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Current State of Scaffolding Unsafe Factor: A Thematic Review

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Abstract: Construction industry plays a significant part in the growth of Malaysia's economy, and it is one of the country's most vital industries. Therefore, falling from a scaffolding is one of the most prevalent construction hazards. Scaffolding accidents are increased by factors such as inadequate capacity and incorrect usage of Personal Protective Equipment. Based on the previous studies, none of the researcher has reviewed scaffolding safety issues by using systematic literature review method. As a result, this review was driven to emphasize the current state of scaffolding unsafe factors in order to close this research gap. The purpose of this systematic review is to summarize the available research from 2012 to 2022 about the current state of scaffolding unsafe factors. The research used Atlas.ti 8, a keyword search, and a snowballing approach to filter for inclusion criteria from SCOPUS, Science Direct, and Web of Science. However, following the inclusion and exclusion procedure, only 29 papers were utilized to assess the final articles. A thematic assessment of these 29 papers identified initial codes identifying and categorizing them as follows: worker behavior, worker skill, site condition, design fault, insufficient equipment, management problem, and Personal Protective Equipment. The discovery is likely to enhance scaffolding safety on construction sites. For future research, other researcher can use primary method such as qualitative or quantitative method focusing on specific location to determine scaffolding unsafe factors for a particular type of scaffoldings.

Keywords: Thematic review, Atlas.ti, scaffolding, unsafe factors, construction industry

1. Introduction

The construction industry plays a significant part in the growth of Malaysia's economy, and it is one of the country's most vital industries. The construction sector, on the other hand, is one of the most dangerous in the world. Construction activity is still characterized by a high level of threat to the employees' health, as well as a high accident rate. The rising cases of construction-related accidents and fatalities is a huge concern. Falling from a height is one of the most prevalent construction hazards. In the workplace, a fall is a downward movement caused by a worker's loss of equilibrium (Vacanas et al., 2020). An essential part of the construction, maintenance, and repair of all man-made structures, scaffolding is a temporary framework that supports a work crew and supplies. The use of frameworks to obtain access to areas that would otherwise be inaccessible is commonplace and may lead to death or severe injury. Scaffolding incidents on construction sites have been a serious topic also in Malaysia in these recent years. Each year,

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the scaffolding incidents result in thousands of injuries and fatalities on construction sites. Recently, two women died in the 6 p.m. crash after scaffolding at the flyover Sungai Besi-Ulu Klang Elevated Expressway (SUKE) site crashed into the vehicle. It is dangerous to work at heights. The ones mentioned above are only among the incidents that have included scaffolding. Moreover, on 29 July 2021 one foreign worker was killed and four others were wounded after steel scaffolding fell at a building site along the Jalan Langat Light Rail Transit (LRT) 3 track in Bandar Bukit Tinggi, Malaysia (Jananey Ramachandran, 2021).

As a result, there is an urgent need to address this problem. To ensure secure and conducive working conditions, some factors need to be considered. This study shows that to prevent major scaffold incidents from occurring, it is crucial to analyse the triggers of scaffold incidents on the worksite to implement precautionary measures. Thus, the aim of this paper is to identify scaffolding unsafe factors.

2. Literature

Scaffolding serves primarily as a means of helping construction workers working at heights or in otherwise difficult-to-reach locations (Błazik-Borowa & Szer, 2015). A research found that scaffolding is extensively employed not just on building sites, but also in other places, such as shipyards, processing line re-engineering projects, billboards, stages, and convention centers, where it may also be used as a decorative feature. Scaffolding helps people get to their workplaces more swiftly (scaffolding refers to any platform or ramp that facilitates the movement of construction materials and equipment) (Ismail & Ghani, 2012).

Besides, scaffolding is a temporary structure that allows work to be performed at a height of between two and many dozens of meters above the ground. Scaffolding is mostly used to assist construction activities at heights and in areas with limited access. Apart from that, scaffolding is utilized in a variety of other applications, including renovations, supporting the installation of billboards, and temporary hall construction (Haslinda Abas et al., 2020). From its critical function as a temporary framework, scaffolding-related incidents result in a high number of injuries and fatalities on construction sites.

Scaffolding operations are the primary cause of construction site accidents, which is a problem that is becoming worse and worse every year (Olanrewaju et al., 2021). Each year, such incidents result in hundreds of injuries and fatalities on construction sites. Malaysia's Social Security Organization (SOCSO) reported in 2000 that the construction industry's mortality rate was more than three times that of other workplaces in the country (Izzuddin Romli & Ozve Aminian, 2017). According to Halperin & McCann, (2004), falling from scaffolds and scaffold collapse are the two most common causes of scaffold-related injuries.

3. Methodology

3.1 Data Collection

In this study, predefined criteria and methodology will be used to perform systematic reviews. An essential checklist for systematic reviews, the Preferred Reporting Items for Systematic reviews, and Meta-Analyses (PRISMA) checklist was established by Moher et al., (2009), and includes 27 checklist item. Using this minimal number of items, systematic reviews and meta-analyses may report with confidence. Therefore, a four-phase flow diagram and a 27-item checklist are included in the PRISMA recommendations. Recommendations for subjects like as title, abstract, introduction and techniques are included in a 27-item checklist. To help authors, reviewers & editors, PRISMA's flow diagram and checklist are provided. Corresponding to the flow diagram, reports that come inside the review's scope will be identified, screened, eligible, and included.

According to figure 1, Web of Science, Science Direct, and Scopus were used for the electronic literature search. In-depth research on scaffolding safety and accidents may be found in these three databases. Scaffolding has many distinct names across the world thus all of those words are included in the main search phrases. The first set of keywords in each database were as follows: ("scaffolding accident" AND "construction industry"), (*scaffolding AND accidents AND safety AND factors) AND PUBYEAR > 2011, (Scaffolding accident AND factor causes AND construction industry). The asterisk designates a word's derivatives, and the double quotation mark indicates that the words included inside appear in the same sentence. The time span for this study were restricted for 10 years which from 2012 until 2022. According to Helfer et al., (2015) the research span limit to 10 years to prevents the analysis of obsolete material and also considers the fact that publishing might take a long time. Hence a total of 31 articles were identified.

Expanding the terms in the first search while keeping the 10-year time limit was the next step in doing a secondary search. Additional scaffolding related keywords were added to the search, which are often used in construction safety related publications such as (*scaffolding AND construction AND accident AND investigation OR analysis) AND PUBYEAR > 2011 and ("scaffolding collapse AND construction AND "Causes"). Finally, a total of 96 articles were searched out from the three data bases.

Search results may contain articles that do not directly relate to a study topic, but they're nonetheless likely to include them since they fit the overall framework. Due to the use of overlapping databases, further duplications were to be anticipated. As a result, only articles that are relevant to the topic are picked from each database. The titles and

abstracts of each paper were scrutinized to see whether or not it was appropriate for review. During the process of screening duplicate papers, reviewed papers and non-English papers were removed. Only 75 of the 96 articles found through a search turned out to be suitable for this study. Then, proceed to the process of eligible and included of the papers. From this process, the researcher identified the actual numbers of articles used. The key condition for qualification was that the article must effectively convey an understanding of the viewpoints of developing nations' building industries regarding scaffolding safety concerns. Several papers were eliminated from the analysis because did not include a particular research on scaffolding accidents during construction. Apart from that, research not directly relevant to scaffolding accidents and variables contributing to accidents have been excluded. 46 papers were eliminated from the 75 that were initially evaluated owing to their lack of relevance to the review. Unrelated articles were excluded after the content analysis, remaining 22 items. The details information on how the data collection were conducted is shown in figure 10. According to Selcuk, (2019) complying with every item on the check list ensures that the reporting process is as transparent and easy to understand as possible. This allows for a well-organized report that clearly defines the research question, states its title, and details its goals.

After went through the process of PRISMA method, snowballing method was used to identify the articles that related to scaffolding unsafe factors. The term "snowballing" refers to the practice of leveraging a paper's citations or reference list to locate more relevant studies (Wohlin, 2014). Snowballing, on the other hand, may benefit from a systematic approach to looking at where papers are referred and where papers are mentioned, rather than just looking at the reference lists (Wohlin, 2014). Backward and forward snowballing is a term used to describe the practice of using references and citations to build a snowball.

In this study, both backward and forward method were used to identify articles related to scaffolding unsafe factors. From this method, 7 articles have been found. The abstract, whole of the work and available data being reviewed before a decision is made on whether or not to include the paper. Hence, a total of 29 articles related to factors that influence scaffolding accidents have been identified. Therefore, by using PRISMA and snowballing method objective 1 which is to identify the articles related to factors that influence scaffolding accident has achieve.

3.2 Data Analysis

A thematic analysis of the data was performed in this systematic review. Analyzing qualitative data for patterns and themes is known as thematic analysis (Maguire & Delahunt, 2017). Scaffolding unsafe factors were examined in this study, which employed a qualitative technique to identify the number of articles used. The number of articles based on publications, years, type of papers, and journal rankings were analyzed quantitatively. The incorporation of qualitative studies in a mixed-methods review may give helpful insights into the implementation of research treatments; this approach can be used to a broad spectrum of literature (Sataloff et al., 2021). As a result, this study used qualitative and quantitative method for a thematic analysis.

