

Review

Identification of Health and Safety Prequalification Criteria for Contractor Selection in Construction Projects: A Systematic Review

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Abstract: Selecting an appropriate contractor is a crucial phase that clients normally conduct to execute projects. Extensive research has been conducted on the main contractor selection criteria such as financial stability and technical and management capability. However, few studies focusing on health and safety criteria are being used to assess contractors' safety performance in the existing selection process. Hence, this paper aims to analyse the existing literature on health and safety criteria for contractor selection in construction. The articles were retrieved using developed search string from renowned databases such as Scopus, Ebscohost, Web of Science, Science Direct and Dimensions. This search resulted in a total of 38 papers which can be systematically reviewed. Six main themes were discovered to represent safety prequalification criteria for construction projects, namely, experience and work history, safety control system, safety policy and management, accident rates and records, safety promotion and environmental concerns. Under these six main themes, there are 25 safety prequalification criteria that have been substantially published in previous literature, and the most-cited criteria are examined. This study brings a significant contribution to construction industry professionals, especially clients, when selecting a capable contractor in construction projects. By identifying the safety prequalification criteria, clients can assess a contractor's efforts in ensuring safe execution of a project before awarding the contract to them. Additionally, the findings of the present study could contribute towards developing a comprehensive framework on contractor selection criteria that incorporates safety leading and lagging indicators.

Keywords: prequalification; contractor selection; construction; health and safety; lagging and leading indicators

1. Introduction

The contractor selection process is a critical activity that determines project success or failure [1]. Selecting a competent and capable contractor is vital, because awarding a contract to an incompetent contractor could lead to project interruptions such as delays, cost overrun, poor performance, bankruptcy, disputes and accidents due to lack of adequate safety consideration at worksites [2–5]. It is important to assess contractors' capabilities through a prequalification process before proceeding to tendering, to remove the possibility of selecting an incompetent contractor [6].

According to Russell and Skibniewski [7], prequalification is a screening process conducted by the client based on a standard set of criteria to assess the competency of the contractor to complete the contract that will be awarded. For the past few decades, various techniques have been proposed for a contractor selection method; however,

many decisions lean towards accepting lowest-bid offers. This seems to be a routine practice within the construction industry globally [8]. Enshassi et al. [9], in their study, found that contractor tendering in Palestine suffers from some serious problems, whose major cause is the selection of the lowest bidder. Therefore, Hasnain et al. [10] proposed that besides bid price, several other factors play significant roles. Mahdi et al. [11] and Liu et al. [12] specified health and safety as aspects that need to be examined.

The construction industry has been recognised as one of the most hazardous industries, wherein construction workers are more prone to accidents [13]. Recently, Babulal [14] reported that construction death and injuries are alarming. Statistics shows that the number of death and injuries related to the construction industry are concerning. Therefore, one of the ways towards improving safety, health and environmental (SHE) performance is by integrating SHE activities into the contracting processes, such as prequalification and contractor selection [15]. This is echoed by Puri and Tiwari [16], who stated that prequalifying and selecting fully qualified contractors based on their safety programmes and performance is an important step towards ensuring project success. This shows that safety prequalification criteria should not be neglected.

Extensive research has been conducted on the main contractor selection criteria, such as financial stability, technical and management capability. However, a small number of studies focusing on health and safety criteria are being used to assess contractors' safety performance in the existing selection process.

Therefore, this paper aims to analyse the existing literature on health and safety criteria for contractor selection in construction projects with the following research questions:

- What are the various health and safety criteria for contractor selection in construction projects?
- How can they be categorised into a specific theme?

This paper presents a systematic literature review of the health and safety prequalification criteria as discussed by articles published from year 1994 to 2019. It consists of five sections. The first section consists of an introduction, the second section explains the materials and methodology, the third section presents the results, followed by the discussion and recommendations and, finally, the conclusion.

2. Materials and Methodology

2.1. Literature Search

The research design adopted for this study was a systematic literature review. According to Xiao and Watson [17], researchers will comprehend the scope of the existing body of work and will be able to identify gaps to explore by reviewing relevant literature. This research effort provides the most up-to-date systematic review on matters related to the selection of contractors from 1994 to 2019. The review was guided by the PRISMA Statement (Preferred Reporting Items for Systematic reviews and Meta-Analyses), which is a standard protocol for conducting a systematic literature review. A standard protocol is provided to equip authors with the appropriate and essential information that will allow them to assess and analyse the quality and rigor of the analysis [18].

The articles were retrieved from five renowned databases. Additionally, manual searching was also conducted based on citation or reference tracking to carry out a wider analysis. This research process involved three stages, as suggested by Moher et al. [19] (see the illustration in Figure 1). The first stage is the identification of keywords. Accordingly, search strings on all databases were developed after all relevant keywords were determined, as shown in Table 1. The online research indicated 224 references, from Ebscohost (141), Scopus (20), Web of Science (15), Science Direct (2), Dimensions (43) and manual searching (3).

