

# A Scientometric Analysis of Wellbeing Research in The Construction Industry

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**Abstract:** The significance of wellbeing in the construction industry has increased due to the high frequency of accidents. However, the existing research fails to comprehensively address the various aspects of wellbeing. To address this gap, this study conducts a literature review on wellbeing in the construction industry and provides a trend analysis of its multiple dimensions. A systematic review of 162 peer-reviewed journal articles is performed using scientometric analysis and qualitative trend analysis techniques. The results indicated that the discussion on wellbeing in the construction industry tends to overlook its multifaceted nature. Prominent publication outlets are identified, with a focus on environmental and physical wellbeing, while recognizing notable contributions in the field of mental wellbeing and limited contributions to other dimensions of wellbeing. The study offers valuable insights for both researchers and industry practitioners. Researchers can identify priority areas for future research based on the identified gaps, while construction companies can gain awareness of the potential relevance of wellbeing in the industry. This study contributes to the existing knowledge on wellbeing in the construction industry by analysing its various dimensions and providing research directions. It serves as a reference point for interpreting findings and offers guidance for future research endeavours.

**Keywords:** construction industry; qualitative techniques; scientometric; trend analysis; wellbeing.

## 1. Introduction

Wellbeing in the construction industry is increasingly important due to the high incidence of accidents in the construction workforce. Globally, the construction industry is recognized as a hazardous occupation, with a 21.5% fatality rate, the highest compared to other industries in Europe, and the third highest for non-fatal injuries at 12.7% in Europe [1]. In the United Kingdom, 52% of fatal injuries are attributed to the construction industry [2], while in the United States, construction ranks second highest in occupational deaths [3]. Developing countries have also been impacted by these challenges, prompting a significant concern, which has been further intensified by the COVID-19 pandemic [4]. As a result, there has been an increased focus on wellbeing in the construction industry.

The existing research on wellbeing in the construction industry falls short in comprehensively addressing all dimensions of wellbeing due to its intricate nature. Svane [5] introduced the term "wicked wellbeing" to capture the complexity and multifaceted aspects of wellbeing. Wellbeing encompasses a range of dimensions, such as "emotional wellbeing," "physical wellbeing," "social wellbeing," "economic wellbeing," "psychological wellbeing," "mental wellbeing," and "subjective wellbeing" [5,6,7], which adds to its intricate nature. Despite the complexity, it is crucial to assess and prioritize wellbeing to enhance productivity and retain the workforce, especially amid acute skilled worker shortages in the construction industry, worldwide.

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Therefore, a comprehensive approach to wellbeing is needed to encompass its multiple dimensions and enhance safety in the construction industry. Traditional measures that focus solely on fatalities fail to consider psychological factors such as anxiety, depression, and stress, which have been identified as contributors to mental health issues [7-9] and a form of injury. While there has been an increased focus on mental wellbeing in recent times [7,10]) research in the construction industry primarily emphasizes environmental and physical wellbeing while neglecting other dimensions.

Due to the insubstantial knowledge regarding wellbeing in the construction industry and the limited literature available that thoroughly addresses this subject, this study aims to bridge these gaps by utilizing an exhaustive research technique. This approach involves conducting a review that incorporates scientometric analysis and trends analysis. The overarching objective of this research is to develop a broader understanding of wellbeing in the construction industry by focusing on the following specific areas:

1. To ascertain the existing research and prevailing trends pertaining to wellbeing within the construction industry,
2. To assess the most influential scholarly works that delve into the topic of wellbeing in the construction industry, and
3. To analyse the various dimensions of wellbeing and propose potential research directions to facilitate further studies in this field.

This review on wellbeing in the construction industry carries significant implications for both academic researchers and industry practitioners. The article is organized into several sections: Section 2 offers an overview of the background information on wellbeing, Section 3 details the adopted research methodology, and Sections 4 and 5 present the findings and discussions. Lastly, Section 6 puts forward potential directions for future research in this field.

## 2. Background

The discussion on wellbeing originated from Philosophy. Specifically, it is traced to the ideas of Aristippus of Cyrene and Aristotle,[5] with each philosopher offering different conceptualizations that have shaped scholarly discourse [6]. Generally, wellbeing is seen as a robust assessment of a person's overall life, encompassing their health, state of mind, physical wellbeing, finances, and social connections [11]. A broader view considers wellbeing as a confident condition achieved through the simultaneous and harmonious satisfaction of various needs of individuals, cultures, teams, and organizations [12]. This perspective emphasizes the importance of finding a balance of satisfaction across different aspects of life. However, achieving such a balance can be challenging. Furthermore, [12] definition may be seen as idealistic, suggesting that individuals, organizations, and communities can advance together, leveraging their strengths to compensate for weaknesses. However, achieving balanced satisfaction in all aspects of life, both individually and organizationally, is often disrupted by uncontrollable factors like natural disasters and pandemic. Nevertheless, due to the vast applicability of wellbeing in today's globalized organizational settings, it is essential to examine its understanding from various perspectives.

A comprehensive understanding of wellbeing requires considering both subjective and objective perspectives. Existing literature suggests that wellbeing is examined using subjective and objective classifications to enhance comprehension [11-14]. Subjective wellbeing traces back to Aristippus of Cyrene's concept of "hedonic happiness" [6] Subjective wellbeing, as defined by personal desires, interests, needs, and preferences, involves evaluating the balance of satisfaction across all aspects of life [13]. Alternatively, it has been argued that subjective wellbeing relates to attaining a balanced level of satisfaction in emotional and psychological needs [14]. Essentially, subjective wellbeing focuses on how individuals assess their satisfaction in emotional and psychological aspects of life.

Moreover, personal norms and values play a significant role in influencing one's evaluation of satisfaction levels and determining their wellbeing.

In contrast, the objective approach to wellbeing takes a perspective that is independent of personal feelings. It stems from Aristotle's contrasting concept of "eudemonic wellbeing" (Svane et al., 2019). According to this viewpoint, objective definitions of wellbeing focus on evaluating satisfaction levels without being influenced by personal values and norms [11]. In other words, wellbeing is assessed based on the level of satisfaction experienced by an individual, measured using external metrics, regardless of their personal opinions [13]. Objective evaluations of wellbeing also consider the assessment of an individual's physical needs and their satisfaction level using external measurable metrics [12]. Some arguments suggest that the objective approach involves finding meaning through character development and discovering purpose in life [6]. Overall, the objective discussion revolves around the assumption that wellbeing is related to knowledge, virtues, or specific capabilities [15]. The viewpoint on an individual's satisfaction level will be determined through external validation and assessment.

Holistically, wellbeing should be defined as the overall evaluation of subjective and objective satisfaction levels of different needs of an individual.

The usage of the terms "wellbeing" and "wellness" in literature has been varied, prompting the need for a more thorough evaluation. Some scholarly works use these terms interchangeably in their discussions [16-18]. This viewpoint suggests that wellbeing and wellness are essentially synonyms, both referring to the assessment of an individual's satisfaction level of their subjective and objective needs. Conversely, other perspectives distinguish wellness and wellbeing as components of health, where wellbeing specifically pertains to subjective happiness, while wellness encompasses other aspects of health such as mental wellness, psychosocial wellness, and illnesses [16,19]. This viewpoint suggests that wellbeing and wellness are not identical, and each concept pertains to different elements, although both are integral to overall health. Another viewpoint considers health and wellbeing as components of wellness, with wellness representing a holistic approach to health and wellbeing [20]. It can then be argued that health, wellness, and wellbeing are contextually the same. Hence, in a broader sense, health, wellness, and wellbeing can all be regarded as subjective and objective evaluations of an individual's satisfaction level of their needs. An investigation of health, wellness, and wellbeing requires various considerations. One aspect to consider is the spelling of wellbeing, which is commonly presented as either 'well-being' or 'well being' [5,14]. Additionally, there are different word associations related to wellbeing, such as 'emotional wellbeing,' 'physical wellbeing' 'social wellbeing,' 'economic wellbeing' 'psychological wellbeing,' 'mental wellbeing,' and 'subjective wellbeing,' which further contribute to its complexity [5-7]. These dimensions have found applications in diverse fields including education [18], economics, and politics [19], psychology [21], management [22], medical science [17], tourism [23], and construction [24]. Additional dimensions include digital wellness [25], digital wellbeing [26], health and safety [27], financial wellness [28], and financial wellbeing [29]. Due to the multitude of complex dimensions associated with wellbeing, it is no wonder it's sometimes referred to as "wicked wellbeing" [5].

The construction industry has lagged behind in the discussion of wellbeing compared to information technology and manufacturing industries, despite the longstanding interest in this topic dating back to the 13th century. Notably, studies have shown that the focus of wellbeing discussions in the construction industry on mental wellbeing [7,10], might have been largely influenced by factors such as the stressful nature of construction sites, and the growing demand for health and safety measures, and more recently by the pandemic [30]. Factors like anxiety, depression, and stress have been identified as contributors to mental health issues [9]. The persistent challenge of skilled labour shortages in the industry may also contribute to increased stress, anxiety, and depression, further highlighting the wellbeing challenges faced which have not been addressed.

Furthermore, the demand for energy-efficient buildings has been linked to the increased focus on wellbeing. Users' behaviours in energy-saving strategies, driven by the high cost of living, can impact indoor environmental quality and, consequently, their wellbeing [31]. Wellbeing is associated with building performance, including energy efficiency and indoor environmental quality, which are influenced by design, operational efficiency, and maintenance practices [32]. This implies that the efficiency of building performance, particularly in terms of indoor environmental quality and energy efficiency, has an impact on the wellbeing of occupants in terms of high cost, stress, depression, and lack of satisfaction as well as environmental wellbeing in terms of carbon emissions.

The literature on wellbeing in the construction industry commonly includes evaluations of design decisions before and after construction, specifically in relation to the health outcomes of users [33–36]. These studies often have a narrow focus, primarily examining the subjective needs of users within a single case study project. As a result, it can be challenging to generalize.

Overall, the research on wellbeing in the construction industry has not sufficiently explored its numerous dimensions. Hence the need to delve into dimensions such as social wellbeing, digital wellbeing, psychological wellbeing, financial wellbeing, mental wellbeing, and subjective wellbeing, considering their implications for the workforce, organizations, and the environment.

### 3. Methodology

This research adopts Science mapping for a holistic investigation of the existing literature on wellbeing in the construction industry. The choice of the method was predicated on its techniques of visualization and analysis to enhance understanding of the connections between literature [37–38]. Additionally, scientometric techniques define the interrelations of different scientific knowledge and provide spatial representations of authors, documents, and disciplines [37–39]. This approach has also been adopted in previous related research on safety management in construction [40] and construction safety and health [4]. However, there has been no prior holistic scientometric investigation of the existing literature on wellbeing in the construction industry. Therefore, this study adopts a four-stage process of literature review, as illustrated in Figure 1, followed by a discussion of the process.

#### 3.1. Step1 (Scoping)

Due to the limited holistic research on wellbeing in the construction industry and the complex and contradictory usage of various terms, this section aims to define the scope of the literature review. This approach was adapted from a previous scientometric review conducted by [37]. In the construction industry, wellbeing has been addressed from several perspectives, for instance: mental wellbeing [7], indoor environmental quality in terms of user wellbeing [31], and evaluations of design decisions before and after construction, specifically regarding the health outcomes of users [33–36]. Consequently, for a comprehensive approach, this study investigates the wellbeing of all categories of individuals, including both construction workers and dwellers of the built environment. Furthermore, this study views wellbeing as a comprehensive term encompassing wellness, health, and wellbeing within the construction industry. The objectives of this research are to identify the current research and trends regarding wellbeing in the construction industry, to examine the most influential scholarly works on wellbeing in the construction industry, and to propose research directions for further studies in this area.