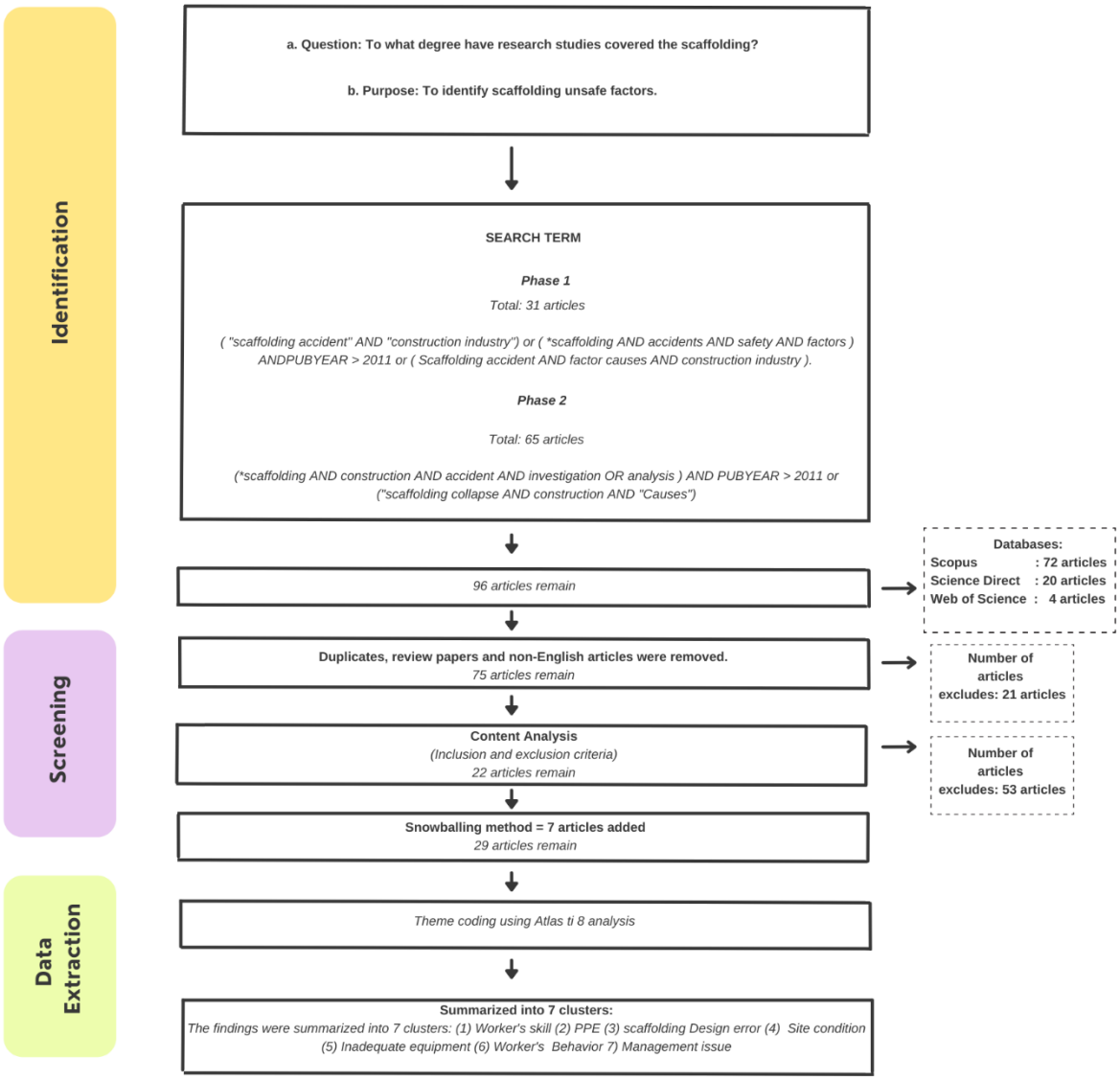

Fig. 1 - PRISMA flowchart

4. Discussion and Findings

4.1 Quantitative Analysis

Microsoft Excel was used to evaluate the quantitative data. The number of articles used, ranking of journal, type of papers, publication and years were recorded in a statistical charts. In data visualization, graphs were often used to show the interrelationships among variables. Consequently, in order to make statistical information more understandable and comprehensible, statistical graphs were being utilized.

4.1.1 Publication by Years

Figure 2 depicts the shifting distribution of publications published between 2012 and 2022. There's only one acceptable publication between 2012 and 2014. Besides, there are 5 relevant papers published in 2021 which the highest number of articles that related to scaffolding unsafe factors. Meanwhile in 2015, 2016, 2019 and 2022 the acceptable publications are 2 articles. As for the publications of papers in 2022, the paper that been used were updated until February 2022. In 2013 and 2020, there are 4 articles and in 2017 and 2018, only 3 articles related to factors that contribute to scaffolding unsafe factors. Overall, the findings shows that the topic has been a popular one among researchers since 2021.

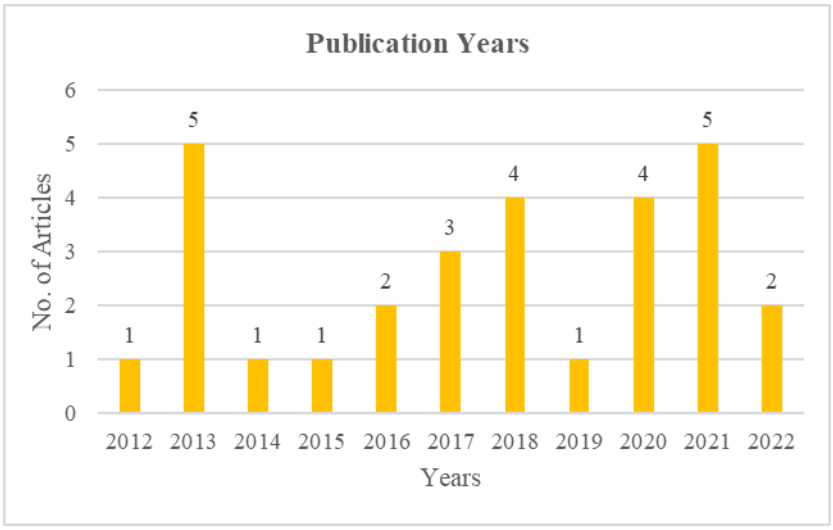

Fig. 2 - Publication by years

Besides, an iterative method of comparing and contrasting the similarities and differences across the 29 studies was used to ensure uniformity in the final sub-categories. There is a list of publications and their subcategories in Table 1. Worker behavior, worker skills, PPE, design flaw, site condition and insufficient equipment and management issues were further classified into seven key categories. Based on the table, the least theme that has been covered from 2012 until 2022 is worker's behavior meanwhile the most themes that has been discussed by the other researchers is management issues that related to scaffolding accidents.

Table 1 - Themes of Articles

Authors	Worker's Behaviour	Worker's Skills	PPE	Design Error	Site Condition	Inadequate equipment	Management issue
A Hola et. Al (2017)			/	/		/	/
Swapan Saha et. Al (2018)	/						/
Anna Hola et. Al (2018)		/	/	/		/	/
Arifuddin, Latief, Suraji (2020)			/		/	/	
Bellamy (2015)				/			/
Błazik-Borowa et al. (2021)				/			
Borges, Reis, Moro (2019)					/	/	/
Gian Paolo Cimellaro, Marco Domaneschi (2017)		/					
Erkan Dogan et. Al (2021)			/		/		
Bradley Evanoff et. Al (2016)					/		
Ewa Blazik-Borowa,						/	

Authors	Worker's Behaviour	Worker's Skills	PPE	Design Error	Site Condition	Inadequate equipment	Management issue
Jaroslaw Bec (2021)							
Nuraffefa Hamdan, Hanizam Awang (2015)		/	/		/	/	/
Hellstedt et. Al (2013)						/	
Bożena Hoła et. Al (2017)	/	/	/	/		/	/
Kyungki Kim et. Al (2016)					/		
Yijun Liu et. Al (2020)	/			/			
Bilal Manzoor et. Al (2021)		/		/			
Marek Sawicki (2020)	/						
Marek Sawicki, Mariusz Szostak (2020)				/		/	
T.Nowobilski, B.Hola (2019)		/	/	/			/
Aminu Darda'u Rafindadi et. Al (2022)		/	/		/	/	/
Juan Carlos Rubio-Romero et. Al (2013)						/	
Rubio-Romero, Rubio, García-Hernández (2013)						/	
Iwona Szer et. Al (2022)					/		
Iwona Szer and Jacek Szer (2021)					/		
Feng Wang et. Al (2013)					/		
Feng Wang et. Al (2014)					/		
Stig Winge , Eirik Albrechtsen (2018)		/		/	/		
June-seong Yi et. Al (2012)	/						

4.1.2 Publication by Database

Three database sources were employed in this study: Scopus, Web of Science, and ScienceDirect. Scopus was the most frequently cited database source with a number of 18 articles, followed by ScienceDirect with a number of 10 articles and Web of Science. According to the figure 3, Scopus received the most publications, while Web of Science received the fewest sources of information related to scaffolding dangerous aspects. This is because abstract and citation database Scopus is made up of scholarly information that has been peer-reviewed (Baas et al., 2020).

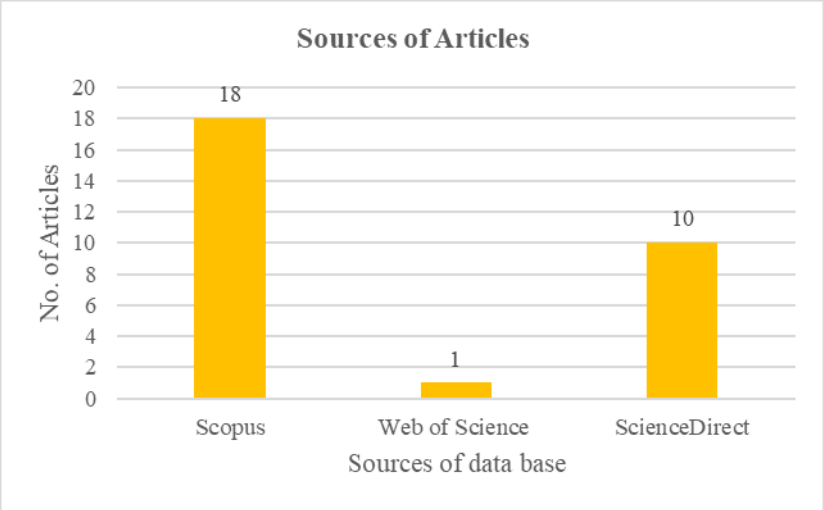

Fig. 3 - Sources of database

4.1.3 Publication by Type of Article

According to figure 4, the search queries given in Figure 10 yielded the statistics shown therein. In Chart 3, the findings are based on the whole period of 2012–2022. Chart 3 shows that only journal and conference paper articles utilized. The number of papers used for journal is much higher than the number of articles published in a conference paper. This is due to the "peer-review" procedure that many academic publications use. To put it another way: the data shown here is accurate and trustworthy (CQUniversity Library, 2021).

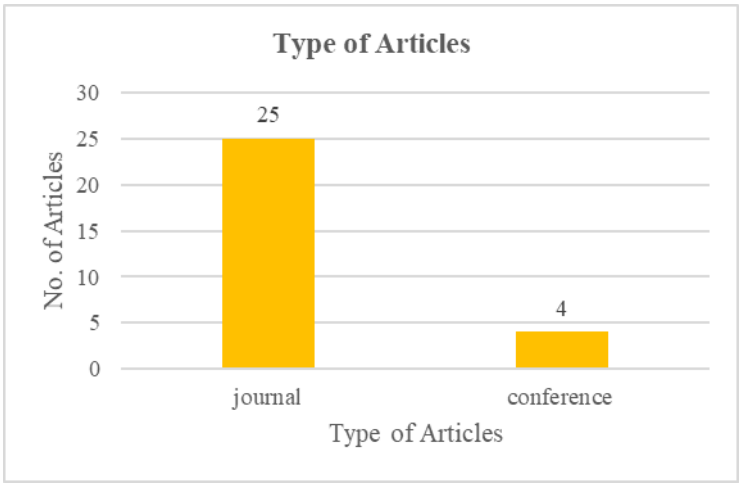

Fig. 4 - Type of Articles

4.1.4 Publication by Journal Ranking

The number of journal rankings by using SCImago is shown in a figure 5 (SJR). For academic journals, SCImago Journal Rank (SJR) is a metric that takes into consideration both the number of times a journal has been cited as well as the prominence or reputation of the journals that have cited it. SJR is the journal's impact factor, which is derived from a citation network analysis. SJR is calculated using a quartile system, with Q1 being the top quarter of journals and Q4 representing the worst quarter. Only the top 25 percent of journals appear in Q1. The next 25 to 50 percent are represented by Q2. The next 50 to 75 percent appear in Q3. The last 25 to 100% are present only in Q4. Q4 is taken up

by journals in the 75 to 100 percent range (Learning Resource Centre LRC, 2022). The statistics in figure 17 obtained through conducting a search using the queries listed in figure 10. According to figure 17, Q1 has the highest number of articles that related to scaffolding unsafe factors with a total of 15 articles, followed by Q2, unranked, Q3 and Q4. Within a given topic area, the most distinguished journals are those in the first quarter, or Q1.

