Journal of Safety Research 98 (2026) 55–68

Contents lists available at ScienceDirect

Journal of Safety Research

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

Safety clutter: An attribute-based conceptualization and taxonomy for diagnosis

Yaqoob Raheemy [a,*], Matthew R. Hallowell [a], Helen Lingard [b], Fred Sherratt [a,1]

[a] Construction Safety Research Alliance, University of Colorado at Boulder, Boulder, Colorado, CO 80309, USA
[b] School of Property, Construction and Project Management, RMIT University, GPO Box 2476, Melbourne, VIC 3001, Australia

ARTICLE INFO

Keywords:
Construction safety
Safety clutter
Safety management
Serious injuries and fatalities

ABSTRACT

Introduction: Serious injuries and fatalities (SIF) in construction have plateaued despite decades of investment in safety management systems. Many organizations contend with expanding safety processes that feel impractical, duplicative, and weakly connected to operational risk control. This has raised concern that some safety effort functions as "safety clutter:" work that consumes time and resources without improving safety. Yet, without an empirical conceptualization and classification, clutter is hard to diagnose and remove safely. *Method:* This study addresses this gap by conceptualizing safety clutter and developing a taxonomy for construction. Three expert focus groups with experienced construction safety practitioners were conducted, along with rapid ethnography across 11 active jobsites. Thematic analysis was applied to conceptualize clutter and organize recurring patterns into clear categories. Triangulation between focus-group findings and rapid ethnography was then used to refine and validate category boundaries and definitions. *Results:* Safety clutter is best understood as waste within a safety effort that, as implemented, consumes attention, effort, and resources without improving the safety of work. Two overarching forms are identified: conditional clutter, where an otherwise useful effort becomes clutter because of its design, delivery, access, or use; and pure clutter, where the effort is inherently low value. Conditional clutter comprises three families (Excessive, Irrelevant, Inaccessible), while pure clutter comprises one (Invalid). Across these families, 11 clutter types are defined with diagnostic cues and empirical examples. *Conclusions and practical applications:* The taxonomy provides a shared language and supports more disciplined decluttering by clarifying what the waste is, where it resides, and how it can be recognized in practice.

1. Introduction

Despite significant efforts, the rate of serious injuries and fatalities (SIFs) in the North American construction industry remains alarmingly high and seemingly intractable (Bayona et al., 2024, 2025). This persistent plateau has drawn increasing attention from researchers seeking new ways to tackle and mitigate SIFs. In response, numerous studies have emerged that focus explicitly on SIF prevention (Selleck et al., 2023), reflecting a growing recognition that traditional safety approaches have not been sufficient to drive down SIFs (Dekker, 2017). There is now broad agreement in the literature that SIFs must be studied and managed differently from less severe events (e.g., Bayona et al., 2024; Busch et al., 2021).

Recent literature from the safety risk sciences has more specifically suggested that fatalities in construction often stem from high-risk activities where controls are undefined, ineffective, or inadequate (Selleck et al., 2023, 2022; Lingard et al., 2021). A notable segment of this work concludes that attention should be shifted toward the reliability and effectiveness of controls, and that controls intended to eliminate or mitigate SIFs must be specifically designed, clearly defined, and closely aligned with high-risk activities (Selleck et al., 2022, 2023; Busch et al., 2021; Selleck & Cattani, 2019). Within the energy-based safety framework, the concept of direct control has been developed to target high-energy hazards (i.e., high-risk activities) and mitigate SIF events. Bayona et al. (2024) further demonstrated that SIFs in construction predominantly arise from two conditions: work plans that are absent or not followed, and direct controls that are absent or insufficient. These findings suggest that addressing the SIF plateau requires managing SIFs

* Corresponding author.
E-mail addresses: mohammadyaqoob.raheemy@colorado.edu (Y. Raheemy), Matthew.Hallowell@colorado.edu (M.R. Hallowell), helen.lingard@rmit.edu.au (H. Lingard), fred@nemesisv.co.uk (F. Sherratt).
[1] This author was formerly affiliated with the Construction Safety Research Alliance at the University of Colorado Boulder.

https://doi.org/10.1016/j.jsr.2026.06.005
Received 22 March 2026; Received in revised form 17 May 2026; Accepted 4 June 2026
Available online 15 June 2026

differently, with a stronger focus on SIF-specific work planning and direct controls.

Alongside these efforts to design more effective SIF-focused measures, there is growing recognition that the broader safety management system itself may impede progress. This is particularly important for SIF prevention, because the effort required to plan, implement, and verify effective controls for high-risk activities competes directly with other safety demands for limited organizational attention and resources. Contemporary safety systems have been criticized as wasteful, impractical, and only weakly connected to the realities of operational work (Bieder & Bourrier, 2013; Dekker, 2017; Rae et al., 2018). This concern is captured by an emerging concept in safety research known as "safety clutter." Safety clutter is described as the accumulation of activities, actions, and paperwork carried out under the guise of safety that consumes resources without adding value to operational safety (Rae et al., 2018).

Safety clutter can interfere with SIF prevention in several ways. First, the resulting overgrowth of safety activities strains resources, dilutes focus on critical risk controls, and may even erode frontline engagement (Lim et al., 2025; Størkersen & Fyhn, 2024; Dekker, 2014). Simply stated, clutter consumes time and attention that could otherwise be directed toward planning and implementing SIF-focused measures. For example, extensive paperwork, multiple overlapping meetings, and duplicated reporting requirements divert workers' and supervisors' focus away from what matters most (i.e., controlling high-risk activities; Dekker, 2014; Størkersen et al., 2020).

Additionally, clutter can foster procedural complacency, where safety becomes equated with "doing the paperwork" rather than actively interrogating whether controls are adequate for the specific risks at hand (Hale, 1990; Dekker, 2017). In such environments, the presence of documentation may create a false sense of security even when controls for SIF exposures are absent, ineffective, or poorly specified (Hutchinson et al., 2024; Rae & Provan, 2019).

Moreover, clutter can undermine worker autonomy and engagement. Excessive compliance-based requirements limit workers' ability to make informed, situational decisions about risk, and can generate frustration and cynicism toward safety initiatives more generally (Hale & Swuste, 1998; Størkersen & Fyhn, 2024). Over time, this can weaken the very conversations and critical thinking needed to recognize and manage SIF precursors. Finally, by masking which safety activities are genuinely protective, and which are merely symbolic, clutter makes it harder for organizations to prioritize the design, implementation, and maintenance of SIF-focused controls.

Although more evidence is needed to establish a direct causal relationship between safety clutter and SIFs, safety clutter clearly creates capacity losses that can undermine SIF prevention (Dekker, 2025; Størkersen & Fyhn, 2024; Størkersen et al., 2020). Therefore, there is a need for careful decluttering by eliminating or redesigning activities that do not contribute to meaningful risk reduction in favor of those that do. However, despite growing acknowledgment that safety clutter poses a serious challenge to effective safety management (Lim et al., 2025), it remains under-theorized in construction, with no clear consensus on how it is conceptualized, what its attributes are, or how different forms and types of clutter can be distinguished and classified in a way that supports decision making. This lack of clarity creates a practical risk. Organizations may either maintain ineffective practices or remove elements of safety management too broadly and inadvertently weaken protective functions (Lim et al., 2025). In this paper, we address this gap by asking two questions: (1) how do construction safety practitioners conceptualize and describe safety clutter? and (2) what forms, families, and types of safety clutter can be distinguished, and how can they be defined and classified to support more effective decluttering efforts?

This paper contributes to safety research in two ways. First, it provides an empirically grounded conceptualization of safety clutter in the construction industry that treats clutter as an attribute of implementation. In other words, clutter is not a label for safety activities as a whole. It is the waste inside safety effort that, as implemented, consumes resources without improving the safety of work. Second, it develops a taxonomy that organizes those waste features into forms, families, and types, and defines each type using boundary cues so clutter can be identified consistently in practice rather than argued about abstractly.

2. Literature review

The concept of safety clutter is a relatively new and still emerging idea within safety research, with very limited work exploring it directly. To date, Rae et al. (2018) remains the foundational peer-reviewed study that explicitly articulated and examined the concept of safety clutter. However, while the label is new, the underlying concerns are not. A range of adjacent concepts and empirical studies in safety science and related fields have, in different ways, pointed to phenomena that closely resemble safety clutter, such as excessive bureaucracy and paperwork, meaningless compliance activities, low-value safety work, and wasteful or ineffective safety practices that consume resources without improving safety performance. In this sense, there is a broader literature that, although not framed explicitly in terms of safety clutter, captures important aspects of what clutter looks like, how it emerges, and what its consequences might be. In the sections that follow, we draw on this work to situate safety clutter within existing debates and to build a stronger conceptual foundation for understanding safety clutter in construction.

2.1. Safety clutter in the existing safety literature

Rae et al. (2018, p.2) provided a theoretical definition of safety clutter as "the accumulation of safety procedures, documents, roles, and activities that are performed in the name of safety, but do not contribute to the safety of operational work." Their study sets out three mechanisms that contribute to clutter: duplication, generalization, and over-specification. Duplication is conceptualized as doing multiple similar safety activities that serve the same function without adding additional value. Generalization is the application of safety rules beyond their relevant context, such as requiring administrative staff to follow the same protocols as high-risk field workers. Over-specification refers to situations in which safety measures become overly detailed and proceduralized, turning simple safety practices into bureaucratic burdens. Each of these mechanisms adds layers of safety work that do not necessarily improve safety outcomes and can instead create inefficiencies and frustration. Rae et al. (2018) also identified two key asymmetries with considerable influence on safety clutter: (1) it is easier to add new safety tasks than to remove existing ones; and (2) safety incidents or external pressures frequently trigger the addition of new safety work, but there are rare opportunities to assess and eliminate unnecessary safety work.

Although the term safety clutter is relatively new, the underlying concern is not. A broader body of work has discussed closely related issues by describing the attributes and effects of low-value or excessive safety effort. For example, Hale and Swuste (1998) discussed how overly compliance-based safety can limit worker autonomy to make informed, situational decisions when addressing safety risks, which can result in unintended consequences. Related work also suggests that this approach can draw organizations into maintaining extensive documentation and meeting regulatory benchmarks rather than addressing the risks most relevant to operational safety (Hale & Borys, 2013). While not labeled as safety clutter at the time, this line of work aligns closely with Rae et al.'s (2018) definition.

