Safety Science 168 (2023) 106318

Contents lists available at ScienceDirect

Safety Science

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

Effective transfer of safety interventions within and between organizations: Leveraging translation theory to achieve improved outcomes

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ARTICLE INFO

Keywords:
Context
Translation competence
Transformability
Translatability
Safety interventions

ABSTRACT

Safety interventions are often 'borrowed' from one organizational setting, where they have worked successfully, to another organizational setting but not necessarily with the same positive outcomes. Translation theory could offer potential insights into the processes through which managers translate safety practices either from one organization to another or from one part to another part of the same organization. To examine this possibility, this study used the framework method of analysis, underpinned by a conceptual framework developed from translation theory, to analyse qualitative data from interviews with experienced managers having responsibility for safety in their organization who shared narratives of eight different safety interventions deployed in a variety of industry sectors ranging from oil and gas to retail from around the world. By inference from the data, analysis shows that interventions of low complexity, low embeddedness and high explicitness which theory characterises as more translatable, were also in practice more successfully translated. Furthermore, interventions with senior management support had higher levels of interpretive viability, thus making them more transformable and ensuring translation success. Also, translations were more successful when the safety interventions received adequate resourcing, were targeted at a narrow rather than a broad organizational scope and where they were integrated into existing work practices. The conceptual elements of the framework adopted in this study have the potential to support the development of translation competence among safety professionals, thus permitting the future deployment of more effective safety interventions in the workplace to reduce accidents and injuries.

1. Introduction

Globally, thousands of workplace fatalities per day are compounded by work-related accidents, injuries and diseases, sometimes with life-changing consequences (WHO/ILO, 2021). With around 500 million people's health impacted by work each year (ILO, 2023), poor occupational safety and health (OSH) is a significant global issue. Provided that organizations have effectively identified and assessed their workplace risks, one possible explanation for the figures above may lie in the poor introduction and implementation of interventions to improve safety in particular contexts, resulting in diminished effectiveness of these interventions and poor OSH results over time (Pilbeam et al., 2019; Whysall et al., 2006).

Indeed, as management practices are replicated regularly across firms and countries with differential outcomes (Bloom et al., 2012), so safety interventions are also often 'borrowed' or 'copied' from one setting where they have been successfully deployed to another, where they might not necessarily produce the same positive outcome. For example, checklists are an intervention widely adopted across sectors to improve safety performance (Catchpole and Russ, 2015). Safety outcomes following the deployment of checklists, however, are not consistently and invariably positive. While checklists have contributed significantly to improved safety in aviation, their contribution to safety in healthcare is variable and contested. Partly this variation in performance outcomes 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. According to Catchpole and Russ (2015) this process of translation (in this case between aviation and healthcare) is not well understood and consequently poorly implemented.

Successful OSH interventions, on the other hand, are usually tailored to their specific organizational context according to Herrera-Sánchez et al. (2017), but they also note that "generalizing and transferring such interventions to other organizations is a complex endeavour, p.1". The

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https://doi.org/10.1016/j.ssci.2023.106318
Received 27 March 2023; Received in revised form 9 August 2023; Accepted 16 September 2023

above draws attention to the importance of ensuring that safety interventions 'fit' the context in which they are applied to secure successful, that is safer, outcomes (Pilbeam and Karanikas, 2023). Misalignment between safety interventions and context increases the possibility of failure with adverse consequences, and increases system complexity unjustifiably, wastes valuable resources and could lead workers to discredit future safety management initiatives (Casey et al., 2021; Dekker, 2020). Therefore, one of the challenges for managers and OSH professionals responsible for workplace safety is to better understand the relationship between the context of their workplace and the safety interventions they deploy, especially when sourcing interventions from other organizations.

The aim of this paper is, therefore, to investigate this 'complex endeavour' by providing a first empirical investigation into the processes by which managers translate OSH practices either from one organization to another or from one part to another part of the same organization, using as an analytical tool a conceptual framework of translation processes proposed by Røvik (2016). While the components of the framework are not novel, their adaptation and application to OSH research is a new and necessary perspective if the global OSH challenge noted above is to be addressed. As such, this paper reports an initial exploratory study that analysed narrative accounts from individual managers with responsibility for OSH. It has the following objectives:

i. To examine whether Røvik's (2016) instrumental theory of translation can improve our understanding of the processes of translation of safety interventions from one organizational context to another, and
ii. To account for the perceived differences in the successful deployment of different safety interventions in different organizational settings by characterizing the intervention and identifying those contextual factors that influence the translation processes.

The next section of the paper draws heavily on the Scandinavian Institutionalism perspective of translation studies (Wæraas and Nielsen, 2016) to differentiate this study from other OSH 'translation' studies. It provides a brief review of key concepts from this perspective and describes an analytic framework that captures conceptually the processes of translation based predominantly on the work of Røvik (2016). This conceptual framework is then used to analyse data collected through semi-structured interviews with managers with responsibility for OSH in their organization, regarding safety interventions in different settings, as outlined in the research design and method section. Eight interventions and their application in different settings are examined in the findings section to identify triggers for their adoption, processes by which they are translated from one setting to another and the contextual factors that influence these processes. Last, the discussion includes a consideration of limitations, future work, and practical applications.

2. Literature review

2.1. Translation studies or knowledge transfer

According to Van Grinsven et al. (2016), "… translation signifies a process through which concepts are modified by agentic actors in relation to a particular context, p. 273". In OSH research this is often understood as the translation of outputs of basic or applied research into practice (e.g., Schulte, et al., 2017; Wensing, et al. 2010), which in other fields might be described as knowledge transfer (Agarwal, 2001; Geuna and Muscio, 2009). However, this perspective fails to account for the translation of existing practices (or ideas) between organizations, where managers play a key role (Spring and Unterhitzenberger, 2022) and which is the focus of this paper.

Safety-related ideas are often embedded in the safety practices found within a specific organizational context or section/area of an organization. Since ideas represent an abstraction of a practice and lack materiality (Wæraas, 2021), they are subject to interpretation and translation (Lamb and Currie, 2012) as they move across space and time (Øygarden and Mikkelsen, 2020). The processes by which this occurs is the focus of translation studies (Wæraas and Nielsen, 2016) that examine how a general idea is transferred and reinterpreted in a new setting (Morris and Lancaster, 2006).

Translation is considered to have geometric, semiotic and political dimensions (Nicolini, 2010) relating respectively to the movement of an idea, the shift in meaning resulting from this movement, and the ways in which "… conflict, persuasion and power determine which ideas eventually gain ground, p.3" (Wæraas, 2021). Therefore, translation accepts that this transfer of an idea is not a 'friction-less' process, like diffusion; inevitable change (transformation) will occur during the translation process, thus implying that each translation is unique (Cassell and Lee, 2017).

