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A Review of Safety Knowledge Sharing in the Construction Industry (2021-2025)

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ABSTRACT

Despite decades of work on safety initiatives, incidents of safety failure recur regularly in the construction field because critical safety knowledge is not being shared and shared effectively where it matters most, on-site. This systematic review examines the results of 41 studies published from 2021 to 2025 to clarify how safety knowledge sharing is currently taking place and why breakdowns persist. Using the tool PRISMA, the review finds widespread dependence on toolbox meetings, inductions, digital systems, and informal peer learning, but sees these practices as fragile because of 8 entrenched barriers: language and communication issues, poor organisational culture, digital fragmentation, loss of tacit knowledge, resource constraints, project discontinuity, psychological insecurity, and limited transferability across context. These barriers, taken together, negatively affect workers' willingness and ability to exchange functional safety knowledge. The review emphasizes the need for more than just procedures for meaningful knowledge sharing; it also calls for leadership support, a psychology of safety, integrated digital workflows, and mechanisms to retain experiential knowledge in temporary, high-turnover teams. The paper concludes with strategic recommendations for establishing learning-oriented safety cultures, as well as research opportunities, particularly in Malaysia, where empirical evidence remains scarce.

Keywords: Construction Safety; Knowledge Sharing; Safety Barriers; Tacit Knowledge; PRISMA Review

INTRODUCTION

The construction industry has been recognized as one of the most dangerous, accounting for 20-40% of all occupational deaths while employing only about 7% of the workforce (Mei et al., 2024; Pandithawatta et al., 2024). In Malaysia, the accident rate remains high, and unsafe behaviors and a lack of safety knowledge have been identified as the main factors contributing to accidents and fatalities (Mei et al., 2024; Rafindadi et al., 2022). The dynamic, complex, and fragmented nature of construction projects adds further to these risks, which make the effective dissemination of safety knowledge crucial in preventing accidents, near misses, and unsafe behaviors (Huang & Yang, 2019; Mei et al., 2024; Pandithawatta et al., 2024; Rafindadi et al., 2022).

Safety knowledge sharing on construction is generally a toolbox meeting, induction training, digital knowledge sharing platforms (such as social media and knowledge management systems), safety briefing, peer mentoring, and incident reporting systems (Chellappa & Salve, 2022; Edwin, 2023; Huang & Yang, 2019; Pedro et al., 2022; Tezel et al., 2021; Yao et al., 2021). The organizations push for explicit knowledge by adopting standard operating procedures (SOPs), manuals, and formal training, while on-site interactions, mentoring, and experiential learning support tacit knowledge (Ashraf et al., 2025; Duryan et al., 2020; Huang & Yang, 2019). While the accessibility and documentation remaining through digital platforms and structured training improve, many workers, particularly older and less-educated workers, still depend on traditional face-to-face communication, which limits the range of the solutions using digital technology (Huang & Yang, 2019; Mei et al., 2024; Yao et al., 2021). Current practices are often unstructured, disjointed, and inconsistently implemented between projects and organizations, making them less effective (Edwin, 2023; Pedro et al., 2022).

Some of the barriers to effective safety knowledge sharing, as highlighted by recent research, include low trust, communication gaps, power distance, fear of blame, and inadequate leadership support (Duryan et al., 2020; Edwin, 2023; Mei et al., 2024; Ni et al., 2025; Pedro et al., 2022). High employee turnover, reliance on temporary employees, and decentralized project structures also impede knowledge transfer (Edwin, 2023; Huang & Yang, 2019; Ni et al., 2025). Additional obstacles include low digital literacy, the lack of incentives, and cultural norms against open communication or reporting of incidents (Mei et al., 2024; Edwin, 2022; Ni et al., 2023; Pedro et al., 2022). These barriers affect workers' willingness to share safety-related knowledge, reinforcing unsafe behaviors and hindering organizational learning (Mei et al., 2024; Edwin, 2022; Ni et al., 2023).

Poor knowledge sharing is associated with recurring accidents, low organizational learning, and nonenforcement of safety standards (Mei et al., 2024; Edwin, 2022; Huang & Yang, 2019; Pedro et al., 2022). The transfer of both explicit and tacit safety knowledge is directly related to enhanced safety performance, as it can facilitate workers in recognizing risks, adopting safe behavior, and preventing incidents (Mei et al., 2024; Huang & Yang, 2019; Ashraf et al., 2023). In the absence of effective knowledge sharing, organisations are failing to harness the potential of learning from past incidents and to take preventative measures.

Despite increased interest, little synthesis of current practices of safety knowledge sharing can be found in recent literature (2021-2025) (Edwin, 2023; Pandithawatta et al., 2024; Pedro et al., 2022). Few studies include systematic reviews of socio-organizational and psychological barriers to sharing behaviors, and discussions of integrating tacit and explicit knowledge are rare (Ashraf et al., 2025; Huang & Yang, 2019; Mei et al., 2024). There is also a dearth of recent, Malaysia-specific evidence on the challenges of knowledge sharing, and poor comparative analysis of various barriers and practices.

The objective of such a review is to create an updated understanding (2021-2025) of existing safety knowledge-sharing practices, the critical barriers and their impacts, and the gaps for future empirical research. The findings will guide policymakers, contractors, and safety managers in building stronger knowledge-sharing mechanisms and a learning culture and eventually reducing the accident rate in the construction industry.

Therefore, this is a necessary review to summarise current information on the sharing of safety knowledge, the barriers to its dissemination, and opportunities to facilitate safety practice in the construction industry.

Research Question

RQ1: What are the current practices of safety knowledge sharing in the construction industry?

RQ2: What are the key barriers to safety knowledge sharing in the construction industry?