More recent studies have made similar observations. Although the term safety clutter was not adopted, Størkersen and Fyhn (2024) argued that safety management has become increasingly focused on compliance through procedural adherence, documentation, and audits, which has contributed to a proliferation of tasks that primarily serve administrative functions rather than improving safety outcomes. They describe such activities as "bullshit tasks." In the safety space, these tasks can

include redundant paperwork, unnecessary meetings, and overly procedural compliance, which frontline workers often view as having little value (Størkersen & Fyhn, 2024).

This theme also appears in literature on the bureaucratization of safety. The proliferation of paperwork and policies has been widely discussed and, in some studies, treated as a form of safety clutter itself (Størkersen et al., 2020; Dekker, 2014). Dekker (2014), for instance, argued that bureaucratic burdens such as rules, policies, and administrative work consume a significant portion of workers' and managers' time, shifting attention toward compliance-related activity rather than meaningful risk mitigation, and reducing operational efficiency. This shift has been linked to procedural complacency, where safety becomes equated with following rules rather than actively identifying and addressing hazards (Hale, 1990; Dekker, 2017). Related work similarly notes that extensive management systems and reporting procedures can consume time that would otherwise be spent on the "real job" (Størkersen & Fyhn, 2024; Størkersen et al., 2020).

Regulatory context has also been discussed as a contributor to these dynamics. The concept of functional regulation has been criticized as a driver of over-regulation, clutter, and bureaucracy in the safety space. Functional regulation is a deregulatory approach that gives organizations responsibility for implementing systems that result in safe operations, while governments verify that such systems exist. Le Coze (2017) argued that regulatory overreach arising from this process can contribute to the accumulation of safety paperwork and increased focus on audits and compliance checks, many of which have not been validated. This may also lead to more managerial work rather than attention to the technical analysis of safety–critical systems (Johnson, 2014). Other studies have likewise noted that clutter can grow in industries where certification and regulatory oversight strengthen documentation demands, prompting organizations to demonstrate compliance through paperwork rather than through proactive approaches (Dekker, 2014; Almklov et al., 2014; Størkersen et al., 2020).

Alongside these conceptual discussions, several empirical studies have examined specific safety tasks that are experienced as low-value or whose effectiveness has not been validated. Rae and Provan (2019), for example, showed that administrative tasks form a considerable portion of safety work in organizations and have increased over time, while the question of whether administrative safety supports or hinders operational safety remains unresolved. In a questionnaire study among construction workers, Cheng et al. (2012) found that "accident statistical analysis" and "safety audits" were ranked as low importance from field perspectives. Biggs et al. (2013) similarly reported that excessive paperwork was cited as a major barrier to developing an effective safety culture. Wang et al. (2021) also noted that while more stringent safety policy can reduce workplace accidents, excessive regulation may lead to diminishing returns and a shift toward procedural compliance rather than proactive safety management.

While safety clutter may not be a long-established, clearly defined concept, it has been present in safety research for several decades under various guises. Historically, many studies suggest the need to critically assess safety systems to remove unnecessary and excessive work, such as documentation, paperwork, and redundant activities, so that resources can be focused on actions or activities that genuinely contribute to operational safety and enhance productivity (Rae et al., 2018; Dekker, 2017). Yet since Rae et al. (2018) sought to crystallize the concept and define it, there have been relatively few peer-reviewed studies undertaken with a clear focus on safety clutter and the goal of its identification and removal.

Importantly, Rae et al. (2018) conceptualized safety clutter primarily at the level of systems and mechanisms, offering a theoretical explanation for how clutter accumulates and persists through processes such as duplication, generalization, and over-specification. While this work was essential in naming the problem and distinguishing safety work from the safety of work, it did not seek to operationalize clutter for use in day-to-day decision making. In particular, there is limited guidance in existing literature on how to identify clutter within specific safety activities, how to distinguish different forms of waste embedded in implementation, or how to decide what can be redesigned versus what should be removed. As a result, safety clutter remains a compelling concept but a difficult one to diagnose consistently in practice.

2.2. Clutter and inefficiency

The above discussion points to a critical pattern in safety clutter, namely that safety effort can grow without a matching gain in operational safety. More specifically, more investment can be made in the work of safety without a corresponding improvement in the safety of work. That gap between what is invested and what is gained points directly to inefficiency.

Inefficiency is commonly understood as the gap between how well a system is actually performing and how well it could perform with the same resources (Leibenstein, 1966). In economic and organizational theory, this idea is used to describe how internal factors such as organizational slack, weak motivation, and suboptimal management practices can cause firms to operate inside, rather than on, their efficiency frontier (Perelman, 2011). In other words, inefficiency emerges when time, effort, and other resources are absorbed by activities that do not meaningfully contribute to the system's core objectives, even though better performance would be technically possible.

Within this framing, safety clutter can be seen as an inefficiency issue embedded inside safety management systems. Rae and Provan (2019) position clutter as an efficiency problem by drawing a clear distinction between safety work, which consists of the activities organizations perform to manage and demonstrate safety, and the safety of work, which concerns the actual prevention of harm in day-to-day operations. Safety clutter arises where safety work consumes resources without improving the safety of work. In this sense, inefficiency is not simply a side effect of clutter; it is its functional signature.

Recent work by Lim et al. (2025) extends this view in construction by showing that cluttered practices can be grouped as misintended, excessive, and irrelevant activities. Misintended practices add no genuine safety value and persist mainly as tick-box or compliance demonstrations. Excessive practices may have an underlying purpose but are implemented to such an extent that they overwhelm users. Irrelevant practices are disconnected from actual work and risk. Across these categories, the outcome is consistent. Work is done and resources are consumed, but the safety of work does not change, which is what makes clutter an inefficiency problem.

Safety clutter and inefficiency can reinforce each other over time. Studies of functional, or goal-based, regulation show how complex regulatory and client environments encourage organizations to build increasingly elaborate internal safety bureaucracies, often focused on documentation and auditability rather than on direct risk control (Le Coze, 2017, 2019; Størkersen et al., 2020). Lim et al. (2025) make this more visible by describing how clutter can arise from interacting sources at three levels: contextual factors (e.g., overlapping regulations, client audits), system responses (e.g., defensive documentation and blame-shifting), and implementation practices (e.g., accumulation without review, misinterpretation of regulatory intent). All of these factors can create a loop where problems trigger more safety work, and that added work further absorbs capacity while leaving the underlying gap between safety work and the safety of work unresolved.

Recognizing safety clutter as a structural form of inefficiency inside safety management systems has important implications. Viewed through this lens, decluttering safety is not simply a matter of reducing annoyance or paperwork. It is a way of reclaiming attention, effort, and resources from low-value safety work so they can be redirected toward safety work that improves the safety of work. In this study, inefficiency is not treated as a separate construct, but as the evaluative lens through which safety clutter is recognized, namely the presence of safety effort that absorbs resources without producing a corresponding improvement

in the safety of work.

2.3. Clutter, inefficiency, and lean

The gap between what is invested and what is gained creates a practical problem for research and practice. If safety clutter is waste, then the next question is how that waste can be seen clearly enough to describe it, study it, and reduce it. Safety research has long recognized that some safety work can lose value, but it has had fewer shared tools for naming different forms of waste within a management system. This is where lean becomes useful, not as a method to import into safety, but as a way to learn how another field has made waste visible and actionable. The logic for drawing on lean in a discussion of clutter is clear because they share the same basic concern. Both focus on work that consumes resources without producing a meaningful return. Lean frames this as non-value-adding work and waste, while safety clutter focuses on safety related work that does not improve the safety of operational work (Holweg, 2007; Rae & Provan, 2019).

Lean originated at Toyota as an alternative to traditional mass production, with the aim of improving performance by identifying and eliminating waste in everyday work (Holweg, 2007; Womack et al., 1990). In lean, waste is understood as work that consumes resources without adding value from the customer's perspective (Rahman et al., 2010; Taj, 2008; Cudney et al., 2013). Lean is therefore built around a simple discipline. It does not assume that all work is valuable just because it is done. It treats waste as something that can be detected in how work flows, how it is designed, and what it demands from people (Cudney et al., 2013; 2015; Holweg, 2007).

Lean provides a structured way of thinking about waste that can inspire the study of safety clutter. A central lens within lean is the 3M framework, which includes Muda, Muri, and Mura (Buckley et al., 2017). Muda refers to activities that do not add value and can be eliminated without affecting the process. In a safety context, this can be seen when time is spent completing steps that add no usable information or change nothing about the safety of work, such as duplicate entries or reports. Muri refers to overburden, where people or systems are pushed beyond capacity (Buckley et al., 2017). In safety practice, this can be seen when the volume or complexity of safety processes overwhelms supervisors and crews, even though the intent of the process may be reasonable (Buckley et al., 2017). Mura refers to unevenness and irregularity in work (Buckley et al., 2017). In safety systems, this can be seen when safety requirements arrive in spikes rather than steady flow, such as surges of paperwork before audits or end-of-month reporting cycles that interrupt day-to-day work and create stop-start patterns in the safety effort (Buckley et al., 2017).

Lean also helps illustrate, in practical terms, how different shapes of waste can resemble what safety clutter looks like in the field. Extra processing waste can be seen when safety elements become overcomplicated, requiring more steps, more navigation, or more detail than is needed to be effective (Pestana & Gambatese, 2016; Rae et al., 2018; Lim et al., 2025). Inventory and overproduction wastes can be seen when safety systems generate more outputs than anyone can use, or when multiple documents and procedures cover the same issue and add volume without adding value (Pestana & Gambatese, 2016). Defects waste can be seen when safety practices persist even after their value has expired, so work continues to be done to correct or maintain something that no longer fits the current context (Pestana & Gambatese, 2016).

This perspective is important because it suggests that waste is not a single condition, but a set of distinguishable forms that arise through different design and implementation features of work. These examples matter because the forms can be observed in how work is designed and carried out. It has recognizable forms, and those forms often become visible in how safety effort is designed and repeated (Holweg, 2007; Rae et al., 2018). Therefore, lean is relevant because it offers a way to think about waste as something built into the design and flow of work, not only as an outcome (Holweg, 2007). This is the same basic move that the safety clutter concept makes, because it focuses attention on where effort is consumed without benefit and on how that waste can be recognized in practice (Rae & Provan, 2019; Rae et al. 2018). Lean is therefore used here as an inspirational backdrop for studying clutter, because it shows how waste can be treated as observable, describable, and reducible (Holweg 2007).

