Occupational stress in the construction industry: a bibliometric-qualitative analysis of literature and future research directions

Dephanie Cheok Ieng CHIANG[a], Maxwell Fordjour ANTWI-AFARI[b*], Shahnawaz ANWER[c]
Saeed Reza MOHANDES[d], Xiao LI[e]

[a]Department of Mechanical, Aerospace and Civil Engineering, The University of Manchester, Manchester, M13 9PL, United Kingdom. Email: dephanie99@gmail.com

[b]Department of Civil Engineering, Aston University, Birmingham, B4 7ET, United Kingdom. Email: m.antwiafari@aston.ac.uk

[c]Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong Special Administrative Region. E-mail: shah-nawaz.anwer@polyu.edu.hk

[d]Department of Mechanical, Aerospace and Civil Engineering, The University of Manchester, M13 9PL Manchester, United Kingdom. Email: saeedreza.mohandes@manchester.ac.uk

[e]Department of Civil Engineering, The University of Hong Kong, Pokfulam, Hong Kong Special Administrative Region. Email: shell.x.li@hku.hk

***Corresponding author:**
Department of Civil Engineering, Aston University, Birmingham, B4 7ET, United Kingdom. Email: m.antwiafari@aston.ac.uk

Abstract

Purpose – Given the growing concern about employees' well-being, numerous researchers have investigated the causes and effects of occupational stress. However, a review study on identifying existing research topics and gaps is still deficient in the extant literature. To fill this gap, this review study aims to present a bibliometric and science mapping approach to review the state-of-the-art journal articles published on occupational stress in the construction industry.

Design/methodology/approach – A three-fold comprehensive review approach consisting of bibliometric review, scientometric analysis, and in-depth qualitative discussion was employed to review 80 journal articles in Scopus.

Findings – Through qualitative discussions, mainstream research topics were summarized, research gaps were identified, and future research directions were proposed as follows: versatile stressors and stress model; an extended sub-group of factors in safety behavior; adaptation of multiple biosensors and bio-feedbacks; evaluation and comparison of organizational stress interventions; and incorporation of artificial intelligence and smart technologies into occupational stress management in construction.

Originality – The findings of this review study present a well-rounded framework to identify the research gaps in this field to advance research in the academic community and enhance employees' well-being in construction.

Keywords: Bibliometric; Construction industry; Occupational Stress; Science mapping; Well-being

Paper type: Literature review

1. Introduction

Occupational stress includes both conscious and unconscious situations in which people are overworked to the point where it exceeds their abilities and endurance, causing them to feel physically and mentally perturbed (Rosenthal and Alter, 2012). According to the Health and Safety Executive (HSE) in 2021, work-related stress, anxiety, and depression rates have been escalating, even before the COVID-19 pandemic (HSE, 2021). A survey conducted by Mental Health America indicated that occupational stress is a significant factor in the increased rate of absenteeism among US workers from various industries (Hellebuyck *et al.,* 2017). It was reported that about 33% of participants experienced work absenteeism due to stress (Hellebuyck *et al.*, 2017). Another report from Forbes stated that unhealthy workplace settings, particularly those characterized by high levels of stress, result in approximately $180 billion in extra healthcare expenses, equivalent to almost 8% of total healthcare spending (Denning, 2018). In Hong Kong, it was revealed that the yearly economic cost of work-related stress, encompassing the combined costs of absenteeism, presenteeism, and medical treatment, accounts for around HK$4.81 billion to HK$7.09 billion (Siu *et al.,* 2020). Controversies about stress being a motivator and productivity booster are only about short-term stress; however, occupational stress refers to long-term distress that adversely impacts one's well-being and work performance (Rosenthal and Alter, 2012; Nielsen *et al.,* 2017). On a personal level, it may lead to sleeping disorders (McEwen and Lasley, 2002), anxiety, and depression (Lehrer, 2006). Meanwhile, from an organizational perspective, this matter if not tackled, can evolve to a loss of billion dollars every year due to high absenteeism and poor productivity (Roberts, 2019).

The construction industry is often described as "competitive, dynamic, and challenging" with its project-based nature (Chan *et al.,* 2014). Personnel or workers in the construction industry are impelled to handle a plethora of stress, having to balance schedule, budget, and quality within many uncertainties (Asquin *et al.,* 2010). Due to the existence of a notable amount of stress among construction workers, research on occupational stress in construction has been growing in the last decade, covering a variety of dimensions, including stressors and stress (Bowen *et al.,* 2014c); different types of stress (Leung *et al.,* 2016); and relationships between job stress, work, and safety performance (Poon *et al.*, 2013). Existing empirical studies have verified the negative correlation between work stress and performance (Enshassi and Al.Swaity, 2015) and ranked the ascendant factors of stress (i.e., stressors) (Leung *et al.,* 2005). Major findings show that heavy workloads, excessive working hours, role ambiguity, and work-life imbalance are critical stressors, as well as interpersonal relationships and the working environment, which impact several personnel to some extent (Leung *et al.,* 2005; Bowen *et al.,* 2014a). With the presence of these factors, stress develops, affecting individuals both physically and physiologically (Leung *et al.,* 2016). In the long term, stress can lead to burnout, exhaustion, and inefficacy, which are derived from frequent stressors (Leiter and Maslach, 2003). Subsequently, poor work performance, high turnover (Yang *et al.,* 2017), and accident rates increase significantly (Wu *et al.,* 2019).

Many studies on occupational stress are either empirical or not directed at the construction industry. Most of these studies in the construction industry adopted a primary data collection method, which is conditioned by the limitations of samples and scope. Hence, studies have been conducted with a particular group of professionals in a specific place, for instance, construction project managers in the UK (Naoum *et al.,* 2018). As a result, these studies have minor discrepancies due to variables, indicating that the findings could not be generalized to the entire construction industry. For example, the working environment plays an essential role in stress management for on-site construction workers (Michael *et al.,* 2009); however, it may appear insignificant to construction project managers (Senaratne and Rasagopalasingam, 2017). Additionally, the status quo of review-based studies on occupational stress mainly emphasizes either health professionals during the COVID-19 pandemic (Sriharan *et al.,* 2021), health care professionals in Ethiopia (Girma *et al.,* 2021), or the relationship between occupational stress and social support (Haly, 2009). Sriharan *et al.* (2021) identified the causes of occupational stress and burnout in women in medicine, nursing, and other health professions during the COVID-19 pandemic. They reported that the key concerns about stress include safety (65%), staff and resource adequacy (43%), workload and compensation (37%), and job roles and security (41%). Girma *et al.* (2021) conducted a systematic review and meta-analysis on the prevalence of occupational stress and its associated factors among healthcare professionals in Ethiopia. Their findings indicated that most healthcare professionals had occupational stress, and female healthcare professionals were a significant predictor of occupational stress. To the best of the authors' knowledge, there is limited review-based research on work-related stress in the construction industry (Tijani *et al.,* 2020). Tijani *et al.* (2020) developed a conceptual framework for mental stressors and suggested further exploration of the effects of each stressor. Since the World Health Organization (WHO) introduced mental health as one of the Sustainable Development Goals in 2015 (WHO, 2022), there is a need for more recent research on occupational stress and the diversity of its context in previous reviews should be enhanced.

Given the above, this review study aims to apply a bibliometric and science mapping approach to review journal articles about occupational stress in the construction industry. A science mapping review aims to enhance the objectivity of existing empirical studies and introduce objective data mining findings into extant literature (Moral-Muñoz *et al.,* 2019). This study has the following objectives:

(1) To analyze the annual publication trends of journal articles addressing occupational stress in the construction industry.

(2) To utilize the VOSviewer tool to objectively examine relevant keywords and document analyses.

(3) To summarize the mainstream research topics on occupational stress in construction.

(4) To suggest potential future research directions of the studied topic.

This review-based study intends to establish a comprehensive framework and offer recommendations for researchers and practitioners across various aspects of occupational stressors, stress, and their effects within the construction industry.