The process of translation requires ideas to be dis-embedded from their original context before they can travel to another organization or area where they are re-embedded (Czarniawska and Joerges, 1996). Both Røvik (2016) and Wæraas (2021) describe this process of translation as decontextualization – transportation of 'ideas' – contextualization. Furthermore, Benders and Van Veen (2001) conclude that the conceptual ambiguity around an idea facilitates translation, allowing more people to exploit the idea because they can recognise within the idea those elements that help to solve their particular problem. This 'interpretive viability' of neither stable nor invariant ideas provides different stakeholders in different contexts with the opportunity to work flexibly with any idea, allowing them to interpret it appropriately for their circumstances such that work activity is not constrained (Mueller and Whittle, 2011).

2.2. Key variables in translation studies

Ideas are often stratified, with several different levels of an idea bundled together tightly (Sahlin and Wedlin, 2008). 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) (Lamb and Currie, 2012). Changes may happen at an operational level without necessarily changing the programmatic level ideas. Conversely, changes at the programmatic level may not inevitably change operational level practices. A practice common to two settings may be enacted for different reasons, as indicated by the example of safety checklists in the introduction section above.

In addition, translations may occur following the initiative of different actors at different levels within the system (Nielsen et al., 2020). For instance, translation may occur at the 'field-level' (i.e., the sector or industry level) instead of the organizational level where practices are typically translated and adopted by different business units. Evidence suggests that ideas originating from outside a sector are more successfully embedded in an organization of a particular sector when they have been previously translated at the sector level prior to being received by the organization (Nielsen et al., 2020). These 'field level' translations occur, for example, at conferences and in workshops conducted by consultants and academics, and lead to sector 'best-practices' (Nielsen et al., 2020). Other studies note that such translations may be conducted by unions and governments (Cassell and Lee, 2017).

Translations may also occur at the level of the organization, mainly led by (senior) managers (Cassell and Lee, 2017; Spring and Unterhitzenberger, 2022), who are expected to make the idea, "… relevant and understandable in the particular context of the adopting organization, p.237" (Nielsen et al., 2020). In response to any safety issue, managers are responsible for initiating organizational transformation, thus acting as change agents, by adopting new safety practices or amending existing ones. Nilsen and Sandaunet (2020) suggest that these managers require competence in translation processes to introduce new or changed practices effectively into the organization. '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 translation rules which include copying, modifying, or alteration (Røvik, 2016).

Copying attempts to achieve similar outcomes in the recipient unit as in the source unit 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 unit scarcely resembles the version in the source unit, the latter functions more as an inspiration rather than a source of specific and concrete practice, and the process can no longer be considered a translation (Røvik, 2016).

2.3. Conceptual framework for translation

Røvik (2016) developed an instrumental theory of translation, which we have captured diagrammatically in Fig. 1. This conceptual framework, which we use as an analytical framework for this study, draws attention to the micro-processes of change explaining "… how actors apply various translation rules when de-contextualizing practices in source units and contextualizing representations of practice in recipient units, p.291" (Røvik, 2016). The framework has two key variables, translatability and transformability. Translatability is a decontextualization 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. Transformability is a contextualization process whereby the abstract concept is recontextualized 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.

Røvik (2016) also posits that the ease of translatability 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 decontextualize and then translate. As the level of complexity and embeddedness decrease and the idea becomes more explicit, decontextualization and transfer 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, as tacit practices are non-verbalised, non-codified and non-standardised, they need to be verbalised and made explicit before they can be translated. All these features of the source influence the translatability of the practice into an abstract representation that retains the essential features to permit proper functioning.

Furthermore, the 'editing' or 'translation rules' (Øygarden and Mikkelsen, 2020) from copying, through modification to radical alteration, as discussed above, are determined by the "degree of freedom that translators have to interpret, change or make their own version of the construct, p. 300" (Røvik, 2016). Transformability depends, therefore, on the extent to which the idea or practice inheres in a particular technology; if this is high, then the scope for transformation is limited. Transformation of an idea or practice can also be influenced by the degree of regulation associated with it either internally, from senior managers in the organizational hierarchy, or externally, from government bodies. Where the degree of regulation is high, it is suggested that the scope for transformation is again limited.

Additionally, the 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 (Nielsen, et al., 2020). 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. Apart from national, cultural, and institutional proximity (Røvik, 2016), other contextual factors that regularly differ between organizations include organizational culture, organizational processes, employee demographics and criticality of OSH as part of the organization's 'licence to operate' (Porter and McLaughlin, 2006). These differences may all influence the success of the translation process. Furthermore, differences in structural and psychosocial parameters, including work over- or under-load, unclear communication, conflicting demands and job insecurity, are increasingly recognised as contributing to poor safe outcomes in organizations (Brown et al., 2020). These too may affect translation success.

3. Methods

3.1. Research design

This initial explorative study sought to examine the applicability of the conceptualization of the process of translation of ideas and practices between different contexts, as outlined in the literature review section above, to the transfer of safety interventions between organizations, which seems to be a common practice. This conceptualization of the translation process has received limited empirical application generally, and to the best of the authors' knowledge, this is the first study that has used this approach to investigate how a safety intervention is translated

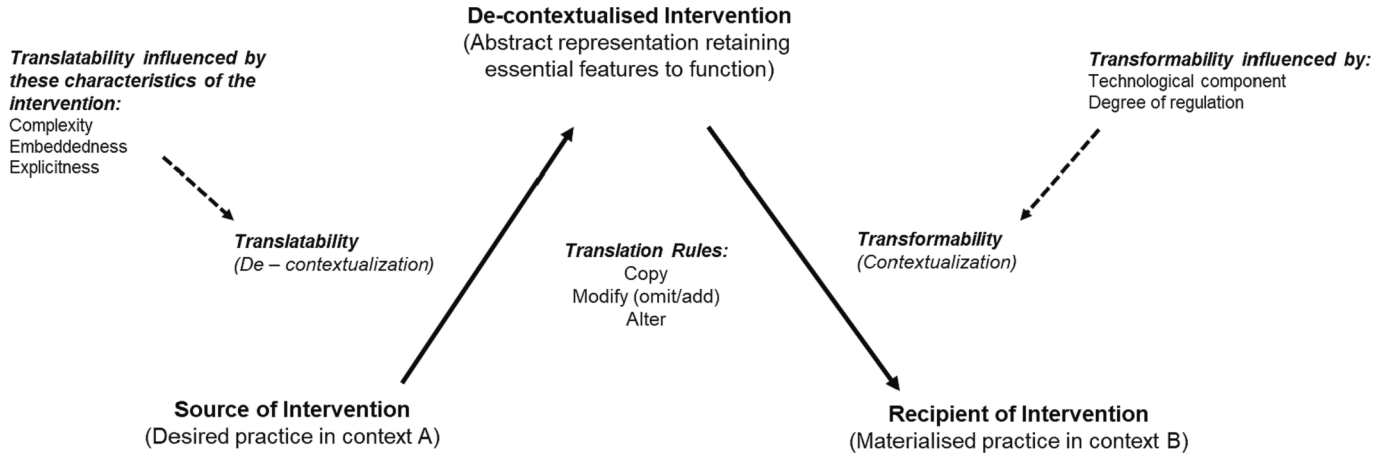

Fig. 1. Conceptual framework of the key variables in the process of translation of interventions from a source to a recipient organizational setting (Based on Røvik, 2016).