Lean is not introduced here as an intervention framework or prescriptive solution for safety management, but as an illustrative example of how another field has made waste visible, classifiable, and discussable in everyday work.

2.4. Lean and safety

Although the safety clutter literature remains relatively limited, the broader idea of identifying and removing low-value work is well established in other domains. One of the most developed examples is lean thinking, which provides structured ways to conceptualize, classify, and identify waste within systems and processes. Interestingly, lean principles have been applied in the safety space, although typically with a different emphasis from that of safety clutter. In existing literature, accidents and injuries are treated as a form of waste because they involve human suffering, compensation costs, lost productivity, and disruption to workflow (Saurin et al., 2008; Pestana & Gambatese, 2016). Unsafe acts, unsafe conditions, and their consequences are therefore interpreted primarily as Muda within the production system (Cudney et al., 2013). In other words, the waste that lean seeks to remove is usually defined as incidents and health outcomes, rather than non–value-adding safety activities themselves. Table 1 summarizes how different types of waste have been conceptualized in the safety space.

There is a notable body of work unpacking the interface between lean practices and safety management. Numerous studies suggest that lean principles can align with safety by addressing inefficiencies that contribute to hazardous conditions. For example, applying 5S or 6S has been shown to improve housekeeping, reduce unnecessary motion, and decrease slip, trip, and fall hazards on construction sites (Antillón et al., 2011; Pestana & Gambatese, 2016). Lean construction tools such as the

Table 1
Types of waste and associated safety considerations (Pestana & Gambatese, 2016).

Waste Type	Description	Safety Implications
Defects	Failure to meet customers' expectations or conform to specification.	Additional production and correction time increase workers' exposure to hazards.
Overproduction	Producing more than needed, faster than needed, or before it is needed.	Excessive material handling increases risk due to overexertion, extra handling, and unnecessary machine interaction.
Transportation	Additional and unproductive movement of products or materials.	Each additional movement of materials increases the risk of harm to personnel.
Waiting	Periods of inactivity; unproductive time spent waiting (e.g., during workflow interruptions).	Delays may contribute to rushed work, schedule compression, or disruption, which can increase safety risk.
Inventory	Buildup in excess of what is needed.	Frequent handling of inventory increases the risk of injury.
Motion	Extra steps taken by workers due to inefficient or cumbersome processes.	Inefficient and cumbersome processes may expose workers to additional hazards.
Over-processing	Unnecessary steps in operations, such as using a more expensive resource or double-checking.	Additional process steps increase time on task and may increase exposure to hazards.
Making-do	Starting or continuing a task without all standard inputs available.	Improvised access or work areas increase the likelihood of unsafe conditions and unnecessary risk.

Last Planner System can enhance pre-task planning and expose potential hazards before work begins (Ballard, 2000; Pestana & Gambatese, 2016). Survey-based studies often report that practitioners perceive lean practices as having a moderate to high positive impact on worker safety (Antillón et al., 2011; Saurin et al., 2008; Pestana & Gambatese 2016).

On the other side, another body of work, especially in industrial sociology and work organization research, has raised concerns that lean can also have detrimental safety effects in some settings. The literature argues that lean initiatives may reduce slack and increase work intensity, time pressure, and psychosocial demands, which can contribute to stress, musculoskeletal strain, and injury risk when worker well-being is not explicitly protected (Hasle et al., 2012; Longoni et al., 2013). Importantly, this critique does not reject efficiency aims in principle, but it emphasizes a practical risk in how lean is sometimes implemented.

From the standpoint of safety clutter, the lean literature reveals both a connection and a gap. On one hand, traditional lean principles share a common concern with waste and non–value-adding activities. This is conceptually consistent with decluttering safety, because clutter can be seen as waste in the safety system that consumes resources without adding value to the safety of work. Lean provides a systematic foundation for distinguishing value from waste by offering clear definitions, types, and classifications of waste, and by outlining methods for identifying it. On the other hand, most lean–safety research has focused on accidents and injuries as waste, rather than on waste within safety management itself. In practical terms, there is very limited empirical work that explicitly applies or investigates how different types of waste such as Muda, Muri, or Mura might arise from a cluttered safety system.

Importantly, the present study does not apply lean principles or waste typologies to safety management but draws on the lean literature to illustrate how waste has been conceptualized and classified in other domains. In this sense, lean provides a useful caution as well as a vocabulary, because it shows both the promise of systematic waste reduction and the potential for adverse effects when efficiency efforts are pursued without a clear account of what is value creating for safe work (Koukoulaki, 2014; Longoni et al., 2013).

3. Point of departure

The literature reviewed above points in a clear direction but leaves a clear diagnostic gap. Safety clutter is increasingly discussed as a problem in safety management, but it remains rarely explored in construction. While prior work has shown that safety systems can accumulate layers of requirements that persist and consume resources, there is still limited clarity in construction on how clutter is described in practice and how it can be identified in a disciplined way.

More specifically, what is not yet well understood is how construction safety practitioners describe clutter, what attributes and cues are used to judge when a safety activity is experienced as low value or disconnected from operational risk, and what distinct forms of clutter can be distinguished in a way that supports careful decluttering.

Therefore, this study is designed to address this gap in construction by conducting a multi-method qualitative study using focus groups and rapid ethnography. Specifically, this study asks: (a) how do construction safety practitioners conceptualize and describe safety clutter; and (b) what forms, families, and types of safety clutter can be distinguished, and how can they be defined and illustrated in a way that supports future decluttering efforts.

4. Research methods and analysis

A multi-method approach, including focus groups and rapid ethnography, was employed to achieve the research objectives. Because safety clutter is newly theorized and explored in practice, this design was important for developing a practice-based understanding of how clutter is perceived and experienced across different contexts, an understanding that could not be accessed through a single method alone (Carter et al., 2014; Thurmond, 2001). The focus groups provided structured, collective insight into how safety clutter is conceptualized, what cues signal it, and what attributes distinguish it from safety work that adds value. The rapid ethnographic work on active jobsites then grounded these ideas in everyday practice by observing safety activities as they happened and discussing how they were carried out and experienced in real time. Finally, the two methods were triangulated to strengthen coherence and rigor by checking whether the same clutter attributes, cues, and candidate types appeared across both datasets (Thurmond, 2001). In the following sections, we describe the design, sampling, data collection, and analysis procedures for each method, and outline the strategies used to enhance validity and reliability.

4.1. Method 1 – focus groups

4.1.1. Sampling and recruitment

Focus groups were conducted to begin contextualizing and understanding safety clutter. A focus group is a well-structured method of obtaining qualitative data through face-to-face group discussions with a carefully selected group of people, concentrating on a specific issue (Bhandari & Hallowell, 2021; Folch-Lyon & Trost, 1981; Breen, 2006). These discussions are moderated by one or more facilitators who guide the conversation and shape the group dynamic to yield meaningful data (Folch-Lyon & Trost, 1981; Bhandari & Hallowell, 2021).

In this study, three focus group sessions were held with an expert panel of construction safety professionals. As recommended by Hallowell and Gambatese (2010) and Gambatese et al. (2008), expert panels typically consist of construction professionals with extensive experience in the relevant topic area. The expert panel for this study was assembled from members of the Construction Safety Research Alliance (CSRA), following the minimum requirements proposed by Hallowell and Gambatese (2010): (1) a minimum of seven years of professional experience in the construction industry, (2) at least four years of experience in construction health and safety, and (3) a bachelor's degree or higher.

A total of 29 experts participated in the focus groups, contributing 544 years of construction experience in aggregate. Participants represented a wide cross-section of the industry, including commercial building, infrastructure, utilities, oil and gas, industrial, manufacturing, and general construction sectors, with roles spanning contractors, clients and owners, insurance, specialist suppliers, and engineering and construction management. This breadth of representation strengthens the basis for considering the findings relevant across multiple construction settings, rather than limited to a single sector or project type.

4.1.2. Focus group procedure

The discussions were structured around questions aligned with the study's objectives, including how safety clutter is conceptualized in construction, what makes an activity clutter, and what attributes distinguish clutter from safety work that adds value. Participants were first prompted to describe safety activities they encounter in practice and then guided through consistent follow-up questions designed to surface the attributes of clutter. Specifically, participants were asked to: (1) describe the activity as it is carried out, (2) explain the purpose it is intended to serve, (3) describe how it is implemented in practice and what it requires from users, and (4) explain what, in their view, makes it clutter, including the cues that signal it as clutter. These prompts were designed to capture how safety clutter is understood and conceptualized, identify the attributes that make an activity clutter, and generate comparable descriptions that could later be used for definition-building and classification.

Two experienced academics facilitated all sessions using a semi-structured script. Facilitators probed for clarification, invited contrasting and disconfirming examples, and periodically summarized key points back to the group to check shared understanding. Each of the three focus group sessions lasted approximately seven hours and was

conducted on a separate date. Each session began with a brief recap of the previous session, and the day was organized into short blocks with planned breaks to manage fatigue. Facilitators periodically summarized key points and re-anchored discussion to the guiding prompts to maintain consistency. All sessions were audio-recorded and supplemented with detailed facilitator notes to support subsequent analysis.

4.1.3. Bias mitigation

Following the guidance of Bhandari and Hallowell (2021), potential cognitive and procedural biases relevant to expert focus groups were identified and explicit controls were incorporated into the study design. The mitigations targeted those biases most likely to arise in group discussion and addressed them through structured procedures and ground rules. Table 2 summarizes the key anticipated biases and the main strategies used to mitigate them in this study.

4.2. Method 2 – Rapid ethnography

4.2.1. Purpose and approach

To capture how safety clutter manifested on jobsites among fieldworkers, and to provide insights that complemented the focus groups, rapid ethnography was conducted. Rapid ethnography is a qualitative approach designed to generate rich, contextual understanding of people's behaviors, practices, and interactions within a specific setting (Vindrola-Padros, 2021; Oswald & Lingard, 2024). In simple terms, it supports understanding work as it unfolds by spending time alongside those doing it. Ethnographic methodologies have also been advanced for construction research, supporting close engagement with knowing, practice, and intervention on projects (Pink et al., 2010).