2. Method

This review study adopts a combination of bibliometric analysis and a science mapping approach to provide researchers and practitioners with comprehensive state-of-the-art research and recommendations on occupational stress in the construction industry. Bibliometric analysis is a quantitative study of descriptive and scientific data. It provides a general view of a research field and categorizes journal papers, authors, and publications in that field (Shi and Antwi-Afari, 2023). A science mapping approach is a collective process of visualization and domain analysis (Chen, 2017), whose goal is to display the conceptual representation and connection of fields, authors, and disciplines within a research domain (Small, 1999). Moreover, a science mapping approach measures research impact, analyzes peer-reviewed journals and publications, as well as provides a profound interpretation of scientific knowledge and citations (Mingers and Leydesdorff*,* 2015; Antwi-Afari *et al.,* 2023; Sun *et al.,* 2023). Figure 1 outlines the workflow design of the study.

[Please insert Figure 1 about here]

2.1. Bibliometric search

The first step of this review study was to conduct a bibliometric search in Scopus. Scopus database was adopted because it not only contains a wide range of journals that are advantageous to keywords and citation searching, but also consists of more recent publications (Chadegani *et al.,* 2013). Moreover, it has a greater coverage of approximately 20% on citation analysis compared to any other digital sources (e.g., Web of Science) (Falagas *et al.,* 2008). Figure 2 demonstrates the search strategy and steps.

[Please insert Figure 2 about here]

The search was conducted on 20th June 2022. Initially, 388 documents were extracted using the search terms “occupational stress” and “construction industry” within the “title, abstract, and keywords” search in the Scopus database. Related documents would be recognized when these terms appeared in the article title, abstract, or keywords; this helps to maximize the inclusiveness of the retrieved data. Conversely, it also increases the chance of having irrelevant data. Hence, these documents were further screened by only including journal articles written in English, and those in the final publication stage because they are considered more reliable sources with “certified knowledge” (Ramos-Rodríguez and Ruíz-Navarro, 2004). Articles in conference proceedings were excluded because they tend to have less valuable information due to the lack of second-round reviewing (Butler and Visser, 2006). This process resulted in 263 documents. It is noteworthy that there is a close linkage between oxidative stress, heat stress, and occupational stress in the construction industry; thus, irrelevant subject areas such as “Chemistry”, “Immunology and Microbiology”, and “Pharmacology, toxicology and pharmaceutics” were excluded. Main research subject areas including “Medicine”, “Engineering” and “Social Science” were retained because they have a direct relationship with industrial workers, thus, enhancing this research study on occupational stress in the construction industry. In total, 220 documents were obtained during the initial screening process. The complete search strategy consists of “(TITLE-ABS-KEY (occupational AND stress) AND TITLE-ABS-KEY (construction AND industry)) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (PUBSTAGE, “final”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (EXCLUDE (SRCTYPE, “p”)) AND (LIMIT-TO

(SUBJAREA, “MEDI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “PSYC”) OR LIMIT-TO (SUBJAREA, “NURS”) OR LIMIT-TO (SUBJAREA, “COMP”) OR LIMIT-TO (SUBJAREA, “DECI”) OR LIMIT-TO (SUBJAREA, “ENER”) OR LIMIT-TO (SUBJAREA, “ARTS”))”.

As depicted in Figure 2, all journals included in the search underwent a rigorous two-stage screening process. Initially, a manual review was conducted for the 220 articles, involving a comprehensive assessment of their titles, keywords, abstracts, and full texts. During this stage, papers that were irrelevant or failed to fit within the predefined domains were eliminated. For example, a study by Brolin *et al.* (2021) mentioned the term “construction industry” in its abstract, but it did not specifically focus on occupational stress. Similar articles that did not focus on occupational stress were also removed. In another instance, an article (i.e., Cheng *et al.,* 2005), despite being related to job stress, examined various occupations with the construction industry as one of its sampled areas. Since the scope of this study did not align with such a broad sample size, similar articles were also excluded. After the final screening process, a total of 80 journal articles were identified and selected as the included articles on 20 June 2022. These included articles were subsequently downloaded, indexed into a CSV Excel, and used as input variables in VOSviewer for further analysis.

2.2. Bibliometric and science mapping analysis

The second part of the review is to carry out a bibliometric and science mapping analysis, mainly using VOSviewer. First, a descriptive analysis was conducted on the annual publication trends. The included articles were imported and analyzed by using VOSviewer, where the aforementioned two techniques were adopted. VOSviewer is an easily accessible tool that assists in interpreting large amounts of data and maps, focusing on the diagrammatic presentation of bibliometric maps (Van Eck and Waltman, 2010). This step generated results regarding the influence of keywords in the reign of occupational stress in the construction industry, which gives readers insights into the current research situations.

2.3. Qualitative discussion

Along with the previous steps, document analysis was conducted to summarize and combine different data in the research corpus. Meaningful themes and sub-themes were synthesized from the results. Document analysis is considered a systematic approach as it demands data selection, instead of data collection. Additionally, it counterbalances the restriction of reflexivity, commonly found in other qualitative methods because documents are constant factors and will not vary during the research process (Bowen, 2009). Within the process, thematic analysis and clustering were adopted. The results of this process reveal existing knowledge gaps. Together with the results of prior analyses, a detailed evaluation and framework connecting the research status quo and future directions were proposed for researchers and practitioners involved in the community of construction stress to further advance the research work and improve the current state of the studied area, respectively.

3. Results

3.1. Attributes of document outputs

Figure 3 illustrates the distribution of the 80 included articles from 1996 to 20th June 2022. It clearly depicts the deficiency in research on the topic of occupational stress in the construction industry before 2012, with a maximum publication of 2 per annum. However, there has been an overall upward trend since 2015, with two major bursts in 2017 to 2018 (+233% number of publications) and 2021 (+75% number of publications), which coincidentally serve as the peak points in Figure 3. This growing trend is presumed to be driven by the inclusion of mental health as one of the Sustainable Development Goals of the WHO. Majority of research in 2018 emphasized the relationship between job stress and safety behavior (Wu *et al.,* 2018), as well as stress interventions (Tonnon *et al.,* 2018). Meanwhile, more than half of the research in 2021 highlighted the correlation between work-related stressors and stress (Dennerlein *et al.,* 2021). Note that this research regards, for the year 2022, publications in the first half of the year, thus explaining the lower number in that year. If a linear regression is enacted, 2022 continues the growth and estimates over 10 publications on the research topic, outgrowing the peak in 2018. With increasing concern for well-being and the launch of the earliest review study on the research topic (Tijani *et al.,* 2020), more researchers are expected to have an interest and contribute to the body of knowledge, benefiting the entire construction industry and community.

[Please insert Figure 3 about here]

3.2. Co-occurrence of keyword analysis

Keywords represent the core contents of the published articles and illustrate the range of research topics within the given domain (Su and Lee, 2010). From the keywords co-occurrence network, trending topics can be recognized in the studied area over a specific time period, and the inter-closeness among them can also be investigated. “Author Keywords” and “Full Counting” were adopted in VOSviewer when conducting the analysis. By adjusting the minimum occurrences of keywords at 2, 41 out of 243 keywords were initially selected. A second-round text-mining of keywords was also conducted. Repeated general keywords such as “total worker health”, “construction”, “construction worker”, and “mental health” were eliminated. Some other keywords with the same semantic meaning, for instance, “job stress”, “work stress”, “workplace stress”, and “occupational stress”, were combined. Finally, 23 keywords were generated, and the network visualization is shown in Figure 4.

[Please insert Figure 4 about here]

The network contains 23 nodes, 66 links, and a total link strength of 91. The node size is determined by the occurrence of keywords in the bibliometric record, whereas the connection lines show the interconnection among them. Other than the main keywords that describe the research domain, such as “occupational stress”, “stress” and “construction industry”, “structural equation modeling” (occurrence = 7), “safety behavior” (occurrence = 6), and “stressors” (occurrence = 6) are keywords that were widely used in previous research. “Structural equation modeling” is the most frequent keyword because almost all existing studies conducted on occupational stress in the construction industry have adopted a quantitative research method. By incorporating statistical techniques to quantify data, subjectivity in human behavioral-related topics can be eliminated (Hill, 2012). In terms of connections, for instance, occupational stress is closely related to stressors, which covers the studies emphasizing the exploration of factors that lead to stress in the workplace (Van Heerden *et al.,* 2021). Moreover, stress is connected to safety behavior; this concept is strongly presented in several studies (Wu *et al.,* 2018, Jung *et al.,* 2020). The keywords in Figure 4 are categorized into different clusters. Keywords within the same clusters have a closer internal relationship. For example, labor and personnel issues are often co-studied with stressors.