METHODOLOGY

In construction safety research, systematic literature reviews (SLRs) grounded in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework have gained popularity due to the field's fragmented, interdisciplinary nature, which has led to a lack of standardized methodological approaches. Conducting a systematic review following PRISMA increases methodological rigor by maintaining transparency, consistency, and replicability throughout the identification, screening, eligibility, and inclusion phases (Page et al., 2021). In this review, the PRISMA framework was used to explore safety knowledge sharing in construction projects, using two major databases, Scopus and Web of Science (WoS), chosen for their coverage of the engineering, management, and social sciences literature. The search strategy combined key terms related to safety, knowledge sharing, and the construction context, using Boolean operators (AND, OR) to refine the results. The specific search strings that were used are provided in Table 1:

Table 1. Database search strategy

Database	Boolean Search String
Scopus	(“safety” OR “health and safety” OR “occupational safety” OR “OSH” OR “HSE”) AND TITLE ABS KEY (“knowledge sharing” OR “knowledge transfer” OR “knowledge exchange” OR “knowledge communication” OR “knowledge management”) AND TITLE ABS KEY (“construction industry” OR “construction project*” OR “building industry”)
Web of Science (WoS)	ALL (“safety” OR “health and safety” OR “occupational safety” OR “OSH” OR “HSE”) AND ALL (“knowledge sharing” OR “knowledge transfer” OR “knowledge exchange” OR “knowledge communication” OR “knowledge management”) AND ALL (“construction industry” OR “construction project” OR “building industry”)

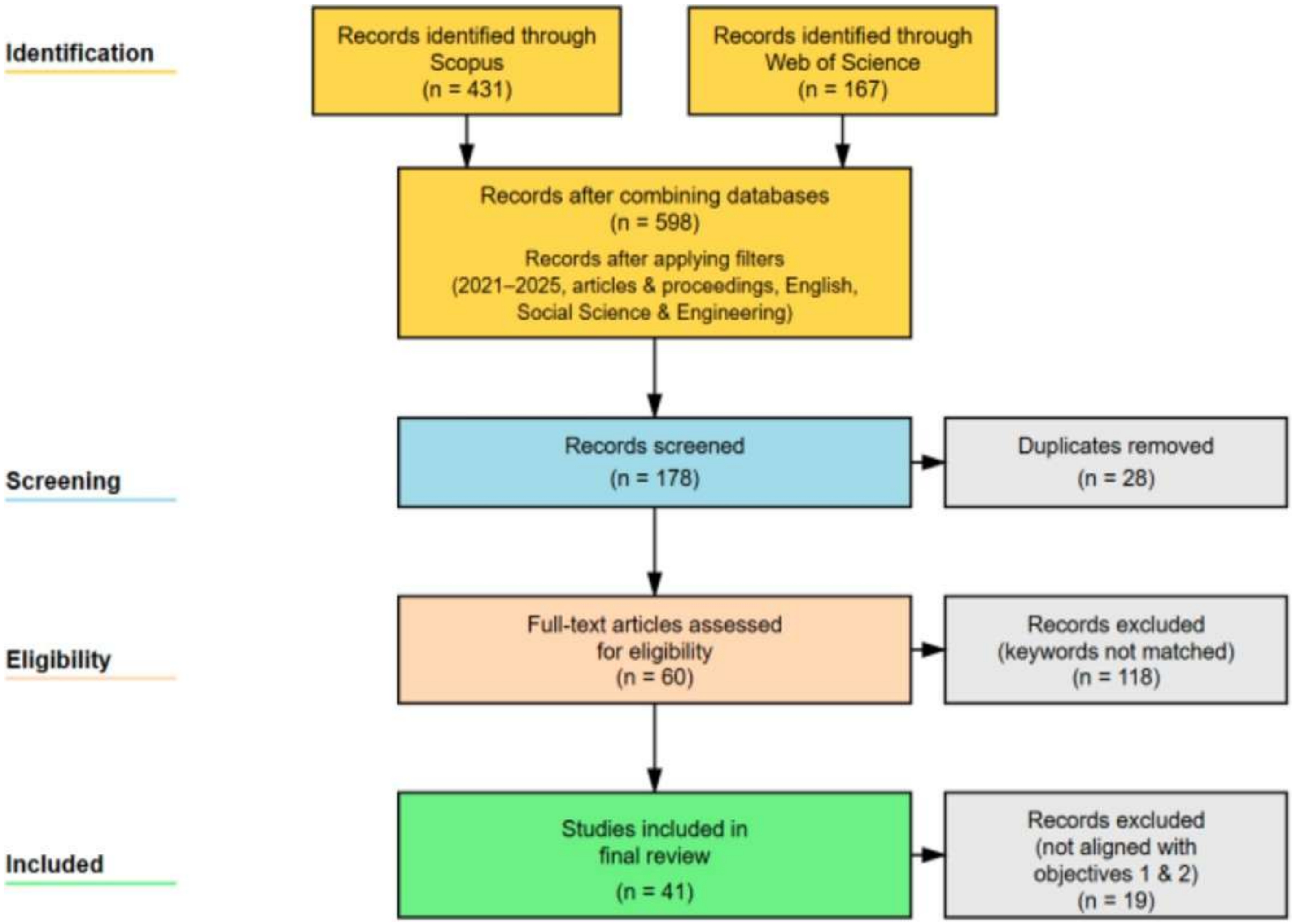

Figure 1. PRISMA Flowchart

The search returned 598 records (431 from Scopus; 167 from WoS) after applying filters for publication years 2021-2025, English language, and subject areas in Social Science and Engineering. During the screening stage, 28 duplicates were removed, leaving 178 records to be screened by title and abstract. Following this, 60 full-text articles were evaluated to identify eligible articles, based on relevance to safety knowledge sharing in construction contexts, peer-reviewed status, and English-language publication. Studies that did not align with the research focus or were not methodologically rigorous were excluded. Ultimately, 41 studies were included in the final synthesis, and 19 were excluded because they did not meet the review objectives. A PRISMA flow diagram was used to document this process, ensuring traceability and reproducibility. Data was extracted by using a structured Excel form to record bibliographic information, study context, study objectives, methods, and key findings. A thematic analysis, following the six-phase framework of Braun & Clarke (2006), was then conducted to identify and interpret recurring themes. As a result, two critical analytical dimensions were identified: (1) current practices of safety knowledge sharing and (2) barriers to safety knowledge sharing in the construction industry. To ensure quality and reduce bias, the Joanna Briggs Institute (JBI) Critical Appraisal Checklist was used for methodological evaluation (Aromataris & Munn, 2020). Using the PRISMA guide to conduct a systematic review, this study aimed to provide a transparent and credible synthesis that advances safety knowledge management in the construction industry.