Ethnographic approaches can surface insights that often remain hidden in more traditional research designs (Oswald & Lingard, 2024; Oswald et al., 2019). A pilot phase was conducted on two jobsites in Colorado, USA. The pilot suggested that safety clutter was not always easy for fieldworkers to describe when asked in abstract terms. Difficulties with concept clarification and recall indicated that a more immersive approach would produce richer and more accurate accounts. Shadowing crews during day-to-day work supported discussion that was grounded in real tasks and safety activities rather than hypothetical examples. Ethnographic research in the U.S. construction industry has also examined safety in the field over a long period, including early work on ironworkers' reactions to fear and danger (Haas, 1977). Ethnographic research has also examined rule violations in relation to safety, as well as the gap between work practices in documents and in the field (Iszatt-White, 2007; Borys, 2009). For example, Provan et al. (2019) examined the work of safety among safety professionals using ethnographic methods.

Table 2
Bias mitigation.

Potential bias	Mitigation strategies
Dominance effect	Facilitators set ground rules about equal participation, invited quieter members to speak, and redirected discussion when any single participant began to dominate.
Confirmation (myside) bias	Questions were framed broadly and neutrally, facilitators explored for disconfirming examples, and contrasting views were invited and recorded.
Recency bias	Facilitators encouraged participants to reflect on both recent and earlier experiences, and end-of-session summaries revisited key points from the full discussion rather than only the last topics.
Framing effect	Questions were introduced using simple, neutral language, and participants were encouraged to describe safety clutter in their own words before any tentative definitions were discussed.
Bandwagon effect	Facilitators emphasized that disagreement was expected and useful, regularly asked if anyone held a different view, and noted marginal perspectives rather than seeking convergence.

4.2.2. Data collection procedure

Rapid ethnography was conducted across 11 active construction jobsites and involved 26 participants, totaling approximately 200 h of field engagement. Sites were selected purposively to capture variation in construction contexts and work arrangements. Sites included vertical commercial construction, utility work (gas, water, and electric transmission and distribution), and energy and infrastructure (oil and gas and power generation), across both contractor and owner contexts. Participants were recruited on site based on direct involvement in day-to-day work and safety activities. Roles included superintendents, supervisors, foremen and lead foremen, crew leads, safety personnel, a lead welder, and an electrician in a supervisory role.

Data collection in rapid ethnography commonly draws on multiple sources, including observation, informal interviewing, document review, and structured discussion (Vindrola Padros, 2021). In this study, data were collected primarily through direct observation and informal, in-the-moment conversations with fieldworkers. During each site visit, the researcher joined the crew at the start of the shift and remained with them through the end of the shift, repeating this full-shift shadowing across visits. Rather than limiting observation to pre-defined "safety moments," the researcher followed the normal flow of work and attended to any activities crews carried out across the day. This included routine production tasks as well as safety-related activities such as pre-task planning and briefings, permit processes, risk assessment practices, coordination discussions, and other safety interactions as they occurred in real time. Guided engagement was used to keep conversations aligned with the study objectives (Baker, 2006). Rather than asking fieldworkers directly to name "safety clutter," the researcher used context-based questions tied to activities that were already occurring on site. In this study, this involved asking workers to walk through what they were doing and why, including what the activity was, who was involved, when it was required, what it was intended to achieve, and what it took to complete in real terms (e.g., time, steps, approvals, tools, or systems). Follow-up questions were asked to explore how useful the activity was in their view, what parts felt unnecessary or disconnected from risk, and what signs suggested that the activity was creating burden without improving the safety of work. These prompts supported natural discussion of clutter cues and attributes while keeping the focus on work as done.

The data were collected using field notes. Detailed field notes were maintained throughout, capturing both what was observed and what was said, along with relevant context such as workflow patterns, site conditions, and interactions between roles that could help explain how clutter emerged and persisted (McCall, 1984). Notes were refined during breaks on site and expanded immediately after each visit, typically the same day, to strengthen accuracy and reduce reliance on later recall. This produced a stable record of observations and informal conversations that could be carried forward into analysis.

Rapid ethnography relies on short, intensive periods of field engagement, which makes the researcher's position and expectations especially influential on what is noticed, recorded, and interpreted. For this reason, reflexivity was treated as a core element of rigor in the ethnography (Finlay, 2002; Berger, 2015). In this study, all ethnographic observation and documentation were conducted by a single researcher across all site visits (Vindrola Padros, 2021). The researcher's practical background in construction safety supported access, rapport, and interpretation of work as done, which is important when observations must be made quickly and in real time. At the same time, that familiarity can increase the risk of taking routines for granted or prematurely labeling activities as clutter. To manage this risk, reflexive memos were kept alongside field notes to separate observed actions from interpretations, document assumptions as they emerged, and record alternative explanations or uncertainties for later checking (Emerson et al., 2011; Finlay, 2002). Data collection was concluded after observations at 11 sites because the dataset had reached thematic saturation; across successive visits, accounts and observations became repetitive

and no substantively new safety clutter attributes, cues, or types were identified (Saunders et al., 2018).

4.3. Research ethics

During all phases of this research, participants were provided with informed consent, and confidentiality measures were implemented to protect their privacy. The observational procedures and on-site engagements have received Institutional Review Board (IRB) approval from the Office of IRB at the University of Colorado Boulder (Protocol No. 24-0566).

4.4. Data analysis

The analysis produced two outputs: (a) a conceptualization of safety clutter grounded in practice, and (b) an attribute-based taxonomy that classifies recurring waste within safety effort. The data were analyzed in three stages. First, the focus group data were analyzed to understand how practitioners conceptualize clutter and what cues they use to recognize it. Second, the rapid ethnography field notes were analyzed to examine how the same cues and attributes appeared on jobsites in work as done. Third, the two datasets were compared through structured triangulation to refine definitions and tighten taxonomy boundaries.

Thematic analysis was conducted to analyze the qualitative data. Thematic analysis is a systematic approach used to identify and organize patterns of meaning within a qualitative dataset. It enables the interpretation of significant aspects of the phenomenon under investigation and provides flexibility for both inductive and deductive approaches to the data (Gupta et al., 2019). This study followed the guided process outlined by Braun and Clarke (2006).

4.4.1. Focus group analysis

The analysis process consisted of the following phases as per the guidance of Boyatzis (1998) and Gupta et al. (2019):

- The data were read and re-read to build familiarity with how participants described safety clutter and how they distinguished it from safety work that adds value.
- The data were coded by labeling segments that captured: (a) the safety activity being discussed, (b) the purpose it was intended to serve, (c) how it was implemented in practice, and (d) the cues used to judge it as clutter (i.e., what made it feel wasteful, low value, or disconnected from operational risk). Codes were revisited and refined as analysis progressed.
- Codes were grouped into themes and sub-themes that reflected how practitioners conceptualized clutter and the recurring attributes and cues that signaled clutter in practice.
- Themes were reviewed and refined to ensure coherence, and were then defined and named with attention to their boundaries and alignment with the full dataset.

The unit of analysis was the specific feature within a safety activity that participants described in detail (e.g., a form field, an approval step, a meeting segment, a system requirement, where and when an activity occurred, and what happened to its outputs). These features were grouped into types based on the main way waste was produced and the boundary cues that marked it. The types were then organized into forms using a simple rule: features were classified as conditional clutter when the waste could plausibly be reduced through changes in implementation (e.g., simplification, redesign, better timing, better targeting, improved access, or better handling of outputs), and as pure clutter when the waste persisted because the feature was incorrect or obsolete in the contexts examined. Disconfirming cases were actively sought throughout, including cases where a feature that looked repetitive or overdone nonetheless supported a meaningful discussion, decision, or action. Where such cases were identified, definitions and boundary cues were refined to ensure the types captured the waste mechanism rather than the activity category.

Coding and type development were carried out by two researchers. One researcher led the analysis, and the second researcher refined the coding and type definitions through iterative review with the research team. Disagreements on type assignment and boundary cases were discussed with the research team until consensus was reached. Lean concepts were used only after the initial themes were established, during the category-building and naming stage, to strengthen conceptual clarity and tighten category boundaries. Lean was not used to predetermine codes. Instead, it was used to support refinement by ensuring definitions captured how waste was produced within safety effort and that the classification could plausibly support practical decluttering.

4.4.2. Rapid ethnography analysis

Rapid ethnography field notes were analyzed using the same thematic logic. First, the notes were read in full and then re-read with attention to observed safety activities, how they were performed in context, and the cues that indicated low value or waste in the activity. Second, the data were coded inductively, with codes capturing both the activity itself and the contextual conditions that shaped how it was performed. Specifically, the notes were coded to capture how clutter was described in the field, the attributes used to describe clutter, and the cues or signals that workers and supervisors used when judging an activity as clutter. Third, the codes were grouped into relevant sub-themes and themes.

Rapid ethnography analysis was also carried out continuously alongside data collection, as visits progressed from site to site. This was done for two main reasons. First, it supported reflexivity by encouraging the ethnographer to record early interpretations, question assumptions, and note alternative explanations while observations were still fresh (Vindrola Padros, 2021). Second, it supported data quality by allowing field notes to be refined during natural breaks and expanded immediately after each site visit, which reduced reliance on later recall and helped preserve detail and context.

As part of this ongoing analysis, rapid ethnography findings were also compared against focus group themes to examine whether the same clutter attributes and types appeared in field settings, to identify types that were visible on site but less salient in discussion settings, and to refine definitions so that they remained grounded in work as done. This is discussed in the following section.

4.4.3. Data triangulation between methods

Triangulation refers to the use of multiple methods or data sources to develop a comprehensive understanding of a phenomenon (Patton, 1999). While there are several reasons for applying triangulation in research, this approach is particularly valuable when exploring concepts that are newly theorized or have received limited attention in a specific research area, as triangulation enhances the reliability and validity of the work. Given that clutter is an under-explored topic, triangulation was used to strengthen reliability and validity.

In this study, the primary approach was methodological triangulation (Thurmond, 2001), combining expert focus groups with rapid ethnography. Specifically, the focus groups supported collective sensemaking and definition building, including how clutter is conceptualized, what attributes signal clutter, and how different types can be distinguished. Rapid ethnography supported contextual checking in day-to-day work, which allowed the same ideas to be examined against observed routines, interactions, and in-the-moment explanations on active jobsites. The triangulation was applied through structured comparison rather than merging datasets prematurely. Each dataset was analyzed first on its own, and then key themes, attributes, and candidate clutter families and types were compared across datasets. Safety clutter was understood in the same basic way across both datasets, and the overall taxonomy structure remained stable. Disconfirming cases were actively sought during cross-method comparison. Focus groups provided

the foundation for how safety clutter was defined and organized through detailed discussion and shared examples, while rapid ethnography refined the cues, definitions, and boundaries by grounding them in real-time discussion of work as done.