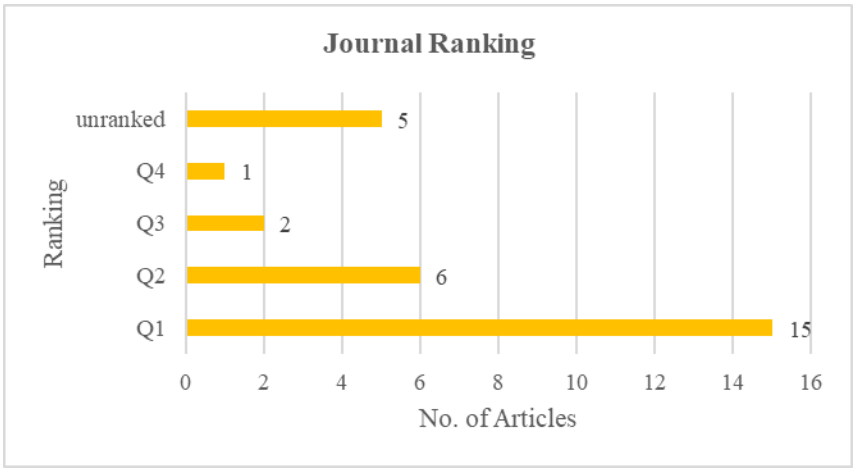

Fig. 4 - Journal Ranking

4.2 Qualitative Analysis

Base on the thematic review approach method by Zairul (2021) and Samsudin et al., (2022) this research was used to transfer all 29 pieces of information to Atlas.ti 8 software. It was at this point that a number of code groups were developed. The purpose of a thematic analysis is to find themes, or significant or relevant patterns in the data, and to utilize these themes to address the study or make a point about a problem (Maguire & Delahunt, 2017). Therefore, the tool that is suitable to analyze the qualitative data is Atlas.ti 8. Atlas.ti has been recognized as a crucial tool for researchers to use in order to do well-organized, systematic, effective, and efficient data analysis (Rambaree, 2013). This section provides a summary of the data from the papers that have been evaluated. The authors of the original publications reviewed or used as references in the chosen articles are credited. Using a deductive approach from the theme results, ATLAS.ti 8 was used to code the 7 clusters for ease of visualization in the network. The clusters (shown as codings) are linked to the research questions and serve as the basis for the discussion of the study. The following is a summary of clusters based on the thematic evaluation shown in figure 6.

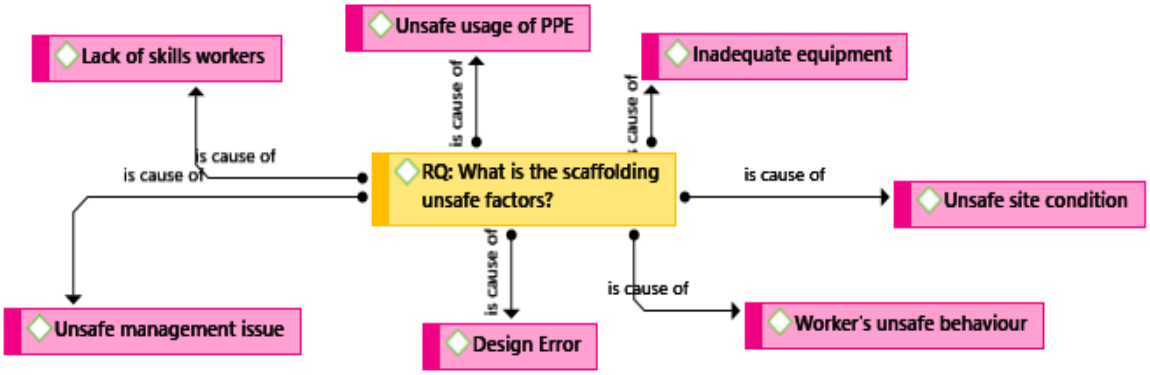

Fig. 6 - A thematic review was conducted utilizing ATLAS.ti 8 network view to address the research topic

4.2.1 Lack of Skills Workers

Scaffolding accidents were caused in part by inadequate training, the use of untrained personnel, and a lack of safety awareness and risk management skills, according to research by (Rafindadi et al., 2022). This is due to the fact that personnel who lack scaffolding training and expertise will be unable to do their jobs (Hamdan & Awang, 2015) as shown in figure 7. According to the findings of the Winge & Albrechtsen, (2018), a construction site mishap was caused by a faulty or improperly fastened scaffold that shifted when a worker stood on it. This supported by the study of (Manzoor et al., 2021), a lack of worker skills resulted in scaffolds that were not properly secured and tightened. Working at heights is dangerous enough without having to worry about being killed or seriously injured because of a

worker's lack of safety awareness. Workers with no intellectual talents are often hired to do the necessary labor because of the reasons of falls from height. Due to a lack of expertise among construction employees, scaffolding mishaps occurred on building sites (Cimellaro & Domaneschi, 2017). This is due to the fact that personnel who lack the proper training to erect or dismantle scaffolding are more likely to be involved in an accident (Anna Hola et al., 2018; Bożena Hoła et al., 2017). For example, the research by Manzoor et al., (2021) shows that significant accidents in building projects are also caused by improper installation of scaffolding. Scaffolding accidents are caused by workers who have not received enough training in occupational health and safety. Scaffolding accidents are caused by a lack of or inadequate training in occupational health and safety, as shown by the research of (Nowobilski & Hoła, 2019). As a result, personnel must be trained prior to the construction of the scaffolding in order to avoid a repeat of the error. According to figure18, a lack of scaffolding safety teaching or personnel who disregarded such instruction were also responsible for scaffolding incidents (A Hola et al., 2017; Hoła et al., 2018). An employee's familiarity with scaffolding safety instructions can only lead to scaffolding mishaps at a building site if proper training is not provided (Bożena Hoła et al., 2017).