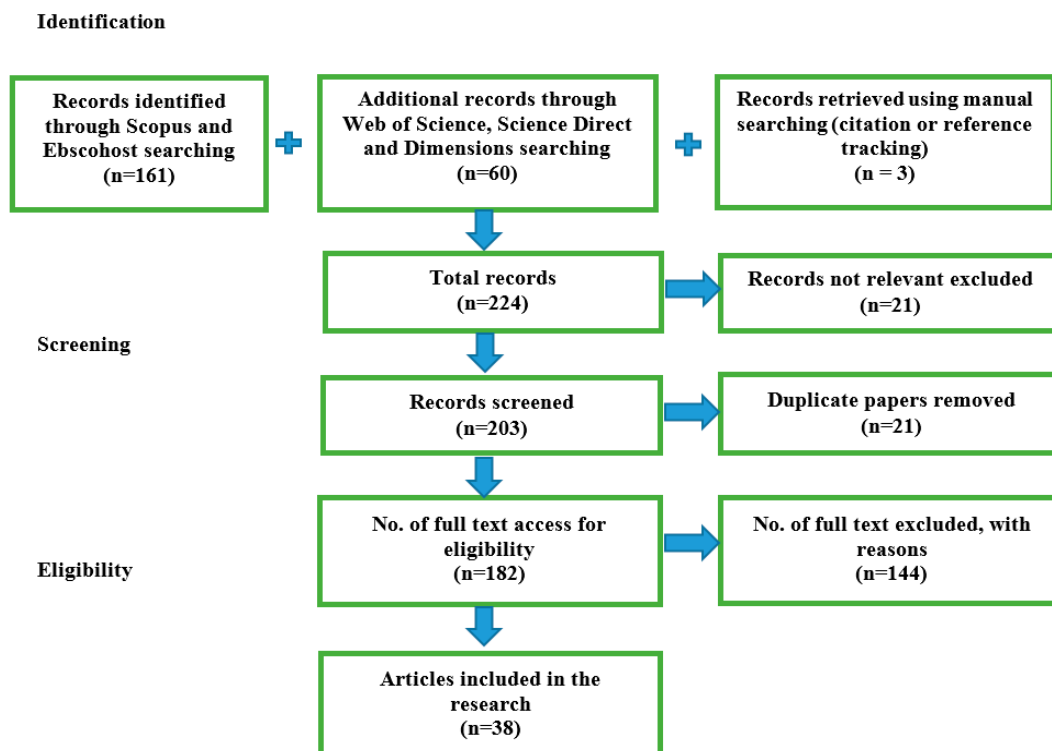


Figure 1. Flow diagram of the study. Adapted from Moher et al. [19].

Table 1. Search string for all databases.

Database	Search String
Scopus	TITLE-ABS-KEY ("contractor* selection*" OR "contractor* prequalification*" OR "contractor* pre-qualification*" OR "contractor* evaluation*") AND (criteria*) AND ("health criteria*" OR "safety criteria*" OR "health and safety" OR safety))
Web of Science	TS = (("contractor* selection*" OR "contractor* prequalification*" OR "contractor* pre-qualification*" OR "contractor* evaluation*") AND (criteria*) AND ("health criteria*" OR "safety criteria*" OR "health and safety" OR safety))
Science Direct	("contractor selection" OR "contractor prequalification" OR "contractor pre-qualification" OR "contractor evaluation") AND (criteria) AND ("health criteria" OR "safety criteria" OR "health and safety" OR safety)
Ebscohost	("contractor selection" OR "contractor prequalification" OR "contractor pre-qualification" OR "contractor evaluation") AND (criteria) AND (safety)
Dimensions	("contractor selection" OR "contractor prequalification" OR "contractor pre-qualification" OR "contractor evaluation") AND (criteria) AND (safety)

2.2. Data Abstraction and Analysis

A total of 38 selected articles were carefully analysed based on thematic analysis. First, any content of the articles that discussed safety prequalification criteria was extracted and the data were gathered in table form using an Excel spreadsheet. This process resulted in a list of 25 different safety prequalification criteria that are normally implemented in the existing contractor selection process. Secondly, from the data gathered, the criteria were then divided into six main themes. This process generated a total of six main themes,

namely, experience and work history, safety control system, safety policy and management, accident rates and records as well as safety promotion and environmental concerns.

3. Results

3.1. General Findings and Background of the Studies Included in the Review

The analysis produced a total of six themes and 25 sub-themes related to safety criteria for contractor selection in construction projects. The six themes are experience and work history (four sub-themes), safety control system (six sub-themes), safety policy and management (three sub-themes), accident rates and records (three sub-themes), safety promotions (five sub-themes) and environmental concerns (four sub-themes).

All articles were been categorised into different types of projects. From the review, it was found that seven previous studies focused on contractor selection for contractors involved in building construction [5,20–25], with two studies focused on institutional and commercial projects [26,27]. Moreover, there are also studies focusing specifically on contractor selection for electrical works [28], railway projects [29], roadways [10] and industrial projects [30]. However, a majority of the papers do not specify the type of construction project, thus all of these were classified in the general category [1,4,8,9,11,23,27,31–52], as shown in Figure 2.