More detailed information on the generated keywords are shown in Table 1 and are ranked following the average normalized citations. It is evident that keywords with the highest occurrence are not necessarily equivalent to the highest average citation or average normalized citation. According to Table 1, “coping behaviors”, “confirmatory factor analysis”, and “safety behavior” have the highest average normalized citation. It is suggested that studies focusing on stress coping behaviors (Bowen *et al.,* 2021), applying a confirmatory factor analysis approach (Liang *et al.,* 2022a, b), and highlighting safety behavior caused by job stress (Huang *et al.,* 2021) are anticipated to have a higher impact in the research domain of occupational stress in the construction industry. Average publication year signifies the recentness and average time period a keyword has been used in publications. Overall, most of the keywords have been studied in recent years, except “project management”, “South Africa”, “job control”, and “injury incidents”, which appear to be more traditional keywords. On the contrary, “co-creation”, “implementation”, and “work-life balance” have received more attention in recent years since 2020.

[Please insert Table 1 about here]

3.3. Document analysis

Document analysis, as its name implies, examines the quantity, authority, and relationship of the co-cited references in the 80 included articles. With the minimum number of 22 citations of a document, 28 out of 80 documents met the threshold. The network visualization is demonstrated in Figure 5, which encompasses 28 nodes and 35 links. The node represents a publication and is labeled with the first author’s name and publication year. The size of the node is proportional to its frequency. On the other hand, the links refer to the co-citation relationships between publications. The top 15 cited documents in this field are summarized in Table 2.

Given the data in Figure 5 and Table 2, a total of 14 citation clusters were formed based on the abstracts of the documents cited. For example, Cluster #1 (red color) contains the greatest number of documents, focusing on stressors and impacts on safety behavior, while the other clusters focus on diverse angles of stress, including interventions, demographics, and well-being. Regarding the number of citations, Siu *et al.* (2004) received the highest citation (302 citations), assessing safety climate and performance through the lens of occupational stress. Seo *et al.* (2015) obtained second place with 118 citations, which also investigated safety behavior, however, on temporary construction workers. Chen *et al.* (2017b) ranked third with 115 citations, assessing the influence of individual resilience and safety climate on safety performance. It can be concluded that the top cited documents focus on the influence of stress on safety in the construction industry. In terms of normalized citations, Wang *et al.* (2018) emerged on top of the list with 3.72 normalized citations, followed by Chen *et al.* (2017b) (normalized citations = 3.66), and Jebelli *et al.* (2019) (normalized citations = 3.40). The top two documents, coincidentally, also studied safety behavior, while the remaining focused on methods to assess work stress. To sum up, articles on stress and safety have made a significant contribution to this research domain.

[Please insert Figure 5 about here]

[Please insert Table 2 about here]

4. Discussion

After applying bibliometric analysis and science mapping to the selected articles from Scopus, a detailed qualitative discussion is presented in this section. This includes a summary of the mainstream research topics within the theme of occupational stress in the construction industry, followed by the identification of research gaps and future research directions.

4.1. Summary of mainstream topics in occupational stress in the construction industry

Regarding the co-occurrence of keyword analysis, the most representative research topics in the field of occupational stress in the construction industry are reviewed below.

4.1.1. Work-related stressors and occupational stress

The investigation of work-related stressors has always been one of the hot topics in occupational stress in the construction industry. As mentioned earlier, studies in this domain started in 1996 (Gunning and Cooke, 1996). Despite the constant key stressors within the industry, continuous exploration of work-related stressors serves the purpose of updating and validation from time to time. In fact, during the last two decades, the anatomy of work-related stressors has evolved several times. Studies before 2000 tend to focus only on factors related to job tasks such as job demand and complex contractual arrangements (Gunning and Cooke, 1996). Then, in the 2000s, work-related stressors were expanded to an interpersonal level, where leadership and mobbing behaviors were recognized to have a significant impact on stress (Meliá and Becerril, 2007). Studies that follow complement previous research by developing a framework on work-related stress.

In status quo, several critical stressors within the construction industry are repeated in multiple studies with great implications for factor analysis, structural equation modeling, and regression model: (1) work-life imbalance due to job demand, design, and structure (Langdon and Sawang, 2018; Bowen *et al.,* 2014b); (2) role conflict and complex tasks (Sun *et al.,* 2022; Dale *et al.,* 2021); (3) poor relationships between co-workers and supervisors resulted from position hierarchy in the industry (Dennerlein *et al.,* 2021; Bowen *et al.,* 2014a); (4) job insecurity (Van Heerden *et al.,* 2021); (5) hostile work environment, including bullying, discrimination, and harassment (Dennerlein *et al.,* 2021; Alterman *et al.,* 2013).

In addition, stressors were organized into different levels and categories. For example, Van Heerden *et al*. (2021) classified stressors into individual level, group level, and organizational level, while Bowen *et al.* (2014c) integrated work-related stressors into the job demand, control, and support (J-DCS) model. By clustering work-related stressors, problems leading to stress could be addressed precisely with a variety of interventions (Van Heerden *et al.,* 2021).

4.1.2. Demographics, surroundings, and occupational stress

Multiple factors can affect occupational stress. In addition to work-related stressors, demographics, and personal surroundings also play a vital role in one's well-being. Demographics have displayed significant impacts on perceived work-related factors in existing studies, which proved that marital status correlates with job insecurity, greater vulnerability to financial problems and work-life conflicts, as well as higher exposure to legal problems like divorce and child custody (Liang *et al.,* 2022a; Milner *et al.,* 2017). On the other hand, age and educational background regulate job security and job demand (Kamal *et al.,* 2017). Moreover, females were found to experience higher stress than males (Bowen *et al.,* 2013a; Sang *et al.,* 2007).

In terms of surroundings, the economy (Van Heerden *et al.,* 2021) and cost of living (Langdon and Sawang, 2018) were considered extra-organizational or personal stressors. Several studies were undertaken in developing countries, such as South Africa (Bowen *et al.,* 2013b), and Nigeria (Omeje *et al.,* 2021), where economic hardships, social inequality, and crimes add an extra burden to one's well-being (Bowen *et al.,* 2013a). Bowen *et al*. (2013b) pointed out that gender-based discrimination and sexual harassment were more frequent in developing countries, and their ethnicity also led to greater job insecurity and underpayment that steer a vicious cycle.

4.1.3. Safety attitudes, behaviors, and injuries from job stress

There is a significant correlation between the mentioned stressors, job stress, and safety performance, which is supported by extant literature during the last decades (Huang *et al.,* 2021; Siu *et al*., 2004). In addition, many studies from the literature samples were conducted on assessing workers' safety behaviors through the lens of occupational stressors and stress. Extant literature on these topics were also included in the top 15 cited documents in Table 2. These evidently support the idea that safety attitudes, behaviors, and injuries or accidents are the most popular topics in the context of occupational stress among construction professionals. Generally, two major viewpoints were derived from existing studies: work injuries occurred due to (1) job stress, which has a negative relationship with cognitive factors such as safety awareness (Liang *et al.,* 2022b), safety motivation (Jung *et al.,* 2020), safety attitudes (Siu *et al.,* 2004), and unsafe actions (Widajati, 2018); and (2) work-related stressors (Arcury *et al.,* 2014) and personal traits (Seo *et al.,* 2015), which impact safety behavior and climate.

However, these two viewpoints do not stand alone in any single study; they were chained as a linkage or package in almost all the current studies in the literature samples because of the multivariant nature of job stress.