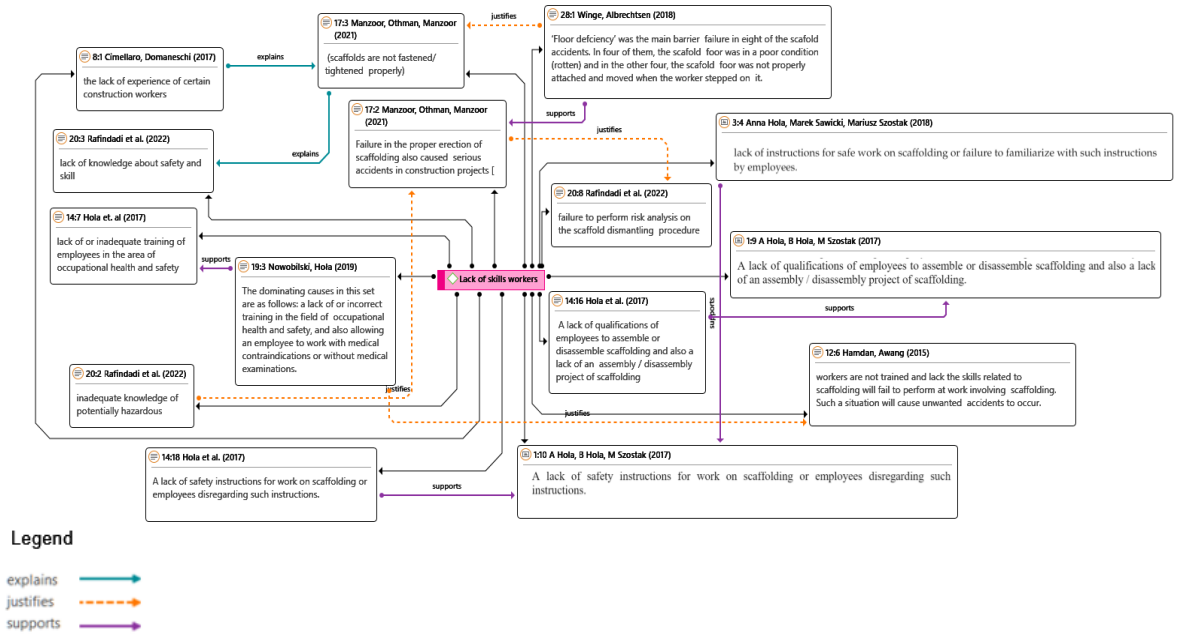

Fig. 7 - Lack of skills workers network diagram

4.2.2 Unsafe Usage of Personal Protective Equipment (PPE)

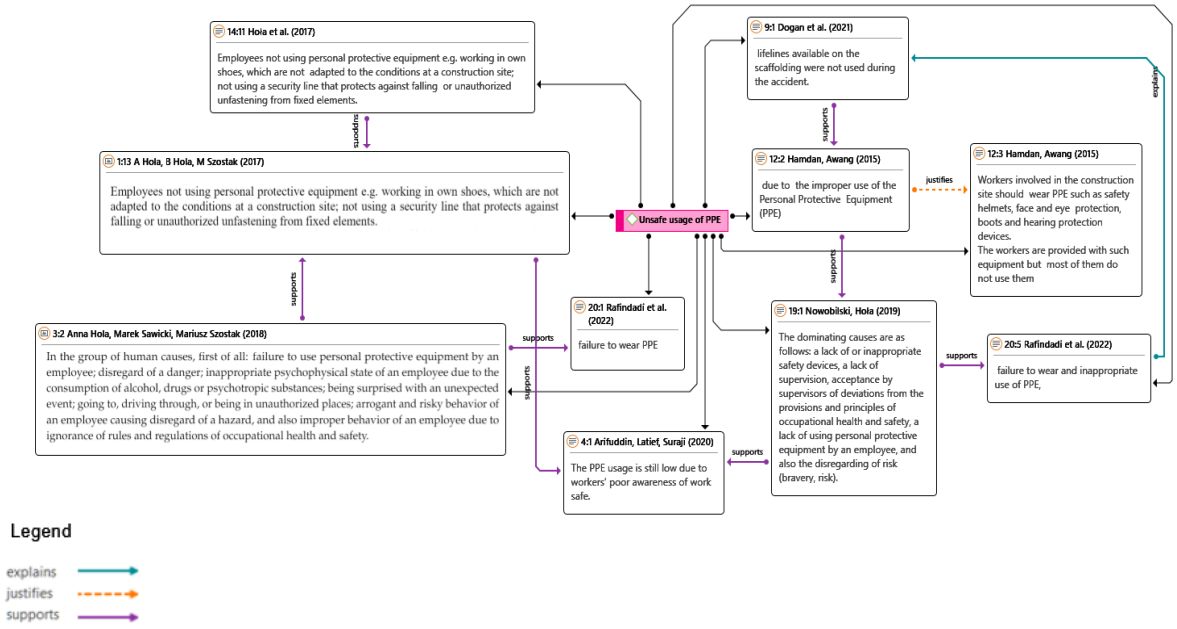

Fig. 8 - Unsafe usage of PPE network diagram

Figure 8 depicts a scaffolding-related network unsafe usage of Personal Protective Equipment (PPE). Workers not wearing personal protection equipment, such as shoes that are not appropriate for the conditions of the building site or lifelines to prevent them from falling or unlawful unfastening from fixed components, caused scaffolding mishaps, according to the report from A Hola et al., (2017). This is in line with the study of Rafindadi et al., (2022) and (A. Hoła et al., 2018) the scaffolding mishap was blamed on a worker's failure to wear PPE and improper usage of PPE on the building site. During the accident, the lifelines installed on the scaffolding were not utilized (Dogan et al., 2021). According to (Hamdan & Awang, 2015) Accidents involving scaffolding have occurred as a result of the scaffolding being used incorrectly. In addition, the scaffolding accident was caused by a failure to wear personal protective equipment (Nowobilski & Hoła, 2019). Protective Equipment (PPE) should be worn by construction site workers including safety helmets, face and eye protection, boots, and a hearing aid. Equipment like this is offered to the employees, but most do not utilize it (Hamdan & Awang, 2015). This is owing to the fact that employees are still unaware of the need of wearing protective gear while on the job (Arifuddin et al., 2020). Accidents are prevalent in the construction sector as a result of the lack of or insufficient usage of Personal Protective Equipment (PPE). Thus, PPE should be worn by all employees since it protects workers from health and safety dangers on the workplace and minimizes employee exposure to hazards.

4.2.3 Unsafe Site Condition

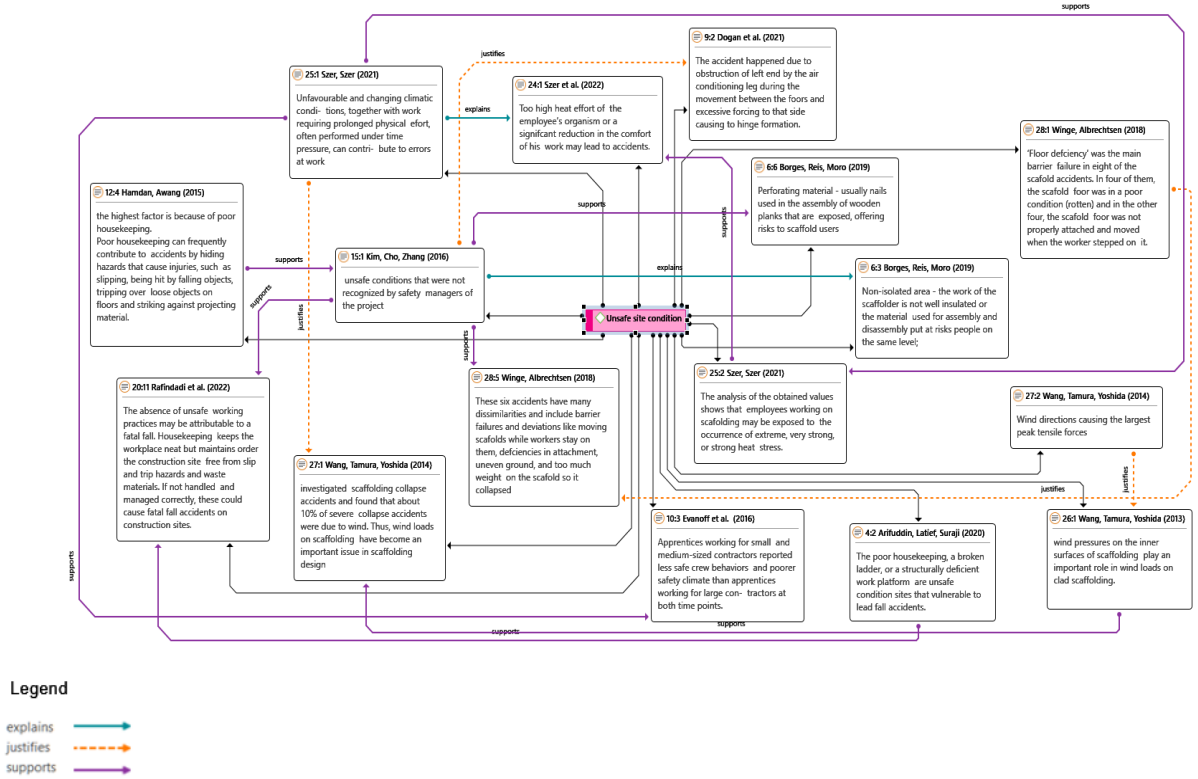

Fig. 9 - Unsafe site condition network diagram

Scaffolding mishaps occurred because of a design fault seen in Figure 9. Scaffolding accidents have been linked to unstable scaffolding, according to research conducted by A. Hoła et al., (2018) and Nowobilski & Hoła, (2019). According to a research by B. Hoła et al., (2017) , inadequate material agent stability led scaffolding to collapse owing to an inappropriate scaffolding foundation and a lack of scaffolding anchoring to permanent structural components. Aside from uneven foundations and unsuitable underlays, unstable scaffolding was caused by the use of unsuitable materials in the underlay such as hollow bricks, bricks, and loose boards to support the framework of scaffolding frames (Sawicki & Szóstak, 2020). To put it another way, based on the study of Bellamy (2015), a design flaw led to a significant number of scaffold-related incidents. Inadequately designed, calculated, and checked for sufficient strength and stability were to blame (Bellamy, 2015). In particular, the scaffold's design was poorly handled since it was not appropriately designed for the scaffold's weight and had inadequate anchoring. (Bellamy, 2015). According to research of Winge & Albrechtsen, (2018), the scaffolding that fell down was weakly attached, the ground was uneven, and there was too much weight on the scaffold. This is because scaffolding has a significant possibility of exceeding the authorized service load (Błazik-Borowa et al., 2021). Some of the other causes of scaffolding accidents were dangerous machinery, equipment situations, such as defective materials and structural instability, as well (Liu et al.,

2020). Scaffolding-related incidents have also been documented owing to inadequate manufacturing materials, according to research by Manzoor et al., (2021). Since the design of scaffolding cannot be utilized without proper calculations, it is vital to design scaffolding successfully.

4.2.4 Inadequate Equipment

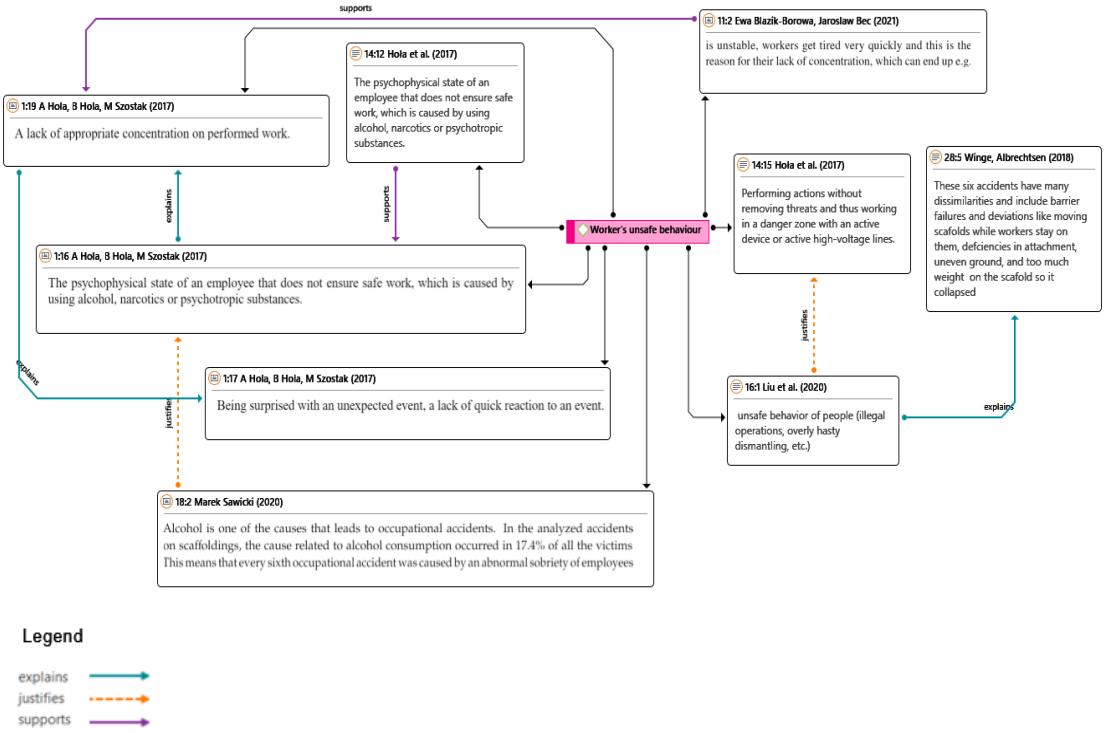

Fig. 10 - Inadequate equipment network diagram

A further element contributing to scaffolding accidents is the absence or inadequate provision for individual and collective protection (A Hola et al., 2017; A. Hoła et al., 2018; B. Hoła et al., 2017). Scaffolding incidents occurred because of the risky working platform when working at height according to Rafindadi et al., (2022). Based on Figure 10, scaffolding-related fall incidents were additionally exacerbated by a damaged ladder (Rafindadi et al., 2022). Rubio-Romero et al., (2013) discovered some scaffolding that did not contain stairways or ladders for employees, corroborating this claim. Research by Sawicki & Szóstak, (2020) found that 114 scaffolds studied included at least one component that might lead to scaffolding accidents, such as a railing or a frame which some of scaffolding were found that did not have stairways or ladders for the workers. Apart from that, according to study Borges et al., (2019), there is no guardrail, it is not firmly mounted, or it is not dimensioned appropriately. This is because scaffolding was often inadequate in the absence of safety rails (Hellstedt et al., 2013). As a result, the fact that over a third of scaffolding-equipped construction sites lack guard rails demonstrates insufficient safety precautions as well as the increased danger of falls from heights to which employees are exposed (Rubio-Romero et al., 2013). Hamdan & Awang, (2015) indicate that the absence of guardrails is the most frequent cause of injury and death on building sites. This research, together with Rafindadi et al., (2022) established those scaffolding accidents occurred as a result of the absence of a guard rail and safety sign. Additionally, scaffolding typically rests directly on the earth, without the use of sleepers or foundation plates to distribute the weight adequately (Rubio-Romero et al., 2013). Errors committed during the system scaffolding's development from legal issues may result in the scaffolding's technical state deteriorating during its operation (Błazik-Borowa & Bęc, 2021).