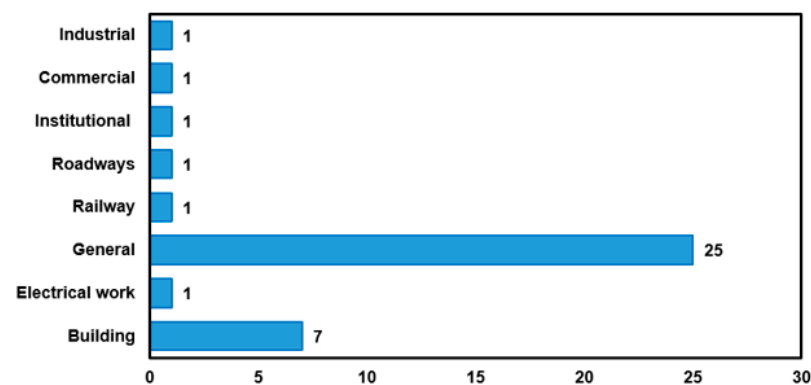


Figure 2. Distribution of construction projects based on reviewed studies.

In terms of year of publication, there were five ranges of years, as shown in Figure 3. It was observed that the publication of papers increased tremendously in the past 10 years (2009 to 2019). In this period, the number of papers published increased by about 41% compared to the previous years (1994–2003). This increase in the number of articles reflects an increase in the importance of safety as a topic of study in the construction field. This shows that researchers are starting to address and express interest in exploring multiple criteria for contractor selection, specifically in health and safety aspects.

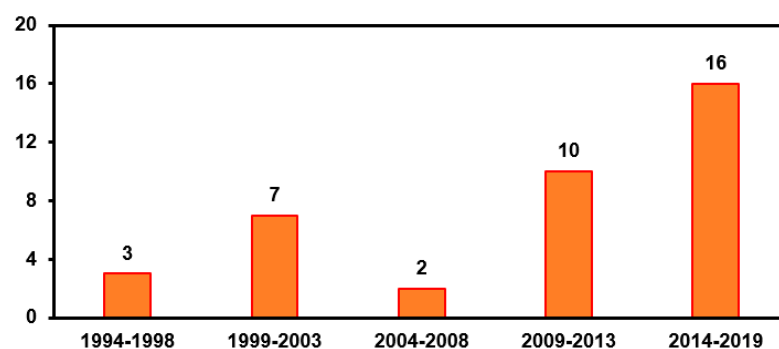


Figure 3. Number of papers published by year.

The frequency analysis presents a descriptive analysis of the 38 reviewed articles extracted from 24 research journals. The source of publication across different journals was analysed, as shown in Table 2. There are eight papers from the *Journal of Engineering, Construction and Architectural Management*. This is followed by three articles from *Construction Management and Economics* and the *Journal of Construction Engineering and Management*, respectively. Two papers are from the *International Journal of Project Management*, *International Journal of Engineering and Technology and Automation in Construction* each, while 18 journals contribute only one article each on the reviewed topic. Based on this analysis, the core journal in the topic of the review is *Engineering, Construction and Architectural Management*. Moreover, the list of journals indicates that the issue has received attention in the main field of construction management, engineering and technology.

Table 2. Distribution of articles per journal.

Journal	Frequency	Total
<i>Engineering, Construction and Architectural Management</i>	8	8
<i>Construction Management and Economics</i> <i>Journal of Construction Engineering and Management</i>	3	6
<i>International Journal of Project Management</i> , <i>International Journal of Engineering and Technology</i> <i>Automation in Construction</i>	2	6
<i>Building Research and Information</i> <i>Canadian Journal of Civil Engineering</i> <i>Engineering and Technology</i> <i>Expert Systems with Applications</i> <i>International Journal of Civil Engineering</i> <i>International Journal of Occupational and Environmental Health</i> <i>Journal of Computing in Civil Engineering, Management,</i> <i>Procurement and Law</i> <i>Journal of Decision Systems</i> <i>Journal of Environmental and Occupational Health Policy</i> <i>Journal of Loss Prevention in the Process Industries</i> <i>Journal of Management in Engineering</i> <i>Journal of Science</i> <i>Journal of The Institution of Engineers, Series A</i> <i>Management Science Letters</i> <i>Procedia Engineering</i> <i>Research Journal of Applied Sciences</i> <i>Socio-Economic Planning Sciences</i> <i>The International Journal of Construction Management</i>	1	18

3.2. Main Findings

This section covers the discussion on six key health and safety criteria for contractor selection in construction projects, namely, experience and work history, safety control system, safety policy and management, accident rates and record, safety promotion and education and finally environmental concerns, as shown in Table 3.

Table 3. The main themes and the sub-themes related to safety criteria for contractor selection in construction projects.