before and while being introduced into a new organizational setting from another. Because of this exploratory approach, safety interventions were not narrowly specified but encompassed any intervention aimed to improving organizational safety outcomes, including accident and injury rates, safety behaviours and worker wellbeing. As such, safety intervention could be any physical artefact, process, procedure, set of skills or specialist knowledge that can be implemented across a whole organisation or sizeable parts of it and aims to restore, maintain, or strengthen safety. This accords with the early definition of a safety intervention provided by Robson et al. (2001) and a more recent variant (Van Kampen, et al., 2023) where a safety intervention is defined as "… an intentional effort to systematically improve 'safety' within a work organization through a series of actions, measures and/or steps which are seen as related to each other, p2".

Individual narrative accounts provided by experienced managers who had deployed a single safety intervention in two different organizations, or very different contexts within the same organization, were analysed using the framework method (Gale et al., 2013), where the data matrix integral to the method captured the different elements of Røvik's conceptual framework, indicated in Fig. 1. Accounts of the translation processes of different safety interventions would allow us to establish the possible utility of this conceptualisation for understanding the process of translation of safety interventions between two organizations or organizational areas, helping to explain why it may fail and suggesting ways to improve the effectiveness of translations in practice.

The framework method of analysis we used provides a systematic and flexible approach to analysing qualitative data and is not anchored to any particular philosophical perspective (Gale et al., 2013). Originally developed for policy research, it has been used in safety science, for example in the analysis of qualitative data in the construction industry (Lingard et al., 2021). A defining feature of the method is the creation of a matrix which allows the data from each case (often a single individual) to be summarised against a consistent set of codes. These may be predetermined or generated inductively from the data (Gale et al., 2013). This enables the identification of commonalities and differences in the data as well as patterns and relationships between different parts of the data set.

3.2. Participants

Managers, particularly those who are proximal to the intervention in the workplace, play a vital role in the translation process (Spring and Unterhitzenberger, 2022). Therefore, capturing their experience of what they did and what they believe influenced the outcome was vital to advancing our understanding of this process. Also, typically, senior, or high-status, OSH professionals play a decisive role in the introduction of safety interventions into an organization (Hale et al., 2010). Hence, based on a convenience sample drawn from the authors' collective networks, we interviewed 17 experienced managers, who had significant responsibility for OSH in their organization as part of their role. These individuals were those who had brokered the translation of a safety intervention into a new organizational setting.

At the time of the study, most of the participants lived in the United Kingdom (UK; n = 12); two lived in Australia and one in each of the United States (US), France and United Arabic Emirates (UAE). Nonetheless, they all had experience of working in organizations of different sizes, ranging from global corporations to small and medium sized enterprises (SMEs), across seven sectors, including oil and gas, construction, telecommunications, maritime and retail. Of the 17 individuals, five identified themselves as female. This diversity of experience in different contexts was necessary to capture a wide range of safety interventions applied in various settings, allowing us to explore, for the first time, the instrumental application of translation theory proposed by Røvik (2016) in the field of safety practice.

3.3. Data collection

A participant information sheet indicating the nature of the study and the ways in which the data would be shared and managed (including confidentiality and anonymity) was shared with potential participants. An interview protocol (A.ppendix A) was developed through consultation between the researchers and the project sponsor from the charity funding the work. The interview questions were shared in advance with the 17 volunteers to afford sufficient preparation time and allow them to recollect and/or gather the details of safety interventions and the contexts in which they had been deployed. After securing their consent to participate, the semi-structured interviews were conducted on-line and recorded. With one exception, which lasted 27 min, the interviews ranged from 46 to 65 min, averaging 53 min. Transcription of these audio files was outsourced to a transcription service while also ensuring confidentiality of the participants' identities. As recommended by McMullin (2021), intelligent verbatim transcripts of each interview were cross-checked with the audio-recording and proofread by the first author of this paper to correct punctuation and misspelt or missing words.

3.4. Data analysis

Pope et al. (2000) identified five stages of data analysis in the framework method. These were:

1. Familiarisation with the data. All the transcripts were read by the first author twice before coding commenced to get an overall sense of the available data.
2. Identifying a thematic framework. The conceptual framework proposed by Røvik (2016), as outlined above and captured in Fig. 1, provided a set of predetermined codes against which the data could be arranged. These related to the translatability (including the level of complexity, embeddedness, and explicitness), transformability (technology component and degree of regulation) and translation rules pertinent to each intervention. Other codes were established in advance in consultation between the researchers, who have significant experience in safety practice and research. These codes included the characterisation of the target population, details of the organizational context, the factors perceived to enable or inhibit the translation of the intervention into the new setting and its consequent success, and background that triggered the initial search for a new safety intervention. The elements and variables of this framework were represented in a spreadsheet, with each row corresponding to a different code and each column representing a different case.
3. Indexing. Each transcript was analysed separately. Relevant data excerpts and passages were 'lifted' from a transcript and incorporated into a single column in the spreadsheet under the appropriate code. Where information relating to a code could be inferred from the narrative account, a summary note was included in the matrix. Where data pertinent to a particular code could not be found either overtly or by inference, this too was noted. This process was checked by the second author with reference to the transcripts. Any disagreements were resolved by referring to the data collected.
4. Charting. Quotes, comments and inferences were condensed and summarised in a refined version of the matrix.
5. Mapping and interpretation. The data in the summary matrix were examined to identify patterns and relationships between the codes and exclude incomplete datasets that missed necessary elements of the conceptual framework. For example, some interviewees focused only on generic competencies of OSH professionals and their effectiveness in specific contexts, while others emphasised a particular competence, such as a safety conversation, but with insufficient detail for further analysis. Other participants mentioned the deployment of a new technology (e.g., using sensors on cranes to

prevent collision with buildings or other cranes), but considered only a single worksite. Some interviewees shared the introduction of sector-wide interventions (e.g., best practice guidelines for permits to work and checklist development), rather than interventions at an organizational level.