4.2.5 Unsafe Management Issue

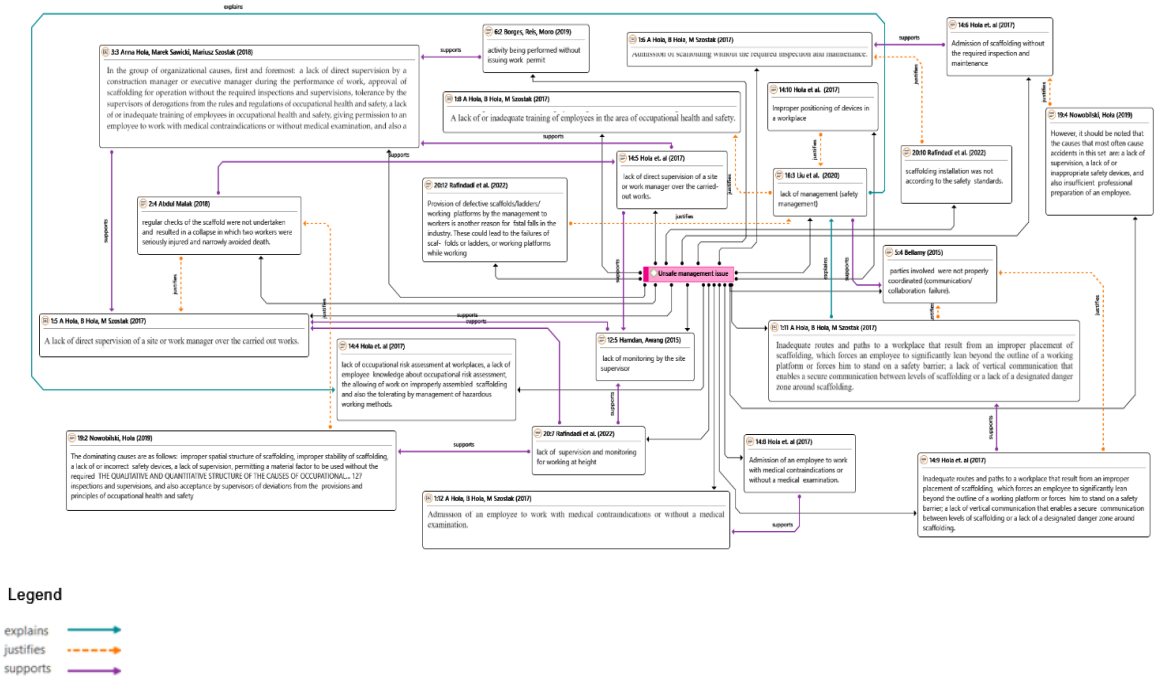

Fig. 11 - Unsafe management issue

Scaffolding incidents occurred in the construction due to a lack of direct supervision by a site or work manager over the completed job (A Hola et al., 2017; B. Hoła et al., 2017; Nowobilski & Hoła, 2019). Figure 11 shows that according to a study conducted by (A. Hoła et al., 2018), a lack of direct supervision by a construction manager or executive manager during the course of work, as well as approval of scaffolding for operation without the required inspection and supervision, were the primary causes of scaffolding accidents on construction sites. As per (Abdul-Malak, 2018) investigation, routine inspections of the scaffold were not performed, resulting in a collapse in which two employees had significant injuries and barely escaped death. This accident occurred as a result of a lack of supervision and monitoring for operating at height Hamdan & Awang, 2015 and Rafindadi et al., 2022). Additionally, scaffolding admittance without the necessary inspection and maintenance resulted in scaffolding accidents (A Hola et al., 2017; B. Hoła et al., 2017). For instance, scaffolding was not installed in accordance with safety requirements (Rafindadi et al., 2022). However, it should be emphasized that the most frequent causes of accidents in this category are a lack of supervision, a lack of or an inadequacy of safety measures, and also an employee's poor professional preparedness (Nowobilski & Hoła, 2019). Borges et al., (2019), demonstrate that scaffolding accidents occurred as a result of work being conducted without a work authorization. Apart from that Liu et al., (2020), assert that a lack of safety management adds to scaffolding accidents. This is because the parties involved were not coordinated appropriately (Bellamy, 2015). For example, management's distribution of substandard scaffolds, ladders, working platforms to employees is another cause of deadly falls in the business (Rafindadi et al., 2022). These factors might result in scaffolds, ladders, or work platforms collapsing during use. Additionally, insufficient routes and paths to a workplace as a result of improper scaffolding placement, which forces an employee to lean significantly beyond the outline of a working platform or to stand on a safety barrier; a lack of vertical communication between levels of scaffolding; or a lack of a designated danger zone around scaffolding (A Hola et al., 2017; B. Hoła et al., 2017). Inadequate safety management, such as Improper device placement in the workplace contributes to scaffolding accidents as well (B. Hoła et al., 2017). According to the study of (A Hola et al., 2017), scaffolding accidents are caused by a lack of safety management, such as insufficient training in the field of occupational safety and health. Apart from that, workplaces lack occupational risk assessment, employees lack information about occupational risk assessment, work on inadequately built scaffolding is permitted, and management tolerates dangerous working techniques (B. Hoła et al., 2017). Moreover, (B. Hoła et al., 2017) establishes that scaffolding accidents occurred as a result of an employee being admitted working despite medical contraindications or without a medical evaluation, which is corroborated by the research of (A Hola et al., 2017).

4.2.6 Design Error

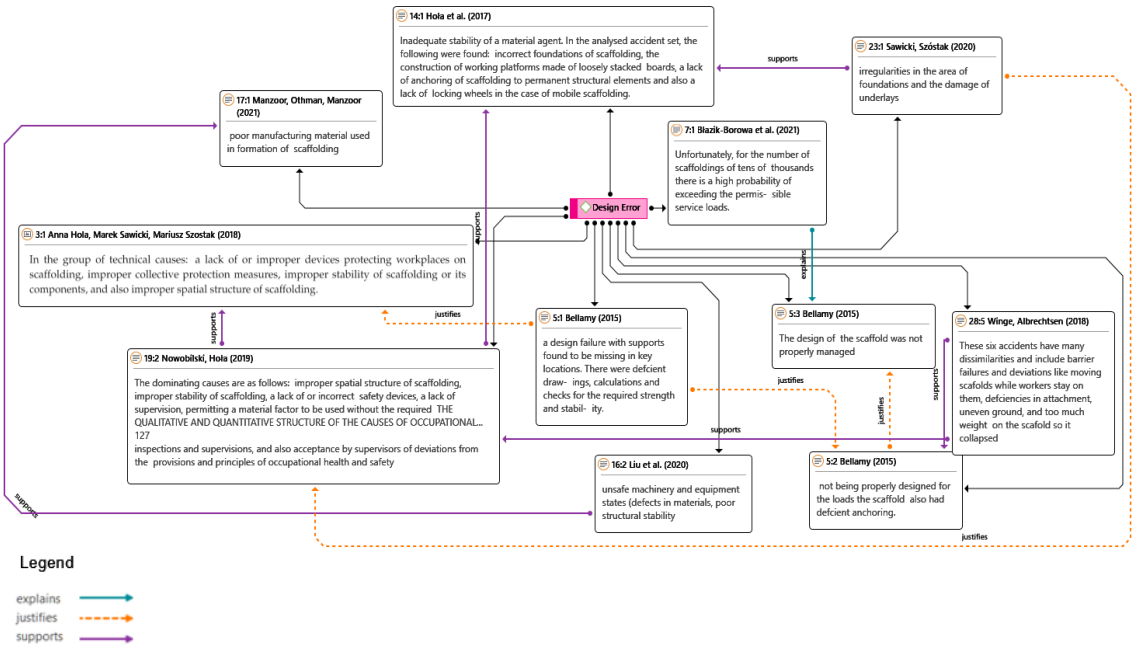

Fig. 12 - Design error network diagram

Scaffolding mishaps occurred because of a design fault seen in Figure 12. Scaffolding accidents have been linked to unstable scaffolding, according to research conducted by A. Hoła et al., (2018) and Nowobilski & Hoła, (2019). According to research by B. Hoła et al., (2017), inadequate material agent stability led scaffolding to collapse owing to an inappropriate scaffolding foundation and a lack of scaffolding anchoring to permanent structural components. Aside from uneven foundations and unsuitable underlays, unstable scaffolding was caused by the use of unsuitable materials in the underlay such as hollow bricks, bricks, and loose boards to support the framework of scaffolding frames (Sawicki & Szóstak, 2020). To put it another way, based on the study of Bellamy (2015), a design flaw led to a significant number of scaffold-related incidents. Inadequately designed, calculated, and checked for sufficient strength and stability were to blame (Bellamy, 2015). In particular, the scaffold's design was poorly handled since it was not appropriately designed for the scaffold's weight and had inadequate anchoring. (Bellamy, 2015). According to research of Winge & Albrechtsen, (2018), the scaffolding that fell down was weakly attached, the ground was uneven, and there was too much weight on the scaffold. This is because scaffolding has a significant possibility of exceeding the authorized service load (Błazik-Borowa et al., 2021). Some of the other causes of scaffolding accidents were dangerous machinery, equipment situations, such as defective materials and structural instability, as well (Liu et al., 2020). Scaffolding-related incidents have also been documented owing to inadequate manufacturing materials, according to research by Manzoor et al., (2021). Since the design of scaffolding cannot be utilized without proper calculations, it is vital to design scaffolding successfully.