4.4.4. Research reliability and validity

In this study, specific quality checks were built into the study, including consistency in how data were produced and recorded, iterative checking of interpretations during analysis, attention to whether the concepts and categories truly reflected what participants meant, and sampling strategies that supported variation and saturation. Table 3 summarizes how these checks were addressed across the focus groups and rapid ethnography, alongside the use of triangulation to strengthen the overall interpretation.

5. Findings and discussion

5.1. Conceptualization of safety clutter

In this study, the findings show that safety clutter is understood in a way that goes beyond the idea of a simple buildup of safety activities. Safety clutter is not treated as "too much safety" in general, and it is not assumed that the presence of forms, meetings, or procedures automatically makes safety effort cluttered. Instead, the findings point to a consistent core meaning. *Safety clutter is waste within a safety effort that, as implemented, consumes attention, effort, and resources without improving the safety of work.*

This starting point shaped how clutter is described in practical terms. Clutter is judged by looking at what safety effort requires from people and what it returns to operational safety. When safety effort draws time and attention but does not improve the safety of work, it is experienced as clutter. As one electrician put it, *"I do a lot of paper rather than focusing on my actual work… Personally for me, I do not believe any of these help us be safe."* Another field leader described the same trade-off in operational terms: *"I waste a lot of time, and it does not let me be onsite."* A foreman made the same judgment by describing how safety work can persist without a safety return: *"Many of these activities… [are] a check in the box process."* Across roles, this logic was consistent. Clutter was described as a drain on the very attention and presence that practitioners repeatedly associated with meaningful protection, such as being in the field, observing work as it occurs, and engaging directly with workers about hazards and controls.

Table 3
Validity and reliability.

Rigor and validation	Strategies
Reliability	The focus groups used a consistent structure and the same follow up prompts to capture what the activity is, why it is done, and how it is done. Focus groups were audio recorded and supported with facilitator notes. Rapid ethnography relied on detailed field notes that were refined during breaks and expanded the same day to reduce later recall errors. This ensured data consistency across visits.
Internal validity	The generated themes and sub-themes were reported back to the focus group team for refinement through multiple iterative rounds. In addition, group risks or bias were actively managed, as discussed in section 4.1.3. In rapid ethnography, reflexive notes were kept alongside field notes to separate observation from interpretation and to record alternative explanations for later checking.
Construct validity	In focus groups, participants first described real safety activities from practice, then answered the same follow up prompts about the purpose, how it is carried out, what it requires from users, and what cues signal clutter. This produced comparable descriptions that supported definition building and classification. Rapid ethnography then checked whether the same cues and attributes appeared in work as done, not only in discussion.
External validity	Sampling aimed to capture variation. Focus group participants represented multiple construction sectors and roles. Rapid ethnography covered 11 active sites and 26 participants across different contexts, and data collection continued until the descriptions of clutter became repetitive and no substantively new attributes or types were emerging.
Triangulation	Focus group data and rapid ethnography notes were analyzed separately first, then compared. Themes, attributes, and candidate clutter families and types were checked across both datasets. This follows established descriptions of triangulation as using multiple methods or sources to strengthen understanding.

The study revealed five principles that help frame how safety clutter is conceptualized in construction.

First, safety clutter is an adjective, not a noun. Clutter is not the safety activity itself, but a description of how the activity is carried out. A pre-job safety brief, for example, is not clutter by definition. However, clutter can exist in how the brief is designed, delivered, documented, or repeated. This principle matters because it avoids the assumption that certain safety practices should be removed as a whole. Instead, it focuses attention on the aspects of implementation that create burden without safety benefit. This distinction was visible in how practitioners described paperwork and routines. A lead welder explained that the issue was not the existence of safety activities, but how they were executed: *"It is not that I am saying they are useless, but it can be done in an efficient way."* Similarly, a safety coordinator emphasized that even important practices can become cluttered through poor implementation: *"I know inspections are important, but this way I do not think so."*

Second, what seems like clutter in one organization may deliver value in another. The findings show that clutter is not fixed or universal. The same activity may be experienced as clutter in one setting and as useful in another. The difference lies in how the activity is implemented. Activities such as orientations, pre-job briefs, inspections, and permits were consistently described as legitimate in intent, yet often experienced as clutter when they were repetitive, overcomplicated, or disconnected from actual work. This variability was illustrated by how participants described repeated safety discussions. One supervisor noted that the same crew was exposed to identical hazard information multiple times for the same task: *"Many repeated things… the same crew listening to heat hazard and its mitigation in three different meetings, for the same task, and on the same day."* In these cases, the activity itself was not questioned, but its implementation reduced its value.

Third, today's clutter was often yesterday's safety solution. The findings show that clutter is not usually created in bad faith. Many requirements begin as reasonable responses to real problems. Over time, however, these responses can remain in place even when conditions change and the original purpose becomes less clear. This was visible in descriptions of legacy training and activities that persisted despite weak relevance to current work. One safety coordinator described this drift as a mismatch between formal systems and operational reality: *"There is a gap between the book and the actual work."* The same participant emphasized that these documents often remain untouched for long periods: *"We have not touched this for quite a while,"* even though they continue to be distributed and formally maintained.

Fourth, safety clutter is easy to add and difficult to remove. The findings show an imbalance in how safety systems evolve. New steps, documents, checks, and approvals can be introduced quickly, especially after incidents or external pressure. By contrast, there are few routine opportunities to review what already exists and decide what can be stopped. One superintendent described this dynamic directly: *"They just add stuff without actually seeing if it works or not, or do we actually need it."* A related concern was that requirements were introduced without meaningful follow-up in the field: *"They talk the talk but not walk the walk!"* These accounts help explain why clutter accumulates through layering, with limited mechanisms for repair or removal.

Fifth, the legacy of a serious injury or fatality can itself become clutter when corrective actions yield blanket safety requirements. The findings show that serious events often trigger broad responses that extend well

beyond the original context. In these cases, new requirements can be applied widely, even when the same risk is not present. This can create safety effort spread across many tasks and roles, consuming time and attention while contributing little to the safety of work in most situations. A field leader described this pattern briefly: *"When an accident happens… they make other stuff. They do not stop to think there are already loads of procedure and to think why it did not work."* Another participant described how this dynamic plays out through repeated retraining: *"If any accident happens, they want everyone to retake training that they have already taken. It does not help."*

Overall, these principles show that safety clutter is not a general complaint about bureaucracy. It is a practice-based judgment about waste within safety effort. It is recognized when time and attention are absorbed by safety work that does not strengthen control of risk, and when that absorption reduces capacity for the safety work that practitioners associated with real protection, especially time in the field and attention to critical hazards.

5.2. Taxonomy of safety clutter

Fig. 1 shows the classification developed in this study to organize and describe safety clutter. The classification separates clutter into two forms, conditional clutter and pure clutter, and then organizes each form into families and types. Conditional clutter includes excessive, irrelevant, and inaccessible families, while pure clutter includes an invalid family with incorrect and obsolete types. The findings show that once safety clutter is understood as waste within a safety effort, the next step is to describe that waste in a consistent and usable way. The data did not support treating clutter as a single, uniform phenomenon. Instead, clutter appeared in different forms and for different reasons, and those differences mattered because they point to different responses. Sections 5.2.1 and 5.2.2 describe these forms, families, and types in detail and illustrate the cues used to recognize them in practice.

A critical point in this study is that the classification is attribute-based and was applied at the level of features within safety activities, rather than outcomes or intentions. Conditional clutter, pure clutter, and each family and type are not intended to label an entire activity as clutter. They describe specific features of an activity that create waste as implemented in practice. As a result, the same safety activity can be cluttered in more than one way at the same time, and it can also contain features that are not clutter at all. A near-miss reporting system, for example, may be valuable overall while still containing repetitive, dead-end, or noisy features depending on how it is implemented.

This attribute-based approach also reflects a practical limitation in safety management. Clutter removal is often described as requiring an evidence-based approach, yet most safety practices have not been rigorously evaluated for effectiveness (Rae et al., 2018, 2010). As a result, it is often difficult to defend a clear boundary between clutter and not clutter. Many activities sit in a grey area. They may offer a safety benefit under some circumstances, but are frequently applied in ways or contexts where that benefit is not realized. For that reason, this study did not assess whether activities are inherently valuable. Instead, the taxonomy evaluates whether specific features such as design, timing, targeting, placement, access, and output flow create waste. Assessment of the return on investment of an activity is better approached once wasteful features have been removed, so that value is judged on the most efficient version of the activity.

This also means that classification is context dependent. The same activity, or the same feature of an activity, may be experienced as clutter in one organization or project and not in another. Different stakeholders may also experience different forms of waste from the same element, depending on whether the burden sits with those completing it, reviewing it, or acting on its outputs. For this reason, classification should begin by defining the specific context under review, including who uses the element, where and when it runs, and the main constraints shaping its use. Finally, the distinction between conditional and pure clutter was guided by whether the waste could reasonably be corrected. Conditional clutter captured waste that could plausibly be reduced through changes in implementation. Pure clutter captured features that remained wasteful regardless of how they were delivered, because the underlying basis of the safety effort was not valid or no longer fit the work.

5.2.1. Conditional clutter

Conditional clutter includes flaws in design, execution, timing, targeting, access, or output that render an otherwise useful activity unattractive or impractical. When those features are corrected, the same activity may shift from clutter to a state that adds greater value. Conditional clutter has three families: Excessive, Irrelevant, and Inaccessible. These families are defined and discussed in the following sections.