#### 3.2. Step 2 (Data collection)

##### 3.2.1. Database

The primary databases utilized for sourcing up-to-date construction literature were Web of Science, Google scholar and Scopus. There are concerns about Google Scholar's

suitability for scientometric analysis given that it enables publishing from predatory journals and lacks strict quality control [39]. Web of Science is renowned as a major database for scientific publications [37], while Scopus is recognized for its broader coverage of scientific publications and recent literature [41,42]. Therefore, Scopus was chosen as the database for this research due to its comprehensive collection of peer-reviewed articles, conference papers, and reviewed articles. It is worth noting that Scopus also includes other types of literature such as editorials, book chapters, letters, and surveys. Therefore, as adopted by [38,41,42] regarding the scientometric analysis purposes, this study focused exclusively on journal articles written in the English language to ensure a higher level of academic credibility.

### 3.2.2. Keyword Search

The searching terms were categorized into two parts. The first part includes terms related to wellbeing, such as 'wellbeing' [17,18], 'wellness' [16,19], 'well-being' [5,14], 'health and wellbeing' [20], and 'subjective wellbeing' [5,7] and other dimensions of wellbeing. The second part includes terms related to the construction industry, such as 'construction industry' [43], 'built environment' [44,45], and 'building industry' [46]. Additionally, bibliographic records including citation information, bibliographical information, abstract and keywords, funding details, and other relevant information were included for all retrieved documents. The exact search code used is as follows:

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( TITLE-ABS-KEY ( wellbeing OR "wellness" OR "well being" OR "well-being" OR "health and wellbeing" OR "health and well-being" OR "emotional wellbeing" OR "Physical wellbeing" OR "social wellbeing" OR "psychological wellbeing" OR "mental wellbeing" OR "economic wellbeing" OR "digital wellness" OR "digital wellbeing" OR "financial wellness" OR "financial wellbeing" ) AND TITLE-ABS-KEY ( "construction industry" OR "construction sector" OR "built environment" OR "construction professional" OR "building industry" OR contractors ) ) AND ( EXCLUDE ( SUBJAREA , "DENT" ) OR EXCLUDE ( SUBJAREA , "VETE" ) OR EXCLUDE ( SUBJAREA , "Undefined" ) OR EXCLUDE ( SUBJAREA , "IMMU" ) OR EXCLUDE ( SUBJAREA , "PHAR" ) OR EXCLUDE ( SUBJAREA , "CHEM" ) OR EXCLUDE ( SUBJAREA , "BIOC" ) OR EXCLUDE ( SUBJAREA , "PHYS" ) OR EXCLUDE ( SUBJAREA , "NURS" ) OR EXCLUDE ( SUBJAREA , "HEAL" ) OR EXCLUDE ( SUBJAREA , "AGRI" ) OR EXCLUDE ( SUBJAREA , "MEDI" ) OR EXCLUDE ( SUBJAREA , "BUSI" ) OR EXCLUDE ( SUBJAREA , "CENG" ) OR EXCLUDE ( SUBJAREA , "MATH" ) OR EXCLUDE ( SUBJAREA , "MATE" ) OR EXCLUDE ( SUBJAREA , "EART" ) OR EXCLUDE ( SUBJAREA , "PSYC" ) OR EXCLUDE ( SUBJAREA , "ARTS" ) OR EXCLUDE ( SUBJAREA , "NEUR" ) OR EXCLUDE ( SUBJAREA , "ECON" ) OR EXCLUDE ( SUBJAREA , "DECI" ) OR EXCLUDE ( SUBJAREA , "ENER" ) OR EXCLUDE ( SUBJAREA , "COMP" ) OR EXCLUDE ( SUBJAREA , "ENVT" ) ) AND ( EXCLUDE ( DOCTYPE , "cp" ) OR EXCLUDE ( DOCTYPE , "re" ) OR EXCLUDE ( DOCTYPE , "ch" ) OR EXCLUDE ( DOCTYPE , "bk" ) OR EXCLUDE ( DOCTYPE , "no" ) OR EXCLUDE ( DOCTYPE , "cr" ) OR EXCLUDE ( DOCTYPE , "sh" ) OR EXCLUDE ( DOCTYPE , "ed" ) OR EXCLUDE ( DOCTYPE , "er" ) OR EXCLUDE ( DOCTYPE , "le" ) OR EXCLUDE ( DOCTYPE , "dp" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )
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### 3.2.3. Data Retrieval

The initial search on keyword, abstract, and title resulted in 296 articles, with no date range limit. This approach was adopted due to the limited number of studies available on wellbeing in the construction industry, as previous research suggests including all papers to ensure comprehensive coverage of indexed publications in Scopus [47]. However, conference papers, which are considered less influential publications [48], were excluded from the retrieved sample as well as papers whose primary focus is not wellbeing. Ultimately, a final sample of 162 articles was obtained, which is reasonably adequate compared to previous scientometric analyses that used much lower thresholds, namely 50

samples [42] and 60 sample [38] respectively. The bibliometric data of 162 journal articles retrieved was obtained in Comma Separated Values (CSV) format. Subsequently, the CSV file was imported into VOSviewer, a software tool used to create scientific maps of research literature [38].

### 3.3. Step 3 (Scientometric Analysis)

#### 3.3.1. Quantitative method

For analysis in this study, the quantitative method of science mapping was employed. This method was selected for its capability to handle large volumes of bibliometric data and uncover connections between publications and disciplines [49,50]. Additionally, it allows for the discovery of broader associations between concepts that may be overlooked during manual review [51]. Furthermore, the adoption of scientometric analysis enables the examination of countries, authors, publishing institutions, and journals, providing a scientific approach to mapping the literature [47].

#### 3.3.2. Software

To conduct the scientometric analysis, the VOSviewer software was utilized due to its advantageous features. It is known for its user-friendly nature and its ability to produce visually appealing and easily comprehensible results [41,42]. Moreover, VOSviewer has gained significant popularity among researchers in the construction field [38,41,42,51,52]. While Gephi is another commonly used software for scientometric analysis [42], it has been criticized for its limited analytical capabilities [38]. Compared to this, VOSviewer provides interactive capabilities and a range of tools for examining and clustering bibliometric data networks. [39].

### 3.4. Step 4 (Trend Analysis)

The study aims to achieve specific objectives, which include exploring the existing research and prevailing trends related to wellbeing in the construction industry, analysing influential scholarly works on wellbeing within this field, and proposing research directions for future studies. Through an in-depth discussion, the study will provide insights into trends and offer suggestions for further research. Adopting a review-based approach, like one recommendation by [41], will provide a framework and guidance for researchers in this field, enabling them to focus on potential areas of research and emerging topics in the study of wellbeing in the construction industry.

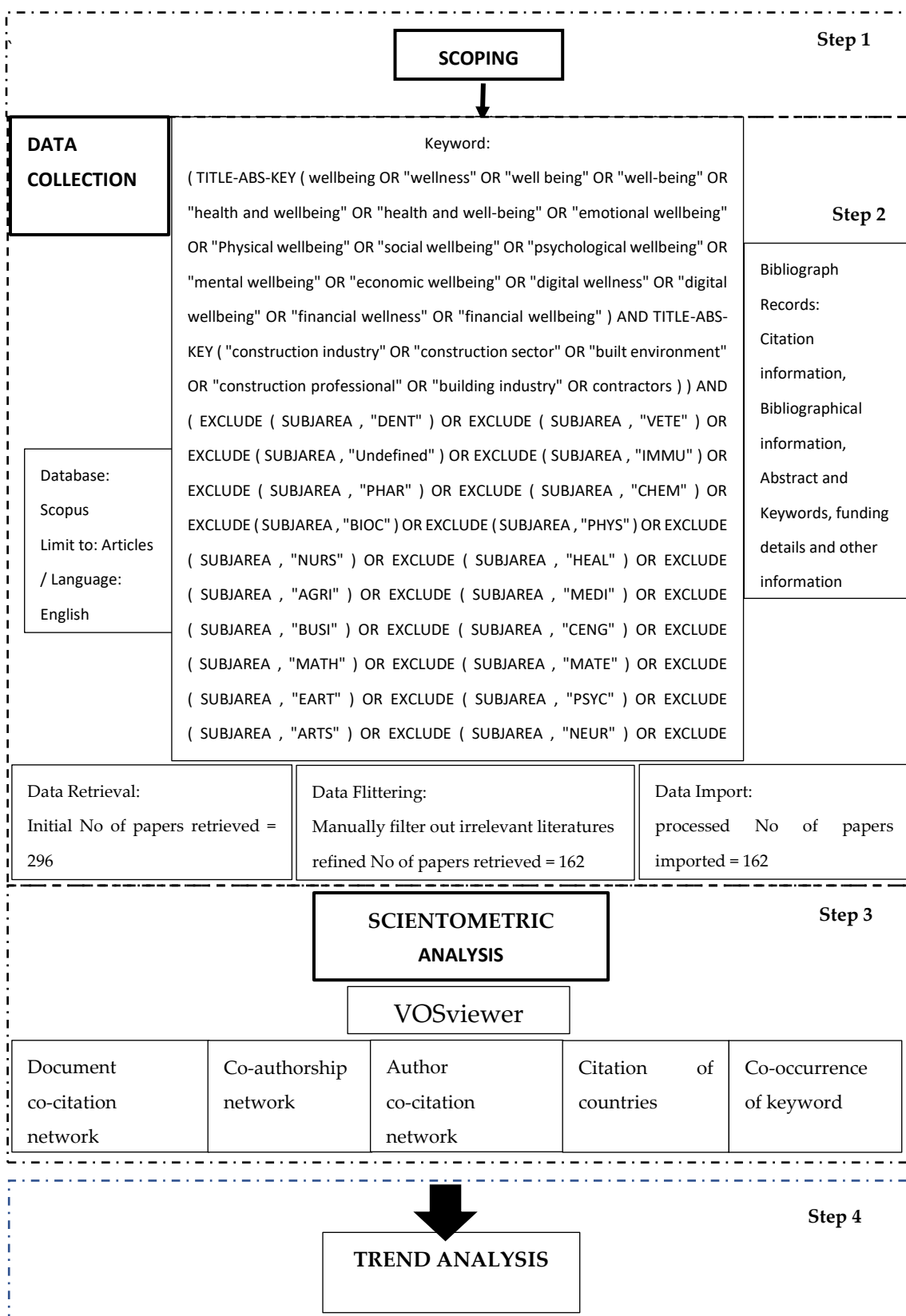


Fig 1: Research Methodology

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## 4. Results and Findings

### 4.1. Surge in Publications

Publications focusing on wellbeing in the construction industry have been documented from 1979 to 2023, as depicted in Figure 2. The pioneering study conducted by Lewis [54] and published in the Journal of the American Planning Association explored the relationship between urban stress and the impact of the technological environment. This study emphasized the importance of understanding the interactions between humans and nature to effectively address stress in current urban settings and prevent its occurrence in future urban developments. Furthermore, among the highly cited papers, [55] published in the Journal of Safety Research investigated the influence of individual resilience and safety climate on job stress and performance in the Canadian construction sector, while [56] examined the connection between community design and individuals' fear of crime in terms of wellbeing. These three influential papers have shed light on different dimensions of wellbeing, highlighting its multifaceted nature and underscoring the need for further exploration.