4.2.7 Worker's Unsafe Behaviour

Figure 13 shows on workplace accidents may be exacerbated by drinking alcohol. Employees who use alcohol, opioids, or psychotropic substances have a psychophysical condition that does not guarantee safe work (A Hola et al., 2017; B. Hoła et al., 2017). Alcohol misuse may result in disordered thinking and disorientation, making it difficult to concentrate on tasks such as studying or picking up a new skill. This might lead to a loss of focus on the task at hand (A Hola et al., 2017). Due to their lack of attention, workers get exhausted rapidly (Błazik-Borowa & Bęc, 2021). This is because alcohol has a sedative effect on the central nervous system. It has a calming effect that aids in relaxation and induces drowsiness, allowing people to fall asleep quickly. In addition, scaffolding accidents were caused by a lack of prompt response to an occurrence and by being shocked by an unexpected event (A Hola et al., 2017). According to (Marek Sawicki, 2020), 17.4 percent of all scaffolding accident victims had a reason connected to alcohol usage. Moreover, people's careless conduct resulted in a number of incidents (Liu et al., 2020). A study by Winge & Albrechtsen, (2018) found that accidents have a wide range of characteristics, including barriers that fail and deviations, such as employees changing scaffolds while they are on them. Other factors contributing to scaffolding accidents include worker negligence, such as failing to remove potential hazards before completing tasks or working in a dangerous area near live electrical equipment or wires (B. Hoła et al., 2017). Accidents on construction sites, whether committed by construction firms or by employees themselves, have a negative impact on not just safety, but also on the construction process.

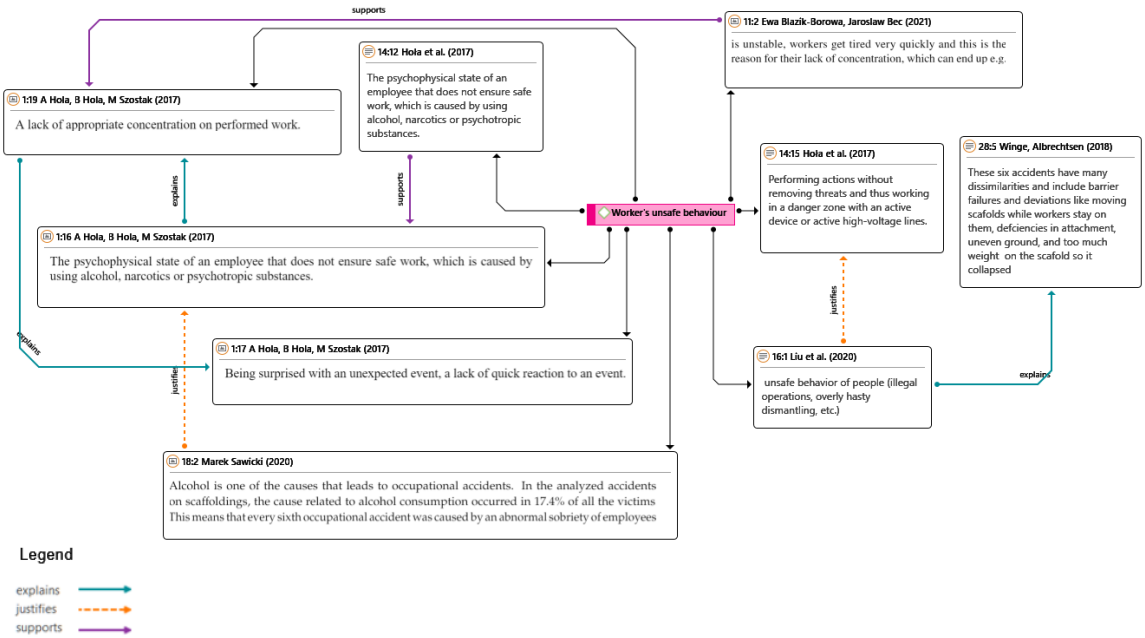

Fig. 13 - Worker's unsafe behaviour network diagram

4.3 Thematic Analysis Pattern

In summary, the study has summarized seven groups of dangerous scaffolding elements extensively as shown in Figure 14. There have been a number of research on scaffolding-related events that have focused on determining the components that led to the occurrences. In order to eliminate scaffolding-related dangers, it's critical that they're identified early on in the project. Scaffolding accidents are caused by a combination of human, technical, environmental, and organizational variables, according to Hamdan & Awang, (2015). Hence, this study used Atlas.ti 8 to review the pattern of scaffolding unsafe factors. An important benefit of using theme analysis is that it allows researchers to develop a theoretical or conceptual framework for future research loops (O'Grady et al., 2021). The segments retrieved from the synthesis results of this research revealed that the seven clusters are related with five basic patterns: human factors, environmental factors, technological factors, and organization factors. There are several elements that contribute to scaffolding accidents at a building site that are covered by the clusters.

In this study, lack of skills workers and unsafe management issues are considered as organizational factors. In the case of organizational factors, the highest-ranking factors were the lack of proper training and lack of monitoring by the site supervisor (Hamdan & Awang, 2015). A company should provide a training and knowledge for the workers and make sure that the company have a good management to avoid any issue like lack of supervision on construction happened. The health and safety of all construction employees is put at risk if the site supervisor is not adequately supervised (Hamdan & Awang, 2015; A. Hoła et al., 2018; Nowobilski & Hoła, 2019). Thus, in terms of safety management, these sites must improve safety education and training procedures, enhance the overall safety management system with a focus on daily equipment maintenance and fall prevention device reliability and develop an appropriate accident emergency plan (Liu et al., 2020). If an organization fails to provide training and safety education to the workers, it can lead to the unsafe behavior that can lead to the scaffolding accidents. This is due to the health and safety issues on construction sites are mostly due to unsafe human behaviors.

Human dangerous behavior is the most significant factor determining the level of building site safety, according to research (Z. Li et al., 2021; Park et al., 2020; Zhang et al., 2020). Human mistake is to blame for 90% of construction site accidents (Newaz et al., 2020) and dangerous human conduct accounts for 88% of construction engineering mishaps (Suraji et al., 2001). Besides, according to the past research of kumarP et al., (2019), the most astounding human risk factor affecting scaffold mischance's is the ill-advised utilization of PPE. Unsafe usage of Personal protective equipment also considered as human unsafe behavior. Personal protective equipment is a must while working in a dangerous environment. This means that employee need to choose equipment that is both reliable and functional as well as one that has been used and maintained correctly. Workers in the construction industry have a higher risk of damage and accident if they don't use personal protective equipment (PPE) at all times (A Hola et al., 2017). Therefore, Enshassi & Shakalaih (2015), recommended that contractors should follow up their workers regarding the use of the personal protective equipment (PPE). Human error on construction sites may be attributed to a variety of variables, including the workplace and organizational structure (Asilian-Mahabadi et al., 2018). Thus, by controlling and preventing risky work practices, building projects may improve their safety production management and their overall safety production results (Fang et al., 2019; Jiang et al., 2020; Z. Li et al., 2021).

Other than that, unsafe condition is influenced by an organization error which also can lead to the scaffolding accidents. Unsafe condition usually related to the technical factors of the scaffolding which it's common for them to be tied to issues with a company's facility, equipment, tools, materials handling system, or overall working environment. Scaffolding accidents may be caused by a variety of technical problems, such as faulty foundations, attachment point failures, insufficient fall protection, dangerous building designs, overloaded platforms, incompetent erectors, insecure bracing, and inappropriate material handling. According to A Hola et al., (2017) lack of or insufficient equipment that attaches work posts on scaffolding and also unsuitable collective protection measures such as poor stability of scaffolding or its components were shown to be the most significant factors in the creation of accidents in. Scaffold collapse may also be caused by a lack of scaffold support and guardrail components. According to the research of Rubio-Romero et al., (2013), the lack of guard rails on almost a third of scaffolding sites, shows both a lack of safety precautions and the higher danger of employees falling from great heights. This is due to standard scaffolding is more costly than non-standard scaffolding(Rubio-Romero et al., 2013). A hazardous scenario may arise if the guardrails were not installed appropriately and in accordance with the required method (Enshassi & Shakalaih, 2015). When operating at high altitudes, many organizations either use improper or non-existent standards of safety. A tragic fall may have been caused by a lack of safe work procedures. This is because there is a larger proportion of inadequacies in non-standard scaffolding components than in standard scaffolding components, according to previous studies. Rubio-Romero et al., (2013), revealed that the standardization of scaffolding equipment has a direct and favorable effect on building site safety conditions. Both of these elements directly affect the scaffolding's load-bearing capability and the risk of collapse (Enshassi & Shakalaih, 2015).

Besides, a design error in scaffolding also considered as an unsafe conditions. According to Bellamy (2015), research, a fault in the scaffold's design was to blame for a high number of accidents as the scaffold design was not adequately supervised, and the parties involved were not effectively coordinated. Therefore, the project team's inability to communicate effectively has resulted in inaccurate information (Ahmed et al., 2018). For this reason, excellent communication is critical in building trust among the project's investors. To attain their goals, all participating in the building project must work together to pool their talents and resources . In order for communication to be effective, all stages of the project must be well coordinated by utilizing reliable information. Other than that, poorly estimated, inadequately planned, and inadequately verified for proper strength and stability were to fault due to the scaffold's construction was insufficient for its weight and lacked suitable anchoring, it was badly managed (Bellamy, 2015). According to the author, scaffolding that collapsed was found to be inadequately fastened, the ground was uneven, and there was an excessive amount of weight on board. This is due to the fact that scaffolding has a high potential for exceeding the approved service load as the strength of a scaffolding support is determined by the soil's condition since scaffolds were often set up on concrete or asphalt. A flat and compacted ground should be prepared early if the scaffold is to be installed on the ground because of insufficient compaction of the earth.

Other than that, unsafe condition that related to the unsafe site condition is considered as the environmental factors as the condition and surrounding of the site plays an important role to avoid scaffolding accidents. This is due to the most dangerous environmental component is the working surface, followed by objects hanging in the air or falling from above, soil conditions, material handling, and the weather (kumarP et al., 2019). According to Hamdan & Awang, (2015), The most significant reason is due to bad housekeeping. Poor housekeeping usually contributes to accidents by concealing risks that might result in injury, such as sliding, being struck by falling items, tripping over loose things on floors, and hitting against protruding material (Hamdan & Awang, 2015). This is because poor housekeeping is to blame for the importance given to the work surface. This were due to hazardous situations that were not detected by the project's safety managers (Kim et al., 2016). Hence, it can be said that an organization should play an important roles to inspect the condition of the site regularly. Besides that, Wang et al., (2014) examined scaffolding collapse incidents and concluded that roughly 10 percent of scaffolding collapse due to wind. Thus, wind loads on scaffolding have become an essential concern in scaffolding design. This is because, wind forces on the interior surfaces of scaffolding play a key part in wind loads on covered scaffolding (Wang et al., 2013). By providing sufficient reinforcement, support ropes, and girders, unstable construction or assembly situations may be avoided (Radevsky et al., 2012). If required, they should be placed quickly when a storm is coming, and construction schedules should be meticulously planned to prevent dangerous tasks during storm season in order to minimise exposure time. If the storm season cannot be avoided, a thorough plan must be devised. Unsafe site condition due to poor climatic condition also contribute to scaffolding collapse. Unfavorable and fluctuating weather circumstances, as well as physically demanding tasks conducted under time constraints, may all contribute to workplace accidents (Szer & Szer, 2021). According to Szer & Szer, (2021) accidents may occur if an employee's organism expends too much heat or if his working conditions are significantly worsened. Besides, scaffolding workers may be subjected to severe, very strong, or strong heat stress, according to the results of the investigation (Szer & Szer, 2021). Based on the study of Asilian-Mahabadi et al., (2018), work group and contractor workplace or organizational circumstances are influenced by the safety environment. Human error, another kind of risky conduct, may occur if the harmful circumstances are not recognized or experienced by the employees (Asilian-Mahabadi et al., 2018).