FINDINGS AND DISCUSSION

Findings and Discussion for Objective 1: Current Practices of Safety Knowledge Sharing in the Construction Industry

Safety knowledge sharing is an integral part of guaranteeing the effectiveness of safety management on the construction site. In high-risk industries, the successful implementation of safety depends on compliance with procedures and on the exchange and use of safety knowledge amongst stakeholders. According to Shafiq and Afzal (2021), knowledge-sharing practices can reinforce cross-disciplinary communication and accelerate the resolution of safety problems at the operational and design levels. The existing practices of safety knowledge sharing in construction projects are shown in Table 2:

Table 2. Current Practices in Safety Knowledge Sharing

Theme/Categories	Sources
Formal Safety Meetings & Briefings	(Arifuddin et al., 2025; Cajavilca et al., 2024; Durmus et al., 2025; Holen et al., 2024; Hou et al., 2024; Imam et al., 2025; Jia & Wu, 2024; Liu et al., 2025; Mei et al., 2024; Seyis & Özkan, 2024; Swallow & Zulu, 2024; Vigneshkumar & Salve, 2022b, 2022a; Williams et al., 2024; Xiahou et al., 2022; Yao et al., 2021; Zhou et al., 2023)
Safety Training & Induction	(Arifuddin et al., 2025; Cajavilca et al., 2024; Desai et al., 2025; Durmus et al., 2025; Hou et al., 2024; Imam et al., 2025; Liu et al., 2025; Luo et al., 2022; Mei et al., 2024; Ni et al., 2025; Shafiq & Afzal, 2021; G. Wang et al., 2025; Wu et al., 2025; Yao et al., 2021; Zhou et al., 2023)
Digital/ICT Systems (BIM, IoT, KM, Cloud)	(Arifuddin et al., 2025; Cajavilca et al., 2024; Chellappa & Salve, 2022; Chenchu et al., 2025; Desai et al., 2025; Durmus et al., 2025; Hou et al., 2024; Imam et al., 2025; Jia & Wu, 2024; Liu et al., 2025; Luo et al., 2022; Mei et al., 2024; Seyis & Özkan, 2024; Shafiq & Afzal, 2021; Sherratt et al., 2023; Swallow & Zulu, 2024; Vigneshkumar & Salve, 2022b, 2022a; G. Wang et al., 2025; L. Wang et al., 2025; Williams et al., 2024; Wu et al., 2025; Xiahou et al., 2022; Xu & Zou, 2021; Yao et al., 2021; Zhang & Lin, 2024; Zhou et al., 2023)
Documentation & Lessons-Learned Repositories	(Shafiq & Afzal, 2021; Chellappa & Salve, 2022; Yao et al., 2021; Mei et al., 2024; Wu et al., 2025; Arifuddin et al., 2025; Seyis & Özkan, 2024; G. Wang et al., 2025; Zhou et al., 2023; Chenchu et al., 2025) Hou et al., 2024; Swallow & Zulu, 2024; Xiaoping & Tao, 2021; Edwin et al., 2021; Diniz Fonseca, 2021; Martínez-Rojas et al., 2021)
Informal Peer-to-Peer/ On-site Exchanges	(Afzal & Shafiq, 2021; Arifuddin et al., 2025; Cajavilca et al., 2024; Holen et al., 2024; Luo et al., 2022; Mei et al., 2024; Seyis & Özkan, 2024; Vigneshkumar & Salve, 2022b, 2022a; Yao et al., 2021; Zhang & Lin, 2024)

KM Systems & Organisational Learning	(Arifuddin et al., 2025; Chellappa & Salve, 2022; Chenchu et al., 2025; Desai et al., 2025; Durmus et al., 2025; Holen et al., 2024; Hou et al., 2024; Imam et al., 2025; Liu et al., 2025; Luo et al., 2022; Martínez-Rojas et al., 2021; Mei et al., 2024; Seyis & Özkan, 2024; Shafiq & Afzal, 2021; Swallow & Zulu, 2024; G. Wang et al., 2025; L. Wang et al., 2025; Williams et al., 2024; Wu et al., 2025; Yao et al., 2021; Zhang & Lin, 2024; Zhou et al., 2023)
AI/Automation-Based Knowledge Extraction	(Durmus et al., 2025; Hou et al., 2024; Imam et al., 2025; Liu et al., 2025; G. Wang et al., 2025; L. Wang et al., 2025; Wu et al., 2025)
Visual & Simulation Tools (Dashboards, VR)	(Arifuddin et al., 2025; Chenchu et al., 2025; Durmus et al., 2025; Liu et al., 2025; Luo et al., 2022; Mei et al., 2024; Seyis & Özkan, 2024; L. Wang et al., 2025; Yao et al., 2021; Zhang & Lin, 2024; Zhou et al., 2023)
Client/Owner Presence & Walk-Throughs	(Holen et al., 2024; Jia & Wu, 2024; Luo et al., 2022; Vigneshkumar & Salve, 2022b; Williams et al., 2024)
Social media	(Chellappa & Salve, 2022; Jia & Wu, 2024; Xiahou et al., 2022)
Smart & Wearable Technology (IoT, PPE, Sensors)	(Desai et al., 2025; Durmus et al., 2025; Imam et al., 2025; Liu et al., 2025; Mei et al., 2024; Ni et al., 2025; L. Wang et al., 2025; Zhang & Lin, 2024)