Researchers' interest in wellbeing in the construction industry has been rising, as depicted in Figure 2, by the surge in publications from 2012 to 2023. This increase is attributed to the adoption of new design strategies in building design, which aim to incorporate the psychologically beneficial effects of nature [57]. Furthermore, the emphasis on the significant role of urban planning in promoting human health and the recognition of the need for a clearer understanding of the relationship between planning and health, particularly from the perspective of built environment professionals, may have also contributed to the growing discourse [58]. Additionally, the Covid-19 pandemic might also have contributed to the upsurge [59,60].

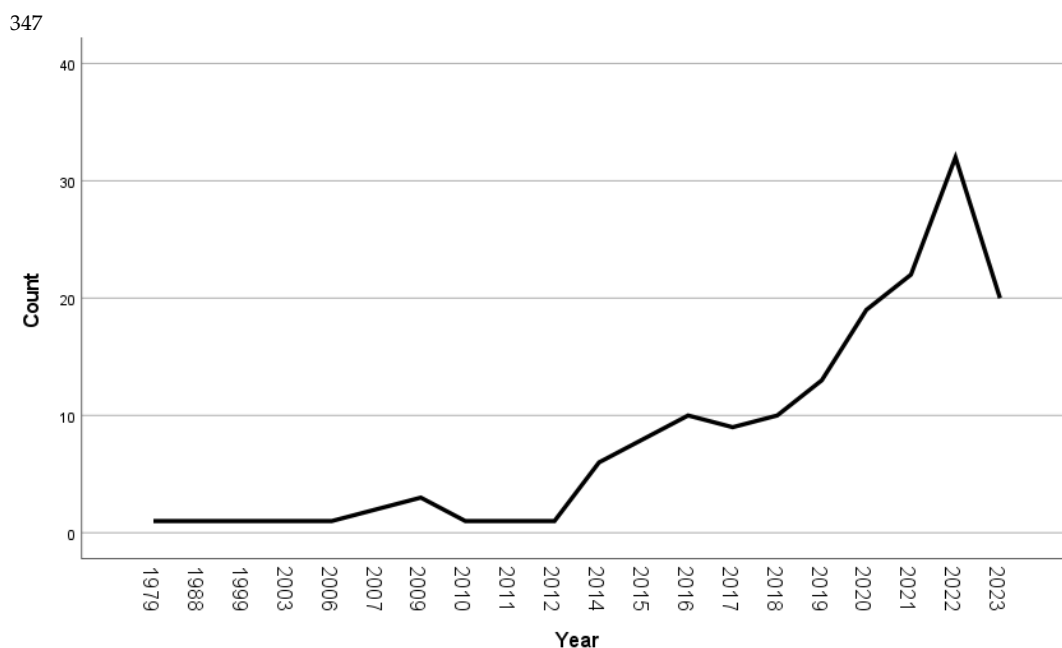


Figure 2. Surge of Publications.



## 4.2. Author Citation Network

Table 1 highlights the top 5 highly cited publications in the discourse of wellbeing in the construction industry. Chen [55] obtained 157 citations for their study, which focused on the stress experienced by construction workers. However, it should be noted that the findings of the research cannot be generalized due to its limited scope as a case study conducted in the Canadian construction sector. Foster [56], also with 157 citations, examined the relationship between community design and individuals' fear of crime, which falls under the category of environmental wellbeing. Ryan [61], with 152 citations, contributed to the discussion on wellbeing by exploring the concept of biophilic design, which relates to architectural design and falls under the category of environmental/physical wellbeing. Taking a different perspective on environmental wellbeing, Lowe [62] obtained 115 citations for their research on policies for wellbeing in construction. In contrast, Leyden [63] garnered 130 citations for their focus on subjective wellbeing in urban design. Overall, the most cited literature in the discourse of wellbeing predominantly revolves around environmental and physical wellbeing. However, the influence of Chen [55] on research pertaining to construction workers' stress may have contributed to an increased focus on mental wellbeing, even though the research primarily relates to psychological wellbeing.

**Table 1.** Summary of Most Cited Publications on Wellbeing in the Construction Industry.

Citations	Author & Year	Article	Keywords
157	Chen et al., (2017)	Impact of individual resilience and safety climate on safety performance and psychological stress of construction workers: A case study of the Ontario construction industry	Canadian construction industry; Injuries and accidents; Positive psychological states; Psychological health; Safety climate
157	Foster et al., (2010)	Neighbourhood design and fear of crime: A social-ecological examination of the correlates of residents' fear in new suburban housing developments	Built environment; Collective efficacy; Crime; Fear; Walking
152	Ryan et al., (2014)	Biophilic design patterns: Emerging nature-based parameters for health and wellbeing in the built environment	Biophilia; Biophilic design; Complexity and order; Mystery; Pattern language; Prospect-refuge theory; Thermal comfort
130	Leyden et al., (2011)	Understanding the pursuit of happiness in ten major cities	built environment; happiness; public sphere; social connections; urban design
115	Lowe et al., (2015)	Planning Healthy, Liveable and Sustainable Cities: How Can Indicators Inform Policy?	Indicators; Integrated planning; Liveability; Melbourne; Social determinants of health
109	Brown et al., (2009)	The relationship of built environment to perceived social support and psychological distress in Hispanic elders: The role of "eyes on the street"	Ageing; Built environment; Hispanics/Latinos; Psychological distress; Social support

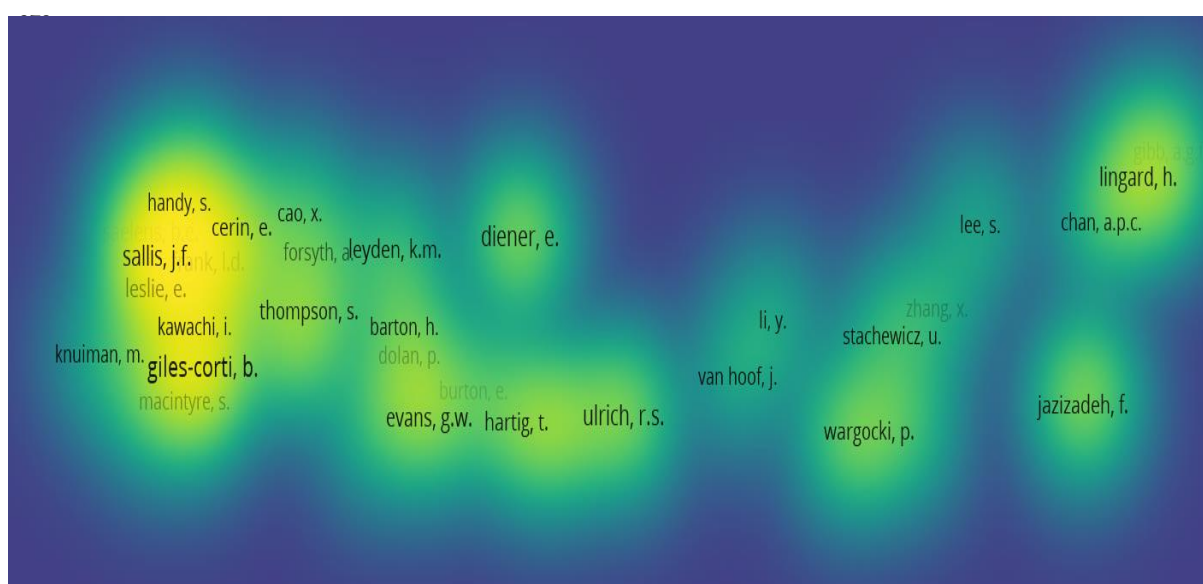
94	Yi et al., (2016)	Development of an early-warning system for site work in hot and humid environments: A case study	Artificial neural networks (ANNs); Construction industry; Early-warning system; Heat stress; Hong Kong; Occupational health and safety (OHS)
77	Pearce, (2006)	Is the construction sector sustainable? Definitions and reflections	Assets; Environmental (natural) capital; Human capital; Man-made capital; Social capital; Sustainability; Sustainable development; Wealth; Wealth accounting
57	Mouratidis, (2018)	Rethinking how built environments influence subjective well-being: a new conceptual framework	City; Happiness; Liveable; quality of life; Sustainability; Urban planning
49	Zhang et al., (2019)	Healing built-environment effects on health outcomes: environment–occupant–health framework	Buildings; Built environment; Healing; Health; Healthcare facilities; Occupants; Outcomes; Wellbeing
35	Grum & Kobal (2020)	Concepts of social sustainability based on social infrastructure and quality of life	Built environment; Quality of life; Social environment; Social infrastructure; Social sustainability
33	Tagliabue et al., (2021)	Data driven indoor air quality prediction in educational facilities based on IoT network	Artificial Neural Network; Indoor air quality; IoT network; User Centred Design
27	Lewis, (1979)	Healing in the Urban environment: A person/plant viewpoint	Healing in the Urban environment: A person/plant viewpoint
20	Pollack et al., (2012)	Toward environments and policies that promote injury-free active living-it wouldn't hurt	Injury prevention; Physical activity; Safety; Unintentional injuries
17	Spokane et al., (2007)	Identifying streetscape features significant to well-being	Block-level analysis; Coding systems; Community design; Environmental health; Environmental measurement; Streetscapes; Urban planning; Well-being
15	Salami et al., 2022	Coping with the Covid-19 pandemic: an exploration of the strategies adopted by construction firms.	Construction management; Construction site; Contract; Coping strategies; Coronavirus; Covid-19; Pandemic; Safety management
3	Song et al., (2023)	Unobtrusive occupancy and vital signs sensing for human building interactive systems.	Air conditioning; Breathing rate; Doppler ultrasonography; Human; temperature; Vital sign;

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Humans; Respiratory Rate;  
Temperature;  
Ultrasonography, Doppler;  
Ventilation; Vital Signs

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Figure 3 presents the author co-citation network, which consists of 706 total link strengths. The most influential researchers in this network are Sallis JF, Giles-Corti B, and Frank LD, indicating significant collaboration based on shared interests and/or institutional affiliations [38]. The co-citation density maps in figure 3 visually represent similarities and identify nodes representing different scholarly works. Larger node sizes correspond to higher co-citations and signify greater influence of the scholarly work in the field. Furthermore, the density of "links" among scholars reflects the frequency of citations received, illustrating the level of co-citation among them.



**Figure 3.** Author Co-Citation Network Density Map.

#### 4.3. Co-author citation by Organisation

The study identified and analysed the most influential research institutions shaping the discourse on wellbeing in the construction industry. The Co-author citation by institutions is significant in scientometric analysis, as it reflects the numbers of research papers and collaborations among institutions [42]. Table 2 reveals that the research institutions with the highest citations each have one paper in the network. The University of Western Australia and the University of Toronto, Canada, both received 157 citations. However, the University of Toronto, Canada, had two different departments, the Department of Civil Engineering, and the Rotman School of Management, with each being cited 157 times, resulting in a total of 314 citations for the university. Additionally, three institutions from the United States, namely Terrapin Bright Green LLC, the University of South Carolina, and West Virginia University, had one publication each, with 152, 130, and 130 citations, respectively. Collaborations between research institutions have proven beneficial for the study of wellbeing in the construction industry, as exemplified by the partnership between West Virginia University, Morgantown, and the National University of Ireland, Galway, which resulted in 130 citations.