As a result of this research, it can be concluded that organizational error is the primary cause of scaffolding accidents. According to the past research, safety management relies heavily on effective organizational management

(Y. Li et al., 2018). This makes it easier to understand how things work at the firm and to spread a culture of safety across the company. This is due to construction mishaps are mostly caused by human mistake which can be relate to organization factors. If an organization have an ignorance workers and have workers that practice unsafe behaviors in construction site, it can lead to the scaffolding accidents. In addition, individual manifestations have an effect on these behaviors. Individual manifestations can be defined as human traits or human behaviors that might influence the way workers behave and think (F.lora Madinane Magoro, 2012). Hence, human flaws and errors of judgement may easily result in job injuries and deaths in construction. A few seconds and a lapse are all that is required. Therefore, employer attitudes and motivation play a major role in this. This might cause carelessness, complacency, shortcuts or even diversion from the job at hand. When people have a poor outlook on safety, they will ultimately engage in risky or reckless conduct as a consequence. This is because incidents on the workplace that result in injury or property damage are caused by unsafe practices. Consequently, the number of construction-related accidents, injuries, and deaths might be minimized by addressing the organization aspect. In the workplace, attitudes about safety have a significant impact on how employees make decisions and respond to challenges, incentives, and rewards. Positive safety attitudes in the workplace are needed for a work environment free of accidents, which provides greater productivity, the highest quality, saves budget on accident costs, boosts employee morale, corporate profit, and goodwill. Hence, improving organization factor analysis may have a positive impact on safety and health, as well as on quality, productivity, and employee happiness (Kamal et al., 2013).

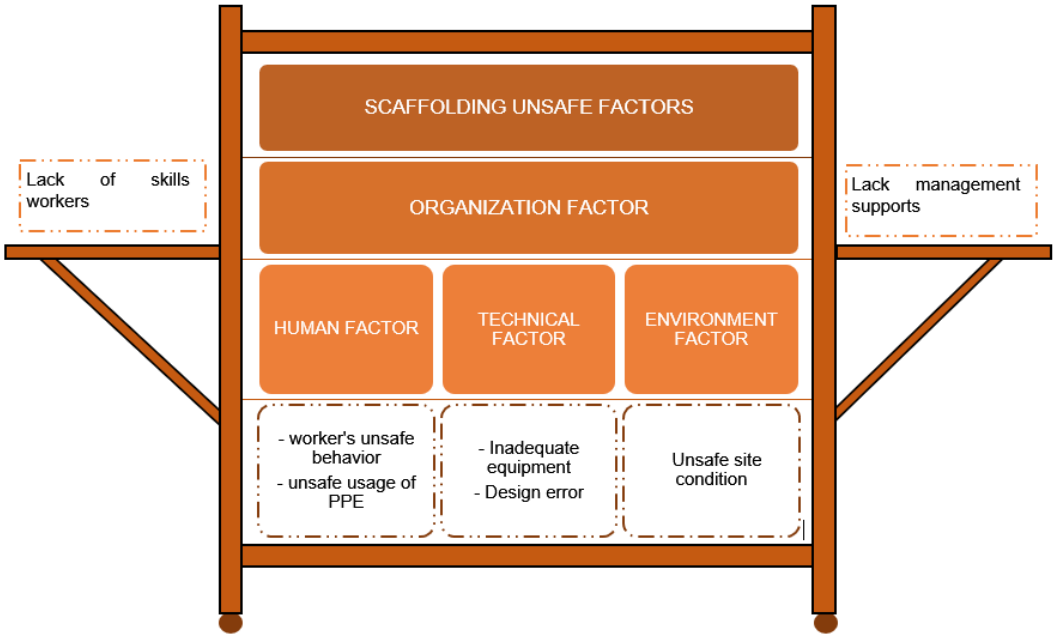

Fig. 14 - Thematic pattern analysis

5. Conclusion

Scaffolding collapse or planking failure, falling items, and falls from high positions are all forms of dangers that often occur on scaffolding-related work sites. The number of cases regarding scaffolding incidents is high due to several unsafe factors such as human and technical factors. A quantitative and qualitative study consequently assist evaluated the themes of the scaffolding unsafe factors. This article discusses the present situation of scaffolding hazards. Using Atlas.ti 8's code-to-document analysis, seven clusters were found to have patterns and trends that answered the study topic. Four basic pattern clusters have been developed from seven identified scaffolding unsafe factor of worker's skills and conduct; worker's behavior; management issue; design error; PPE; site condition; and inadequate equipment; and site condition. Human, organizational, environmental, and technological factors have been identified as the four primary clusters of factors that impact scaffolding accidents.

Human factors are the initial pattern cluster. Human factors include a worker’s unsafe behavior and unsafe usage of PPE. The second pattern cluster consists of organizational factors, which include employee abilities and management concerns. This is because a firm should give training and information to its employees and ensure that it has a strong management team in place to prevent issues such as lack of oversight during construction. Meanwhile, for the third pattern cluster, environmental factors are examined since the site's state and surroundings play a significant part in preventing scaffolding mishaps. This is because of the significance placed on the work surface as a result of inadequate housekeeping. Apart from that, the fourth pattern cluster consists of design errors and insufficient equipment, both of which are regarded to be risk factors for technical scaffolding. The technical error of scaffolding contributes to the large number of accidents that involving scaffolding.

This study revealed that organization factor is the main cause of scaffolding accidents. This is due to attitudes and motivations of employers are crucial. So, carelessness, complacency, shortcuts, or even distraction may result. People who lack concern for safety will eventually engage in unsafe or irresponsible behavior. Unsafe working practices cause workplace injuries and property damage. Taking care of people may reduce the incidence of construction-related accidents, injuries, and fatalities. Workplace safety attitudes influence how workers make choices and react to challenges, incentives, and rewards. Positive safety attitudes in the workplace provide improved productivity, higher quality, lower accident costs, higher employee morale, corporate profit, and goodwill.

Hence, this study may contribute to the development of a safe scaffolding environment on construction sites, thus reducing the number of accidents and ensuring the utmost safety of employees. Since this is a thematic review study, hence other researcher can focus on primary method such as qualitative or quantitative method at specific locations to determine scaffolding unsafe factors for a particular type of scaffoldings. This study encourages construction workers in predicting and identifying scaffolding mishaps. For safety reasons, contractors and other project participants should hire a scaffolding inspector. By identifying the most risky and unsafe scaffolding factors, the problem may be addressed.

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References

A Hola, B Hola, & M Szostak. (2017). Analysis of the causes and consequences of falls from scaffolding using the Polish construction industry as an example. Materials Science and Engineering.

Ahmed, A., Othman, E., Gabr, H., & Hussien, M. A. (2018). CAUSES AND IMPACTS OF POOR COMMUNICATION IN THE CONSTRUCTION INDUSTRY Sustainable Buildings and Project Waste Management during the Design and Construction Phase View project. https://www.researchgate.net/publication/330994921

Anna Hola, Marek Sawicki, & Mariusz Szostak. (2018). Methodology of Classifying the Causes of Occupational Accidents Involving Construction Scaffolding Using Pareto-Lorenz Analysis. Applied Science.

Arifuddin, R., Latief, R. U., & Suraji, A. (2020). An investigation of fall accident in a high-rise building project. IOP Conference Series: Earth and Environmental Science, 419(1). https://doi.org/10.1088/1755-1315/419/1/012144

Asilian-Mahabadi, H., Khosravi, Y., Hassanzadeh-Rangi, N., Hajizadeh, E., & Behzadan, A. H. (2018). A qualitative investigation of factors influencing unsafe work behaviors on construction projects. Work, 61(2), 281–293. https://doi.org/10.3233/WOR-182799

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. Quantitative Science Studies, 1(1), 377–386. https://doi.org/10.1162/qss_a_00019

Bellamy, L. J. (2015). Exploring the relationship between major hazard, fatal and non-fatal accidents through outcomes and causes. Safety Science, 71(PB), 93–103. https://doi.org/10.1016/j.ssci.2014.02.009

Błazik-Borowa, E., & Bęc, J. (2021). Influence of dynamic properties on scaffoldings safety. Archives of Civil and Mechanical Engineering, 21(4). https://doi.org/10.1007/s43452-021-00295-3

Błazik-Borowa, E., Pieńko, M., Szer, I., Hoła, B., & Czarnocki, K. (2021). Probability distribution functions for service loads of frame scaffoldings. Bulletin of the Polish Academy of Sciences: Technical Sciences, 69(2). https://doi.org/10.24425/bpasts.2021.136734

Błazik-Borowa, E., & Szer, J. (2015). The analysis of the stages of scaffolding "life" with regard to the decrease in the hazard at building works. Archives of Civil and Mechanical Engineering, 15(2), 516–524. https://doi.org/10.1016/J.ACME.2014.09.009

Borges, G. D., Reis, A. M., & Moro, A. R. P. (2019). Ergonomic Analysis of Labor Applied to Scaffolders in a Shipyard in Brazil. Advances in Intelligent Systems and Computing, 819, 725–738. https://doi.org/10.1007/978-3-319-96089-0_79

Bożena Hoła, Tomasz Nowobilski, Jarosław Rudy, & Ewa Borowa Błazik. (2017). Dangerous events related to the use of scaffolding. Czasopismo Techniczne, 7. https://doi.org/10.4467/2353737xct.17.106.6647

Cimellaro, G. P., & Domaneschi, M. (2017). Stability analysis of different types of steel scaffolds. Engineering Structures, 152, 535–548. https://doi.org/10.1016/j.engstruct.2017.07.091

CQUniversity Library. (2021). Evaluating Books, Journals, Journal Articles and Websites. CQUniversity Library.

Dogan, E., Yurdusev, M. A., Yildizel, S. A., & Calis, G. (2021). Investigation of scaffolding accident in a construction site: A case study analysis. Engineering Failure Analysis, 120. https://doi.org/10.1016/j.engfailanal.2020.105108

Enshassi, A., & Shakalaih, S. (2015). Construction Workers Fall Accidents from Scaffolding in Gaza Strip. www.iccepm2015.org

Fang, L., Zhong, M., Hou, Y., & Chen, X. (2019). Research on the influence of group safety behavior of agricultural enterprises on production safety performance. J. Agrotech. Econ, 137–144.