Formal Safety Meetings and Briefings

Across many studies, formal safety meetings remain a fundamental way to share safety knowledge among construction worker teams. Chellappa & Salve (2022), Mei et al. (2024), and Imam et al. (2025) show that toolbox talks, pre-task briefings, and regular safety meetings are used to communicate hazards, explain procedures, and clarify expectations. Holen et al. (2024) and Luo et al. (2022) also report client-contractor and management walk-throughs during which safety issues are discussed on site. These practices fit the stage of externalisation in Nonaka's SECI model (Nonaka & Takeuchi, 1995), where collective understanding, in this case, the individual sense of risk, is converted into shared, explicit guidance through structured talk. At the same time, the quality of these meetings is just not consistent. Desai et al. (2025) and Imam et al. (2025) note that meetings are more effective when there is active participation and follow-up, rather than a one-way instruction from management to mentee. In some instances, frequent inspection by the clients or management may lead to "inspection fatigue", in which workers are less attentive because they perceive the process as routine and symbolic (Holen et al., 2024). Xiaoping & Tao (2021) also recommend that formal reviews can slip into compliance exercises if lessons are not related to planning and design decisions. Overall, formal meetings and briefings are a focal and necessary channel for sharing safety knowledge. Still, it is participation, follow-up, and a balance between actual learning and mere compliance that makes the difference.

Safety Training & Induction

Safety training and induction are other common ways to disseminate safety knowledge. Shafiq & Afzal (2021) and Mei et al. (2024) show that induction programmes, classroom training, and toolbox training help to build basic safety awareness among workers. Imam et al. (2025) and Zhang and Lin (2024) highlight more participatory approaches, such as participatory ergonomics and team-based training, in which workers and supervisors discuss risks and work together to design solutions. These practices are both processes of socialisation (the sharing of tacit experience) and externalisation (the externalisation of that experience into shared rules). Digital tools are transforming the delivery of training. Swallow and Zulu (2024), Cajavilca et al. (2024), and Afzal (2021) use 4D-BIM and VR to simulate site conditions and hazards, enabling workers to "rehearse" risky tasks in a virtual environment. Chen et al. (2025) associate IoT data with training dashboards, in which real-site data serve as training samples. These approaches support combination and internalisation in SECI, because explicit information (drawings, schedules, sensor data) becomes meaningful practice through repeated exposure and incremental development through reflection. However, some gaps are apparent. Holen et al. (2024) and Edwin (2021) suggest that training is sometimes delivered as a one-off event with little onsite reinforcement, which adds the risk that digital training excludes workers with low digital skills. The key takeaway is that there is strong potential for training, but it still depends on the design, repetition, and integration with the site's weekday routine.

Digital / ICT Systems (BIM, IoT, KM, Cloud)

Digital and ICT-based systems are increasingly adopted to facilitate the formalisation and storage of safety knowledge in construction projects. Platforms such as BIM-based risk databases and knowledge management systems enable the codification and dissemination of explicit safety information across project stages, supporting planning, coordination, and compliance-related activities (Chellappa & Salve, 2022; Arifuddin et al., 2025). Empirical studies indicate that such systems improve access to documented safety knowledge and enhance information consistency across multidisciplinary teams (Seyis & Özkan, 2024).

Despite these advantages, the literature suggests that the effectiveness of digital systems in supporting safety knowledge sharing depends heavily on their integration into routine site workflows and organisational practices. Fragmented platforms, limited interoperability, and uneven digital literacy among workers have been identified as persistent constraints that reduce system utilisation and practical impact (Shafiq & Afzal, 2021; Desai et al., 2025). These findings indicate that while digital systems provide a necessary infrastructure for sharing safety knowledge, they are insufficient on their own to ensure meaningful knowledge exchange.

Documentation and Lessons-Learned Repositories

Many papers reveal an increased attention to formal documentation and to lessons learned systems. Wu et al. (2025) and Zhou et al. (2025) are using the knowledge graphs and ontologies to convert accident reports and emergency knowledge into "structural data knowledge" that can be searched and used for other purposes. The works of Cajavilca et al. (2024) and Collinge (2022) associate risk information with 3D/4D models so that design and construction teams can benefit from experience in safety. Vigneshkumar & Salve (2022b) suggest a modular approach in which data from incidents, design rules, and training content are interlinked. These studies reflect the KBV thinking about organisational advantage, that knowledge is retained and reused across projects, rather than having to start from scratch every time. However, the literature also shows that documentation alone is insufficient. According to Chellappa and Salve (2022), some companies collect reports but do not analyse them systematically. Sherratt et al. (2023) argue that "no-blame" approaches, if applied too simply, may result in reports with little details of root causes, thus weakening learning. Edwin (2021) also proposes that many businesses focus on gathering incidents for compliance rather than connecting them back to decision-making and training. Therefore, documentation and repositories are essential in the long term for effective retention of safety knowledge, but are of little use without high-quality data and without organisations actively using them to review and change practice.

Informal Peer-to-Peer and On-Site Exchanges

Informal peer-to-peer communication remains one of the most powerful channels for sharing safety knowledge. Mei et al. (2024) and Ni et al. (2025) describe workers sharing safety tips and experiences through person-to-person discussions, small-group talks, and even disputes. Hollicrants et al. (2014) and Luo et al. (2022) demonstrate that questions, advice, and stories exchanged on site affect how workers come to understand risk, compared with formal documents. According to Imam et al. (2025), when leaders foster an environment of open discussion and participation to promote greater actualization, employees are more inclined to report incidents and near misses. This is classic socialisation in the SECI model—tacit knowledge passing directly from one person to another. However, informal channels also have weaknesses. Shafiq and Afzal (2021) and Desai et al. (2025) warn that without a specific structure or reflection; informal talk can reinforce bad habits or incomplete understanding. In multilingual or multicultural teams, misunderstandings may arise, and junior workers may be unwilling to question. Informal sharing is also challenging to capture in repositories, meaning there is a risk that valuable knowledge will be lost when people leave. Even with these limitations, the evidence shows that informal exchanges are fundamental to making safety knowledge real and usable. Formal systems work best to the extent they address and build upon these everyday conversations.