**Table 2.** Citations of Publications on Wellbeing in the Construction Industry by Organisation.

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s/n	Organisation	Documents	Citations
1	Centre For the Built Environment and Health, School of Population Health, The University of Western Australia, 35 Stirling Highway, Crawley WA 6009, Australia	1	157
2	Construction Engineering & Management Group, Department of Civil Engineering, University of Toronto, Toronto, Canada	1	157
3	Rotman School Of Management, University of Toronto, Toronto, Canada	1	157
4	Terrapin Bright Green LLC, United States	1	152
5	Department Of History, Political Science, Philosophy and American Studies, University Of South Carolina Upstate, 800 University Way, Spartanburg, Sc 29303, United States	1	130
6	West Virginia University, Morgantown and National University of Ireland, Galway, Ireland	1	130
7	West Virginia University, Morgantown, Wv, United States	1	130

#### 4.4. Origins of research by countries

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Table 3 reveals that the United States has the highest number of citations, with 806 citations from 33 published papers. However, in terms of publications, only the United Kingdom surpasses the United States with 38 papers, but with only 533 corresponding citations. Australia, on the other hand, has a higher citation count than the United Kingdom, making it the second highest with 678 citations from 31 publications. In addition to these three countries, other nations such as Canada contributed 8 publications with 224 citations, Italy contributed 5 publications with 128 citations, Egypt contributed 9 publications with 58 citations, India contributed 5 publications with 45 citations, New Zealand contributed 7 publications with 37 citations, and Malaysia contributed 7 publications with 7 citations, all of which reflects the global scope of the discussion on wellbeing in the construction industry. Notably, the total link strength of 8 from Table 3 indicates limited interactions and collaborations in the discourse surrounding wellbeing in the construction industry.

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**Table 3.** Shows the Origins of research by countries.

s/n	Country	Documents	Citations	Total Link Strength
1	United States	33	806	7
2	Australia	31	678	6
3	United Kingdom	38	533	8
4	Canada	8	224	5
5	Italy	5	128	0
6	Egypt	9	58	2
7	India	5	45	3
8	New Zealand	7	37	1
9	Malaysia	7	7	0

#### 4.5. Publication by Sources

Table 4, generated using the scientometric analysis tool VOSviewer, identified the major journal outlets for academic publications on wellbeing in the construction industry by setting a minimum threshold of 5 documents and 2 citations. Out of the 65 journal sources analysed, 9 met this threshold. Previous studies have emphasized the importance of conducting direct citation analysis to determine the prominence of journal sources in a specific field [38,47]. The most cited journal in the field of wellbeing in the construction industry, as indicated in Table 4, is *Health and Place* with 344 citations from 11 publications. *Building Research and Information* follows closely with 268 citations from 15 publications, while *Archnet-IJAR (International Journal of Architectural Research)* ranks third with 202 citations. Other journals include the *Journal of the American Planning Association* with 158 citations, *Architectural Science Review* with 70 citations, *Buildings* with 56 citations, *Journal of Building Engineering* with 39 citations, *Building Services Engineering Research and Technology* with 35 citations, and *Malaysian Construction Research Journal* with 2 citations.

**Table 4.** Publications on Wellbeing in the Construction Industry by Journal Name.

Number of publications	Journal Name	Citations
11	Health and Place	344
15	Building Research and Information	268
7	Archnet-IJAR*	202
7	Journal of the American Planning Association	158
6	Architectural Science Review	70
11	Buildings*	56
6	Journal of Building Engineering	39
6	Building Services Engineering Research and Technology	35
5	Malaysian Construction Research Journal	2

**Note:** Archnet-IJAR\* International Journal of Architectural Research. *Buildings\** Journal on Building Science, Building Engineering and Architecture.

#### 4.6. Co-occurrence keywords network

Keywords serve as indicators of research themes, and the co-occurrence network allows for the identification of commonly used keywords that reflect the themes of publications [64]. Fractional counting, which is arguably preferred over full counting, has been adopted in previous co-occurrence keyword networks analysed using VOSviewer [41,47,65]. In this analysis, "All Keywords" and "Fractional Counting" were employed. Figure 4 displays the network of frequently used keywords, represented by nodes with line connections indicating link strength. The size of the keyword node corresponds to the frequency of the keyword appearance in the articles. Additionally, the colours of the nodes represent different clusters. Within this network, the most influential keywords are "Built environment," followed by "Human wellbeing," "Design," "Health and Safety" and "Living environment".

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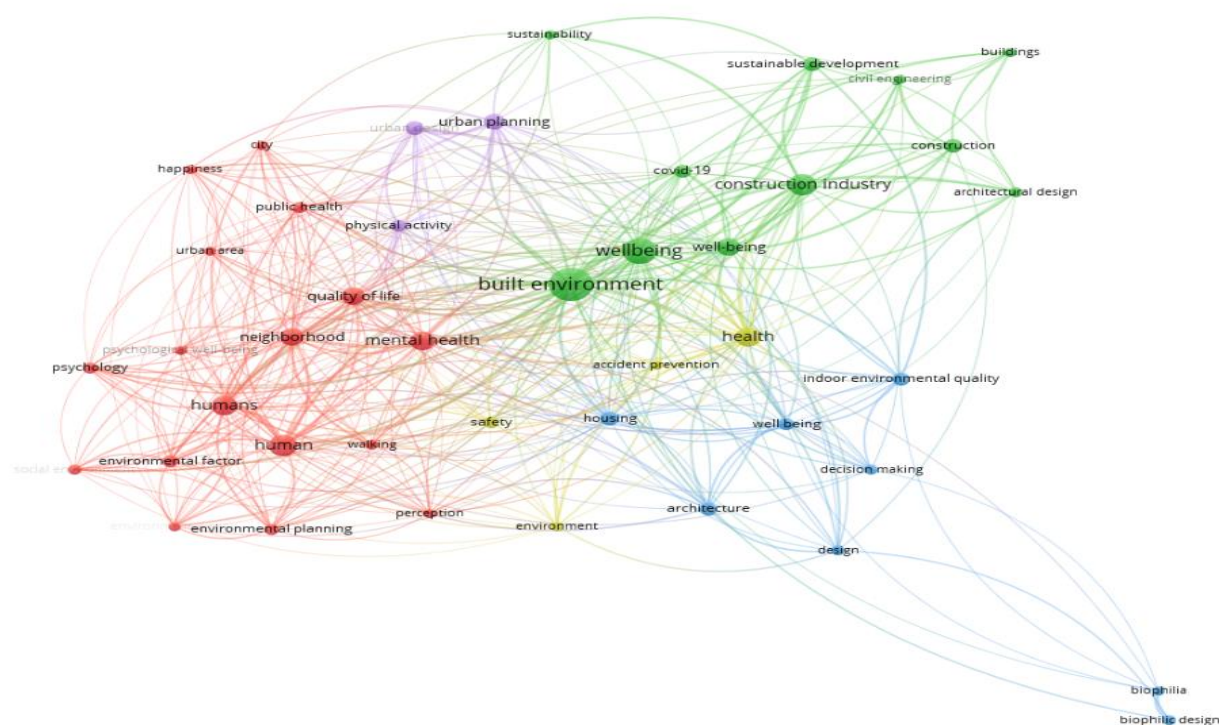


Figure 4. Network Visualization of Keywords.

## 5. Discussion

Wellbeing in the construction industry is essential but often overlooked, requiring a greater focus on its various dimensions to enhance workforce health and organizational productivity. Wellbeing in the construction industry is better described as the overall evaluation of subjective and objective satisfaction levels of different needs of both the construction force and individual dwellers in the built environment. However, research in the industry has primarily used keywords such as "Built environment," "Human," "Design," "Health and Safety" and "Living environment" thereby neglecting the broader understanding of wellbeing as shown in Figure 4. It is also important to recognize that other dimensions of wellbeing, such as emotional, social, digital, psychological, financial, and subjective wellbeing, also play vital roles in the overall wellbeing of the construction industry. Therefore, the following discussion highlights the existing research gap in the discourse on wellbeing in the construction industry.

### 5.1. Human and Wellbeing in Construction Industry (Cluster 1)

The discourse on health and safety in the construction industry has centred around the wellbeing of the workforce. However, accidents and hazardous work environments have led to a decline in worker wellbeing and performance, with a lack of attention given to underlying factors such as adverse working conditions that contribute to stress and mental health issues [40]. It was only through the study on psychological stress among construction workers that the significance of this occupational health aspect began to gain recognition [55].

Moreover, the results of the study are consistent with more recent research, highlighting the impact of mental health concerns in the challenging work environment, particularly in the context of the COVID-19 pandemic [7,10]. This has resulted in a surge of publications focusing on mental health. The demanding nature of the construction environment remains a key factor affecting the mental wellbeing of construction workers. This indicates that the wellbeing of construction workers is a multidimensional issue that requires creative intervention approaches.

The multidimensional nature of wellbeing, as revealed in the findings of this research, suggests the need for an alternative approach to mental health in the construction industry. One such approach focuses on the positive aspect of mental health, incorporating the concepts of happiness and psychological wellbeing to strive for excellence in mental health [8]. This emphasizes the importance of psychological wellbeing in attaining desired mental health outcomes. However, despite its significance, there has been limited research and implementation in the construction industry in this regard.

Despite the increasing focus on mental wellbeing, there are several perspectives that have yet to be explored. For instance, the construction industry, which is predominantly male-dominated, places additional stress on female workers. Factors such as stereotypes of female weakness, pressure to conform to masculine norms, sexual harassment, lack of flexibility, heavy workloads, absence of female role models, and safety concerns have been identified as contributing to mental health issues among women in the construction industry [7]. This area of research remains largely unexplored but is crucial for the development of the construction industry.

## 5.2. Built Environment and Wellbeing in Construction Industry (Cluster 2)

The Network Visualization of Keywords highlights the predominant focus on the built environment in the discourse on wellbeing, with various approaches recognizing its intricate nature. For instance, there has been significant attention given to a user-based perspective of mental health, exemplified by the field of Neurourbanism. This interdisciplinary field explores the connection between the environment and the human brain, emphasizing the impact of urban infrastructure on the mental wellbeing of urban dwellers [9]. This perspective may have evolved from studies on environmental wellbeing, underscoring the need for an interdisciplinary approach that integrates neuroscience and urban studies to promote the wellbeing of urban populations.

Research on environmental wellbeing has long been a focal point within the realms of sustainability and urban design. This is evident through the substantial number of publications primarily dedicated to this subject area. Table 1 shows that influential authors in this field primarily focused on environmental wellbeing, agreeing that outdoor spaces and neighborhood conditions can negatively impact psychological and mental wellbeing [54,62,63,66,67]. While their work may not have covered wellbeing comprehensively, there is a consensus that the environment significantly influences residents' wellbeing. Factors such as safe environments, aesthetically pleasing buildings, and revitalized neighborhoods contribute to positive psychological and mental wellbeing [54,63,66,67]. This suggests that typical construction workers, besides experiencing workplace stress, might also face additional stressors related to their environments. On the other hand, stress experienced because of their occupation could be mitigated through a therapeutic environment. Remarkably, this aspect has received limited attention in the research on wellbeing in the built environment.

### 5.3. Design and Wellbeing in Construction Industry (Cluster 3)

The results highlight that wellbeing is not only associated with outdoor environments but also indoor spaces. Ryan [61], as shown in Table 1, has significantly influenced the discussion on design and wellbeing, particularly in relation to biophilic design. Ryan, [61] argues that incorporating nature into the design of interior spaces positively impacts human wellbeing in psychological, cognitive, and physiological ways. However, biophilic design goes beyond the impact of buildings on wellbeing; it also involves integrating biophilic interior design features into the design process itself [68]. The goal is to enhance individuals' wellbeing in building environments through the inclusion of design elements that promote psychological, cognitive, and physiological wellbeing.