5.2.1.1. Excessive. Excessive clutter is defined as going beyond what is necessary to be effective. Excessive clutter includes features that make an activity overcomplicated, overdone, or repetitive, where additional

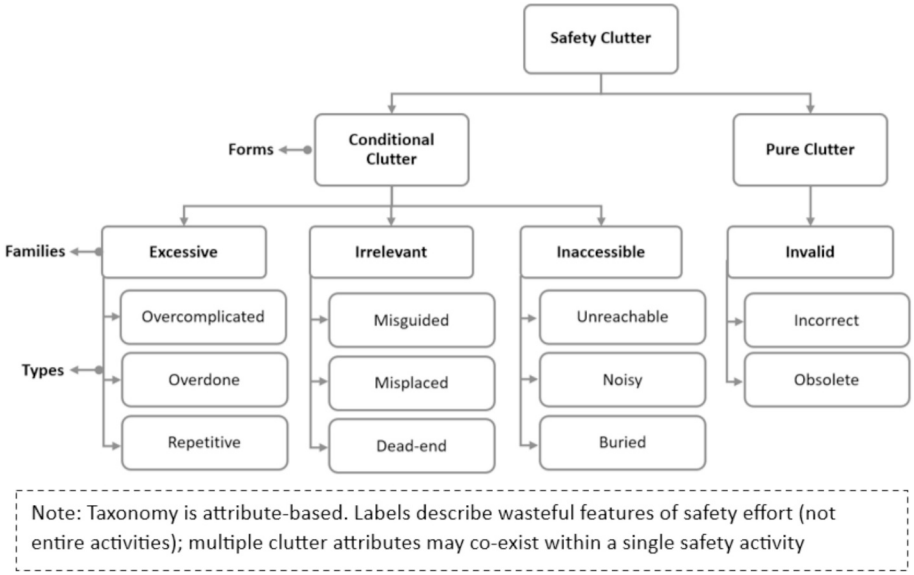

Fig. 1. Safety clutter classification.

steps, occurrences, or outputs add little or no safety value. Within this family, three types capture the main ways excess shows up in practice: overcomplicated, overdone, and repetitive. Table 4 provides the definition, examples, and cues for each type; cues serve as practical boundary markers for classification, and quotes are exemplars from the dataset rather than prevalence claims.

5.2.1.2. Irrelevant. Irrelevant clutter arises when the context, delivery, use, or flow makes a safety activity meaningless or disconnected from its purpose. This occurs when the wrong people are involved, the activity happens at the wrong time or place, or it produces information no one uses. Within this family, three types capture how misfit shows up in practice: misguided, misplaced, and dead-end. Table 5 provides the definition, examples, and cues for each type; cues serve as practical boundary markers for classification, and quotes are exemplars from the dataset rather than prevalence claims.

5.2.1.3. Inaccessible. Inaccessible clutter occurs when a safety activity has relevant information that is unreachable, in a noisy environment, or is buried in complex systems. Waste arises in the effort required to reach and use the information, rather than in the intent of the activity. Within this family, three types capture how access breaks down in practice: unreachable, noisy, and buried. Table 6 provides the definition, examples, and cues for each type; cues serve as practical boundary markers for classification, and quotes are exemplars from the dataset rather than prevalence claims.

5.2.2. Pure clutter

Pure clutter refers to safety effort that participants consistently judged as noncontributory to the safety of work across the contexts observed in this study, regardless of how it was delivered or executed. In other words, the waste is not produced by poor implementation that can be fixed, but because the underlying basis of safety effort is perceived as invalid or no longer fitting the work. Pure clutter has one family, Invalid, with two types: Incorrect and Obsolete. The types below distinguish whether the problem is that the effort is built on a false assumption (incorrect) or that it persists after its context has moved on (obsolete).

Table 4
Excessive clutter types.

Type	Definition	Example	Boundary cues
Overcomplicated	Unnecessarily difficult to understand, follow, or carry out.	"Our online JHA takes 45 min to complete. It is because the system is confusing and has too many steps, many of them that even do not apply the work we do."	Activity that contains complex attributes such as complicated wording or jargon, difficult flow, or numerous branching steps that waste time.
Overdone	Carried out or produced in excess, where each additional occurrence provides little or no benefit.	"A single work permit requires four signatures from different departments even when only one has relevant oversight."/ "every morning… I have to do the FLHA, Drop Object Sheet, Fall protection plan and the harness sheet… I spend more than 1.5 h."	Excessive in volume or frequency: details, steps, or outputs that are wasteful and add no value.
Repetitive	Done more than once unnecessarily, by itself or through another action, after full value has already been delivered.	"We do three meetings before starting the job. The first meeting started at 6:25, and here we go; we start the actual job at 9:25."	Performed or produced more than once, with the second iteration entirely redundant.

Table 5
Irrelevant clutter types.

Type	Definition	Example	Boundary cues
Misguided	Situations where safety information or tasks are assigned to the wrong people or delivered by the wrong people.	"No matter what the outcome of the meeting is I am not the person that should be taking decision or communicate anything from this meeting."/"I do a lot of trainings that do not relate to me… I am a welder why should I be trained on issues that do not relate to my work at all."	Led by, or delivered to, people outside the intended scope.
Misplaced	Being carried out at the wrong time or in the wrong place, where timing or location weakens the connection between the activity and when or where it could influence work.	"It happens at 03:00… But for me it is in the middle of the heat when I need to be onsite and check on the guys."/"a pre-job meeting is completed in the trailer, away from the work area, long before the work begins."	Wrong time: Performed at an unsuitable time. Wrong place: Delivered in an unsuitable location.
Dead-end	Cases where production effort has no consumer, or the results are not read, discussed, or used to inform action.	"This safety observation thing is out of control. I get a dozen near-miss reports every week. It is too much to even read… I think it only happens because management keeps pushing for more. They just want the numbers, so people keep submitting, and it goes nowhere."	Rarely or never used, read, or referenced in any way.

5.2.2.1. Invalid. Invalid clutter refers to safety effort that is incorrect or obsolete because it lacks foundation in fact, logic, or law. It appears when practice is treated as meaningful even though its assumption does not hold, or when a practice remains in place even though it no longer fits the work, risks, or system. Table 7 provides the definition, examples, and cues for each type; cues serve as practical boundary markers for classification, and quotes are exemplars from the dataset rather than prevalence claims.

The taxonomy developed in this study is intended as a practical classification tool. It provides a structured way to identify clutter at the level of features within safety effort, distinguishing between conditional and pure clutter and organizing these into families and types. The practical implications of this classification are elaborated further in the conclusion. Before turning to those implications, however, it is important to clarify the boundaries of the study.

6. Limitations

This study investigated the conceptualization and taxonomy of safety clutter using focus groups and rapid ethnography. The study design included detailed field notes that were refined during site engagement,

Table 6
Inaccessible clutter types.

Type	Definition	Example	Boundary cues
Unreachable	Situations where obstacles make an activity or its value extremely difficult to access.	"A safety observation system sits behind application permissions where weak internet connectivity causes links to fail and limits access on site."	There is a stubborn barrier such as technological, procedural, or situational that makes an element difficult to deliver or access.
Noisy	Situations where useful information is crowded by too much irrelevant information, making it harder to notice, prioritize, or act upon what is important.	"A pre-job form contains dozens of low-value fields and checkboxes that drown out attention to serious risks or meaningful inputs."	Safety content mixed with other items. Or, critical safety element flooded with non-critical ones.
Buried	Cases where output is hidden deep within a complex or poorly organized system, making it difficult to find or use.	"Once we upload this to the system, we do not look at it."/"from June last year"/"lessons learned are stored as quarterly PDF compilations without bookmarks or tags, where searches return hundreds of hits and users often abandon the task."	The item lives in the system, but nothing points to it and retrieving it is painfully slow.

Table 7
Invalid clutter types.

Type	Definition	Example	Boundary cues
Incorrect	Being based on incorrect assumptions that have been disproven with evidence.	Using TRIR as a proxy for SIF risk or as a comparative project/company performance signal rests on assumptions that are not supported.	No recognized evidence or standard backs the activity. Built on assumptions now known to be false.
Obsolete	Legacy practices that persist out of habit even after the context, technology, or methods have moved on.	"We still get the same onboarding training, but the job does not even deal with that anymore. It is old content, but it stays because it has always been there."/"We have this safety policy that is generic and outdated. It is still there, but it does not match what we actually do now."	Retired or replaced items retained in the system.

iterative refinement during analysis, and triangulation between methods. These steps strengthen credibility, but they do not remove all limitations.

First, the study is grounded in construction industry contexts. The taxonomy is not presented as a universal explanation for how safety systems evolve, and it is not used here to generalize causes of clutter across settings. Instead, the contribution is intentionally attribute-based. It describes observable features of waste within safety effort that can plausibly appear in many environments, even when the reasons those features arise differ across projects, firms, or regulatory contexts. In other words, the attributes of clutter may transfer more readily than the causes that produce them, and this distinction should be kept in mind when applying the taxonomy outside the study context.

Second, sampling was purposive rather than representative. Sites and participants were selected to capture variation and to support conceptualization and classification, not to estimate prevalence. As a result, the study does not support claims about how common specific clutter forms or types are across the wider industry.

Third, the analysis required thematic interpretation. The iterative coding process, team refinement, and cross-method comparison reduced individual bias and strengthened coherence, but classification still involves judgment. In some cases, a single feature may plausibly fit more than one type depending on how it is implemented and who experiences the burden. For this reason, the taxonomy should be treated as a structured diagnostic lens rather than a final, exhaustive map of all possible clutter in construction.

Fourth, rapid ethnography is time-limited at each site. This can reduce exposure to infrequent activities that occur outside the observed periods. In this study, however, the risk of this limitation affecting the main findings is likely low because the primary aim was not to enumerate every safety activity on site. The aim was to identify stable attributes and cues of clutter that recur across settings. The ethnography used full-shift shadowing across multiple sites, analysis was carried out alongside data collection, and site engagement continued until observations became repetitive and no substantively new clutter attributes or types were identified. Even so, rare or highly context-specific examples of clutter may still exist outside the dataset.

Lastly, the taxonomy developed in this study is grounded in practitioner experience and interpretation, meaning that whether a safety effort is viewed as adding value or functioning as clutter may vary across roles, organizations, and operational contexts. The study therefore does not claim to objectively measure whether a safety activity improves safety outcomes. Instead, it identifies how participants recognize and describe low-value safety effort in practice, including the cues and attributes used to distinguish clutter from safety work perceived as useful. Future work should examine how different stakeholders define and negotiate safety value in practice, particularly in situations where one group experiences a safety effort as burdensome, while another views it as protective or necessary.