Knowledge Management Systems and Organisational Learning

Several studies explicitly situate safety knowledge sharing within the broader scope of knowledge management (KM) and organisational learning. Desai et al. (2025) outline knowledge management and learning as key organisational elements that influence safety performance. Wu et al. (2025) and Vigneshkumar & Salve (2022b) develop systems that gather, process, and circulate safety data within a structured KM cycle. Imam et al. (2025) empirically demonstrate that safety leadership, in part, enhances compliance by fostering knowledge sharing among workers. These findings are consistent with KBV, which defines knowledge as a strategic resource that can be managed and developed. At the same time, papers indicate that KM systems are not always successful in deep learning. Sherratt et al. (2023) note that incident systems can generate large amounts of data and little real reflection on system flaws or management decisions. Vigneshkumar & Salve (2022b) argue that many organisations focus on single-loop learning (fixing immediate issues) rather than double-loop learning (questioning underlying assumptions). Edwin (2021) further indicates that safety systems can even become isolated from production pressures, resulting in limited influence. Taken together, these studies show that KM tools are essential, but they must be combined with a culture of questioning, reflection, and leadership support to enable genuine organisational learning around safety.

AI / Automation-Based Knowledge Extraction

AI and automation-based approaches primarily contribute to safety knowledge sharing by enhancing the processing and structuring of large volumes of safety-related data. Techniques such as knowledge graphs, machine learning, and automated incident analysis enable organisations to identify patterns in accident data and generate predictive insights that may not be readily apparent through manual analysis (Wu et al., 2025; Liu et al., 2025). These systems support the transformation of raw safety data into structured knowledge that can inform risk assessment and decision-making.

However, evidence suggests that AI-based systems remain limited in their ability to influence knowledge-sharing behavior at the operational level directly. Several studies report that such systems are often deployed at pilot or analytical stages and are weakly connected to everyday site practices, reducing their uptake by frontline workers (Desai et al., 2025; Durmus et al., 2025). Consequently, AI-based tools appear to function primarily as analytical support mechanisms rather than as stand-alone drivers of safety knowledge sharing.

Visual and Simulation Tools (Dashboards, VR)

Visual and simulation-based tools support safety knowledge sharing by enabling workers and managers to interpret hazards spatially and temporally. BIM-linked dashboards, 4D simulations, and virtual reality environments facilitate experiential learning by illustrating risk scenarios and task sequences in ways that textual documentation alone cannot achieve (Cajavilca et al., 2024; Swallow & Zulu, 2024). These tools have been shown to improve communication across design and construction teams, particularly during safety planning and training activities.

Nevertheless, the effectiveness of visual and simulation tools varies significantly across organisational contexts. Studies indicate that limited technical skills, lack of facilitation, and unequal access to digital resources constrain their widespread adoption, especially among small contractors and site-based personnel (Seyis & Özkan, 2024; Holen et al., 2024). This suggests that while visual tools enhance the internalisation of safety knowledge, their impact depends on organisational readiness and support mechanisms.

Client / Owner Presence and Walk-Throughs

The involvement of the client and owner can serve as a channel for safety knowledge and as a signal of the safety priority. Holen et al. (2024) show that regular client presence and safety walk-throughs in renewable energy projects help keep safety in sight and encourage discussion among clients, contractors, and workers. According to Luo et al. (2022), when clients exert pressure for safety-by-design, knowledge of hazards is shared earlier between designers and constructors. Desai et al. (2025) also see leadership by top management and clients as an essential factor for developing safety knowledge practices. However, not all is positive evidence. Holen et al. (2024) report that persistent inspections, or those focused on compliance, lead workers to see them as a "show" rather than a genuine learning opportunity. Xioping (2024) suggests that some client-led audits are motivated

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not by learning but by reputational concerns. In such instances, information flows upwards, but not necessarily sideways and back down. Thus, client and owner presence can be a powerful force in building safety knowledge sharing if it supports an open dialogue and joint problem-solving, but less so if it is merely symbolic or serves as a rule-checker.

Social Media

Social media are new but less developed practices. Yao et al. (2023) show that Twitter is used to share construction safety information, although much of it is one- way broadcasting by organisations rather than interactive discussion. Williams et al. (2024) studied communication between contractors and communities and identified safety demonstrations, mass media, and social media as means of passing health and safety messages beyond the project boundary. Ni et al. (2025) note that some younger workers rely on platforms such as YouTube to access and disseminate construction safety content, particularly during the pandemic. At the same time, there is current evidence that such channels remain on the periphery of the formal safety knowledge systems. Yao et al. (2023) report low interaction rates and minimal network density in Twitter safety networks. Williams et al. (2024) note broader issues in the literature regarding the politics of communication in community settings, including trust, literacy, and access. Organisations may also be reticent about detailed incidents going to the public due to legal and reputational concerns. So, social media and external communication do increase understanding of safety, particularly among communities and younger workers. Still, they have not yet emerged as a core mechanism for internal, project-based learning.

Smart and Wearable Technology (IoT, PPE, Sensors)

Finally, smart and wearable technologies enable new ways to share safety information in real time. Li et al. (2025) describe smart PPE that monitors workers' conditions and sends alerts when unsafe situations arise. Chen et al. (2025) and Wang et al. (2025) link IoT sensor networks with analytics to identify risky behaviors and conditions. The IoT & Fuzzy Markup study Martinez-Rojas et al. (2021) describes how developing the ability to process this sensor information using fuzzy logic can estimate the risk of falling objects and send a warning to workers on a smart wristband. These systems enable the processing of raw data into timely feedback, from which workers and managers can learn while in the middle of work operations, not just in the aftermath of incidents. However, adoption remains limited. Cost, integration, and privacy concerns have been identified as significant barriers by Desai et al. (2025) and Seyis and Özkan (2024). Workers may have the feeling of being "watched" and small companies may not be able to keep such systems running. There is also still minimal evidence on how these technologies impact long-term learning, aside from immediate alerts. Smart and wearable technologies are, therefore, a promising yet developing practice. They can offer immediate functional support for safety knowledge sharing, but will need to be connected to larger KM and training systems to turn sensor data into tangible learning.