Authors	Experience & Work History				Safety Control System					Safety Policy & Management				Accident Rates & Records			Safety Promotion			Environmental Concerns					
	H&SR	EMR	SP	SO	ASP	SP	H&SM	OSHA	HSE	SM	SP	MC	MSA	AR	AI	AR	HSP	SC	STE	H&S	OSHA	ED	H	EM	EI
1 Assaf and Jannadi [20]																		/							
2 Holt et al. [21]	/										/														
3 Hatush and Skitmore [5]	/	/			/						/					/									
4 Khosrowshahi [22]	/																								
5 Fong and Choi [50]			/																						
6 Sonmez et al. [52]	/																								
7 Mahdi et al. [11]								/																	
8 Sonmez et al. [51]	/										/														
9 Maloney [28]						/													/						
10 Poggeng and Liston [31]								/																	
11 Palaneeswaran and Kumaraswamy [32]	/						/				/														
12 Singh and Tiong [4]	/																								
13 Lam et al. [34]			/																						
14 Oladapo [35]															/							/	/		
15 Ramezaniyan et al. [8]								/																	
16 Nieto-morote and Ruz-vila [26]			/									/													
17 Alzahrani and Emsley [36]	/	/																							

Note: H&SR—Health & Safety Records; EMR—Emergency Modification Rate; SP—Safety Performance; SO—Safety Outcomes; ASP—Adequate Safety Precautions; SP—Safety Procedure; H&SM—Health & Safety Management System; OSHA—Occupational Safety & Health Administration; HSE—HSE Plan; SM—Safety Monitoring; SP—Safety Policy; MC—Management Commitment; MSA—Management Safety Accountability; AR—Accident Records; AI—Accident Investigation & Analysis; AR—Accident/ Incident Rates; HSP—H&S Programme; SC—Safety Consciousness; STE—Safety Training & Education; H&S—Health & Safety Competency; OSHA—OSHA Partnership; ED—Environmental Disruption; H—Housekeeping; EM—Environmental Management; EI—Environmental Impact.

Table 3. Cont.

	Authors	Experience & Work History				Safety Control System				Safety Policy & Management				Accident Rates & Records				Safety Promotion				Environmental Concerns			
		H&SR	EMR	SP	SO	ASP	SP	H&SM	OSHA HSE	SM	SP	MC	MSA	AR	AI	AR	HSP	SC	STE	H&S	OSHA	ED	H	EM	EI
18	Hosny et al. [37]															/									
19	Enshassi et al. [9]	/														/									
20	Attar et al. [38]			/											/										
21	Hosseini Nasab et al. [39]							/																	
22	Rashvand et al. [40]								/																
23	Hadidi and Khater [30]							/																	
24	Tripathi and Jha [41]							/																	
25	Morkūnaitė et al. [23]							/																	
26	Liang et al. [29]						/	/				/						/							
27	Liu et al. [27]		/		/		/									/					/				
28	Chiang et al. [42]		/									/	/			/									
29	Ozyurek and Erdal [43]																							/	
30	Hasnain et al. [10]			/																					/
31	Rao and Rathish [24]	/																							
32	Khalafallah et al. [25]	/				/					/	/		/	/										
33	Khoso and Md Yusof [1]	/		/																					
34	Acheamfour et al. [49]			/						/															
35	Cheaitou et al. [45]											/			/										
36	Idrus et al. [46]							/																	
37	Aje [47]	/																							
38	Rashid et al. [48]						/								/			/						/	

Note: H&SR—Health & Safety Records; EMR—Emergency Modification Rate; SP—Safety Performance; SO—Safety Outcomes; ASP—Adequate Safety Precautions; SP—Safety Procedure; H&SM—Health & Safety Management System; OSHA—Occupational Safety & Health Administration; HSE—HSE Plan; SM—Safety Monitoring; SP—Safety Policy; MC—Management Commitment; MSA—Management Safety Accountability; AR—Accident Records; AI—Accident Investigation & Analysis; AR—Accident/ Incident Rates; HSP—H&S Programme; SC—Safety Consciousness; STE—Safety Training & Education; H&S—Health & Safety Competency; OSHA—OSHA Partnership; ED—Environmental Disruption; H—Housekeeping; EM—Environmental Management; EI—Environmental Impact.

3.2.1. Experience and Work History

There are six sub-themes under experience and work history. The most cited criterion from previous literature is health and safety records; 14 out of 38 papers cited that this should be one of the criteria in contractor prequalification.

Holt et al. [21] suggested safety record as an alternative project-specific criterion that needs to be included in addition to selective criteria such as design suitability, estimated cost for the projects and contract duration. This is supported by several studies [5,22,32,36] that also listed safety records as one of the sub-criteria to assess safety aspects during contractor selection in construction projects. This is also echoed by Khoso and Md Yusof [1] who did an extended review on contractor selection criteria and revealed that safety record is ranked as the first sub-criteria under the safety category. Sonmez et al. [51] and Sonmez et al. [52] included health and safety records as one of the main criteria to assess contractors in their proposed model for contractor selection. Health and safety records are important in order to assess a contractor's past performance. Khalafallah et al. [25] suggested that contractors are required to submit their safety records before the issuance of substantial completion certificates. Aje's [47] assessment reveals that the evaluation of health and safety records of respondents validate that construction players do not attach importance to health and safety policies at construction sites, specifically in the Nigerian construction industry. As a result, accidents frequently occur on construction sites in Nigeria. Meanwhile, Singh and Tiong [4] mentioned that due to past major accidents in Singapore (refer to Nicoll Highway collapse and the Fusionpolis cave-in accident), clients have recognised the need for a more thorough evaluation of contractors' safety record attributes during the selection process. Enshassi et al. [9] found that the weights assigned by respondents to safety criteria indicate that clients need to select contractors with better safety records. This is because health and safety records are one of the important attributes for contractors [24].