Following this screening process, a complete set of data was obtained for the eight interventions shown in Table 1 (i.e., interventions with all elements of the analytical framework and a complete set of contextual information about the recipient organisations). Four interventions aimed at improving individual safety performance by assessing competency (I1, I7) or through particular training interventions (I3, I8), three sought improvements to organizational safety performance by using recognised practices (I2, I4) or exploiting technological innovations (I5), and one intervention aimed at improving organizational safety performance through cultural transformation (I6).

3.5. Example of data coding

Poor manual handling was a key issue at a food manufacturing production line at a single site resulting in a significant volume of compensation claims. The introduction of a programme of manual handling training based on ergonomic principles "… *eliminated all manual handling accidents within 18 months*". The interviewee moved to a large UK retailer with multiple stores where manual handling issues were the main cause of accidents. The training reduced this, and "… *so historically manual handling was top trumps. Manual handling was 30%. That was the mass of our causes of our accidents. Now we're getting a little bit of struck by objects or slips and trips taking top position*". From the narrative provided we can infer that although people were involved the principles were straightforward and there was a clear cause-effect relationship, poor technique results in injuries. Complexity was therefore low. The responsibility for training and maintaining compliance on each production line remained with a small group of people and so embeddedness was concentrated and deemed low. The intervention was explicit, codified and standardized for everyone making explicitness high. The intervention was an ergonomic principles-based manual handling practice, so the technical component was considered high. This was regulated tightly through oversight by a local supervisor. The interviewee copied the process from the food manufacturing setting to the retail setting, only modifying the examples in the training to provide contextual relevance to the learner.

4. Results

4.1. Summary description of interventions and their context

Table 2 presents the summary data per intervention context and the success of the intervention as reported by the participants. In this data, we identified three different scenario types for intervention application. In the first, an intervention was applied throughout an organization, but with different outcomes in different parts of the business. In I1, a competency assessment framework was designed within the organization, "*published by top managers*" and subsequently applied more successfully to employees working in approximately 1,000 airports world-wide than to employees in 40,000 retail filling stations. Differences in the organizational culture between the two settings and in the extent of ownership of the intervention were identified by the interviewee as key reasons for this difference. More specifically, a senior figure in the company visited each of the 40 senior managers responsible for airport operations globally to persuade them of the importance of the framework and gave them licence to adapt it as required to local circumstances, "*So it wasn't a one size fits all, it was 'this is what you need to do, and how you do it is up to you but this is what you must achieve'. So, it must be tailored locally by local people with the specifics of their work and equipment*". Regarding I4, a risk assessment and tracker were deployed more successfully in a warehouse with a stable, loyal workforce of 60 employees than in 30 geographically dispersed stores owned by the same retail company with "*very few employees who have any loyalty to the business they work in*".

The next scenario type covered situations where an intervention deployed in one organization by the interviewee was then repeated in another but with less success. HAZOP reviews (I2) were first introduced to a large global oil company following intense board level scrutiny but accepted and deployed without questions throughout the organization ("*they referred to their practices as the bible*") because of the '*command and control*' culture. Their introduction into an equally large global oil company was less successful because local business units operated independently from the headquarters and sought to do the minimum to secure compliance: "*you're working in this environment where frankly they didn't want to be governed by a central organization*". Continuous organizational change and a lack of expertise were also perceived to have undermined successful adoption in this second case: "*[company name] seems to have rearranged the deck chairs and the people in the deck chairs at least once every two years, if not more frequently*".

The second intervention of the same scenario type concerned a bespoke manual handling training programme (I3) based on ergonomic

Table 1
Descriptions of eight safety interventions, their sector and geography of application and initiating trigger.

Identifier	Sector(s) of application	Geography	Trigger	Intervention
I1	Oil and Gas	Global	Sector-wide concerns over task competency levels following publication of Royal Commission report into gas explosion at Esso Longford plant.	A competency assessment framework for safety critical positions across the global organization was developed, and then deployed
I2	Oil and Gas	Global	Industry standard to conduct HAZOP reviews periodically.	HAZOP studies mandated and were repeated on a regular basis at sites globally
I3	FMCG / Retail	UK	Continued high level of manual handling incidents resulting in significant volume of claims totalling £ms.	Develop a programme of manual handling training based on ergonomic principles supported by external company, and then deployed
I4	Retail	UK	Legal requirement to demonstrate risk analysis to comply with H&S legislation.	Implementation of a standardised risk assessment tool with action tracker to manage risks
I5	Oil and Gas / Water	Middle East	Transparency of safety data across multi-site company and opportunity to digitalize process.	Implement a software tool for recording and reporting safety information at each location
I6	Public services	Australia	Dissatisfaction with safety culture.	Initiate a safety culture transformation
I7	Telecommunications	UK	Series of accidents and near-misses raising questions about task competence.	Build a physical site for assessing the competence of company and contractor operatives
I8	Energy	UK and Ireland	Review of accident / incident reports over time showed that typical response to incidents was ineffectual.	Change the nature of safety interventions emphasizing coaching for senior staff

Table 2
Summary features of the contexts where eight safety interventions were deployed with different levels of success.

Intervention	Setting 1 – success / consistent	Setting 2 – less success / variable
I1: Competency assessment framework	c.1000 airports globally. Champion visited all senior managers. Hierarchical structure with limited span. Hazard aware setting. Interpreted to suit local contexts.	c.40 k retail filling stations + depots. Production/sales orientation. Organizational structure creates 'fiefdoms' and push-back against headquarters mandate.
I2: HAZOP reviews	c. 71 k employees globally. 'Command and control' culture. Enforced compliance. Board level scrutiny. Trusted competence of those in role. Organizational stability.	c. 70 k employees globally. Locally independent units challenge HQ decisions. Continuous organizational change. Lack of local expertise. Uncertain competence.
I3: Manual Handling training	200 employees on 9 production lines on single site. Identified local experts to act as trainers. On-going engagement. Aligned to work.	83 k employees nationally across multiple retail stores. Limited Director level involvement. Gatekeepers in other functions. Bureaucratic process. Silo'd H&S team. No sanctions for non-compliance
I4: Risk assessment and tracker	Single warehouse with 60 employees. Continuity breeds loyalty. Small team. Close monitoring	30 small stores geographically dispersed. Small numbers of FT / PT staff. Frequent turnover of staff no ownership.
I5: Software for incident reporting	c. 3 k employees across MENA region. Existing safety management systems incorporated new software. Weekly meetings with vendor; direct support. On-line resources / guides created for users. Frequent training with users. Wide support across senior management team.	c. 11 k employees geographically dispersed across 30 locations. Expertise centralized. Work process additional to existing work. Vendor support through 'general user support'. Limited enthusiasm even by top level management.
I6: Safety culture transformation	Small, centralised organization with c.2 k employees. CEO supportive. Engaged board / executive team. Budget available. New H&S team.	Large, decentralised organization with c.14 k employees in the region. No board involvement. Small safety team. Safety staff in business units report to business unit heads. No budget.
I7: Test site for competency	New SME business with c.150 staff. CEO supportive. Small team. Resource available but limited.	*N/A (pre-intervention)*
I8: Redesign approach to safety training	Single organization comprising 12 divisions, c. 4 k people. Senior management commitments with consequences. Continuous review at board level. Integrate into existing activities.	*N/A (pre-intervention)*