FLORA MADINANE MAGORO. (2012). KNOWLEDGE, ATTITUDE AND PRACTICES REGARDING PERSONAL PROTECTIVE EQUIPMENT AMONGST STEVENS LUMBER MILLS EMPLOYEES IN THE CAPRICORN DISTRICT OF LIMPOPO PROVINCE, SOUTH AFRICA. FLORA MADINANE MAGORO.

Halperin, K. M., & McCann, M. (2004). An evaluation of scaffold safety at construction sites. Journal of Safety Research, 35(2), 141–150. https://doi.org/10.1016/j.jsr.2003.11.004

Hamdan, N., & Awang, H. (2015). Jurnal Teknologi Full Paper SAFETY SCAFFOLDING IN THE CONSTRUCTION SITE (Vol. 75, Issue 5). www.jurnalteknologi.utm.my

Haslinda Abas, N., Ridhwan Noridan, M., Hanafi Rahmat, M., Ain Abas, N., & Qamarina Ibrahim, N. (2020). Journal of Technology Management and Business Causes of Accidents Involving Scaffolding at Construction Sites. JOURNAL OF TECHNOLOGY MANAGEMENT AND BUSINESS, 7(1), 75–86. https://doi.org/10.30880/jtmb

Helfer, B., Prosser, A., Samara, M. T., Geddes, J. R., Cipriani, A., Davis, J. M., Mavridis, D., Salanti, G., & Leucht, S. (2015). Recent meta-analyses neglect previous systematic reviews and meta-analyses about the same topic: a systematic examination. https://doi.org/10.1186/s12916-015-0317-4

Hellstedt, M., Kaustell, K. O., & Kivinen, T. (2013). The occupational safety on the construction sites of the farm production buildings in Finland. Journal of Agricultural Engineering, 44(2s). https://doi.org/10.4081/jae.2013.s2.e131

Hoła, A., Sawicki, M., & Szóstak, M. (2018). Methodology of classifying the causes of occupational accidents involving construction scaffolding using Pareto-Lorenz analysis. Applied Sciences (Switzerland), 8(1). https://doi.org/10.3390/app8010048

Ismail, H. B., & Ghani, K. D. A. (2012). Potential Hazards at the Construction Workplace due to Temporary Structures. Procedia - Social and Behavioral Sciences, 49, 168–174. https://doi.org/10.1016/J.SBSPRO.2012.07.015

Izzuddin Romli, F., & Ozve Aminian, N. (2017). A Study on Potential Physical Hazards at Construction Sites Evaluation of Civil Flight Deck Design using Fuzzy Logic Approach View project USER EXPERIENCES STUDIES OF CRANE OPERATORS' View project. https://www.researchgate.net/publication/319416078

Jananey Ramachandran. (2021). 1 Dead And 4 Injured After Bukit Tinggi LRT3 Scaffolding Collapses. Says.Com.

Jiang, X. L., Mao, C. J., & He, H. (2020). Summary of research on unsafe behaviors of construction workers. Construction Safety, 35, 70–74.

Kamal, I. S. M., Ahmad, I. N., & Ma'arof, M. I. N. (2013). Review on Accidents Related to Human Factors at Construction Site. Advanced Engineering Forum, 10, 154–159. https://doi.org/10.4028/www.scientific.net/aef.10.154

Kim, K., Cho, Y., & Zhang, S. (2016). Integrating work sequences and temporary structures into safety planning: Automated scaffolding-related safety hazard identification and prevention in BIM. Automation in Construction, 70, 128–142. https://doi.org/10.1016/j.autcon.2016.06.012

kumarP, D., Student, P., & Professor, A. (2019). Study on Safety in Scaffolding at Construction Industry. In Journal of Automation and Automobile Engineering (Vol. 4, Issue 1).

Learning Resource Centre LRC. (2022). PUBLICATIONS IMPACT INDEXES. MONDRAGON UNIBERTSITATEA Loramendi.

Li, Y., Ning, Y., & Chen, W. T. (2018). Critical Success Factors for Safety Management of High-Rise Building Construction Projects in China. Advances in Civil Engineering, 2018. https://doi.org/10.1155/2018/1516354

Li, Z., Bao, X., Sheng, Y., & Xia, Y. (2021). Research on Unsafe Behavior of Construction Workers Under the Bidirectional Effect of Formal Rule Awareness and Conformity Mentality. Frontiers in Psychology, 12. https://doi.org/10.3389/FPSYG.2021.794394/FULL

Maguire, M., & Delahunt, B. (2017). Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. * (Issue 3). http://ojs.aishe.org/index.php/aishe-j/article/view/335

Manzoor, B., Othman, I., & Manzoor, M. (2021). Evaluating the critical safety factors causing accidents in high-rise building projects. Ain Shams Engineering Journal, 12(3), 2485–2492. https://doi.org/10.1016/j.asej.2020.11.025

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Group, P. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. www.annals.org

Newaz, M. T., Davis, P., Jefferies, M., & Pillay, M. (2020). Examining the Psychological Contract as Mediator between the Safety Behavior of Supervisors and Workers on Construction Sites. Journal of Construction Engineering and Management, 146(1), 04019094. https://doi.org/10.1061/(asce)co.1943-7862.0001722

Nowobilski, T., & Hoła, B. (2019). THE QUALITATIVE AND QUANTITATIVE STRUCTURE OF THE CAUSES OF OCCUPATIONAL ACCIDENTS ON CONSTRUCTION SCAFFOLDING. https://doi.org/10.2478/ace-2019-0023

O'Grady, T., Chong, H. Y., & Morrison, G. M. (2021). A systematic review and meta-analysis of building automation systems. In Building and Environment (Vol. 195). Elsevier Ltd. https://doi.org/10.1016/j.buildenv.2021.107770

Olanrewaju, A., Law, X. X., & Preece, C. N. (2021). Evaluation of scaffold accidents during building maintenance works. Proceedings of International Structural Engineering and Construction, 8(1), CSA-03-1-CSA-03-6. https://doi.org/10.14455/ISEC.2021.8(1).CSA-03

Park, I. S., Kim, J., Han, S., & Hyun, C. (2020). Analysis of fatal accidents and their causes in the Korean construction industry. Sustainability (Switzerland), 12(8). https://doi.org/10.3390/SU12083120

Radevsky, R., Taylor, C., Stolfa, A., Generali, A., Uk, L., Cazzaniga, M., Wittowski, R., Re, S., Zurich, S., & Baltis, E. (2012). IMIA-WGP 78 (12) The effect of adverse weather on construction sites Working Group Executive Committee Sponsor.

Rafindadi, A. D., Napiah, M., Othman, I., Mikić, M., Haruna, A., Alarifi, H., & Al-Ashmori, Y. Y. (2022). Analysis of the causes and preventive measures of fatal fall-related accidents in the construction industry. Ain Shams Engineering Journal, 13(4), 101712. https://doi.org/10.1016/j.asej.2022.101712

Rambaree, K. (2013). THREE METHODS OF QUALITATIVE DATA ANALYSIS USING ATLAS.TI: "A POSSE AD ESSE."

Rubio-Romero, J. C., Rubio, M. C., & García-Hernández, C. (2013). Analysis of Construction Equipment Safety in Temporary Work at Height. Journal of Construction Engineering and Management, 139(1), 9–14. https://doi.org/10.1061/(asce)co.1943-7862.0000567

Samsudin, N. S., Mohammad, M. Z., Khalil, N., Nadzri, N. D., & Ibrahim, C. K. I. C. (2022). A thematic review on Prevention through design (PtD) concept application in the construction industry of developing countries. Safety science, 148, 105640. https://doi.org/10.1016/j.ssci.2021.105640

Sataloff, R. T., Bush, M. L., Chandra, R., Chepeha, D., Rotenberg, B., Fisher, E. W., Goldenberg, D., Hanna, E. Y., Kerschner, J. E., Kraus, D. H., Krouse, J. H., Li, D., Link, M., Lustig, L. R., Selesnick, S. H., Sindwani, R., Smith, R. J., Tysome, J. R., Weber, P. C., & Welling, D. B. (2021). Systematic and other reviews: Criteria and complexities. In World Journal of Otorhinolaryngology - Head and Neck Surgery (Vol. 7, Issue 3, pp. 236–239). KeAi Communications Co. https://doi.org/10.1016/j.wjorl.2021.04.007

Sawicki, M., & Szóstak, M. (2020). Quantitative assessment of the state of threat of working on construction scaffolding. International Journal of Environmental Research and Public Health, 17(16), 1–20. https://doi.org/10.3390/ijerph17165773

Selcuk, A. A. (2019). A Guide for Systematic Reviews: PRISMA. Turkish Archives of Otorhinolaryngology, 57(1), 57–58. https://doi.org/10.5152/TAO.2019.4058

Suraji, A., Duff, A. R., & Peckitt, S. J. (2001). DEVELOPMENT OF CAUSAL MODEL OF CONSTRUCTION ACCIDENT CAUSATION. J. Constr. Eng. Manag.127, 337–344.

Szer, I., & Szer, J. (2021). The influence of external environment on workers on scaffolding illustrated by UTCI. Open Engineering, 11(1), 929–936. https://doi.org/10.1515/eng-2021-0093

Vacanas, by, Sanni-anibire, M., Mahmoud, A., & Al-ayouni, M. (2020). Proceedings of International Structural Engineering and Construction Holistic Overview of Structural Design and Construction Edited CAUSES OF SCAFFOLD ACCIDENTS IN CONSTRUCTION INDUSTRY.

Wang, F., Tamura, Y., & Yoshida, A. (2013). Wind loads on clad scaffolding with different geometries and building opening ratios. Journal of Wind Engineering and Industrial Aerodynamics, 120, 37–50. https://doi.org/10.1016/j.jweia.2013.06.015

Wang, F., Tamura, Y., & Yoshida, A. (2014). Interference effects of a neighboring building on wind loads on scaffolding. Journal of Wind Engineering and Industrial Aerodynamics, 125, 1–12. https://doi.org/10.1016/j.jweia.2013.11.009

Winge, S., & Albrechtsen, E. (2018). Accident types and barrier failures in the construction industry. Safety Science, 105, 158–166. https://doi.org/10.1016/j.ssci.2018.02.006

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. ACM International Conference Proceeding Series. https://doi.org/10.1145/2601248.2601268

Zairul, M. (2021). A thematic review on Industrialised Building System (IBS) publications from 2015-2019: Analysis of patterns and trends for future studies of IBS in Malaysia. In Pertanika Journal of Social Sciences and Humanities (Vol. 29, Issue 1, pp. 635–652). Universiti Putra Malaysia. https://doi.org/10.47836/PJSSH.29.1.35

Zhang, X., Zhang, W., Jiang, L., & Zhao, T. (2020). Identification of Critical Causes of Tower-Crane Accidents through System Thinking and Case Analysis. Journal of Construction Engineering and Management, 146(7), 04020071. https://doi.org/10.1061/(asce)co.1943-7862.0001860