- The direct impact of job stress on safety performance was explained in several dimensions. Stress led to a decrease in motivation (Liang *et al.,* 2022a, b) and safety consciousness (Meng *et al.,* 2021) for workers who just wanted to complete the work quickly, hence taking risks (Wu *et al.,* 2018). Furthermore, job stress is physiological, which is very often followed by anxiety and depression (Jung *et al.,* 2020), as well as insomnia (Chakraborty *et al.,* 2018), which all adversely affect safety compliance, knowledge, and behavior (Wang *et al*., 2018). Emotional stress from work was also found to have a more significant impact on injuries than physical stress (Leung *et al.,* 2010).
- With regards to work-related stressors, personal traits, safety behavior, and climate, collective studies shared commonalities in several findings. Abbe *et al*. (2011) summarized that occupational stressors and injuries have a proportional relationship. Job demand, job

control, role ambiguity, and conflict were reported as the most significant factors affecting safety and emotional stress (Zheng *et al*., 2020; Arcury *et al.,* 2014). Working overtime and time pressure have a positive correlation with injuries (Dembe *et al.,* 2008), while job certainty has a negative relationship with injuries (Kiconco *et al.,* 2019). Besides the job itself, poor physical work environment (Leung *et al.,* 2010) and deficient managerial characteristics like inefficient organizational safety climate and insufficient training (Chen *et al.,* 2017a) dominated safety behaviors and injuries. Interpersonal relationships with colleagues and family were found to improve safety behavior due to better job satisfaction and lower stress levels (Huang *et al*., 2021).

- Similar to the aforementioned effect of demographics on occupational stress, psychological capital (PsyCap) plays an important role when determining safety performance. Numerous studies have focused on the relationship between PsyCap and safety behavior (He *et al*., 2019; Wang *et al.,* 2018). Optimism remains arguable among studies (Zheng *et al.,* 2020; He *et al.,* 2019). Additionally, personality and cultural influence were proven to shift one's mindfulness and safety performance (Solomon and Esmaeili, 2021).

4.1.4. Occupational stress interventions and management

Generally, within the construction industry, occupational stress research in stress interventions and management could be categorized as managerial studies that emphasize organizational factors (e.g., training, policies) and physiological approaches (e.g., physiological status monitors). Although studies on stress interventions only began after 2010 in the existing literature, findings on managerial interventions have been comprehensively compiled. Within this context, three levels of interventions were recognized, namely, primary, secondary, and tertiary. Primary interventions such as training, flexible working hours, and a safe working environment were widely mentioned in multiple studies (Leung *et al.,* 2012). Secondary interventions refer to the overall organization network, administration support, and culture, such as better allocation of work and budget, and regular meetings with supervisors (Nwaogu and Chan, 2021; Ajayi *et al.,* 2019). Tertiary interventions incorporate a set of professional stress management facilities (e.g., conflict management system, counseling team) into the organization (De Silva *et al*., 2017).

Moreover, Liang *et al.* (2018) and Liang *et al.* (2022b) divided useful stress management strategies in terms of problem focused and emotionally focused approaches. The former was found to be more effective for construction professionals with job control as it addressed the stressors directly, for instance, realistic workload planning, and planful problem solving (Liang *et al.,* 2022b). On the contrary, emotionally focused approaches such as escapism and emotional support were more applicable for on-site construction workers with no decision-making power (Liang *et al.,* 2018). The idea of escapism as a coping behavior has also been demonstrated in previous studies (Chan *et al*., 2016; Chan *et al.,* 2018).

4.1.5. Wearable sensing technology and AI approaches for monitoring occupational stress

Investigations and experiments on the effectiveness of various wearable technologies to predict, monitor, and assess both physical and mental stress was another converging research topic. Initially, the application of wearable technologies, as well as assessment metrics was widely recommended to raise the visibility of workers' health as a stress intervention (Jones *et al.,* 2019). Actual research that had a specific focus on the subject was followed accordingly. Wristband-type biosensors with electrodermal activity (EDA) and photoplethysmography (PPG) technologies (that monitor skin conductance response and heart rate, respectively), together with supervised learning algorithms were tested to be effective in predicting physical demand levels for construction workers (Jebelli *et al.,* 2019). It was further proven that EDA testing is more accurate than electroencephalogram (EEG), which records brain activity, when in a static condition (Umer, 2022; Chae *et al.,* 2021).

Besides physiological status monitors (PMS), evidence-based approaches using real time data collection (e.g., live data spot check and video capture) assisted in risk identification and customization of physical requirements in job tasks due to work differences among individuals (Pillsbury *et al.,* 2020). However, it was argued that camera monitoring might violate privacy rights and make workers uncomfortable (McAleenan *et al.,* 2019). Work strain is somehow inevitable, yet its recovery process is controllable. Nwaogu and Chan (2021) discovered the linkage among heart rate variability, sleep quality, and recovery process through electrocardiogram (ECG) and sleep data based on actigraphy. Nevertheless, a big leap in this research topic was made in Umer's (2022) study when physical and mental stress were tested simultaneously at actual job sites for the first time. It was concluded that the combination of physiological measures and machine learning algorithms strengthened the accuracy of assessment, which ultimately impacted proactive physical and stress management, as well as prevented accidents.

4.2. Research gaps and future directions on occupational stress in the construction industry

After summarizing the mainstream topics under the realm of occupational stress in the construction industry, this section will discuss research gaps in each sub-section, followed by directions for future studies. Figure 6 summarizes the existing knowledge gaps, while Figure 7 presents a framework of the mainstream topics, gap analyses, and future research directions.

[Please insert Figure 6 about here]

[Please insert Figure 7 about here]

4.2.1. A well-rounded work-related stressors framework

Work-related stressors at various levels, including individual, group, and organizational (Van Heerden *et al*., 2021) are classified into different categories such as job demand, job support factors (Bowen *et al*., 2014c). However, many studies did not explicitly classify these psychosocial hazards (Milner *et al*., 2017). This viewpoint was also emphasized in Sun *et al.* (2022)'s review study in which psychosocial hazards were often mixed together; thus, appearing ambiguous and inaccurate. Therefore, it was suggested that future research could collaborate with professional psychologists to obtain the most accurate terminologies and appropriate self-developed measures to avoid subjectivity. Moreover, no existing studies have examined how managerial decisions can impact subordinates' well-being (Van Heerdan *et al*., 2021). As such, future researchers could use different decision-making frameworks like Cynefin framework (Snowden and Boone, 2007), to conduct a study on how a specific managerial decision affects employees' mental health.

Empirical studies were often subject to geographical and sample size limitations. Most studies on stressors and stress were conducted repeatedly in a specific developing country or region (Chakraborty *et al.,* 2018; Bowen *et al.,* 2014a), with limited extension for cross-country validation or global comparison, especially with developed countries. Consequently, future studies should be conducted on the global prevalence of occupational stress, by comparing developed and developing countries. Similarly, this research gap applies to the sample size in current studies. Multiple studies focused on construction professionals as a general occupation. However, in the construction industry, there are different groups of professionals like architects, and engineers, as well as different levels of hierarchy (Sun *et al.,* 2022). To sum up, future studies should narrow down their sample to minority groups within the industry for better comparison and verification.

4.2.2. Expansion and clarification of demographics

With a male dominant culture in the construction industry, many studies have stated that females experienced higher levels of stress; however, their findings are not completely consistent (Liang *et al.,* 2022a; Kamal *et al.,* 2017; Sang *et al.,* 2007) and require further investigation. Therefore, it is recommended that a comparison study be carried out on only female participants versus the reported findings from both genders. In addition, future research on demographics can focus on a qualitative research approach with open-ended questions rather than a quantitative research approach with pre-set survey questionnaires.

The relationship between demographics and workplace harassment was limited to studies in the South African context (Bowen *et al.,* 2013b). Like the studies on work-related stressors and job stress, the findings of existing studies should be tested in different countries, organization sizes, and levels for comparison. Aside from the existing demographic findings, Liang *et al.* (2022a)'s research called for a need to expand the list of demographic characteristics when assessing stressors. Further studies should also focus on the effect of stress after the COVID-19 pandemic and compare it with pre-pandemic times as an adaptation to a changing environment.

4.2.3. Stressors and safety

Occupational stressors are one of the causes of workplace injuries. It has been confirmed in all studies that fall under the topic of construction safety and stress. However, inconsistencies exist in job support factors (Huang *et al*., 2021; Jung *et al*., 2020), which require further investigation. Likewise, psychological capital (PsyCap) was introduced in few studies (He *et al.,* 2021; Wang *et al*., 2018), in which "optimism" has remained arguable (Zheng *et al.,* 2020). It was suggested that future studies should include other personal traits about mindfulness, and a multidisciplinary framework on PsyCap should be applied to the assessment of safety behavior (Solomon and Esmaeili, 2021; He *et al.,* 2021).