The other safety criterion mentioned in previous literature is the experience modification rating (EMR). EMR refers to an insurance premium indicator based on the assumption that prior (three years') injury claims will predict future costs [27]. Insurance companies used this number to gauge both previous costs of injuries and possible chances of risk. The lower the EMR, the lower the worker compensation insurance premium will be. On another note, Hatush and Skitmore [5] opined that EMR can either financially reward or penalise contractors based on their accident claims. It was observed that Alzahrani and Emsley [36] and Chiang et al. [42] specified EMR as one of the sub-criteria under health, safety and quality cluster. In order to monitor their trend in safety performance, contractors should provide clients with data from the three most recent years. This will also recognise the value of incident rates as an effective measure of past safety performance [53].

Moreover, contractors' safety performance is also one of the criteria that have been highlighted by numerous studies. Safety performance can be assessed through several factors, such as top management support, appropriate site layout planning, proper use of PPEs, availability of welfare facilities as well as safety awareness [49,50]. Poor safety awareness may result in delays and cost overrun, which in turn may affect safety performance. Studies by Nieto-morote and Ruz-vila [26], Hasnain et al. [10] as well as Khoso and Md Yusof [1] are also among those that list safety performance in contractor selection criteria. According to Liu et al. [27], clients may use data from safety outcomes to describe contractors' safety performance. In addition, Lam et al. [34] suggested that in order to assess contractor performance, both past performance references as well as health and safety performance potentials need to be included.

3.2.2. Safety Control System

Construction is known as a high-risk industry because it has traditionally been affected by significantly higher and excessive accident rates relative to other industries, as per Hamid et al. [54]. Therefore, having a better safety control system benefits a contractor in managing projects. Several factors can facilitate the successful operation of the system.

The most cited safety sub-criterion under this theme is health and safety management system, with four articles mentioning it. Examples of health and safety management system elements are hazard prevention and control, programme evaluation and improvement as well as coordination and communication [27]. In order to assess whether the safety management system has been implemented appropriately, contractors can provide auditing programmes to clients. Assessments from the safety audit can be used as corrective actions and to further promote the safety management system according to Liang et al. [29]. According to Rashid et al. [48], it was found that having a health and safety management system ranked as part of the top 15 prioritised criteria for contractor selection. However, despite being listed as a sub-criterion for safety and health aspects, it was found that of all the surveys currently in use, those with best practice elements for a strong safety management system number very few [27,32]. Therefore, there is a need to study this further.

According to Hadidi and Khater [30], contractors should begin planning for the health and safety environment (HSE) at the initial stages of construction work. Clients can assess a contractor's HSE plan based on their previous work performance, workers' expertise as well as technical planning provided. In addition, an HSE plan is essential, as it will be used as a medium to assess the adaptability of the method statement and submitted plans [11]. More importantly, based on the study conducted by Triphati and Jha [41] on evaluating success factors of construction organisations, it was found that the implementation of a health and safety management plan is one of the success attributes for construction projects. However, the results revealed that its implementation is considered the least important attribute.

Moreover, another factor that could help boost safety control systems is having a safety procedure on site, within which the contractor shall provide understandable safety rules and procedure for construction workers, especially on the specific requirements. Other than that, the contractor shall create an effective enforcement scheme and include a statement of penalties for breaches of rules and procedure [29]. A safety procedure is essential in order to ensure workers understand and comply with all safety regulations and that a safe working environment is preserved and all activities at construction sites are conducted safely [28].

In addition, Nasab and Ghamsarian [39] also found valuable findings from their study on contractor selection criteria for electrical contractors. Based on eight experts in the electrical industry who were invited to evaluate the criteria, 22 sub-criteria were listed, and occupational safety and health was one of the sub-criteria for the health and safety aspects. This result is similar to a study conducted by Idrus et al. [46], which focused on decision criteria for contractor selection in Malaysia. The objective of the study was to identify important contractor selection criteria by providing a ranking for each criterion. The result revealed that occupational health and safety is one of the essential criteria for contractor selection, having ranked number 8 out of 14 criteria.

On another note, providing adequate safety precautions is also one of the significant attributes of contractors. Hatush and Skitmore [5] and Khalafallah et al. [25] suggested including safety-related questions on prequalification questionnaire to assess whether contractors put effort into taking adequate safety precautions in their work. Some examples of questions that should be raised are "Did the contractor have difficulty providing adequate number of first-aid facilities, equipment and supplies?" and "Did the contractor provide adequate number of fire-prevention and protection equipment?"