Likewise, research on indoor environmental quality aligns with the benefits of biophilic design, acknowledging that various components of the built environment influence human wellbeing [69,70]. Factors such as thermal comfort in indoor spaces have been identified as determinants of user satisfaction, which is in turn linked to wellbeing. This is supported by the notion that human satisfaction is connected to indoor environmental quality, affecting physical and psychological wellbeing [71]. However, research on indoor environmental quality has been criticized for its lack of clarity regarding whether participant satisfaction with indoor quality is a determinant of wellbeing or an outcome of wellbeing [72]. Nonetheless, a comprehensive approach is necessary to fully grasp the multi-dimensional nature of wellbeing and the interconnectedness of its various dimensions.

### 5.4. Health and Accident Prevention in Construction Industry (Cluster 4)

This research cluster primarily focuses on the impact of construction activities on the physical health of construction workers. Findings indicate that hazardous work environments have contributed to a decline in worker wellbeing and productivity, often resulting in fatal injuries on construction sites [73]. There is a growing consensus that the prevalent long and extended work hours in the construction industry may also contribute to fatalities and physical health issues among construction workers [73-75]. Although research has primarily concentrated on this aspect, the overall impact on the wellbeing of construction workers could be significant. For instance, [73] opined that there is a correlation between long hours operating vibrating machinery and physical health issues. Similarly, workplace policies deeply ingrained in the construction sector, such as competitive bidding processes and the enforcement of financial penalties for delays, lead to longer workdays that are detrimental to the health and welfare of employees [75].

Another perspective is that extended work hours add to the stress experienced by construction workers, adversely affecting their sleep and subsequently impacting productivity [76]. The prevailing culture and nature of the construction business environment contribute to fatigue, which has been identified as a cause of accidents and has negative effects on health and overall wellbeing [73]. Therefore, it is evident that the nature of the construction industry, characterised by extended hours of work, breeds health issues thus impacting individuals' productivity and by extension, organisational productivity.

Given these results, it is crucial to emphasise the necessity for additional critical research into this subject theme. Researchers can create efficient solutions for industry to lessen these problems and develop a more thorough awareness of the challenges faced by construction workers by investigating the numerous elements that affect their physical health and overall welfare. Scholars can also collaborate to develop a more resilient and encouraging sector by putting the health and safety of construction employees first.

### 5.5. Living Environment and Wellbeing in Construction Industry (Cluster 5)

The built environment's impact on human wellbeing, both positive and negative, has been well-established in the literature [54, 63, 66, 67]. This influence is particularly significant for the construction workforce, a subset of individuals living in the built environment. Section 5.3 of the study highlights that the built environment can affect occupants'



psychological wellbeing, leading to the implementation of mitigating measures like biophilic design [69, 70]. Factors such as indoor thermal comfort play a role in user satisfaction, and other aspects like safety climate, family bond, living conditions, and societal acceptance are crucial for evaluating the living environment and its link to wellbeing [7, 15, 55, 71]. However, limited research has been conducted on the wellbeing of construction workers and how their satisfaction with living environments impacts their stress levels. This is an important area to explore, especially considering the hazardous nature of the construction industry [72]. Furthermore, subjective concerns about the challenging work environment in construction, including fatigue, burnout, and sexism against women in the industry [7, 10], may not have been comprehensively evaluated. Considering the negative impact of workers' living environment, which encompasses indoor environment quality, safety climate, family bond, living conditions, and societal acceptance [7, 15, 55, 71], it is evident that the perceived satisfaction level of construction workers may be influenced by external factors like their living environment. Fatigue, often attributed solely to the construction industry's culture [73], may need re-evaluation to consider external factors such as poor safety attitudes, family conflicts, poor financial living conditions, and sexism [7, 15, 55, 71], which could be precursors to reported fatigue. This area requires more research because it is crucial for the wellbeing of the construction workforce.

## 5.6. Wellbeing Dimension Analysis

The integration of scientometric analysis and qualitative trend analysis of existing mainstream publications in the construction industry enabled the categorization of publications based on various dimensions of wellbeing, thereby bridging the existing research gap, and informing future research directions. Appendix 1 presents the classification of authors based on the identified dimensions and their primary research focus on specific aspects of wellbeing in the construction industry. Potential connections between the clusters and dimensions are also identified and emphasized here below.

1) Environmental Wellbeing: This dimension of wellbeing specifically examines the relationship between the outdoor or urban environment and human wellbeing [62,67]. Connecting clusters #2 and #5, it is crucial to acknowledge the influence of urban environments on the wellbeing of construction workers, as they are a subgroup of urban dwellers. While environmental wellbeing has garnered significant research attention, it is essential to shift focus towards the integration of all dimensions of wellbeing to comprehensively evaluate and clarify the factors and outcomes associated with the urban or outdoor environment.

2) Physical Wellbeing: This pertains to the influence of the indoor or physical environment on the wellbeing of individuals [71]. Cluster #2 and #3 are connected in this context as the quality of the indoor environment affects the wellbeing of occupants. However, the impact on construction workers encompasses multiple dimensions. Both living space and office space play a role in the wellbeing of construction workers, an aspect that has received limited attention from researchers. Furthermore, there is need for a comprehensive investigation into the interplay between indoor living spaces and outdoor working spaces, and their effects on the psychological, mental, and subjective wellbeing of construction professionals.

3) Social Wellbeing: This dimension focuses on the influence of organizational culture, diversity, war, conflicts, and pandemics on construction workers and the broader population residing in built environments. The number of publications on wellbeing has increased due to the COVID-19 pandemic, which emphasizes its role as a determinant of social and psychological wellbeing. This has led to emerging research on psychosocial wellbeing in the construction industry. As highlighted in cluster #1, the wellbeing of individuals, specifically construction workers, is interconnected with issues such as prejudice, stereotypes, harassment, gender inequality, and unsafe working conditions [7].

Examining this area is crucial due to the growing diversity within teams and international collaborations.

4) Psychological Wellbeing: Research examines comfort, satisfaction, and overall functioning as key areas of focus. Environmental and physical wellbeing are assessed based on individual satisfaction with thermal, air, noise, light, and aesthetic comfort [31]. Wellbeing is closely associated with building performance, including energy efficiency and indoor environmental quality, which are influenced by design, operational efficiency, and maintenance practices [32]. It is important to differentiate this from psychological wellbeing, as well as mental health. Psychological wellbeing encompasses overall functioning related to emotions, mood, satisfaction, fear, and comfort. Researchers should clearly delineate these different dimensions to avoid confusion. This highlights the necessity for a thorough examination of psychological wellbeing and its interconnectedness with other dimensions. Clusters #1 and #5 underscore the importance of interdisciplinary and interinstitutional collaborations to enhance the quality of studies on psychological wellbeing in the construction industry.

5) Digital Wellbeing: The emerging field of digital wellbeing is in its early stages and requires further exploration. Research in this category primarily focuses on the use of technology for promoting wellbeing [77]. It is connected to cluster #4 due to its emphasis on accident prevention or interventions. While digital wellbeing is gaining interest among researchers, there is a need to investigate it as both a determinant and an outcome of wellbeing. The impact of prolonged computer uses and, more recently, the use of virtual reality, building information tools, and digital engineering tools on the wellbeing of construction professionals should be examined. Additionally, the study of digital awareness as an outcome in the research on digital wellbeing is becoming increasingly important.

6) Mental Wellbeing: This dimension focuses on the mental health of the construction workforce, encompassing their thoughts, actions, and emotions while performing their tasks. It is important to distinguish mental wellbeing from psychological wellbeing, although their interconnectedness with psychological, social, and digital wellbeing should be recognized. Exploring mental wellbeing as a positive outcome is an intriguing aspect. Cluster #4 is relevant for examining stressor prevention in the context of mental wellbeing for construction workers. However, factors like stress, fatigue, and injuries are common across all dimensions of wellbeing, potentially leading to mental health issues [40]. Moreover, the intersection of all the clusters may also contribute to mental health challenges. It is crucial for researchers to clearly differentiate the connections between mental wellbeing and other dimensions of wellbeing. Thus, investigating mental wellbeing as either positive or negative is an area that requires further research for a better understanding and effective implementation within the construction industry.

7) Subjective Wellbeing: It focuses on the premise that wellbeing is synonymous with "happiness," which can be traced back to Aristippus of Cyrene's concept of "hedonic happiness" [6]. In the construction industry, this concept has been applied to assess personal desires, interests, needs, and preferences across all aspects of life. These areas are crucial for a comprehensive exploration of wellbeing and the influence of personal preferences in determining satisfaction levels, which form the basis for evaluating wellbeing. The connection between cluster #1 and #5 highlights the possibility that construction workers' perceived satisfaction levels or fatigue may be influenced by personal biases rather than the construction environment itself. Therefore, it is essential to conduct further research on this theme to gain a deeper understanding of these dynamics.

8) Physical Health and Wellbeing: Primarily focusing on the illness, injury, or health conditions that arise from the hazardous working environment in the construction industry [72], this research area has garnered significant attention in terms of research and implementation. However, the cause-and-effect relationship between physical health and overall wellbeing may be influenced by the connections identified in clusters #4 and #5. This suggests the need to integrate other dimensions of wellbeing when investigating the

underlying causes of behaviours that contribute to accidents. By doing so, a more comprehensive understanding can be achieved, leading to improved prevention mechanisms. It is important to recognize that individual decision-making is influenced by various factors, and this understanding can contribute to both positive and negative outcomes.

9) Financial Wellbeing: This research theme specifically addresses the economic wellbeing of construction workers. However, despite the significant impact of rising energy costs and the financial downturn caused by COVID-19, this important dimension of wellbeing in the construction industry has been largely overlooked which is revealed from various sources (as shown in Table 3). The focus on reducing energy consumption to enhance indoor environmental quality (cluster #3) may inadvertently lead to a decline in the quality of sleep, resulting in fatigue that can impair decision-making and contribute to accidents (cluster #4). Additionally, the psychological impact of financial wellbeing should not be disregarded. Unfortunately, as revealed in Appendix 1, researchers have not given sufficient attention to the topic of financial wellbeing in the construction industry.

### 5.7 Interventions for Positive Wellbeing

To fully understand the complexity of wellbeing in the challenging construction industry environment, collaboration among institutions is essential, both interdisciplinary and intra-institutional. This collaboration can foster a better understanding of wellbeing and enhance its implementation in the construction industry. The co-citation network density map of authors (Figure 3) reveals a lack of collaboration, with authors often working in isolation. Encouraging collaboration can promote interdisciplinary approaches and contribute to advancements in understanding and implementing wellbeing interventions in the construction industry.

In addition, collaboration between industry practitioners and researchers can integrate wellbeing measures into construction activities. Concerns such as job-related stress, fatigue, fear of falls, body pain, and burnout can be reduced through researched, tailored technology deployed via research and industry partnerships. For instance, a predictive model was used to determine therapeutic spaces for mental wellbeing [59]. Similarly, data was collected from construction workers using technology to mitigate sleep disorders caused by body pain [76]. Expanding technology deployment through research and industry partnerships has the potential to reduce the perceived hazardous nature of the construction industry and improve productivity by reducing construction workers' absenteeism due to poor wellbeing.

Overall, efforts to raise awareness about the influence of lifestyle, living conditions, and the environment on the wellbeing of construction workers are crucial. In addition, intervention approaches, like employee wellbeing education and health literacy campaigns, seek to enhance construction workers' knowledge of health-promoting habits and stress management techniques, addressing both work-related and non-work-related stressors by providing necessary support and counseling.