7. Conclusion

Safety clutter is a simple idea on the surface, but the findings of this study show that it is a complex phenomenon in practice. It is not just "too much safety," and it is not automatically created by paperwork, meetings, or procedures. Clutter is better understood as waste within a safety effort that, as implemented, consumes attention, effort, and resources without improving the safety of work. This matters because it changes the question from "Do we need this safety activity?" to "Which parts of this safety effort are adding safety value, and which parts are only adding load?".

This study provides a clear starting point for answering that question. The main contribution is not a list of bad safety practices. It is a way to see clutter in a disciplined and fair way, without dismissing safety effort as a whole. The findings show that clutter is an attribute, not an activity category. The same safety effort can be valuable in one setting and cluttered in another because the difference lies in how it is designed, delivered, accessed, and used. This view helps avoid a common failure in decluttering efforts, where organizations either keep everything because "it is safety," or cut too much because "it is bureaucracy." An attribute-based approach supports a more careful path. It makes it possible to remove wasteful features while protecting the parts of safety work that genuinely improve the safety of work.

The taxonomy in this study was developed for that purpose. It separates clutter into two forms, conditional clutter and pure clutter, and

organizes those forms into families and types that describe what the waste looks like in practice. Just as importantly, the classification is also attribute-based. It is meant to label features within safety effort, not to label entire activities as clutter. That distinction is what makes the taxonomy usable. It reflects how safety effort actually works on projects, where a single activity can contain both high-value features and wasteful features at the same time.

The findings also carry a clear message about why clutter persists. Safety effort is easy to add and difficult to remove. Requirements layer over time, often because they once addressed a real need and were never revisited. In that sense, today's clutter was often yesterday's safety solution. The study also shows how serious events can leave a long shadow. The legacy of a serious injury or fatality can itself become clutter when corrective actions turn into blanket requirements that spread widely and remain in place. These patterns help explain why clutter is not only an annoyance. It is a structural drain on safety capacity because effort is continuously added while little is removed.

This is consequential for SIF prevention because SIF research repeatedly points to the need for work planning and controls that are present, clear, and reliable for high-risk activities (Bayona et al., 2024; Selleck et al., 2022, 2023; Busch et al., 2021). This study does not test SIF outcomes and does not claim that decluttering will directly reduce SIFs. The implication is instead about capacity. When safety effort becomes cluttered, attention and time are absorbed by safety work that does not improve the safety of work, and that reduces capacity for the safety work that needs to be done well around high-risk activities. The taxonomy provides a practical way to identify where safety effort is adding load without strengthening control of risk, and to redesign or remove those wasteful features so that attention can be redirected toward the safety effort that supports planning, control definition, and control checking in practice.

What needs to happen next is larger than simply "declutter." The next stage of research and practice should treat safety clutter as a multilevel problem that can be examined through at least three lenses. At the macro level, clutter can be studied as an industry-wide phenomenon shaped by how safety expectations move across owners, contractors, regulators, and supply chains. At the meso level, clutter can be studied as an organizational phenomenon shaped by internal governance, audit routines, risk tolerance, and how safety work is managed and reviewed over time. This study contributes at the micro level. It shows how clutter is experienced inside the safety elements themselves, and how it appears as features of implementation that consume resources without improving the safety of work. These levels are not competing explanations; they are different vantage points on the same problem. Studying them together will help reveal not only what clutter looks like, but why it emerges and why it keeps returning.

This matters because the long-term goal should not only be to remove existing clutter, but to prevent clutter from being created in the first place. To do that, future work should build on this study's definition and taxonomy in three directions. First, the taxonomy should be tested and refined across different contexts to examine which attributes remain stable and which need adjustment, and to clarify the boundaries in borderline cases. Second, research should map how macro and meso conditions create micro-level clutter features, so that the causes of clutter can be understood at the level where they originate, not only at the level where they are felt. Third, and most importantly for practice, future work should develop diagnostic tools that make the taxonomy usable at scale. This includes tools that help users break safety effort into features, identify clutter using clear cues and boundary markers, and decide whether a feature is conditional and can be repaired or pure and should be removed. Without diagnostic tools, the concept of clutter risks staying theoretical. With diagnostic tools, it becomes actionable.

A related challenge is that decluttering depends on judgment about safety value. In borderline cases, whether something is truly redundant can vary by stakeholder, because the people who pay for, perform, audit, and benefit from safety work do not always share the same criteria for value. Future research should examine how these value judgments are negotiated in practice and how decisions to retain, modify, or remove safety work are made across roles and organizational levels.

The broader impact of this study is that it offers a shared language for a problem that many people recognize but struggle to name. It gives construction a way to talk about safety work with precision, to separate value from waste, and to improve safety effort without weakening safety intent. If the field wants safety systems that are trusted, usable, and connected to the safety of work, then safety clutter cannot remain a vague complaint. It must become a visible, describable, and manageable part of how safety is designed and maintained. This study is a starting point. The next step is to turn the definition and taxonomy into methods that help teams see clutter early, challenge it safely, and keep safety effort focused on what truly improves the safety of work.

Safety clutter also matters because SIF prevention depends on sharp attention to the safety effort that truly improves the safety of work. Decluttering is therefore not a side mission or an efficiency exercise. It is a practical way to protect capacity for the safety work that needs to be done well, so that SIF prevention is supported rather than diluted by waste.

CRediT authorship contribution statement

Yaqoob Raheemy: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Matthew R. Hallowell:** Writing – review & editing, Supervision, Resources, Methodology, Investigation, Funding acquisition, Conceptualization. **Helen Lingard:** Writing – review & editing, Supervision, Methodology. **Fred Sherratt:** Supervision, Methodology, Investigation, 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 supported by the Construction Safety Research Alliance, based at the University of Colorado Boulder, USA. The authors would like to thank everyone who contributed to the research that generated the data for this paper.

References

Almklov, P. G., Rosness, R., & Størkersen, K. (2014). When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge? *Safety Science, 67*, 25–36. https://doi.org/10.1016/j.ssci.2013.08.025

Antillón, E.I., Alarcón, L.F., Hallowell, M.R. and Molenaar, K.R., 2011, July. A research synthesis on the interface between lean construction and safety management. In 19th Annual Conference of the International Group for Lean Construction. Lima, Peru (pp. 13-15).

Baker, L. (2006). Observation: A complex research method. *Library Trends, 55*(1), 171–189.

Ballard, H. G. (2000). *The last planner system of production control (Doctoral dissertation.* University of Birmingham).

Bayona, A., Hallowell, M. R., & Bhandari, S. (2024). The things that hurt people are not the same as the things that kill people: key differences in the proximal causes of low- and high-severity construction injuries. *Journal of Construction Engineering Management, 150*(8), Article 04024089. https://doi.org/10.1061/JCEMD4.COENG-14545

Bayona, A., Hallowell, M. R., Bhandari, S., Moyen, N., & Lien, A. (2025). Impact of Energy-based safety training on quality of prejob safety meetings and control of hazardous energy in construction: Multiple baseline experiment. *Journal of Construction Engineering and Management, 151*(7), Article 04025086.

Berger, R. (2015). Now I see it, now I don't: Researcher's position and reflexivity in qualitative research. *Qualitative Research, 15*(2), 219–234.

Bieder, C., & Bourrier, M., 2013. Trapping Safety into Rules: How Desirable or Avoidable is Proceduralization? (1 ed.). CRC Press. Doi: 10.1201/9781315549774.

Bhandari, S., & Hallowell, M. R. (2021). Identifying and controlling biases in expert-opinion research: Guidelines for variations of Delphi, nominal group technique, and