3.2.3. Safety Policy and Management

Holt et al. [21], in their study on evaluating performance potential in the selection of construction contractors, rank safety policy as a top criterion under contractor organisation factor. Contractors need to provide security information in the form of a health and safety policy. This covers the names of workers responsible for the implementation of the policy, the number of workers, procedures to convey the safety policies to the workers,

procedures for reporting and recording the accidents, first aid provision and details of prosecutions served on the firm by health and safety executives. Additional information includes particulars of existing insurance, taxation, subcontracting and race relations records [5]. On another note, safety policy and management commitment ranked number 8 out of 10 criteria in the study by [25]. Other than that, management safety accountability is also included in the selection criteria, as cited in [42].

3.2.4. Accident Rates and Records

As mentioned earlier, construction is known as a high-risk industry. Safety information can be assessed through many ways. Besides safety records, contractors are urged to record and analyse rates of accidents occurring at the construction site. According to Hatush and Skitmore [5], questioning a contractor's accident rate can generate essential information about their safety performance. A contractor's consideration for health, safety and environment is reflected in their safety parameters, which could be drawn from accident history as well as having necessary personnel and policies in place [1]. It is observed that some of the authors are aware of the importance of this criterion, as reflected in their decision to list accident rates and accident records as relevant criteria in the contractor selection process [35,48]. In addition, Khalafallah et al. [25] also listed accident investigation and analysis as one of the selection criteria. All of these criteria are important in order to ensure clients select a safe contractor for construction projects.

3.2.5. Safety Promotion and Education

In terms of safety promotion and education, it was observed that only a few articles emphasise this criterion. The earliest articles by Assaf and Janadi [20] included safety consciousness as one of the prequalification criteria. Safety consciousness can be promoted through conducting health and safety programmes, which are suggested as one of the relevant criteria for contractor prequalification in several studies [9,27,36]. According to Liu et al. [27], health and safety programmes should be assessed initially to validate that they are being implemented as planned by the contractor. Periodically or annually, clients need to evaluate whether the programme is successful or not.

In the study carried out by Rashid et al. [48], it was found that health and safety competency is listed in the top 10 criteria prioritised in the selection process. Competence in health and safety is the synthesis of a person's training, skills, experience and knowledge, and their ability to apply them to safely carry out a task. Therefore, the contractor needs to provide comprehensive safety training and education programmes to inform workers and management about workplace hazards and control so that they can work safely and productively [27,29]. Moreover, safety training and education programmes should consider varying levels of responsibility, ability, literacy and risks [29]. Through this kind of effort, workers and managers will have greater understanding of safety and health programmes, thus enabling contractors to reduce accidents from occurring at the construction site.

3.2.6. Environmental Concerns

Finally, another criterion that needs to be considered in contractor selection is environmental concerns. Construction is one of the major contributors to environmental impacts such as pollution risks, typically classified as air pollution, waste pollution, noise pollution and water pollution [55]. Moreover, the construction industry is currently facing a global challenge, namely the protection of environmental safety [36]. Failure to comply with environmental requirements at some stage during construction may be very expensive in terms of project costs and delays. In a study carried out by Alzahrani and Emsley [36], who studied the impact of contractors' attributes on construction project success, the results indicated that the environmental qualities of contractors have been found to have a substantial effect on project performance. However, despite evidence to the contrary, findings in Hasnain et al. [10] indicate that emphasis still tends to be placed on cost-based criteria over the relatively abstract factors of quality, health and safety and environmental

impact, which are viewed as less significant. Another criterion that need to be considered is environmental disruption and housekeeping as suggested in Oladapo [35]. However, it was observed that only one paper mentioned this criterion.

3.3. Studies on Contractor Selection and Safety, with a Focus on Leading and Lagging Indicators

The decision of the contractor at the prequalification stage is crucial for the success of the project. Extensive studies have looked into the decision criteria for contractor selection. However, previous studies focused more on other criteria, instead of health and safety, which are important for selecting safe contractors. Even though there are studies that covered certain safety criteria, few studies focused directly on the safety performance assessment for contractors, specifically at the contractor selection stage.

A study by Liang et al. [29] proposed a comprehensive model for clients to assess contractors' safety performance for contractor selection by using leading and lagging indicators. The lagging indicators measure the outcomes of activities or events that have already occurred (for example, injuries or fatalities), while the leading indicators precede the accidents [56]. When using leading indicators, proactive intervention can be initiated to address weaknesses in safety programmes once less-than-desirable safety levels are indicated. Therefore, leading indicators can provide some hints necessary to appropriately monitor workplace safety and avoid future accidents [29].