### 5.8 Agenda for Future Research

1 **Holistic Understanding of Wellbeing:** Researchers should strive for a holistic understanding of wellbeing within the construction industry. It is imperative to recognize that wellbeing is a multidimensional concept, encompassing several dimensions. This comprehensive approach is vital for addressing the complex and interconnected nature of construction workers' overall wellbeing as indicated in the clusters. Establishing precise and encompassing definitions of wellbeing should be the foundational step for future research endeavours.

- 2 **Targeted Interventions:** Stemming from the findings of this study, researchers should be dedicated to the development and testing of targeted interventions across the various wellbeing dimensions. These interventions should specifically address adverse working conditions and gender-specific wellbeing challenges within the construction industry. Targeted strategies can significantly improve working conditions and foster a more inclusive and supportive work environment, as is evident from prior research [7]. Implementing such interventions represents a critical step toward enhancing the overall wellbeing landscape of the construction industry.
- 3 **Living Environment:** Future research endeavours should prioritize the investigation of factors like indoor environmental quality, safety climate, and societal acceptance for enhancing the living environment of construction workers. Understanding the profound influence of these factors on worker satisfaction and stress levels is paramount, especially given the inherently hazardous nature of the construction industry. As highlighted in clusters 1&5 the need for an improved living environment for construction workers, encompassing aspects of both the physical and social milieu cannot be overemphasised.
- 4 **Positive Mental Health:** Research efforts should explore avenues for promoting happiness and psychological wellbeing among construction workers. An in-depth examination of the impact of positive mental health on overall wellbeing and job satisfaction is warranted, as it is a relatively underexplored aspect within the construction industry [cluster 1 & 2]. Focusing on positive mental health can lead to a more content and mentally resilient workforce in the construction sector.
- 5 **Safety and Health:** Safety and health measures in cluster 4 have garnered significant attention. Nevertheless, it is crucial to continue researching health and accident prevention to enhance safety measures in the construction industry. This research should thoroughly explore the complex interplay between work conditions, physical health, and worker wellbeing. This exploration will provide valuable insights to effectively shape policies and practices, aligning with prior comprehensive research [73-75]. Such advancements in safety measures hold the potential to lead to substantial reductions in injuries and health problems among construction workers.
- 6 **Financial Wellbeing:** Financial wellbeing is an essential area for future research within the construction industry. This holds particular importance due to the rising living costs, primarily attributed to high energy expenses and inflation. Previous studies have emphasized the critical role of this dimension in gaining a comprehensive understanding of construction workers' overall wellbeing [15, 55, 71]. Surprisingly, financial wellbeing has not received the necessary attention it warrants. An in-depth exploration of the financial challenges faced by construction workers can offer valuable insights into enhancing their overall quality of life.

## 6.0 Limitations of the study

The importance of this study cannot be overemphasized, yet it is crucial to consider its shortcomings. The substantial dependence on information only from the Scopus database is a notable restriction. Although Scopus boasts thorough coverage of papers, this one data source might have introduced some bias that could have affected the study's findings. It is crucial to consider these constraints when interpreting the results and to investigate further directions to ensure a more thorough comprehension of the issue.

It's also important to note that the study largely avoided looking into the "why" and "how" aspects in favour of focusing on the "what" questions gathered from the literature. Although the study adds useful information to the body of existing knowledge, a deeper investigation of the underlying causes and mechanisms might provide a broader understanding of the topic. This finding highlights the possibility for further exploration into the procedural and causal components of wellbeing in future studies.

While the study effectively identified numerous challenges in the field of construction industry wellbeing research, it is crucial to note that this study did not focus on uncovering the root causes of these issues. While recognizing and documenting the difficulties is an essential first step, addressing the underlying factors and providing actionable remedies is imperative for advancing the state of research in this area. This approach will not only contribute to a more comprehensive understanding of the challenges but also lead to tangible improvements in the construction industry's wellbeing landscape.

Indeed, it's imperative to acknowledge the limitations of this study, particularly concerning the subjectivity inherent in interpreting and assigning conceptual themes to each publication. The presence of vague conceptualizations and definitions of wellbeing in some papers further complicates the analysis and understanding of the topic. This ambiguity in definitions and concepts might have led to different classifications or interpretations as intended by the authors in the study's categorization process.

### 6.1 Conclusions

This scientometric review assessed the dimensions of wellbeing within the construction industry. Analyzing research trends from 1979 to 2023, it revealed a growing interest in wellbeing, with a particular emphasis on environmental, physical, and mental wellbeing. Key institutions and countries driving this research were identified, underscoring the global relevance of the topic. Prominent journals were recognized, emphasizing the importance of academic platforms in disseminating knowledge.

Despite this progress, the study unveiled several critical gaps in construction industry wellbeing research. While many facets of wellbeing were explored, the impact of living environments on construction workers and the broader influence of construction activities on their wellbeing require further investigation. Interconnections between various dimensions, including social, psychological, and financial, call for a multidisciplinary approach to research. Technology's role in both shaping and reflecting wellbeing deserves more attention. Additionally, the study revealed a need for more profound explorations into the "why" and "how" aspects of wellbeing.

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### References

- (1) Eurostat (2022), "Accidents at work statistics", European Commission website, Brussels, available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php/Accidents\\_at\\_work\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php/Accidents_at_work_statistics) (accessed June 2023).
- (2) HSE (2022), "Kinds of accident statistics in Great Britain 2019", Health and Safety Executive, London, available at: <https://www.hse.gov.uk/Statistics/causing/kinds-of-accident.pdf> (accessed June 2023).
- (3) US Bureau of Labour Statistics (2022), "Injuries, illnesses and fatalities", US Bureau of Labour Statistics, Washington, DC, available at: <https://www.bls.gov/iif/oshwc/cfoi/cftb0330.htm> (accessed June 2023).

- (4) Umeokafor, N.; Umar, T.; Evangelinos, K. Bibliometric and scientometric analysis-based review of construction safety and health research in developing countries from 1990 to 2021. *Safety science* **2022**, *156*, 105897. DOI: 10.1016/j.ssci.2022.105897.
- (5) Svane, D.; Evans, N.; Carter, M.-A. Wicked wellbeing: Examining the disconnect between the rhetoric and reality of wellbeing interventions in schools. *Australian Journal of Education* **2019**, *63* (2), 209-231. DOI: 10.1177/0004944119843144.
- (6) Smith, T. S. J.; Reid, L. Which 'being' in wellbeing? Ontology, wellness and the geographies of happiness. *Progress in Human Geography* **2018**, *42* (6), 807-829. DOI: 10.1177/0309132517717100.
- (7) Rotimi, F. E.; Brauner, M.; Burfoot, M.; Naismith, N. N.; Silva, C. W. C.; Mohaghegh, M. Work environment challenge and the wellbeing of women in construction industry in New Zealand - The mediating role of work morale. *Engineering Construction and Architectural Management*, *22*, Article; Early Access. DOI: 10.1108/ecam-02-2023-0152.
- (8) Frimpong, S.; Sunindijo, R. Y.; Wang, C. C.; Boadu, E. F.; Dansoh, A. A Conceptual Framework to Promote the Transition to Positive Mental Health among Young Construction Workers. *Buildings* **2023**, *13* (4), Article. DOI: 10.3390/buildings13041025 Scopus.
- (9) Ndaguba, E.; Cilliers, J.; Mbanga, S.; Brown, K.; Ghosh, S. Re-Imaging the Future in Urban Studies and Built Environment Discourse: A Neurourbanism Perspective. *Buildings* **2022**, *12* (12), Article. DOI: 10.3390/buildings12122056 Scopus.
- (10) Khan, N. A.; Hui, Z.; Khan, A. N.; Soomro, M. A. Impact of women authentic leadership on their own mental wellbeing through ego depletion: moderating role of leader's sense of belongingness. *Eng. Constr. Archit. Manage.* **2022**, *29* (10), 4191-4214, Article. DOI: 10.1108/ECAM-02-2021-0143 Scopus.
- (11) Diener, E.; Lucas, R.; Schimmack, U.; Helliwell, J. F. *Well-being for public policy*; Oxford University Press, 2009.
- (12) Prilleltensky, I. Wellness as Fairness. *American Journal of Community Psychology* **2012**, *49* (1-2), 1-21, Article. DOI: 10.1007/s10464-011-9448-8 Scopus.
- (13) Sumner, L. W. *Welfare, happiness, and ethics*; Clarendon Press, 1996.
- (14) Zotova, O. Y.; Karapetyan, L. V. Occupation as a factor of personality subjective well-being. *Psychology in Russia-State of the Art* **2015**, *8* (2), 126-136. DOI: 10.11621/pir.2015.0211.
- (15) Engelsen, S. Wellbeing Competence. *Philosophies* **2022**, *7* (2), 42. DOI: <https://doi.org/10.3390/philosophies7020042> Publicly Available Content Database.
- (16) McMahan, A.-T.; Tay, P. C.; Tapsell, L.; Williams, P. Building bridges in dietary counselling: an exploratory study examining the usefulness of wellness and wellbeing concepts. *Journal of Human Nutrition and Dietetics* **2016**, *29* (1), 75-85. DOI: <https://doi.org/10.1111/jhn.12282>.
- (17) Burch, A.; Owens, R.; Nisly, S.; Taylor, S. R. Wellbeing during COVID-19: A social media takeover. *PHARMACY EDUCATION* **2020**, *20* (2), 272-275. DOI: 10.46542/pe.2020.202.272275.
- (18) Edmonds, V. S.; Chatterjee, K.; Girardo, M. E.; Butterfield, R. J.; Stonnington, C. M. Evaluation of a Novel Wellness Curriculum on Medical Student Wellbeing and Engagement Demonstrates a Need for Student-Driven Wellness Programming. *Teaching and Learning in Medicine* **2023**, *35* (1), 52-64. DOI: 10.1080/10401334.2021.2004415.
- (19) Holdsworth, M. A. Health, Wellness and Wellbeing. *REVUE INTERVENTIONS ECONOMIQUES-PAPERS IN POLITICAL ECONOMY* **2019**, *62*. DOI: 10.4000/interventionseconomiques.6322.
- (20) Seppala, A.; Nykanen, P. CONTEXTUAL ANALYSIS AND MODELING OF PERSONAL WELLNESS. In KEOD 2011: PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON KNOWLEDGE ENGINEERING AND ONTOLOGY DEVELOPMENT, 2011.
- (21) Margarita-Ospina, A. The psychology of power: a reflection in times of pandemic. *Ratio Juris* **2020**, *15* (30), 277-282. DOI: 10.24142/raju.v15n30a15.