Furthermore, terminologies like “safety compliance”, “safety consciousness”, and “safety attitude” are closely related and hence often mixed up; safety consciousness and behavior were dynamic factors as well (Meng *et al*., 2021). Therefore, a more profound understanding of these factors and regular research updates are required. Additionally, research studies on the impact of demographic factors on safety behaviors are limited (Kiconco *et al.,* 2019). Future studies can investigate how different age groups react to safety compliance and climate. In terms of the study approach, most studies on occupational stress applied a quantitative research approach. A study by Liang *et al.* (2022b) adopted a mixed method, and presented a need for future research to adopt a longitudinal research method that incorporates experiments and control groups to fill the research gap. Like the aforementioned sections, a comparative study between different economics is needed to understand safety compliance, safety consciousness, and safety attitude.

4.2.4. Organizational stress interventions and management

Although a wide range of organizational interventions have been introduced, the effectiveness of these strategies and the best timing to apply them have been undiscovered (Nwaogu and Chan, 2021). Examples include the success rate of stress management seminars (e.g., on mindfulness-based stress reduction) (Liang *et al.,* 2022b). Besides, none of the studies had followed up on the aftermath of any strategic implications; thus, whether the solution to a stressor will lead to the development of a new stressor remains unanswered. Future studies can conduct an experiment by organizing stress management seminars in different timeframes to test their feasibility while examining potential interventions that may lead to new stressors. In addition, future research in stress interventions can explore the variance in the effectiveness of managerial personnel between different organizations and management positions (Huang *et al.,* 2021).

4.2.5. Advanced smart sensing technologies and application of artificial intelligence (AI)

Studies on the application of smart sensing technologies and machine learning algorithms have been conducted in recent years. Hence, research into these subject areas is still at an early stage and requires further advancement. Most existing studies have conducted experiments in a controlled environment using mental workload as a variable (Umer, 2022). However, it is known that there are other stressors, especially demographics, that cause job stress. Future studies are recommended to test the physiological signals of a larger pool of workers with various factors such as age, and years of work experience (Jebelli *et al*., 2019). It can either be undertaken through integrating other physiological signals with newer sensors (Chae *et al.,* 2021) or through advancing the existing PMS systems. Latest sensors can consist of ergonomic interventions such as exoskeletons, robotics, and assistive devices to cope with heavy lifting and safety alerts (Patel, 2022; Antwi-Afari et al., 2021). In addition, improving existing PMS systems can be done by increasing the level of classification in performance measurement (Umer, 2022) and enhancing flexibility to capture both real-time and forensic data (Pillsbury *et al.,* 2020).

AI techniques encompass a wide variety of branches and types of computer science. Examples include digital twins, machine learning, artificial Internet of Things (AIoT) (Mazon-Olivo and Pan, 2021). Their functions are to interconnect physical devices and sensors with cloud platforms to gather timely data about the physiological signals of workers and status of the project (Chen *et al.,* 2021). Behavioral patterns are then generated; they provide immediate solutions and facilitate decision-making to adapt to the dynamic environment (Abioye *et al.,* 2021), which are particularly useful in the construction industry, for instance, safety alerts and spotting errors. In addition, virtual reality (VR) was discovered to be an innovative stress intervention for workers inside or outside the workplace as it offers an immersed, relaxing environment through VR glasses (Broneder *et al.,* 2021). Augmented reality (AR) could also be implemented in coping behaviors and safety training to promote a greater sense of engagement and interaction (De Aquino Lopes *et al.,* 2014). All the mentioned technologies are not tested in the context of occupational stress in the construction industry. Future studies are recommended to incorporate experiments with the latest technologies, to better identify and mitigate stressors, customize job tasks, allocate resources more efficiently, and most importantly promote a safe and healthy workspace for workers.

5. Conclusion

This review study utilized a science mapping approach, consisting of a bibliometric search, scientometric analysis, and qualitative discussion to review articles on occupational stress in the construction industry. The results indicated that “structural equation modeling”, “safety behavior”, and “stressors” were the most frequent keywords. In addition, mainstream topics include work-related stressors and occupational stress; demographics, surroundings, and occupational stress; safety attitudes, behaviors, and injuries; occupational stress interventions and management; and wearable sensing technologies and AI approaches for monitoring occupational stress. Research gaps were spotted in each stated topic and thereby, potential future research directions were proposed. From a theoretical perspective, although the identified research gaps and future research directions may not be applicable in a global context in construction, they can still serve as guidelines and references for scholars interested in conducting research on occupational stress. On the other hand, these findings contribute to gaining a practical understanding of the research status quo that can enlighten construction practitioners' decision-making process to improve employees' safety, health, and well-being. However, it is worth noting that the present review article has limitations. First, it is limited to a selected literature sample published in the Scopus database, and journal articles written in only English. Hence, there is a possibility of excluding some latest articles published in other languages or other documents like conference papers. Consequently, the research findings in this review study might not fully reflect the whole available literature on occupational stress in the construction industry. Future research studies should consider including articles from other databases like Web of Science, Science Direct, etc. Also, journal articles written in other languages and conference papers could be added to the inclusion criteria. Second, the identified existing research gaps and future research directions were based on a systematic subjective deduction. As such, careful interpretation of the findings of this review study should be taken into consideration. Future research could address this limitation by objectively utilizing data samples to quantify the research gaps and future research directions.

Data Availability Statement

All data generated or analyzed that support the findings of this study are available from the corresponding author upon request.

Declarations of interest

None

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Table 1. Quantitative summary of impacts of author keywords in the academic community of occupational stress in the construction industry

Keywords	Occurrences	Average Publication Year	Average Citations	Average Normalized Citations
Coping behaviors	2	2019	11.50	2.17
Confirmatory factor analysis	2	2022	2.00	2.00
Safety behavior	6	2019	30.67	2.00
Structural equation modeling	7	2019	28.29	1.85
Construction workers	10	2018	29.40	1.54
Project management	2	2013	60.00	1.24
Injury incidents	2	2011	94.50	1.21
Construction industry	11	2019	19.27	1.20
Stress	12	2018	17.33	1.20
Job control	3	2012	31.00	1.14
Stressors	6	2015	43.17	1.07
Labor and personnel issues	4	2016	31.50	1.05
Performance	2	2017	21.50	1.02
Occupational stress	15	2017	18.07	1.01
South Africa	2	2013	35.50	0.90
Construction professionals	7	2015	14.71	0.73
Work environment	2	2019	1.50	0.68
Co-creation	2	2021	1.00	0.67
Job satisfaction	2	2016	21.50	0.55
Gender	2	2019	5.50	0.32
Discrimination	2	2016	10.00	0.25
Implementation	2	2020	1.50	0.07
Work-life balance	2	2020	0.00	0.00

Source: Created by authors

Table 2. Top 15 cited documents in the academic community of occupational stress in the construction industry

Articles	**Titles**	**Journal sources**	**Total Citations**	**Normalized Citations**
Wang et al. (2018)	How safety-related stress affects workers' safety behavior: The moderating role of psychological capital	Safety Science	80	3.72
Chen et al. (2017b)	Impact of individual resilience and safety climate on safety performance and psychological stress of construction workers: A case study of the Ontario construction industry	Journal of Safety Research	115	3.66
Jebelli et al. (2019)	Application of wearable biosensors to construction sites. I: Assessing workers' stress	Journal of Construction Engineering and Management	37	3.40
He et al. (2019)	Impact of psychological capital on construction worker safety behavior: Communication competence as a mediator	Journal of Safety Research	25	2.30
Siu et al. (2004)	Safety climate and safety performance among construction workers in Hong Kong: The role of psychological strains as mediators	Accident Analysis and Prevention	302	1.94
Bowen et al. (2014b)	Occupational stress and job demand, control and support factors among construction project consultants	International Journal of Project Management	74	1.89
Seo et al. (2015)	Analyzing safety behaviors of temporary construction workers using structural equation modeling	Safety Science	118	1.87
Langdon and Sawang (2018)	Construction workers' well-being: what leads to depression, anxiety, and stress?	Journal of Construction Engineering and Management	38	1.77
Wu et al. (2018)	Development of construction workers job stress scale to study and the relationship between job stress and safety behavior: An empirical study in Beijing	International Journal of Environmental Research and Public Health	32	1.49

