-national crews. Procedure orientation/'rule following' Trade association distant from operations	Charterers of ships support intervention. Large shipping companies. Multi-national crews.	Ship owners "keen to get message across". Seafarers lack understanding of OSH responsibilities. Allegiance of workforce (to union or agency rather than ship owner)
Key Factors	Focus on simple and clear instructions Prescriptive rather than goal/principle based Attention grabbing	Appetite from ship owners/shipping companies Selectively adapt framework to meet local needs	Clear, simple, single page alerts containing artwork. Varied locations of ship owners.
Outcome	Unclear.	Recent development – too soon to tell. Anticipated adoption as part of Tanker Management Self-Assessment.	New intervention – too soon to tell.