- (22) Watson, K. J. Establishing psychological wellbeing metrics for the built environment. *Build Serv Eng Res Technol* **2018**, *39* (2), 232-243, Article. DOI: 10.1177/0143624418754497 Scopus. 857  
858
- (23) Leite, F.; Correia, R. A. F.; Carvalho, A. 360 degrees Integrated Model for the Management of Well-being Holistic Experiences in Tourist Destinations. In *16th Iberian Conference on Information Systems and Technologies (CISTI)*, Electr Network, Jun 23-26, 2021; 2021. 859  
860  
861
- (24) Karakhan, A. A.; Gambatese, J.; Simmons, D. R.; Albert, A.; Breesam, H. K. Leading Indicators of the Health and Well-Being of the Construction Workforce: Perception of Industry Professionals. *Practice Periodical on Structural Design and Construction* **2023**, *28* (1). DOI: 10.1061/(asce)sc.1943-5576.0000747. 862  
863  
864
- (25) Valasek, C. J. Disciplining the Akratic user: Constructing digital (un)wellness. *Mobile Media & Communication* **2022**, *10* (2), 235-250. DOI: 10.1177/20501579211038796. 865  
866
- (26) Almourad, M. B.; Alrobai, A.; Skinner, T.; Hussain, M.; Ali, R. Digital wellbeing tools through users lens. *TECHNOLOGY IN SOCIETY* **2021**, *67*. DOI: 10.1016/j.techsoc.2021.101778. 867  
868
- (27) Tymchuk, A. J.; Groen, A.; Dolyzniuk, C. A. Health, safety, and well-being reading recognition abilities of young parents with functional disabilities: Construction and preliminary validation of a prescriptive assessment instrument. *Journal of Developmental and Physical Disabilities* **2000**, *12* (4), 349-366. DOI: 10.1023/a:1009484114146. 869  
870  
871
- (28) Rehr, T. I.; Regan, E. P. An exploratory analysis of financial wellness of trans-spectrum college students. *JOURNAL OF LGBT YOUTH* **2022**, *19* (1), 76-91. DOI: 10.1080/19361653.2020.1762147. 872  
873
- (29) Efendi, R.; Mu'at, S.; Arisandi, N.; Samsudin, N. A.; Acm. Removing Unclassified Elements in Investigating of Financial Wellbeing Attributes Using Rough-Regression Model. In *2019 8TH INTERNATIONAL CONFERENCE ON SOFTWARE AND COMPUTER APPLICATIONS (ICSCA 2019)*, 2019. 874  
875  
876
- (30) Sturge, J.; Nordin, S.; Sussana Patil, D.; Jones, A.; Légaré, F.; Elf, M.; Meijering, L. Features of the social and built environment that contribute to the well-being of people with dementia who live at home: A scoping review. *Health Place* **2021**, *67*, Article. DOI: 10.1016/j.healthplace.2020.102483 Scopus. 877  
878  
879
- (31) Balocco, C.; Pierucci, G.; De Lucia, M. An experimental method for building energy need evaluation at real operative conditions. A case study validation. *Energy and buildings* **2022**, *266*, 112114. DOI: 10.1016/j.enbuild.2022.112114. 880  
881
- (32) Jain, N.; Burman, E.; Robertson, C.; Stamp, S.; Shrubsole, C.; Aletta, F.; Barrett, E.; Oberman, T.; Kang, J.; Raynham, P.; et al. Building performance evaluation: Balancing energy and indoor environmental quality in a UK school building. *Build Serv Eng Res Technol* **2020**, *41* (3), 343-360, Article. DOI: 10.1177/0143624419897397 Scopus. 882  
883  
884
- (33) Fay, L.; Real, K.; Haynes, S. The Healthcare Workspace: Understanding the Role of Decentralized Nursing Stations, Corridors, and Huddle Spaces as Locations for Teamwork in a Neonatal Intensive Care Unit. *HERD* **2022**, *15* (4), 270-282. DOI: 10.1177/19375867221106503. 885  
886  
887
- (34) Jesumoroti, C.; Olanrewaju, A.; Khor, S. C. Defects in Malaysian hospital buildings. *Int. J. Build. Pathology Adapt.* **2022**. DOI: 10.1108/IJBPA-12-2021-0166. 888  
889
- (35) da Silva, A. B. J.; Barros, W. M. A.; Silva, B. M.; de Oliveira Nogueira Souza, V.; Lagranha, C. J. Letter to the editor: Comment on Bouziotis et al.'s (2022) Association of body mass index with COVID-19 related in-hospital death. *Clinical nutrition (Edinburgh, Scotland)* **2022**, *41* (12), 3127-3128. DOI: 10.1016/j.clnu.2022.06.012. 890  
891  
892
- (36) van Oel, C. J.; Mlihi, M.; Freeke, A. Design Models for Single Patient Rooms Tested for Patient Preferences. *HERD* **2021**, *14* (2021) (1), 31-46. DOI: 10.1177/1937586720937995. 893  
894
- (37) Xue, J.; Shen, G. Q.; Yang, R. J.; Wu, H.; Li, X.; Lin, X.; Xue, F. Mapping the knowledge domain of stakeholder perspective studies in construction projects: A bibliometric approach. *International journal of project management* **2020**, *38* (6), 313-326. DOI: 10.1016/j.ijproman.2020.07.007. 895  
896  
897

- (38) Makabate, C. T.; Musonda, I.; Okoro, C. S.; Chileshe, N. Scientometric analysis of BIM adoption by SMEs in the architecture, construction and engineering sector. *Engineering, construction, and architectural management* **2022**, *29* (1), 179-203. DOI: 10.1108/ECAM-02-2020-0139.
- (39) Tarragona, J.; de Gracia, A.; Cabeza, L. F. Bibliometric analysis of smart control applications in thermal energy storage systems. A model predictive control approach. *Journal of energy storage* **2020**, *32*, 101704. DOI: 10.1016/j.est.2020.101704.
- (40) Wang, L.; Cheng, Y. Exploring a comprehensive knowledge map for promoting safety management research in the construction industry. *Engineering, construction, and architectural management* **2022**, *29* (4), 1678-1714. DOI: 10.1108/ECAM-11-2020-0984.
- (41) Jin, R.; Zou, Y.; Gidado, K.; Ashton, P.; Painting, N. Scientometric analysis of BIM-based research in construction engineering and management. *Engineering, construction, and architectural management* **2019**, *26* (8), 1750-1776. DOI: 10.1108/ECAM-08-2018-0350.
- (42) Golizadeh, H.; Hosseini, M. R.; Martek, I.; Edwards, D.; Gheisari, M.; Banihashemi, S.; Zhang, J. Scientometric analysis of research on “remotely piloted aircraft”: A research agenda for the construction industry. *Engineering, construction, and architectural management* **2020**, *27* (3), 634-657. DOI: 10.1108/ECAM-02-2019-0103.
- (43) Loosemore, M.; Daniele, F.; Lim, B. T. H. Integrating ex-offenders into the Australian construction industry. *Constr. Manage. Econ.* **2020**, *38* (10), 877-893, Article. DOI: 10.1080/01446193.2019.1674449 Scopus.
- (44) Aliu, J.; Aghimien, D.; Aigbavboa, C.; Ebekozi, A.; Oke, A. E.; Adekunle, S. A.; Akinradewo, O.; Akinshipe, O. Developing emotionally competent engineers for the ever-changing built environment. *Eng. Constr. Archit. Manage.* **2022**, Article. DOI: 10.1108/ECAM-08-2022-0806 Scopus.
- (45) Altomonte, S.; Allen, J.; Bluysen, P. M.; Brager, G.; Hescong, L.; Loder, A.; Schiavon, S.; Veitch, J. A.; Wang, L.; Wargocki, P. Ten questions concerning well-being in the built environment. *Building and Environment* **2020**, *180*, Article. DOI: 10.1016/j.buildenv.2020.106949 Scopus.
- (46) Rodriguez, F. S.; Spilski, J.; Hekele, F.; Beese, N. O.; Lachmann, T. Physical and cognitive demands of work in building construction. *Eng. Constr. Archit. Manage.* **2020**, *27* (3), 745-764, Article. DOI: 10.1108/ECAM-04-2019-0211 Scopus.
- (47) Hosseini, M. R.; Martek, I.; Zavadskas, E. K.; Aibinu, A. A.; Arashpour, M.; Chileshe, N. Critical evaluation of off-site construction research: A Scientometric analysis. *Automation in construction* **2018**, *87*, 235-247. DOI: 10.1016/j.autcon.2017.12.002.
- (48) Butler, L.; Visser, M. S. Extending citation analysis to non-source items. *Scientometrics* **2006**, *66* (2), 327-343. DOI: 10.1007/s11192-006-0024-1.
- (49) Tijssen, R. J. W.; Van Raan, A. F. J. Mapping Changes in Science and Technology: Bibliometric Co-Occurrence Analysis of the R&D Literature. *Evaluation review* **1994**, *18* (1), 98-115. DOI: 10.1177/0193841X9401800110.
- (50) Small, H. Visualizing science by citation mapping. *Journal of the American Society for Information Science and Technology* **1999**, *50* (9), 799.
- (51) Su, H.-N.; Lee, P.-C. Mapping knowledge structure by keyword co-occurrence: a first look at journal papers in Technology Foresight. *Scientometrics* **2010**, *85* (1), 65-79. DOI: 10.1007/s11192-010-0259-8.
- (52) Zhong, B.; Wu, H.; Li, H.; Sepasgozar, S.; Luo, H.; He, L. A scientometric analysis and critical review of construction related ontology research. *Automation in construction* **2019**, *101*, 17-31. DOI: 10.1016/j.autcon.2018.12.013.
- (53) Nawaz, A.; Chen, J.; Su, X. Exploring the trends in construction and demolition waste (C&DW) research: A scientometric analysis approach. *Sustainable energy technologies and assessments* **2023**, *55*, 102953. DOI: 10.1016/j.seta.2022.102953.