principles and designed to align with existing work tasks; it was introduced to employees of nine production lines in a food manufacturing plant, "*making the job much easier, much quicker, and more comfortable*". Local champions were identified and trained to deliver the initial training and on-going coaching of others, because "*its really important to have somebody who can drive it and has got a passion for it*". However, a similar programme encountered more resistance when introduced to a large retailer with multiple stores; "*moving from effectively FMCG into retail, 'good God it's slow'*". A lack of awareness of safety at board level and 'gatekeepers' in different functions, combined with a highly bureaucratic process hampered adoption. "*The difficulty wasn't about getting the money. It was about navigating through the process that nobody really understood what we needed to do*" to successfully implement the new manual handling training programme.

Another intervention in this specific scenario type regarded a software tool for gathering safety data (I5) from multiple locations to aid reporting in headquarters. This proved more successful where the system was "*better integrated with our [existing] safety management systems*" rather than being an additional activity to current practices, "*this tool was almost considered an add-on*". Higher levels of support from senior managers and the software supplier encouraged adoption, as did the local provision of guidelines to support practices. Where "*top level management was not as engaged in having a safety focused digital tool implemented*", then the implementation of the software tool was less successful. A final example of this scenario type is the safety culture transformation (I6). This was successfully delivered in a small, centralised organization, where the board was actively engaged, resources were available and staff who had acted as 'blockers' had left the organization. Yet, it was more difficult to transform organizational safety culture in a larger decentralized organization where there was no board level involvement and those responsible for safety in the business reported to business unit heads rather than the safety function, which was effectively siloed.

A final type of scenario is where an intervention is developed locally and introduced 'in-house', but not replicated elsewhere or achieving contrasting results in different locations. The creation of a physical asset in a small telecommunications company to test the competency of potential recruits and contractors (I7), who "*develop their CV in order to get paid more*", prevented serious incidents in the period following its introduction: "*we haven't had any serious accidents like we did last year*". Similarly effective was a new approach to safety training (I8) deployed across 12 divisions of a single organization. This required senior managers, including business unit heads and managing directors, to make personal commitments to ensuring improvements in safety for which they felt accountable, "*so that when we come out of this [process] we are going to look for full implementation that it is working. This is not just going to be 'tick a box' and say you did it. No. Actually we're going to do a dive into these commitments, where's the evidence. We're going to go and check that this worked here, that it is fully deployed and sustainable*".

4.2. Triggers for adopting a new safety intervention

The triggers for implementing the interventions differed (Table 1), three of them having been driven by a repeating pattern of accidents and incidents and "*the same old, same old*" responses, that was deemed unacceptable (I3, I7, I8). For instance, the participant describing intervention I8 observed that "*an incident that happened five or six years ago, we could write the incident report five or six years on. It would be the same. We just change the date and the location. The same things were happening*". Other interventions were driven by sector-level norms (i.e., I1 and I2 in the oil and gas sector), or mandates to comply with national legislation (I4). Only, interventions I5 and I6 regarded proactive strategic interventions by the company.

4.3. Process of translation

4.3.1. Translatability

In six cases, the intervention was a specified technical artefact with a clear application in each situation: an agreed framework (I1), a standard process (I2, I4), a defined set of principles (I3) and a physical asset (I5, I7). Moreover, these interventions had a clear link to achieving a defined aspect of safety performance, including improved competence (I1, I3, I6), better understanding of risk (I2, I4) and awareness of safety issues (I5). Together, the low levels of causal ambiguity associated with the adoption of a clear technical means to achieve a particular outcome indicates a low level of complexity.

Moreover, in each of these six cases, the embeddedness of the

intervention was judged to be concentrated, and thus more translatable, as no intervention relied upon additional or continual flow of knowledge inputs from external sources or from processes and functions spread across the organization. As such, each intervention could be successfully deployed locally. The competency assessment framework (I1) could be used by individual line manager to assess their direct reports at a single location, "*the line manager of the person would do the assessment, having been trained in the process of assessment. So, the line manager is responsible for the competence of their reports*".

HAZOP reviews (I2) of different parts of the organizations' operations were conducted by several experts working in a small team. Manual handling training was delivered locally by champions working on individual production lines or in specific parts of a retail store (I3). Also, risk assessments were conducted by the manager of the warehouse or retail store together with a consultant and resulting actions were performed by delegated individuals (I4). Operatives at individual locations were required to use the software tool to report safety issues to headquarters, without reference to other parts of the organization (I5). The physical asset built to assess competency (I7) was agreed by three members of the senior management team, and subsequently used by the interviewee to assess the performance of potential recruits and contractors. "*We needed to sit there and quantify these skills in a safe space*", so "*we built a facility to fail safely*".

Last, those six interventions were explicit, codified and standardised. In each case the intervention was documented so that the process of implementation was standardised and not reliant upon additional information. For example, the competency assessment framework (I1) described specific tasks and a required standard to be achieved. Similarly, the software tool for incident reporting (I5) was a prescribed technological tool with associated guidance for users to capture specified data from sites; the software was not open to modification by the users. The HAZOP studies (I2) followed a very rigorous approach "*writing down exactly how we want to do things*", and outcomes were documented. The ergonomic principles behind the manual handling training (I3) were made explicit to trainees and did not change with context. Risk assessments were explicit and standardised, and the tracker codified the required responses (I4). The physical asset (I7) allowed the assessment of competencies that were explicit and standardised, e.g., the use of small mechanical excavators. In summary, our analysis of the data suggests therefore that the six interventions above can be characterised as low complexity, low embeddedness and high explicitness (Table 3).

Although the characterisation of the remaining two interventions was less clear to the researchers, we believe these interventions are likely to be of high complexity, high embeddedness and low explicitness. The process of safety culture transformation (I6) was not fully explained, perhaps because it is more tacit rather than explicit. Moreover, in any culture change causal ambiguity is likely to be high. The revised approach to safety training (I8) included reporting of safety actions, such as safety conversations, and their outcomes to peers at board level meetings on a regular basis. This peer-monitoring, with potential for personal embarrassment, was an integral part of the change, and an important part of the process was therefore dispersed across the organization. This is an indication of high embeddedness.