Leung et al. (2012)	Preventing construction worker injury incidents through the management of personal stress and organizational stressors	Accident Analysis and Prevention	112	1.42
Cattell et al. (2016)	Stress among South African construction professionals: A job demand-control-support survey	Construction Management and Economics	29	1.40
Bowen et al. (2013a)	Workplace stress experienced by construction professionals in South Africa	Journal of Construction Engineering and Management	51	1.29
Sang et al. (2007)	Gender: A risk factor for occupational stress in the architectural profession?	Construction Management and Economics	60	1.29
Dembe et al. (2008)	The effect of occupation and industry on the injury risks from demanding work schedules	Journal of Occupational and Environmental Medicine	23	1.28
Alterman et al. (2013)	Job insecurity, work-family imbalance, and hostile work environment: Prevalence data from the 2010 National Health Interview Survey	American Journal of Industrial Medicine	47	1.19

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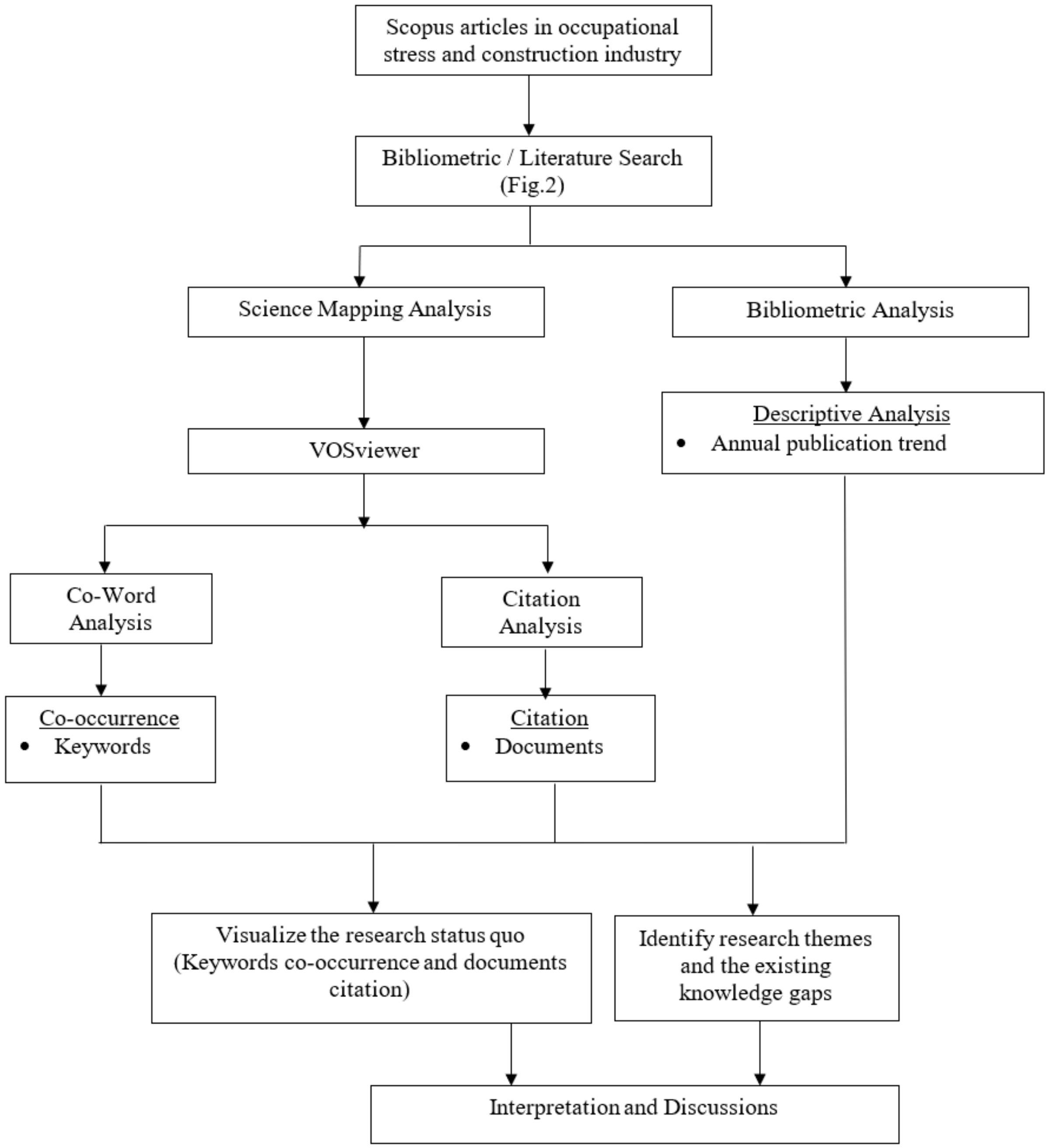