- (54) Lewis, C. A. Comment: Healing in the Urban environment: A person/plant viewpoint. *J. Am. Plann. Assoc.* **1979**, *45* (3), 330-338, Article. DOI: 10.1080/01944367908976971 Scopus. 940-941
- (55) Chen, Y.; McCabe, B.; Hyatt, D. Impact of individual resilience and safety climate on safety performance and psychological stress of construction workers: A case study of the Ontario construction industry. *J. Saf. Res.* **2017**, *61*, 167-176, Article. DOI: 10.1016/j.jsr.2017.02.014 Scopus. 942-944
- (56) Foster, S.; Giles-Corti, B.; Knuiman, M. Neighbourhood design and fear of crime: A social-ecological examination of the correlates of residents' fear in new suburban housing developments. *Health Place* **2010**, *16* (6), 1156-1165, Article. DOI: 10.1016/j.healthplace.2010.07.007 Scopus. 945-947
- (57) Nyrud, A. Q.; Bringslimark, T.; Bysheim, K. Benefits from wood interior in a hospital room: A preference study. *Architectural Science Review* **2014**, *57* (2), 125-131, Article. DOI: 10.1080/00038628.2013.816933 Scopus. 948-949
- (58) Kent, J. L.; Thompson, S. The Three Domains of Urban Planning for Health and Well-being. *J. Plann. Lit.* **2014**, *29* (3), 239-256, Article. DOI: 10.1177/0885412214520712 Scopus. 950-951
- (59) Salama, A. H.; Ragab, D. A.; Abdel-Moneim, N. M. Urban spaces as a positive catalyst during pandemics: Assessing the community's well-being by using artificial intelligence techniques. *Ain Shams Eng. J.* **2023**, *14* (5), Article. DOI: 10.1016/j.asej.2022.102084 Scopus. 952-954
- (60) Salami, B. A.; Ajayi, S. O.; Oyegoke, A. S. Coping with the Covid-19 pandemic: an exploration of the strategies adopted by construction firms. *J. Eng. Des. Technol.* **2022**, *20* (1), 159-182, Article. DOI: 10.1108/JEDT-01-2021-0054 Scopus. 955-956
- (61) Ryan, C. O.; Browning, W. D.; Clancy, J. O.; Andrews, S. L.; Kallianpurkar, N. B. Biophilic design patterns: Emerging nature-based parameters for health and well-being in the built environment. *Archnet-IJAR* **2014**, *8* (2), 62-76, Article. DOI: 10.26687/archnet-ijar.v8i2.436 Scopus. 957-959
- (62) Lowe, M.; Whitzman, C.; Badland, H.; Davern, M.; Aye, L.; Hes, D.; Butterworth, I.; Giles-Corti, B. Planning Healthy, Liveable and Sustainable Cities: How Can Indicators Inform Policy? *Urban Policy Res.* **2015**, *33* (2), 131-144, Article. DOI: 10.1080/08111146.2014.1002606 Scopus. 960-962
- (63) Leyden, K. M.; Goldberg, A.; Michelbach, P. Understanding the pursuit of happiness in ten major cities. *Urban Aff. Rev.* **2011**, *47* (6), 861-888, Article. DOI: 10.1177/1078087411403120 Scopus. 963-964
- (64) Wuni, I. Y.; Shen, G. Q. P.; Osei-Kyei, R. Scientometric review of global research trends on green buildings in construction journals from 1992 to 2018. *Energy and buildings* **2019**, *190*, 69-85. DOI: 10.1016/j.enbuild.2019.02.010. 965-966
- (65) Perianes-Rodriguez, A.; Waltman, L.; van Eck, N. J. Constructing bibliometric networks: A comparison between full and fractional counting. *Journal of informetrics* **2016**, *10* (4), 1178-1195. DOI: 10.1016/j.joi.2016.10.006. 967-968
- (66) Brown, S. C.; Mason, C. A.; Lombard, J. L.; Martinez, F.; Plater-Zyberk, E.; Spokane, A. R.; Newman, F. L.; Pantin, H.; Szapocznik, J. The relationship of built environment to perceived social support and psychological distress in hispanic elders: The role of "eyes on the street". *J. Gerontol. Ser. B Psychol. Sci. Soc. Sci.* **2009**, *64* (2), 234-246, Article. DOI: 10.1093/geronb/gbn011 Scopus. 969-972
- (67) Mouratidis, K. Rethinking how built environments influence subjective well-being: a new conceptual framework. *J. Urban.* **2018**, *11* (1), 24-40, Article. DOI: 10.1080/17549175.2017.1310749 Scopus. 973-974
- (68) McGee, B.; Jin, X.; Park, N. K.; Ball, S.; Carr, A. Designers' perceptions of biophilia and testing of the biophilic interior design matrix in China. *Int. J. Arch. Research: Arch-IJAR* **2022**, *16* (3), 517-535, Article. DOI: 10.1108/ARCH-10-2021-0279 Scopus. 975-977
- (69) Clements, N.; Zhang, R.; Jamrozik, A.; Campanella, C.; Bauer, B. The spatial and temporal variability of the indoor environmental quality during three simulated office studies at a living lab. *Buildings* **2019**, *9* (3), Article. DOI: 10.3390/buildings9030062 Scopus. 978-980

- (70) Zhang, Y.; Tzortzopoulos, P.; Kagioglou, M. Healing built-environment effects on health outcomes: environment–occupant–health framework. *Build Res Inf* **2019**, *47* (6), 747–766, Article. DOI: 10.1080/09613218.2017.1411130 Scopus. 981–982
- (71) Abed, A.; Ali, H.; Ibrahim, A.; Wedyan, M. Impact of setbacks on thermal comfort and visual privacy in detached houses in Jordan. *Build Res Inf* **2023**, *51* (4), 446–458, Article. DOI: 10.1080/09613218.2022.2121906 Scopus. 983–984
- (72) Hanc, M.; McAndrew, C.; Ucci, M. Conceptual approaches to wellbeing in buildings: a scoping review. *Build Res Inf* **2019**, *47* (6), 767–783, Article. DOI: 10.1080/09613218.2018.1513695 Scopus. 985–986
- (73) Edwards, D. J.; Martek, I.; Ejohwomu, O.; Aigbavboa, C.; Hosseini, M. R. Hand-arm vibration management: an operational health and safety strategy framework. *Int. J. Build. Pathology Adapt.* **2021**, *39* (5), 811–830, Article. DOI: 10.1108/IJBPA-09-2020-0079 Scopus. 987–989
- (74) Pilkington-Cheney, F.; Filtness, A.; Jones, W.; Maynard, S.; Gibb, A.; Haslam, R. Biomathematical modelling for managing worker fatigue in civil engineering. *Proc. Inst. Civ. Eng. Civ. Eng.* **2020**, *173* (4), 187–192, Article. DOI: 10.1680/jcien.20.00009 Scopus. 990–992
- (75) Lingard, H.; Turner, M. Exploring the relationship between bodily pain and work-life balance among manual/non-managerial construction workers. *Community Work Fam.* **2022**, *25* (5), 643–660, Article. DOI: 10.1080/13668803.2020.1868409 Scopus. 993–995
- (76) Sathvik, S.; Krishnaraj, L.; Awuzie, B. O. An assessment of prevalence of poor sleep quality among construction workers in Southern India. *Built Environ. Proj. Asset Manage.* **2023**, *13* (2), 290–305, Article. DOI: 10.1108/BEPAM-03-2022-0041 Scopus. 996–998
- (77) Song, C.; Droitcour, A. D.; Islam, S. M. M.; Whitworth, A.; Lubecke, V. M.; Boric-Lubecke, O. Unobtrusive occupancy and vital signs sensing for human building interactive systems. *Scientific Reports* **2023**, *13* (1), Article. DOI: 10.1038/s41598-023-27425-6 Scopus. 999–1001

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## Appendices 1008

### Appendix 1. Analysis of Publications on Dimension of Wellbeing in the Construction Industry. 1009

Dimensions	Authors	Count
<b>Environmental Wellbeing:</b> <i>Research focuses on the intersection of the outdoor/urban environment and wellbeing</i>	Bjørberg, & Temeljotov (2023); Fuller, et al., (2023); Anciaes, (2022); McGee, et al., (2022); Gjerde, & Vale, (2022) Bioria, (2021); Ross, et al., (2021); Cerletti, et al., (2021); Shirtcliff, et al., (2021); Sheppard, & McClymont, (2021); Gaspari, et al., (2020); Schootman, et al., (2020); Rice, (2020); Hanc, et al., (2019); Rice, (2019); Eker, et al., (2018); Christian, et al., (2017); O’Sullivan, (1999); Shiue, (2016); Dolan, (2016); Arthurson, et al., (2016); Panda, & Marks (2015); Howden-Chapman, et al., (2015); Thompson, & Mitchell (2015); Zuniga-Teran, et al., (2017); Paine, & Thompson, (2017); Browne-Yung et al., (2016); Boyko, et al. (2015); Lowe, et al., (2015); Thompson, & Kent (2014); Pollack, et al., (2012); Leyden, et al., (2012); Foster, et al (2010); Knox, (2009); Grierson, (2007); Spokane, et al., (2007); Lewis, (1978)	37
<b>Physical Wellbeing:</b>	De la Hoz-Torres, et al., (2023); Bellini, et al., (2023); Sadek & Willis, (2023); Abed, et al., (2023); Venturini et al., (2022); Alhadedy & Gabr, (2022); McGee, et al., (2022); Cruz Astorqui, et al., (2022); DeLauer, et al., (2022);	32

<i>Research focuses on the impact of the indoor/ physical space on the wellbeing of occupants.</i>	Willems, et al., (2022); Ling, et al., (2021); Willems,et.al., (2020); Engelen, et al., (2022); Dorrah, & Marzouk, (2021); Fu, et al., (2021); Bae, et al.,(2021); Oliveira, et al., (2020); Rohde, et al., (2020); Jain, et al., (2020); Flores-Villa, et al., (2020); Nettleton, et al., (2020); Noguchi, et al., (2019); Sharpe, (2019); Clements, et al., (2019); Barrett, et al., (2019); Zhang, et al., (2019); Bean, & Hourahan, (2018); Chau, et al., (2018); Bunn, & Marjanovic-Halburd (2017); Mc, & Harrison, (2017); Nyrud, et al., (2014); Ryan, et al., (2014)	
<b>Social Wellbeing</b> <i>Research focuses on impact of organisation, community and disasters on construction workers and built environment dwellers</i>	Tiwari, et al., (2023); Rashidfarokhi, & Danivska, (2023); Hartt, et al., (2023); Donegan, et al., (2022); Gurmu, et al., (2022); Rani, et al., (2022); Goodger, & Murray, (2022); Salami, et al., (2022); Kuboshima, & McIntosh, (2022); Furlan, et al., (2022); Agyekum, (2022); Azami, et al., (2022); Agbai, (2022); Subramaniam, et al., (2021); Abas, et al., (2021); Dodanwala, & Shrestha, (2021); Sturge, et al., (2021); Hussein, et al., (2021); Grum, & Kobal Grum (2018); Rajendran, et al., (2020); Grum, (2020); Hooper, et al., (2015); Thompson, & Kent (2014); Kent, &Thompson, (2014)	24
<b>Psychological Wellbeing</b> <i>Research focuses on comfort, satisfaction, and overall functioning</i>	Baumann, et al., (2023); Domjan, et al., (2023), Medhat Assem, et al., (2023) Omjan, et al., (2023); Ahmed Shaaban, et al., (2023); Idris, et al., (2022); Ekhaese &Hussain, (2022); Nwaogu, & Chan, et al., (2021); Mohammed, et al., (2020); Mondschein, & Moga (2018); Bornioli, et al., (2018); Watson (2018); Kobal (2018); Chen, et al., (2017); Ramzy, (2015); Soril, et al., (2014) Brown, et al, (2009)	17
<b>Digital Wellbeing</b> <i>Research focuses on the deployment of technology for wellbeing</i>	Salama, et al., (2023); Song, et al., (2023); Becerik-Gerber, et al., (2022); Raveendran, &Tabet Aoul, (2022); Pelletier, &Calautit, (2022); Pillsbury, et al., (2020); Aghamolaei, et al., (2021); Malakhatka, et al., (2021); Tagliabue, et al., (2021); Rice, (2021); Elrafie, et al., (2019); Perini, et al., (2017); Fisher-Gewirtzman, & Polak, (2019); Yi, et al., (2016); Miller, & Tolle, (2016)	15
<b>Mental Wellbeing</b> <i>Research focuses on mental health of construction workforce</i>	Frimpong, et al., (2023); Rotimi, et al., (2023); Ndaguba, et al., (2022); Jenkin, et al., (2022); Ma, & Ye, (2022); Hu, et al., (2021); Barua, et al., (2021); Chowdhury, et al., (2020); Osama, (2020); Marzukhi, et al., (2020); Pearson, et al., (2019); Ajayi, et al., (2019); Mahazir, & Jing, (2019); Ram, et al., (2017); Firdaus, et al., (2017)	15
<b>Subjective Wellbeing</b> <i>Research focuses on the premises that wellbeing is "Happiness"</i>	Leyden, et al., (2023); Ozbilen, & Akar (2023); Sadeghi, et al., (2022); Dang, et al., (2022); Carvajal-Arango, et al., (2021); Mouratidis (2018); Ma, et al., (2018); Pfeiffer, & Cloutier, (2020); Pfeiffer, & Cloutier, (2016); Gao, et al., (2016)	10
<b>Physical Health and Wellbeing</b> <i>Research focuses on illness, injury, or a health condition</i>	Sathvik, et al., (2023); Lingard & Turner, (2022); Pilkington-Cheney, et al., (2020); Edwards, et al., (2021); Tunji-Olayeni et al., (2017); Gibb, et al., (2015); Court, et al., (2009); Baggs, & Cunningham, (1988)	8
<b>Financial Wellbeing</b> <i>Focuses on the economic wellbeing</i>	Biglieri, (2018); Khairov, et.al., (2016); Pearce, (2006); Blomgren, (2003)	4