Traditionally, the recordable injury rate (RIR), days away, restricted and job transfer (DART) and experience modification rate (EMR) of workers' compensation are commonly used as safety performance indicators [27,30,57]. These indicators are most broadly used in the construction industry, where contractors can monitor their safety status and make comparative analyses [29]. Nevertheless, construction industry researchers have identified some issues inherent in using these metrics. Despite this, inadequate estimations of the safety capacities of contractors using only lagging indicators can discourage continuous improvement of safety performance in the construction industry [29]. Another limitation of this analysis is that the metrics and their weights were calculated based on the views of Chinese construction industry experts, which are expected to be influenced by the region's safety culture and practices. To achieve a more accurate safety ranking, evaluating the safety capacities of contractors should not be limited to conventional lagging outcomes; rather, more emphasis should be placed on the leading aspects. Compensating for shortcomings of conventional safety metrics, some alternative approaches are increasingly being used to provide appropriate knowledge or insight to forecast future safety performance [29].

Liu et al. [27] describe existing safety prequalification surveys in the construction industry to define strategies that include leading indicators of contractors' safety performance. The collection of prequalification surveys available in the public domain was conducted through several mediums, such as construction company websites, published literature, internet searches and construction industry partners. A conceptual framework was utilised based on safety theory and best practices to categorise survey questions. It was discovered that there are 52 prequalification surveys with 112 unique questions. Most included questions are related to lagging indicators (83%), safety management leadership (75%) and worker training (60%). Safety management system components such as hazard prevention and monitoring, programme assessment and development as well as teamwork and communication were noticeably absent in 90% of the surveys. On another note, they found that a combination of leading and lagging metrics is used in existing and available safety prequalification. In particular, recordable injury rates and company experience modification rates (EMR) are included. Most of these contained some calculation of the clients' safety management systems, although several surveys did not include certain elements of best practice. Of the surveys that covered all of the elements of good practice, only two prequalification surveys considered the most relevant leading indicators in the recommendations on best practice. This shows that there is a need to further explore this area, especially the inclusion of more leading indicators in contractors' assessment by clients.

Another valuable study by Hadidi and Khater [30] identified critical safety criteria to prequalify turnaround maintenance contractors and used these criteria to build an analytical hierarchy process (model). They believed that shifting safety strategy to enforce contractors to be selected based on their safety criteria will contribute to the high quality of project safety. This safety strategy can be seen as a constructive approach that will help construction companies with the selection of contractors and lead to improved health safety and environment results. However, this study focuses more on the method of selection rather than what makes contractors pass safety decision.

Later, Hasnain et al. [10] formulated a set of best-value contributing criteria that are most influential in contractor selection. Best value is defined as a trade-off between price and performance that provides the biggest overall gain under the selection criteria specified [58]. Unlike Hadidi and Khater [30], this study uses analytic network process (ANP). This seeks to improve the results of a business operation and underlines productivity, value for money and requirements for success. A total of 5 criteria and 15 sub-criteria were described from various civil engineering, project management and construction engineering and management journals published from 2000 until 2015, based on contractor selection studies. Then, a detailed questionnaire survey was conducted in the Pakistan construction industry. It can be argued that the best-value contract approach improves the optimal combination of performance metrics and offers decision makers the ability to select the right contractor, without exceeding a single criterion. The five main criteria highlighted are cost, performance, quality control, health and safety and project control. The results indicate that the best-value criteria found are interrelated to some degree. Efficient health and safety policies, for example, may impact building efficiency and quality. Good results and competence are evidence of productive ventures that result in good financial ability. However, the criteria identified in this study provide only a basis for the evaluation of best value; thus, they are not detailed and comprehensive.

3.4. Country of the Reviewed Studies

Table 4 shows the distribution of studies related to this research area based on geography. The review shows that the majority of the studies were conducted in the United Kingdom (UK), with the highest percentage of publications (15%). The result also shows that the trend of publication in the UK is active between 1994 and 2002, with the latest publication from this country being in the year 2013. Developing countries like China and Malaysia shared the same percentage (10%). It can be seen that China started publication earlier (2000) compared to Malaysia, and China is researching this area consistently.

Meanwhile, in Malaysia, publication started in 2011, and the most recent publication was in the year 2019. Other than that, Iran contributes 7.8% out of overall publications and the trend of publications is consistent every two years, starting from 2012 to 2015. Other than those mentioned, Iran, Saudi Arabia, Nigeria, India and the United States share the same percentage of 5.26%. Other countries, like Thailand, Singapore, Spain, Turkey, Egypt, Palestine, Lithuania, Kuwait, Ghana, UAE, Taiwan and Pakistan are those with the least contribution in this area. There is also one unique study involving three countries (Kuwait, United Kingdom and Egypt). It is essential to highlight that the countries are determined based on the place where the study was undertaken. From this findings, it can be concluded that published papers that study the contractor selection process in countries other than the United Kingdom are scarce. Therefore, there is vast opportunity for future studies to explore the contractor selection process in other countries.

Table 4. Country of the reviewed studies.