4.3.2. Transformability

Based on the presented data (Table 3) six of the eight interventions were heavily dependent on a technological or technical component. In I7 this was physical infrastructure that acted as a test ground. In some cases (I4, I5) this was a piece of software that required appropriate data

Table 3
Characteristics of the safety interventions, their transformability, mode of translation and factors influencing translation success.

Interventions	Summary characterisation of intervention (Complexity – Embeddedness – Explicitness)	Technology component	Degree of regulation	Translation rule applied	Enabling factors	Inhibiting factors
I1: Competency assessment framework	Low-Low-High	Specified framework of required competencies	High. Senior management oversight, but local adaptation permitted	Alter / Copy	Mandated by senior management; local champions; local interpretation permitted; safety aware context	Culture of production; local 'fiefdoms.
I2: HAZOP reviews	Low-Low-High	HAZOP process specified	Senior management oversight in setting 1 (High). No oversight in setting 2 (Low).	Copy / Modify	Senior management support; Centralized control; 'Command and control' culture	Decentralized; independent business units; staff turnover.
I3: Manual Handling training	Low-Low-High	Principle-based process with clear artifacts	High in setting 1. Low in setting 2. But local oversight of practices.	Copy / Modify	Small organization; local trainers; relevance to task	Silo'd functions; Lack of senior management involvement; bureaucracy
I4: Risk assessment and tracker	Low-Low-High	Work risks specified in system with required actions	Senior management oversight in setting 1 (high). Variable management oversight in setting 2 (low)	Copy	Senior management oversight; loyalty of staff;	Staff turnover; Dispersed units
I5: Software for incident reporting	Low-Low-High	Software developed and technology deployed	High. Software adaptation dependent on external vendor.	Copy	Senior management buy-in; Functionality; resourced; integrated into work.	Perceived as an 'additional task'; senior management indifference
I6: Safety culture transformation	Not determined	No technology	Senior management control in setting 1 (High). No oversight in setting 2 (low)	Copy	Centralized control; resources provided; SMT buy-in; change in staff;	Decentralized business; No involvement with line-management; no resources
I7: Test site for competency	Low-Low-High	Physical infrastructure defined	Senior management team control (high)	Alter	CEO support; Business critical issue.	
I8: Redesign approach to safety training	Not determined	No technology	Senior management team involvement (high)	Alter	New processes embedded in existing tasks; Senior management buy-in; audited responses.	

which then generated a set of actions to be implemented. A written framework (I1) or specified process (I2, I3) that articulated a clear procedure based on a set of principles that sets expectations served a similar function. The technical component of these interventions in many cases served to limit transformability; the intervention had the same characteristics in the recipient organizational setting as in the source setting. Only the safety culture change (I6) and the redesigned approach to safety training (I8) had no apparent technical component.

The degree of regulation present in each intervention also varied. While regulation was often not external to the organization, senior management was typically involved in all cases, but with differing outcomes. In some organizations or organizational settings, they were supportive, and oversight was positive, permitting the transformation of the intervention to achieve the anticipated outcome. For example, the competency framework (I1) could be amended to reflect local training needs, while the software tool (I5) in the second setting could be modified in consultation with the vendor to better meet organizational needs. In other cases, oversight had a negative effect. In several cases (e.g., I6) senior management teams, and also those close to the point of deployment, failed to support the deployment of the intervention. This prevented appropriate local transformation and reduced the effectiveness of the intervention.

4.3.3. Translation rules

Our interpretation of the data suggested that the interventions displayed all three modes of translation: reproducing, modifying and radical (Table 3). In most cases where the interviewee deployed an intervention in two separate locations in sequence, the interventions were allegedly reproduced in the second situation (I2, I3, I4, I5, I6). However, even in these situations, there was evidence to suggest that there was some small modification between contexts. For instance, the processes for the HAZOP studies (I2) were carefully worded to satisfactorily meet the expectations of the local organizational culture; "*we needed to think really carefully about each and every statement, and we needed to be very clear what you shall do and what was optional, because if we used the word 'should' like many regulations do, they would just think they didn't have to do it*". Also, in the case of the manual handling training (I3) the videos presenting the techniques were re-filmed in each company to demonstrate the application of the technique to tasks relevant to the specific context, so that "*[employees] can see and touch and feel almost [their] work area*".

Regarding other translation modes, the competency assessment framework (I1) was left deliberately generic so that it could be modified to fit local conditions. Three interventions (I1, I7, I8) appeared to have been created within each organization without reference to an external source, this classifying them as radical.

5. Discussion

5.1. Nature of safety interventions

Improving safety outcomes in an organization requires the adoption of appropriate safety interventions. Defined by Masi and Cagno (2015) as "… an attempt to improve safety and health conditions in workplaces by means of targeted activities and initiatives, p.227" safety interventions in this study were diverse, ranging from those activities aimed at assessing and improving skills, to technologies for improving the reporting of safety data and information and the management of risk, to safety culture transformations. It is noteworthy that they all sought improvements in safety performance by targeting the base of the 'hierarchy of controls' through administrative controls, occasionally supported by technology, instead of the apex through elimination or substitution. However, this is not unusual. A recent rapid evidence assessment of health and safety publications published since 2011 (Karanikas, et al., 2022) indicated that interventions were focused on administrative controls. Furthermore, in a systematic review of 100 studies of safety interventions for the prevention of accidents at work (Dyreborg, et al., 2022), 83 studies reported administrative interventions rather than engineering ones, although the latter were reported to be more effective.

5.2. Processes of translation

Numerous different evaluation studies of OSH interventions have demonstrated that safety interventions may not always be successful (e.g., Pedersen et al., 2012). To provide an explanation for this equivocal situation we deployed a conceptual framework derived from an instrumental theory of translation provided by Røvik (2016). Interestingly, although six of the interventions in this study share the same features related to higher translatability (Table 3), with low complexity, low embeddedness and high explicitness making interventions more translatable (Røvik, 2016), this did not always guarantee their successful transfer from one organizational setting to another. For example, the successful deployment of a competency assessment framework (I1) in one sector of the organization's business was not matched by similar success in another business within the same organization. Similarly, while HAZOPs (I2) were effective in one global oil and gas company they were less effective in another. Different contextual factors which we will consider below may account for this. Thus, although sufficient translatability might have rendered interventions more identifiable, and possibly memorable to the interviewees, we suggest that two dimensions in the new context seemed to have an important influence on their transformability, i.e., "the degree of freedom that translators have to interpret, change and make their own versions of the construct (Røvik, 2016; p. 300)". These were the technical component and the degree of regulation.