focus groups. *Journal of Management in Engineering, 37*(3), Article 04021015. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000909
Biggs, S. E., Banks, T. D., Davey, J. D., et al. (2013). Safety leaders' perceptions of safety culture in a large Australasian construction organisation. *Safety Science, 52*, 3–12. https://doi.org/10.1016/j.ssci.2012.04.012
Boyatzis, R. E. (1998). *Transforming Qualitative Information: Thematic Analysis and Code Development*. Sage.
Borys, D. (2009). Exploring risk-awareness as a cultural approach to safety: Exposing the gap between work as imagined and work as actually performed. *Safety Science Monitor, 13*(2), 1–11.
Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
Breen, R. L. (2006). A practical guide to focus-group research. *Journal of Geography in Higher Education, 30*(3), 463–475. https://doi.org/10.1080/03098260600927575
Buckley, P., Found, P., & Griffiths, G. (2017). *Staying Lean: Thriving not just surviving*. CRC Press.
Busch, C., Usrey, C., Loud, J., et al. (2021). Serious injuries & fatalities: Why are they constant while injury rates decrease? *Professional Safety, 66*(01), 26–31.
Carter, N., Bryant-Lukosius, D., DiCenso, A., et al. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum, 41*(5), 545–547. https://doi.org/10.1188/14.ONF.545-547
Cheng, E. W. L., Ryan, N., & Kelly, S. (2012). Exploring the perceived influence of safety management practices on project performance in the construction industry. *Safety Science, 50*(2), 363–369. https://doi.org/10.1016/j.ssci.2011.09.016
Cudney, E., Furterer, S., & Dietrich, D. (2013). *Lean systems: Applications and case studies in manufacturing, service, and healthcare*. New York, NY: CRC Press.
Cudney, E. A., Murray, S. L., & Pai, P. (2015). Relationship between lean and safety. *International Journal of Lean Enterprise Research, 1*(3), 217–231.
Dekker, S. (2025). Safety theater: How success can mask growing safety risks. *Professional Safety, 70*(10), 28–34.
Dekker, S. (2014). *Safety differently: Human factors for a new era*. CRC Press.
Dekker, S. (2017). *The field guide to understanding 'human error'*. CRC Press.
Emerson, R. M., Fretz, R. I., & Shaw, L. L. (2011). *Writing Ethnographic Fieldnotes* (2nd edn.). University of Chicago Press.
Finlay, L. (2002). "Outing" the researcher: The provenance, process, and practice of reflexivity. *Qualitative Health Research, 12*(4), 531–545.
Folch-Lyon, E., & Trost, J. F. (1981). Conducting focus group sessions. *Studies in family planning*, 443–449.
Gambatese, J. A., Behm, M., & Rajendran, S. (2008). Design's role in construction accident causality and prevention: Perspectives from an expert panel. *Safety Science, 46*(4), 675–691. https://doi.org/10.1016/j.ssci.2007.06.010
Gupta, M., Shaheen, M. and Reddy, K.P. (eds), 2019. Qualitative Techniques for Workplace Data Analysis. IGI Global. Doi: 10.4018/978-1-5225-5366-3.
Haas, J. (1977). Learning real feelings: A study of high steel ironworkers' reactions to fear and danger. *Sociology of Work and Occupations, 4*(2), 147–170.
Hale, A. R. (1990). Safety rules ok?: Possibilities and limitations in behavioural safety strategies. *Journal of occupational accidents, 12*(1–3), 3–20.
Hale, A. R., & Swuste, P. H. J. J. (1998). Safety rules: Procedural freedom or action constraint? *Safety science, 29*(3), 163–177.
Hale, A., & Borys, D. (2013). Working to rule, or working safely? Part 1: A state of the art review. *Safety science, 55*, 207–221.
Hallowell, M. R., & Gambatese, J. A. (2010). Qualitative Research: Application of the Delphi Method to CEM Research. *Journal of Construction Engineering Management, 136*(1), 99–107. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000137
Hasle, P., Bojesen, A., Langaa Jensen, & Bramming, P. (2012). Lean and the working environment: a review of the literature. *International Journal of Operations & Production Management, 32*(7), 829–849.
Holweg, M. (2007). The genealogy of lean production. *Journal of Operations Management, 25*(2), 420–437. https://doi.org/10.1016/j.jom.2006.04.001
Hutchinson, B., Dekker, S., & Rae, A. (2024). Audit masquerade: How audits provide comfort rather than treatment for serious safety problems. *Safety Science, 169*, Article 106348. https://doi.org/10.1016/j.ssci.2023.106348
Johnson, C. W. (2014). Economic recession and a crisis of regulation in safety–critical industries. *Safety Science, 68*, 153–160. https://doi.org/10.1016/j.ssci.2014.03.008
Iszatt-White, M. (2007). Catching them at it: An ethnography of rule violation. *Ethnography, 8*(4), 445–465.
Koukoulaki, T. (2014). The impact of lean production on musculoskeletal and psychosocial risks: An examination of sociotechnical trends over 20 years. *Applied ergonomics, 45*(2), 198–212.
Le Coze, J.-C. (2017). Globalization and high-risk systems. *Policy and Practice in Health and Safety, 15*(1), 57–81. https://doi.org/10.1080/14773996.2017.1316090
Le Coze, J.-C. (2019). Vive la diversité! High Reliability Organisation (HRO) and Resilience Engineering (RE) in France. *Safety Science, 99*, 84–92.
Leibenstein, H. (1966). Allocative efficiency vs. "X-efficiency". *The American Economic Review, 56*(3), 392–415.
Lingard, H., Cooke, T., Zelic, G., et al. (2021). A qualitative analysis of crane safety incident causation in the Australian construction industry. *Safety Science, 133*, Article 105028. https://doi.org/10.1016/j.ssci.2020.105028
Lim, H. W., Lingard, H., Zhang, R., & Pirzadeh, P. (2025). *Decluttering Safety: A Multistakeholder Approach to Enhancing Safety Management in Construction. Position paper*. Melbourne: RMIT University.
Longoni, A., Pagell, M., Johnston, D., et al. (2013). When does lean hurt? an exploration of lean practices and worker health and safety outcomes. *International Journal of Production Research, 51*(11), 3300–3320. https://doi.org/10.1080/00207543.2013.765072
McCall, G. J. (1984). Systematic field observation. *Annual Review of Sociology, 10*, 263–282.
Oswald, D., Sherratt, F., & Smith, S. (2019). Managing production pressures through dangerous informality: A case study. *Engineering, Construction and Architectural Management, 26*(11), 2581–2596. https://doi.org/10.1108/ECAM-11-2018-0475
Oswald, D. and Lingard, H., 2024. How Ethnographic Methodologies Contribute to Construction Practice. In *Embracing Ethnography* (pp. 92-103). Routledge.
Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Services Research, 34*, 1189–1208.
Perelman, M. (2011). Retrospectives: X-efficiency. *Journal of Economic Perspectives, 25*(4), 211–222.
Pestana, C. and Gambatese, J.A., 2016. Lean practices and safety performance. in Construction Research Congress 2016, San Juan, Puerto Rico, 24 May 2016. American Society of Civil Engineers, pp. 1710–1719. Doi: 10.1061/9780784479827.171.
Pink, S., Tutt, D., Dainty, A., & Gibb, A. (2010). Ethnographic methodologies for construction research: Knowing, practice and interventions. *Building Research & Information, 38*(6), 647–659.
Provan, D., Rae, D., & Dekker, S. (2019). An ethnography of the safety professional's dilemma: Safety work or the safety of work? *Safety Science, 117*, 276–289.
Rae, A.J., Nicholson, M. and Alexander, R.D., 2010, October. The state of practice in system safety research evaluation. In 5th IET International Conference on System Safety 2010 (pp. 1-8). IET.
Rae, A. J., Provan, D. J., Weber, D. E., et al. (2018). Safety clutter: The accumulation and persistence of "safety" work that does not contribute to operational safety. *Policy and Practice in Health and Safety, 16*(2), 194–211. https://doi.org/10.1080/14773996.2018.1491147
Rae, A., & Provan, D. (2019). Safety work versus the safety of work. *Safety Science, 111*, 119–127. https://doi.org/10.1016/j.ssci.2018.07.001
Rahman, S., Laosirihongthong, T., & Sohal, A. S. (2010). Impact of lean strategy on operational performance: A study of Thai manufacturing companies. *Journal of Manufacturing Technology Management, 21*(7), 839–852. https://doi.org/10.1108/17410381011077946
Saurin, T. A., Formoso, C. T., & Cambraia, F. B. (2008). An analysis of construction safety best practices from a cognitive systems engineering perspective. *Safety Science, 46*(8), 1169–1183. https://doi.org/10.1016/j.ssci.2007.07.007
Saunders, B., Sim, J., Kingstone, T., et al. (2018). Saturation in qualitative research: Exploring its conceptualization and operationalization. *Quality & Quantity, 52*(4), 1893–1907.
Selleck, R., Cattani, M., & Hassall, M. (2023). Proposal for and validation of novel risk-based process to reduce the risk of construction site fatalities (Major Accident Prevention (MAP) program). *Safety Science, 158*, Article 105986. https://doi.org/10.1016/j.ssci.2022.105986
Selleck, R., Hassall, M., & Cattani, M. (2022). Determining the reliability of critical controls in construction projects. *Safety, 8*(3), 64. https://doi.org/10.3390/safety8030064
Selleck, R. and Cattani, M., 2019. Preventing fatalities in the construction industry—a review of critical risk management strategies.
Størkersen, K.V. and Fyhn, H., 2024. Untangling Safety Management: From Reasonable Regulation to Bullshit Tasks. In Compliance and Initiative in the Production of Safety: A Systems Perspective on Managing Tensions and Building Complementarity (pp. 29-40). Cham: Springer Nature Switzerland.
Størkersen, K., et al. (2020). How deregulation can become overregulation: An empirical study into the growth of internal bureaucracy when governments take a step back. *Safety Science, 128*, Article 104772. https://doi.org/10.1016/j.ssci.2020.104772
Taj, S. (2008). Lean manufacturing performance in China: Assessment of 65 manufacturing plants. *Journal of Manufacturing Technology Management, 19*(2), 217–234.
Thurmond, V. A. (2001). The point of triangulation. *Journal of Nursing Scholarship, 33*(3), 253–258.
Vindrola-Padros, C. (2021). *Rapid ethnographies: A practical guide*. Cambridge University Press.
Wang, X., Wei, C., He, Y., et al. (2021). Research on the correlation between work accidents and safety policies in China. *Processes, 9*(5), 805. https://doi.org/10.3390/pr9050805
Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the world*. New York, NY: Simon and Schuster.

Yaqoob Raheemy is a Graduate Research Assistant at the Construction Safety Research Alliance based at the University of Colorado Boulder. He earned a BS in Civil Engineering and MS in Construction Project Management. He is currently completing his PhD in Construction Engineering and Management with focus on Construction Safety.

Dr. Matthew R. Hallowell is a President's Teaching Scholar and Endowed Professor of Construction Engineering at the University of Colorado Boulder. He earned a BS and MS in Civil Engineering and a PhD with a focus on Construction Engineering and Occupational Safety and Health. Before his academic career, he worked in construction as a laborer, project engineer, and quality inspector. Dr. Hallowell specializes in construction safety research and has pioneered leading indicators, hazard recognition programs, safety risk assessment, and precursor analysis. He has published over 100 peer-reviewed papers and has overseen over $3 million in external funding. For his research, he has received the National Science Foundation CAREER Award and the Construction Industry Institute Outstanding Researcher Award.

Dr. Helen Lingard currently holds a Distinguished Professorship in construction work health and safety at RMIT University, Melbourne, Australia. Helen started her post-doctoral career working on-site in large scale civil engineering infrastructure projects (including the Hong Kong International Airport and Tsing Ma Bridge). Since moving to Australia, Helen has worked with clients in the mining, telecommunications and construction sectors to develop, implement and evaluate initiatives to improve workers' safety, health and wellbeing. Helen's research has been funded by a wide variety of private and public sector organizations, industry associations and trade unions. In 2009 Helen was an inaugural recipient of a prestigious Australian Research Council Future Fellowship and her recent book, titled '*Work Health and Wellbeing in the Construction Industry,*' was published by Routledge in 2023. Since 2018, Helen has been academic lead and member of the Culture in Construction Taskforce, comprising the Australian Constructors Association and the Governments of New South Wales and Victoria. The Taskforce was established to address three key issues affecting the productivity of the Australian construction industry: gender diversity; health and wellbeing; and time for life. Helen leads the Construction Work Health and Safety Research at RMIT group and is Executive Director of the newly formed RMIT Safety and Health Innovation Network (SHINe).

Dr. Fred Sherratt was previously Associate Director of Research at the Construction Safety Research Alliance at the University of Colorado Boulder. She is a Chartered Builder and Chartered Building Engineer with more than ten years of industry experience working for a major contractor in the United Kingdom. She has also served as a Professor of Construction Sociology in the UK. Her research focuses on the wellbeing of construction workers, with particular emphasis on eliminating serious injuries and fatalities in the construction industry.