Country	Number of Publications	Year of Publications
United Kingdom	6	1994, 1997, 1999, 2001, 2002, 2013
China	4	2000, 2005, 2009, 2018
Malaysia	4	2011, 2015, 2018, 2019
Iran	3	2012, 2013, 2015
Saudi Arabia	2	1994, 2015
Nigeria	2	2011, 2012
India	2	2018, 2018
United States	2	1994, 2015
Thailand	1	2002
Singapore	1	2007
Spain	1	2012
Turkey	1	2018
Egypt	1	2013
Palestine	1	2013
Lithuania	1	2017
Kuwait	1	2019
Ghana	1	2019
UAE	1	2019
Taiwan	1	2018
Pakistan	1	2018
Combination (Egypt, Kuwait and UK)	1	2002
Total	38	

4. Discussion and Recommendations

Sustainability played a significant role in contractor selection, but it has become clear that different types of clients have very different goals for sustainability. Sustainability comprises three aspects: social, environmental and economic [59]. The findings show that all health and safety criteria consider social or ecological elements but do not include financial aspects. They should consider all three aspects to fit in with sustainable development goals for the construction industry.

From the findings of this review, it was revealed that there is a gap in determining safety indicators to assess contractors' safety performance. Each criterion should be classified into leading or lagging indicators, as suggested in Liang et al. [29]. Previous literature shows that the existing contractor selection process is fixed without specifying which are leading and which are lagging indicators. Lagging indicators are used to determine risk, such as the number of fatalities, total occupational safety health (OSH) recordable cases and total lost workday cases. However, these are passive indicators of past outcomes [60]. According to Liang et al. [29], assessing the safety capabilities of contractors should not be limited to traditional lagging indicators, but more attention should be paid to the leading indicators in order to achieve a more accurate safety ranking. Leading indicators proactively assess defined activities to help prevent incidents of a general or specific nature. In short, leading indicators should predict future safety performance [29]. Moving from lagging to leading indicators could help clients reduce risk and overall risk value, thus increasing competitive advantage [60]. Examples of leading indicators are management commitment, safety training and education, safety risk management as well as safety rules and procedures, which are listed as one of the relevant criteria by only a few articles in this study. Hence, further investigation is required in analysing the safety prequalification criteria found in this study and classifying them into leading or lagging indicators. Thus, this study can be continued by determining which factors can predict future safety performance and suggesting the best method to measure them. It was observed that integrating the identified indicators for safety performance in the contractor selection process is important, as it would enable clients to better assess contractors' capabilities to execute projects according to the specified health and safety standards, thus improving safety performance in the industry.

Previous studies indicate that the existing contractor selection process does not consider health and safety performance as a key criterion. This was proven by Nasab and

Ghamsarian [39] and Enshassi et al. [9], where health and safety criteria ranked at the bottom of the list. In fact, some of the studies that highlight health and safety as one of the selection criteria merely provide a brief explanation, if any, on each criterion. Most of the studies focused on other criteria, such as financial stability, technical capability and management capacity. Therefore, there is a vital need for a set of structured safety prequalification criteria that would allow clients to evaluate contractor safety performance, among other important contractor selection criteria.

Recent studies show that most articles study contractor selection criteria in general. According to Araujo et al. [61], the criteria used in the selection process depend on the sector, since each type of project possesses different levels of risk. However, only 13 out of 38 articles specified the type of project. It was observed that there was a lack of discussion on safety prequalification for contractors involved in railways, institutional, commercial, roadworks, electrical works and industrial sectors. Hence, it is recommended to identify the critical safety prequalification criteria specific to different types of projects in future studies.

5. Conclusions

The recent literature on the safety prequalification criteria for contractor selection in construction projects reflects a basic understanding of the various health and safety criteria implemented in the existing contractor selection process. Six main themes were discovered to represent safety prequalification criteria for construction projects, namely, experience and work history, safety control system, safety policy and management, accident rates and records, safety promotion and environmental concerns. Under these six main themes, there are 25 safety prequalification criteria that have been substantially published in previous literature; the most-cited criteria were examined.

As a result, this research can be expanded to investigate the influence of using those criteria on the safety performance of construction projects. Furthermore, additional research might be conducted to see whether there is a relationship between the priority assigned by each contractor to the mentioned themes and the budget that each contractor has set aside for them. A framework for health and safety criteria for contractor selection can be established from here. This study brings a significant contribution to construction industry professionals, especially clients, when selecting a capable contractor in construction projects. At this point, clients should bear in mind that it is essential to search for not just a capable contractor, but also a safe one, for their projects. Each assessment of contractors will impact project success as a whole. By identifying the safety prequalification criteria, clients can assess a contractor's effort in ensuring safe execution of the project before awarding the contract to them. Furthermore, this study is beneficial to researchers, as it may serve as a base or reference for them to identify criteria that are yet to be considered in the current process, which in turn could provide them with more opportunities to explore new findings. This valuable finding can be shared and used as reference to improve the existing contractor selection process, which in turn will raise awareness on the importance of integrating safety and health activities into the contracting process. Moreover, with current death and injury rates increasing alarmingly, this kind of study is relevant and very important in order to produce improvement measures. These measures then need to be enforced into practice in the industry. Should these kinds of incidents continue to happen and no actions for improvement be taken, the construction industry will suffer and deteriorate. Finally, it is worth noting that health and safety criteria should be given similar priority as other main criteria, such as financial stability and technical and management capability.

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