Findings and Discussion for Objective 2: The Key Barriers to Safety Knowledge Sharing in the Construction Industry

Safety knowledge sharing has also received growing recognition as an essential determinant of organisational learning and safety performance in the construction sector. Between 2021 and 2025, a growing body of research illuminates how organisations identify safety communication, and how this can be contrasted with deep-rooted structural, technological, psychological, and cultural organisational barriers to effective and efficient knowledge exchange between workers, their supervisors, subcontractors, and the project's stakeholders. Given that construction work is fragmented across multiple levels, these barriers weaken the construction sector's ability to turn learning into proactive action, leading to recurrent incidents, delayed hazard spotting, and low learning across projects. The barriers to safety knowledge sharing in construction projects are shown in Table 3:

Table 3. Barriers to Safety Knowledge Sharing

Code	Theme/Categories
T1	Communication & language barriers

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T2	Organisational & cultural barriers
T3	Technological & system limitations
T4	Tacit knowledge/knowledge retention problems
T5	Resource/cost/time constraints
T6	Project fragmentation & workforce turnover
T7	Psychological & individual barriers
T8	Contextual transfer barriers

Paper	T1	T2	T3	T4	T5	T6	T7	T8
P1	/					/		/
P3		/	/	/	/			
P4	/	/					/	
P7			/	/	/			
P8	/	/						
P9		/	/	/	/	/		
P11			/	/	/			
P12	/	/	/				/	
P13			/	/	/			
P14			/	/		/		
P15	/							
P16	/		/					
P17	/	/		/				
P18	/						/	
P19	/		/				/	
P20	/		/			/	/	
P21	/			/	/			
P22	/		/			/	/	
P23			/	/		/		
P24			/	/	/	/		

P26			/	/				
P27	/	/	/	/		/		
P28	/		/	/		/		
P29	/	/		/	/	/		
P30		/		/	/	/	/	
P31				/		/	/	
P32	/	/						

P1 – Edwin et al. (2021); P3 – Chellappa & Salve (2022); P4 – Sherratt (2023); P7 – Vigneshkumar & Salve (2022b); P8 – Prabhudesai et al. (2025); P9 – Xu et al. (2025); P11 – Durmuş et al. (2025); P12 – Hou et al. (2024); P13 – Chellappa et al. (2025); P14 – Cajavilca et al. (2024); P15 – Williams et al. (2024); P16 – Shafiq & Afzal (2021); P17 – Holen et al. (2024); P18 – Jia & Wu (2024); P19 – Afzal & Shafiq (2021); P20 – Swallow & Zulu (2024); P21 – Vigneshkumar & Salve (2022a); P22 – Yao et al. (2024); P23 – Wu et al. (2025); P24 – Arifuddin et al. (2025); P26 – Collinge et al. (2022); P27 – Cajavilca (2024); P28 – Martínez-Rojas et al. (2021); P29 – Fonseca et al. (2021); P30 – Liu et al. (2025); P31 – Williams et al. (2023); P32 – Williams et al. (2024)

Communication and Language Barriers

Communication difficulties are among the most widely reported problems in the transfer of safety knowledge, as several recent studies show. Multilingual workforces, outsourcing, and subcontracting pose many challenges in communicating hazards, safety procedures, and learned experience in an intelligible and understandable way (Shafiq & Afzal, 2021; Williams et al., 2024). Research on safety training in multilingual crews suggests that language inconsistencies hinder workers' ability to understand instructions, which affects their involvement in safety communication and knowledge-sharing activities (Afzal & Shafiq, 2021).

The latest empirical research has supported these findings. A study in Indonesia found that language barriers are a significant problem that affects the effectiveness of labor occupational safety and health (OSH) communication, and it emphasizes that safety messages need to be delivered in clear, understandable language to all workers (Octovianus Bin Rojak & Yuniorita Indah Handayani, 2023). Similarly, an investigation of multilingual construction crews found that communication networks weakened due to limited language proficiency, impairing safety performance and raising accident rates (Lyu et al., 2020). Research in the UK also indicates that bilingual workers often act as informal interpreters to address communication gaps. Still, such informal systems are inconsistent and unreliable for ensuring clear safety communication (Fellows et al., 2022).

Poor channel clarity, lack of clear reporting channels, and inconsistent information dissemination across an organization's safety hierarchy also weaken the flow of both tacit and explicit knowledge (Holen et al., 2024; Jia & Wu, 2024). These barriers often lead to miscommunication and a loss of learning and engagement among workers, mainly migrant workers, who may be fearful of reprimands or misinterpretation. Addressing these issues by developing formal multilingual communication systems, uniform safety reporting practices, and focused language training can dramatically enhance the transfer of safety knowledge and foster a culture of safety in the workplace.

Organisational and Cultural Barriers

Organisational and cultural conditions are widely reported as structural barriers to safety knowledge sharing in the construction industry. Factors such as weak safety leadership, limited managerial support, compliance-oriented safety systems, and the absence of recognition or incentive mechanisms have been repeatedly identified as constraints on open communication and shared learning (Chellappa & Salve, 2022; Sherratt, 2023; Hou et al., 2024). In organisational contexts where safety is primarily framed as a regulatory requirement, knowledge sharing tends to be formalised and top-down, with limited opportunities for reflection or feedback from frontline workers.

Empirical studies further indicate that leadership style plays a central role in shaping the organisational environment for safety communication. Transactional or authority-driven leadership approaches are commonly associated with restricted information flows and limited upward communication, whereas participative and trust oriented leadership styles are more frequently associated with supportive conditions for knowledge exchange (Balcerzyk, 2021; Kupa et al., 2024; Toufighi et al., 2024). In highly hierarchical construction settings, the distance between management and site-level personnel may reduce the visibility and perceived value of experiential safety knowledge generated on-site.