Figure 1. Outline of the research design. Source: Created by authors

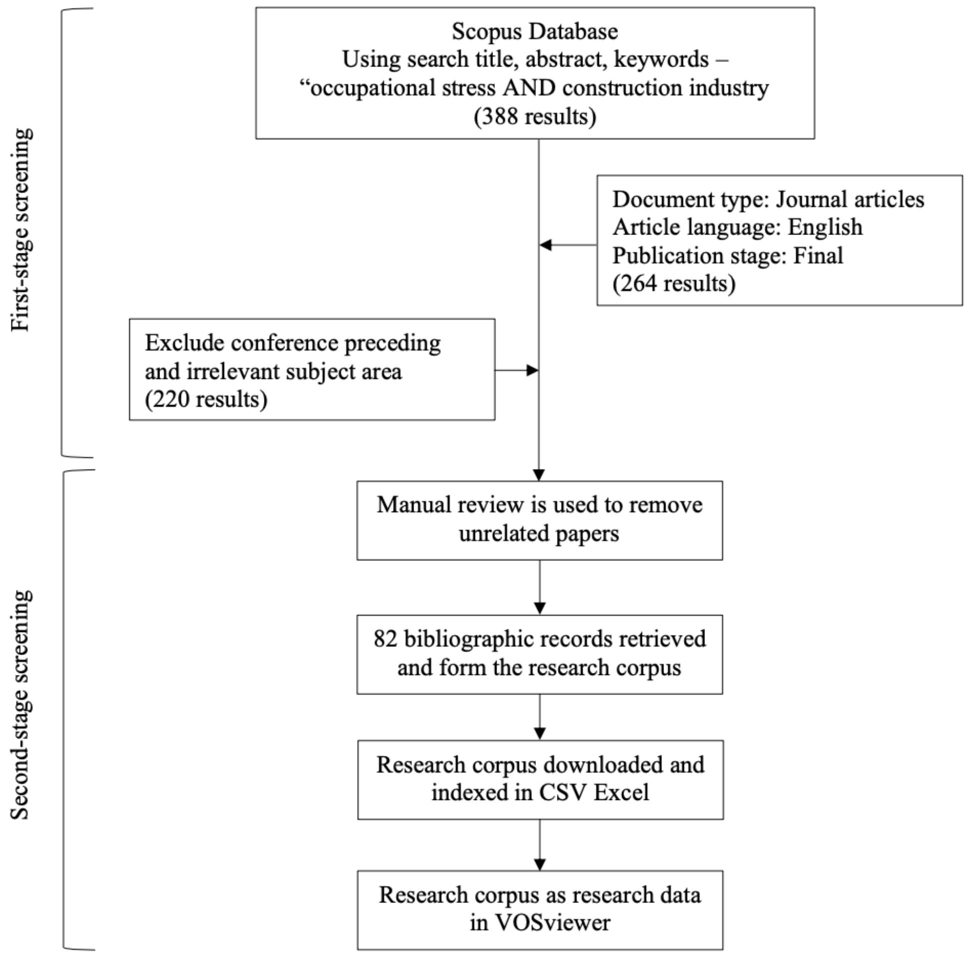

Figure 2. Search strategy and steps. Source: Created by authors

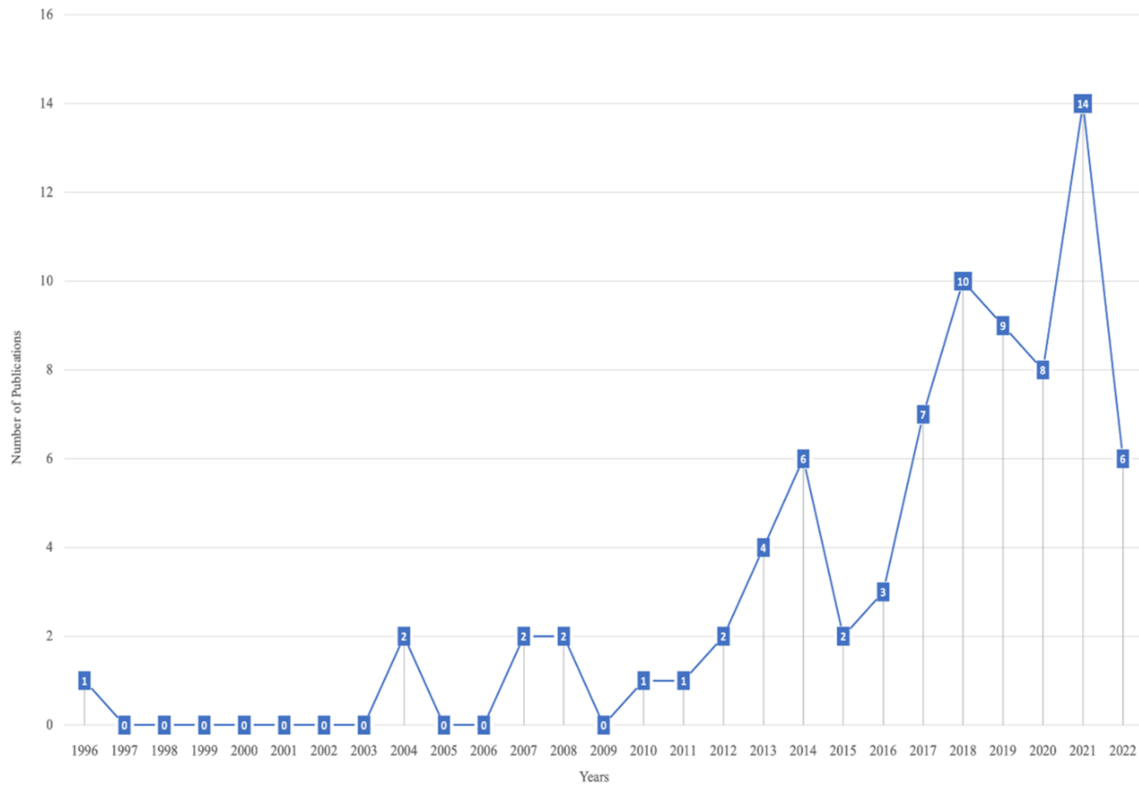

Figure 3. Annual publication trend of articles on occupational stress in construction industry in Scopus database, 1996-2022 (as of 20th June 2022) (Total 80). Source: Created by authors

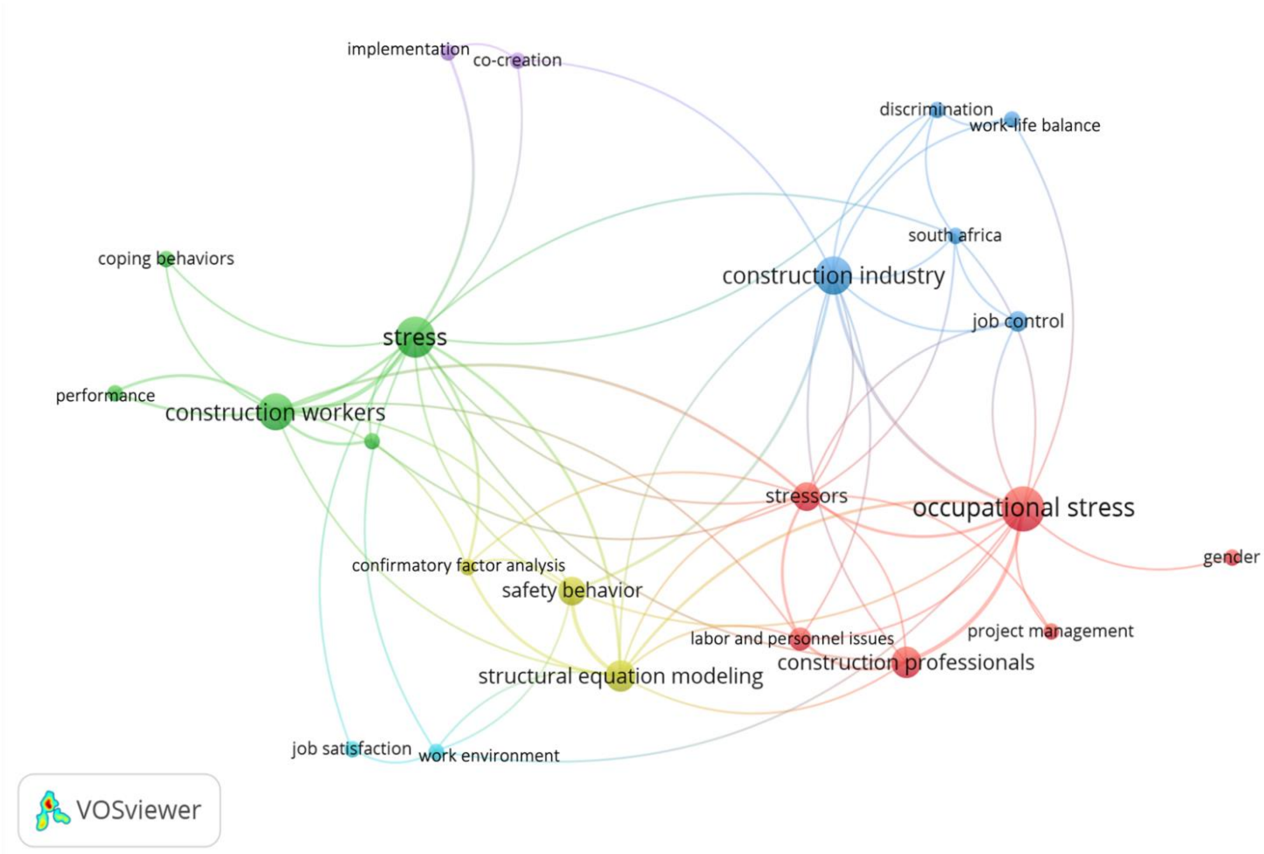

Figure 4. Network of co-occurrence of keyword analysis. Note: The minimum number of co-occurrence of keywords is 2. Source: Created by authors.

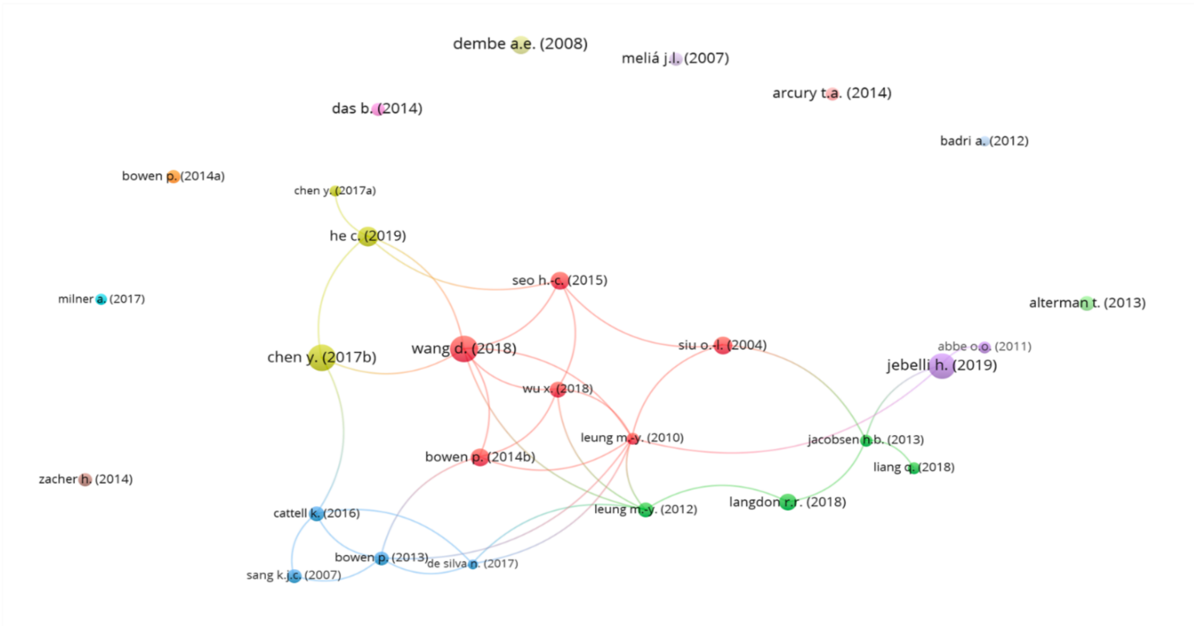

Figure 5. Network of document analysis. Note: The minimum number of citations of a document is 22. Source: Created by authors