Despite being administrative in their aim, most of the interventions in this study included a technical component, for example, specified artefacts (e.g., software tool, competency assessment framework and manual handling training) or clear and established processes and procedures (HAZOP analyses and standardised risk assessment). While this appears to promote translatability, it makes their transformability to fit the conditions of the recipient context less likely (Røvik, 2016). As a result, the interventions may not have their desired effect in the new setting. We suggest that efforts to transform an intervention are reduced either because existing approaches to managing safety in the recipient organization are deemed satisfactory, or because the success of the intervention in improving safety performance in the source organization is not widely visible in the recipient organization, and so the opportunity for improvement in the recipient organization is overlooked.

Regarding the degree of regulation, this is typically high when the constituents of an intervention are prescribed and the process of transfer is monitored, with a low opportunity for transformation. Often, it is presumed that the control exercised by those in authority has a negative and constraining influence seeking to assure compliance (Dekker, 2014, 2020; Hale and Borys, 2013). By contrast, in some of the situations described in our study, for example the use of the competence assessment framework, oversight by those in positions of power had a positive influence. Despite the provision of a ready-to-use product, modification and local adaptation were encouraged to ensure effective use, and the focus was on the final adoption and implementation rather than on the details of the processes integral to the intervention themselves. Reason et al. (1998) similarly drew attention to the differential consequences of controlling for either process or output.

This positive situation resonates with the notion of 'interpretive viability' (Benders and van Veen, 2001), where individuals can exploit the ideas that sit behind the intervention in different ways and for their own purposes. Where the 'what' of an intervention is defined, but the 'how' is left underspecified, then the scope for interpretive viability increases. Accordingly, where safety interventions are a malleable tool to achieve a defined level of safety performance, then adoption by a wider selection of organizational stakeholders is more likely. In the cases

shared by the interviewees, successful translation with improved safety performance was noted more often when local champions had the opportunity to interpret the interventions to suit the local conditions.

5.3. Translation rules

Familiarity with translation rules (i.e., copying, adding or omitting, and alteration activities) and modes (i.e., reproducing, modifying or radical translation) is a key aspect of translation competence (Røvik, 2016). Most of the examples in this study exploited the copying rule, aiming to replicate a practice found in one context in another (Table 3). Given that the characteristics of most of the interventions in this research were low complexity, low embeddedness and high explicitness, this is unsurprising. Røvik (2016) argues that this particular combination of characteristics creates an intervention that is susceptible to copying.

Nevertheless, it is noted that several of these interventions also permitted some form of modification, in terms either of content or of interpretation in the way it should be implemented, hence blurring the threshold between reproducing and modifying. The clear delineation of translation rules attainable conceptually, may be more difficult to achieve in practice. Differently, the interventions (I7 and I8) categorised as radical translations were entirely new to the organization. They share two characteristics, namely an unknown source of ideas to generate the new intervention coupled with a low degree of external regulation. Together these permitted the transformability of these ideas into concrete practice (Røvik, 2016).

5.4. Contextual factors that enable or inhibit translation processes

Røvik (2016) does not specify influential contextual factors in his conceptual framework because it can apply to any knowledge transfer context, including more localised situations, in addition to the business units or entire organizations in this study. Nonetheless, a recent review that used the same framework noted that while communication and support from management colleagues were commonly considered, other organizational factors had not been examined sufficiently to be conclusive (Karanikas et al., 2022). This study indicates that the processes of translation of safety interventions are influenced by a range of factors (Table 3). Four groups of factors, individually or in combination, appeared to facilitate the translatability and transformability of safety interventions into a new setting. A key factor in the successful implementation of interventions is the role members of the senior management team play in actively supporting new interventions (Pilbeam and Karanikas, 2023), eloquently illustrated by the CEO in the telecommunications company (I7): "*this stuff [consequences of fatalities and serious accidents] freaks me out. I really don't want to go to prison. Do what you need to do in order to protect us, but without destroying the corporate piece of the business*". Where the support was absent in the cases included in this study (e.g., I2 and I6) or management appeared less enthusiastic (I5), then a successful adoption of the interventions appeared to be less likely.

Hale et al. (2010) made a similar observation in a study of 298 safety interventions in 29 companies across diverse sectors in the Netherlands. Their study also identified the importance of supportive line managers in the successful implementation of new safety interventions. This point was re-emphasized in a more recent study again in the same country where members of the Dutch National Institute for Public Health and Environment were asked to consider the use and effectiveness of 48 common safety interventions (van Kampen, et al., 2023). The importance of support proximal to the point of adoption was observed in this study, although not only through line managers. Indeed, in the cases shared by our study participants, locally appointed champions, who might have training or coaching responsibilities, made a positive contribution to the successful adoption of the manual handling training (I3) and the implementation of the competency assessment framework (I1). Ipsen et al. (2015) similarly reported the positive role played by 'in-house' facilitators in the adoption of new interventions in knowledge intensive SMEs in Denmark.

Successful translation was also associated with adequate resourcing. In common with other studies (e.g., Ipsen et al., 2015), where time was limited and there was no available funding (e.g., I6) then success was unlikely. Resourcing for critical aspects of the intervention enable adoption and use, as for example in the provision of easily accessible technical support, whether through appropriate guidebooks or on-line help, to support the adoption of a software tool for collecting safety data and information (I5). The importance of specific technical support has similarly been noted by others (e.g., EASHW, 2016).

Moreover, a difference in the scope of the organizational setting in which the intervention was applied appeared to make a difference between success and failure. By this we do not mean organizational size; safety interventions can be effective or ineffective in both small (Masi and Cagno, 2015) and large organizations (Hale et al., 2010). Rather we mean the scope and scale of the particular unit or function within the overall organization. Where the targeted context was more local and narrower or more tightly focused (e.g., I1, I3, I6) rather than broad and diffuse, success appeared more likely.

Several authors have focused on the barriers to successful implementation of interventions (Whysall, et al., 2006; Masi and Cagno, 2015). Naturally, the absence of an enabler may act as a barrier, as for example the availability of resources (Hasle and Limborg, 2006). In our study, in almost all cases, the lack of success to implement an intervention was mostly attributed by the interviewees to the absence of the enablers they had identified as contributing to the previous successful deployment of the same intervention. However, there may also be additional factors acting as barriers; for instance, where the intervention was perceived to be an addition to the daily tasks requiring extra effort, it proved less successful (e.g., the I5 case with the software tool) (Ipsen, et al., 2015). This confirms Whysall et al. (2006) who noted that activities need to be integral to existing tasks rather than an 'add-on' to existing work. Situations where activities are not well integrated are perhaps indications of poor translations.

5.5. Practical implications

The results of this study suggest a number of important practical actions to achieve positive safety benefits from the translation and adaptation of a safety intervention into a new context. First, successful translations might require not only active senior management / board level support and encouragement, but also champions at local levels to encourage adoption. While the importance of active involvement of senior managers has been noted previously by others (Hale et al., 2010; van Kampen, et al., 2023), middle managers have also been shown to play an important role in the translation of other management practices (Spring and Unterhitzenberger, 2022), including those related to safety (Karanikas et al., 2022).