In addition, organisational cultures characterised by low trust and limited recognition of proactive safety behaviour may further constrain knowledge-sharing practices. Studies suggest that when safety responsibilities are viewed primarily as managerial obligations, workers may exhibit lower engagement in safety communication and learning activities (Holen et al., 2024; Yao Lartey et al., 2022; Phung et al., 2016). Taken together, these findings indicate that organisational and cultural barriers operate at a systemic level by shaping communication norms, leadership practices, and institutional priorities related to safety knowledge sharing.

Technological and System Limitations

The digitalisation of construction safety has accelerated significantly; however, technological limitations remain a key barrier to effective knowledge sharing. Dozens of studies mention fragmented digital systems, incompatible platforms, and unstructured data repositories that function towards the retrieval and reuse of safety knowledge (Xu et al., 2025; Wu et al., 2025; Arifuddin et al., 2025). These findings are consistent with the recent reviews that indicated that interoperability issues and data fragmentation still hinder digital safety management in the construction domain (Daniel et al., 2025) and that BIM knowledge-management integration efforts are still hampered by a lack of standards and harmonious platforms (Utama et al., 2025; Fitra et al., 2024).

The lack of digital literacy, particularly among older workers, is a limiting factor in implementing BIM, Knowledge Management Systems (KMS), and IoT-based safety technologies (Durmus, 2025). Empirical studies show that low digital competence and resistance to change are significant hurdles to technology adoption on construction sites (Sandagomika et al., 2020; Hire et al., 2021).

In some cases, organisations invest in advanced digital tools such as BIM-based risk libraries or 4D-VR systems without proper integration with existing workflows, resulting in these tools not being used to their full advantage (Collinge et al., 2022; Cajavilca et al., 2024). Research confirms that complex user interfaces, poor system interoperability, and inadequate training contribute to the underutilization of digital safety management technologies (Nnaji et al., 2023).

These barriers often lead to stored safety information merely being neglected, undermining decision-making and cross-project learning. Studies have shown that data captured in BIM and IoT systems are usually siloed or inaccessible to field personnel, thereby being less valuable for improving safety and learning (Utama et al., 2023). Overall, technological and system-related barriers, such as those of interoperability gaps and low user skills or workflow misalignment, continue to limit the digital transformation of construction safety knowledge sharing.

Tacit Knowledge and Retention Problems

Tacit safety knowledge, rich in experience-based insights from on-site work, is essential for identifying hazards and preventing accidents. However, both retention and transfer of this tacit knowledge pose problems due to the temporary nature of project teams, worker mobility, and the absence of structured mechanisms to capture experiential learning (Chellappa & Salve, 2022; Xu et al., 2025). Similar findings in construction research indicate that project-based work and workforce turnover lead to critical knowledge loss because much of this expertise is held by individuals rather than in systems (Bresnen et al., 2003; L. Jawahar, 2005).

Workers often rely on informal, undocumented exchanges, which lead to inconsistency and a greater risk of knowledge loss when employees leave a project (Fonseca et al., 2021). Studies confirm that tacit knowledge in construction is often shared through informal communication, mentoring, and observation rather than through formal systems, making it difficult to standardize and maintain from one project to another (Duryan et al., 2020; Saini et al., 2015).

Research also emphasises that without organised documentation, mentoring and reflection sessions, tacit safety knowledge is lost very quickly, especially with migrant or temporary workers (Holen et al., 2024). This is consistent with evidence that the project discontinuity and weak learning mechanism inhibit long-term retention of tacit knowledge (Negara et al., 2021). Even with digital technology available, like BIM or VR-based learning systems, tacit knowledge is a challenge that is hard to codify to keep transferring the practical know-how across teams and projects (Lingard et al., 2015; Amit & Sengupta, 2022).

Overall, the capture of tacit safety knowledge in construction is poor, given fragmented communication, project-based employment, and the difficulty of codifying practical expertise. Addressing these barriers involves embedding mentoring, storytelling, and reflection practices throughout digital safety systems to capture and transfer experiential knowledge from one project to another.

Resource / Cost / Time Constraints

High workload, time pressure, and resource limitations leave little room for meaningful knowledge-sharing practices in construction environments. Fast-paced project schedules offer few opportunities for reflective learning, toolbox discussions, or cross-team communication (Chellappa et al., 2025). Consistent with this, empirical evidence indicates that employees who are faced with excessive workloads tend to deprioritize collaborative work and/or reflective work, because being resource-constrained impairs motivation and available time for knowledge exchange (Dirk De Clercq & Pereira, 2024).

Workers do not value the knowledge-exchange process and consider safety discussions time-consuming or secondary to production goals (Swallow & Zulu, 2024). This tendency is especially pronounced in project-based construction environments, where deadlines and productivity exigencies make time for training or even introspective reflection on safety practices very limited. Research done in construction joint ventures and project based organizations further proves that "lack of time" is one of the most cited barriers to effective knowledge sharing (Bakri et al, 2022; Molin & Dahlberg, 2018).

Insufficient training budget, a lack of knowledge-sharing sessions, and low-level staffing also hinder the adoption of a structured safety communication (Liu et al., 2025). These findings are reminiscent of earlier studies in the construction management administration sector, which found that inadequate financial and human resources were significant limitations to implementing knowledge management initiatives (Carrillo et al., 2004; Kasimu & Kolawale, 2019). When resources are stretched, organisations tend to focus on short-term operational needs and, as a consequence, safety learning becomes reactive rather than proactive.

Ultimately, too much work, squeezed schedules, and a lack of resource allocation create an environment where safety knowledge sharing is undervalued or delayed. Addressing such barriers requires management commitment to allocating time and resources for structured reflection, cross-project learning, and continuous improvement of safety practices.