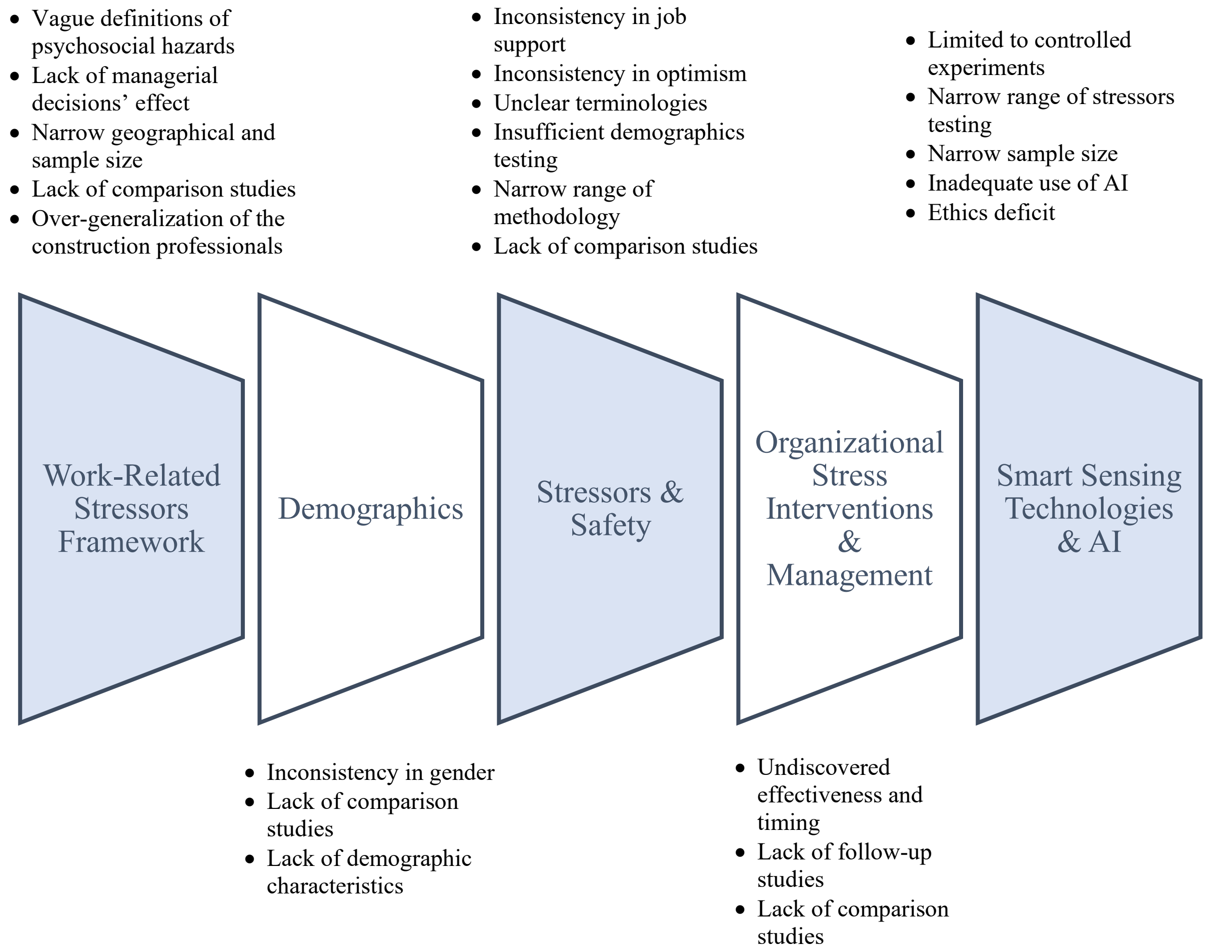

Figure 6. Existing research gaps in occupational stress in the construction industry. Source: Created by authors

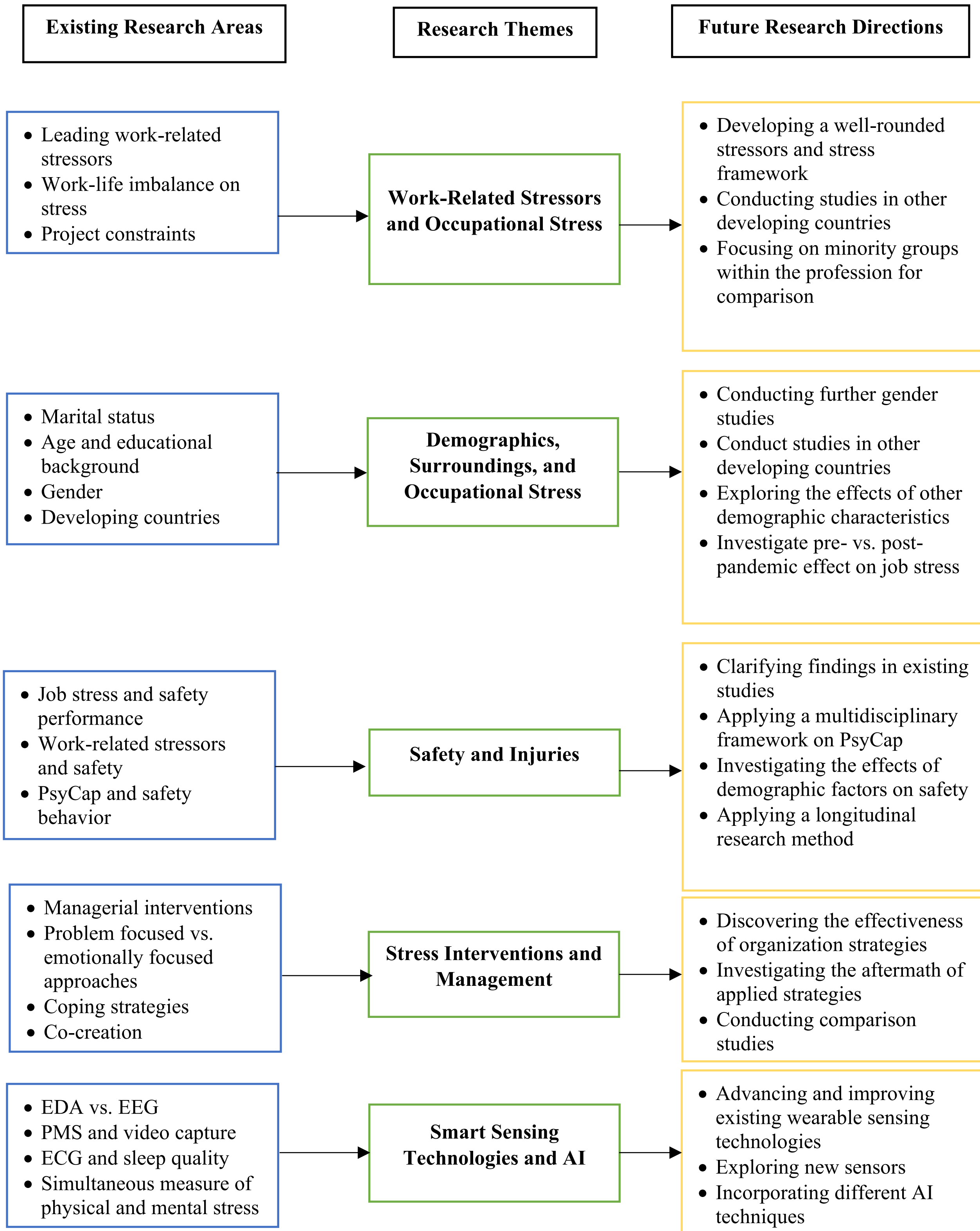

Fig. 7. Research framework for future research directions of occupational stress in the construction industry. Source: Created by authors