Second, translation success appears to be more likely in small discrete business units rather than across large organizations, and where resources are actively made available. Third, translations could be more successful when the intervention is integrated into existing work practices rather than being an additional task.

Last, 'translation competence' (i.e., the ability to "translate practices and ideas between organizational contexts in ways that increase the probability of achieving organizational ends, p299" Røvik, 2016) could be incorporated into the training frameworks of professional bodies (e.g., International Network of Safety & Health Professional Organisations, Institution of Occupational Safety and Health, American Society of Safety Professionals, Australian Institute of Health & Safety). Drawn from the analytical framework deployed in this study, translation competence requires a thorough knowledge of (i) the source and the translatability of the intervention, (ii) the transformability of the intervention in the new setting, (iii) those factors that may influence these processes, and (iv) the translation rules. This would serve to improve the

success rate of safety interventions in addressing global safety challenges.

5.6. Limitations and future work

This was an exploratory study into the processes by which managers with OSH responsibilities in their organization translate OSH practices from one organizational setting into another. It deployed a set of concepts that have hitherto been sparingly investigated empirically, and not at all in safety. There are inevitably some limitations. First, the limited number of interventions considered does not afford the generalizability of the findings. Although the case examples included in our study are illustrative of commonly occurring safety interventions (Van Kampen, et al., 2023), their diversity makes direct comparisons between interventions impossible. However, their analysis demonstrated that it is possible to deconstruct interventions to identify common characteristics relating to levels of complexity, embeddedness and explicitness. If this deconstruction process were applied to several interventions, then comparison of their potential for translation would be possible.

Moreover, as data were obtained from single respondents in a single extended interview, without the opportunity to verify or triangulate the information obtained, we cannot guarantee that the respondents in their retrospective accounts of interventions recalled the details of each case entirely and accurately (Roese and Vohs, 2012). However, each narrative account demonstrated a clearly perceived difference in the performance of an intervention in one context from its performance in another, sometimes after many years had elapsed. This variation in performance of an intervention in different work settings is widely recognised (Nielsen et al., 2010; Nielsen and Miraglia, 2017), not only with safety interventions (Pilbeam et al., 2019), but also with interventions to improve occupational health, specifically musculoskeletal disorders (Whysall, et al., 2006).

Moreover, the research draws only on interviews, and a full consideration of the notion of translation of safety interventions from one setting to another should perhaps take into account a broader range of empirical data, in particular ethnographic accounts of how these interventions were introduced (Lamb and Currie, 2011). However, we do highlight that the interviewees were experienced, knowledgeable and high-status OSH professionals (Hale et al., 2010) and able to give detailed accounts of their own experience of introducing new safety interventions into different organizational settings.

The results of this study suggest several opportunities to explore further the application of translation theory in the field of safety science. First, in contrast to the cross-sectional design of this study, longitudinal research of the translation of safety interventions from one setting to another could allow a closer examination of the microprocesses associated with the translation and transformation of an intervention during transfer. This would permit the further elaboration of the conceptual model presented in Fig. 1, increasing the likelihood of future translation success by identifying features within commonly used safety interventions that make them more or less translatable. Also, instead of focusing on interventions belonging to the administrative class of controls, future studies could focus on the translation of interventions at the higher levels of the hierarchy of control (e.g., engineering, substitution and elimination) to discover whether these are more or less easy to translate from one setting to another.

Furthermore, as the examples reported in this paper illustrate the transfer of interventions between organizations, future studies could examine the transfer of safety interventions between sectors, and the subsequent deployment from the sector level to the organizational level, as a vehicle for encouraging cross-sector learning. Examples of similar studies in other disciplines include the work by Morris and Lancaster (2005) who examined the translation of lean manufacturing processes from the automotive industry into construction in the UK, and Nielsen et al. (2020) who investigated the influence of the interplay between field (sector) and organization on the translation of leadership development programmes in Danish municipalities.

6. Conclusion

Interventions to improve safety performance are not always easily and successfully transferred from one organizational setting to another. This paper is the first to apply a conceptual framework developed from translation theory to empirically investigate this particular phenomenon, and thereby improve our understanding of this seemingly common but underexplored safety practice.

Six of the eight different safety interventions for which there were complete data sets shared the same characteristics of low complexity, low embeddedness and high explicitness making them more translatable, although not necessarily more effective in influencing safety performance following transfer. Also, the successful interventions examined in this study had a high technical component but also were permitted a high level of interpretive viability allowing some modification between settings making them more transformable.

Contextual factors that supported successful translation and transformation were senior management support, adequacy of resourcing and targeted application to a discrete business unit. Interventions that were an addition to existing practices were less likely to be successfully translated. Considering the insights gained by applying the translation theory to safety interventions, we recommend considering the possible value and development of translation competence amongst safety professionals to increase the success rate of safety interventions and so reduce the number of people adversely affected by work.

CRediT authorship contribution statement

Colin Pilbeam: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Nektarios Karanikas:** Writing – review & editing, Visualization, Resources, Methodology, Funding acquisition, Conceptualization.

Declaration of Competing Interest

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

Acknowledgements:

This work was part of a research project funded by the Lloyds Register Foundation, London, UK.

Appendix A

Interview questions

1) Please describe the safety intervention.
   - What is its purpose (what was the intent of the implementation)?
   - What are the basic features / elements / characteristics of the intervention?
   - How does it achieve this outcome?
2) Please describe the organizational context from which the intervention was sourced
   - What are the most important / salient characteristics of this context?
   - How well did the intervention work in this context? Why?
   - How embedded was the intervention in the original context?
3) Please describe the organizational context in which the intervention was applied
   - What are the most important / salient characteristics of this new context?

- Why was the intervention applied in this new context?
- How well did the intervention work in this context? Why?
- How does this context differ from the first one?
- How well was the intervention integrated into the new context?

4) To what degree was the safety intervention changed to fit the new context? what was changed?
- What contextual factors did you consider to be important in making any changes? Why these?
- Did the changes occur during the design or during the implementation?
- Who was involved in the changes?

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 organization you work for, changed the processes for implementing safety interventions in new settings?
7) From your perspective, why are/were some interventions more effective in some settings than in others, in general?

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Effective transfer of safety interventions within and between organizations: Leveraging translation theory to achieve improved outcomes

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2023-12-01

Pilbeam C, Karanikas N. (2023) Effective transfer of safety interventions within and between organizations: leveraging translation theory to achieve improved outcomes. Safety Science, Volume 168, December 2023, Article number 106318

https://doi.org/10.1016/j.ssci.2023.106318