Project Fragmentation & Workforce Turnover

Construction is inherently fragmented, with different subcontractors involved, temporary workforces, temporary project teams, and rapid worker turnover, all of which impair knowledge sharing (Xu et al., 2025; Afzal & Shafiq, 2021). This spatial fragmentation in the structure has long been identified as a defining challenge for the construction industry, resulting in poor integration and replication of efforts and poor communication practices across organizational boundaries (Ali Mohammed et al., 2011; Alashwal & Fong, 2015).

Subcontractor boundaries often create silos where information flow does not cross teams, and there are differences in contractor responsibilities; therefore, communication practices are not always consistent across teams (Wu et al., 2025). Studies confirm that coordination barriers and contractual segregation are contributing factors that make collaboration and knowledge flow among project participants difficult (Hai et al., 2012; Mohd Nawi et al., 2014).

When workers often migrate to other locations or companies, previously shared knowledge is usually not retained in organisational memory (Fonseca et al., 2021). High workforce mobility is a key driver of knowledge discontinuity and lost experiential learning, especially in project-based environments (Abdolmaleki et al., 2023). High turnover among subcontractors and temporary workers means lessons learned are not embedded in organisational systems or future projects (Al-Suraihi et al., 2021).

This fragmentation creates duplication of errors, gaps in hazard awareness, and the inability to learn from past incidents, and this is one of the most structurally embedded barriers within the industry. Addressing fragmentation through integrated project delivery, long-term subcontractor relationships, and systems addressing across organisational boundaries to support a continuous flow of safety knowledge.

Psychological and Individual Barriers

At the individual level, psychological factors influence how workers perceive and engage in safety knowledge-sharing activities. Empirical studies indicate that fear of negative evaluation, low self-efficacy, and limited confidence may reduce workers' willingness to participate in safety discussions or to share experiential knowledge (Hou et al., 2024; Yao et al., 2024; Mei et al., 2024). These psychological factors affect individual decision-making regarding whether it is safe or worthwhile to speak up in work-related safety contexts.

Construction safety research further highlights the role of psychological safety, defined as the perceived ability to express concerns without fear of negative consequences, in shaping individual knowledge-sharing behavior (Li & Wareewanich, 2024; Stăneiu, 2022). Where psychological safety is perceived to be low, workers may be less inclined to report hazards or near-miss incidents, particularly in environments characterised by strong power distance or temporary employment arrangements (Jia & Wu, 2024).

Additional individual-level factors, including generational differences, skill levels, and workforce diversity, have also been associated with variations in safety knowledge-sharing behaviour. Studies suggest that inexperienced, migrant, or less digitally literate workers may experience heightened communication anxiety or uncertainty, which can further limit participation in safety-related exchanges (Holen et al., 2024; Wahyu Adi & Musbah, 2017; Durmus et al., 2025). These findings indicate that psychological and individual barriers reflect how workers interpret and respond to their organisational context, rather than operating independently of broader structural and cultural conditions.

Contextual Transfer Barriers

Although less commonly discussed, some studies emphasise the fact that safety knowledge developed in one context may not, in some cases, transfer effectively to another, particularly across different industries, regions, or project types. Edwin et al. (2021) note difficulties in applying safety lessons learnt from offshore oil and gas to the construction industry due to variations in regulatory culture, training standards, and risk tolerance. Similarly, models of knowledge sharing developed in Western countries may not be directly applicable in developing regions due to cultural, institutional, or socio-economic differences (Williams et al., 2023). This contextual mismatch limits the generalisability of some safety practices, causing barriers to the adoption of global best practices.

CONCLUSION

The studies reviewed include 41 publications from 2021 to 2025 that offer an updated, comprehensive understanding of how safety knowledge is shared in the construction industry, as well as the barriers that persist to its effectiveness. The conclusions based on the results of this research demonstrate that whilst a range of formal and informal processes, including toolbox meetings, safety inductions, digital platforms, incident repositories, and peer-to-peer interactions are widely practised, implementation is inconsistent and fragmented, and subject to the influence of organisational culture and resource availability. This review concludes that safety knowledge sharing depends not only on the availability of tools and systems but also on psychological safety, leadership commitment, digital readiness, and the ability to retain tacit knowledge for temporary, high-turnover project teams. Without action on these deep-rooted structural, cultural, and individual barriers, safety knowledge sharing will remain reactive, patchy, and inadequate at limiting the recurrence of incidents across construction projects.

Like all systematic literature reviews, this study has several limitations. First, the review was based on peer-reviewed journal articles indexed in Scopus and Web of Science, which may omit relevant industry reports, grey literature, or doctoral theses that provide more information. Second, the review covered studies published from 2021 to 2025; thus, emerging practices and technologies outside this time frame were not studied. Third, although thematic analysis was conducted rigorously, there may still be some influence of subjective judgment arising from the available reporting in the included papers. Lastly, the review synthesises the global literature. Although some gaps are identified in Malaysia specific research, the generalisability of the findings to the Malaysian context is constrained by a lack of locally driven empirical studies.

Based on the results and shortcomings, some recommendations are made for future research and the industry. More empirical studies, specifically focusing on Malaysia, are needed to better contextualise safety knowledge dynamics within the local regulatory and cultural environment, including the socio-organisational determinants, psychological factors, and technology adoption. Longitudinal and mixed-methods studies are also encouraged, in which the change in safety knowledge can be captured throughout the lifecycle of projects and organisational change. For industry practitioners, organisations should put a focus on building a learning oriented safety culture aligned with trust, non-blame communication, and participative leadership. Investment in digital literacy, system integration, and easy-to-use ICT tools is crucial to maximise the value of BIM, IoT, VR, AI, and knowledge management systems. Most importantly, companies need to put in place systematic ways to preserve tacit knowledge such as mentoring programmes, after-action reviews, storytelling sessions, and cross-project learning platforms to prevent the loss of experiential safety learning when workers move from project to project. Strengthening these areas will help the construction industry make greater strides towards uniform, proactive, and practical safety knowledge sharing.

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