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Identification of Desired Qualifications for Construction Safety Personnel in the United States

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Abstract: Construction is a hazardous industry with a high number of injuries. Prior research found that many industry injuries can be prevented by implementing an effective safety plan if prepared and maintained by qualified safety personnel. However, there are no specific guidelines on how to select qualified construction safety personnel and what criteria should be used to select an individual for a safety position in the United States (US) construction industry. To fill this gap in knowledge, the study goal was to identify the desired qualifications of safety personnel in the US construction industry. To achieve the study goal, the Delphi technique was used as the main methodology for determining the desired qualifications for construction safety personnel. As a result, a panel of 15 subject-matter experts was selected, and 4 rounds of surveys were carried out. The findings of the study led to the identification of the desired qualifications for three construction safety positions (safety entry, safety professional, and safety manager). The present study contributes to the body of theoretical knowledge on construction safety and presents practical guidelines to assist industry stakeholders select qualified safety personnel for their projects. The selection of qualified safety personnel is expected to improve workplace safety performance and positively reflect on other project outcomes. Construction stakeholders should pay attention to three key aspects (namely, education, experience, and certification) when determining the qualifications for a safety leadership position and take into consideration the type of position intended to be filled. This study fills the gap in knowledge by identifying the desired qualifications and criteria on how to select safety personnel in the US construction industry.

Keywords: construction safety; occupational accidents; qualifications; safety personnel

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1. Introduction

The construction industry is an essential element in establishing a prosperous economy. It is estimated that in 2017, the construction industry contributed over USD 10 trillion to the global domestic product (GDP) [1] and approximately USD 892 billion to the GDP in the United States (US) [2]. This contribution significantly relied on the production of the industry workforce [3]. The US construction industry employs over 7 million people, with a steadily increasing employment rate that is anticipated to attract nearly 400,000 new employees [4,5]. In fact, construction employees face substantial challenges, especially concerning their health and safety. The construction industry is one of the most hazardous industries, with high fatal and nonfatal injury rates. One in every five worker deaths in the US occurs in the construction industry [6,7]. On average, construction workers are 5.5 times more likely to be killed than nonconstruction workers in US workplaces [7]. According to the Bureau of Labor Statistics, 1061 workers died in the construction industry in 2019 alone, the largest total since 2007 [4]. It is estimated that construction workers have 3–4 times higher chances of being involved in a fatal accident at work than workers employed in a different industry [8–10].

An underlying belief among industry professionals and researchers is that the high number of injuries in construction is not always caused by errors and misjudgments of frontline workers [7,11]. In many cases, construction accidents are caused by the poor safety control and planning implemented on the job site by the middle and top management [11–13]. Safety control and planning are oftentimes performed by specialized safety personnel. As a result, the probability of improving the overall safety performance increases by 2.29 with full-time safety personnel [14]. This means that the likelihood of improving safety performance increases by 229% with a full-time safety professional as opposed to not having one.

In order to be able to effectively mitigate workplace risks and prevent occupational accidents, safety personnel must be capable of fulfilling their responsibilities. The issue is that there are no standards/guidelines or even a consensus among industry stakeholders in the US about the desired qualifications for construction safety personnel, and, therefore, the process of examining the qualifications of construction safety personnel is often overlooked [7,15]. This lack of standards/guidelines and consensus has led to substantial discrepancies in the qualifications of construction safety personnel. Research demonstrated that not only safety personnel but also construction supervisors, whose responsibilities include managing workplace safety on their projects, must have certain qualifications and competencies in order to be able to effectively mitigate workplace hazards and prevent worker injuries/fatalities [16]. It should be acknowledged that there are some standards/guidelines in some European countries that may or may not be applicable to the US construction industry due to the uniqueness of the US construction industry including the high number of immigrant workers in the US, geographical differences, etc.

Despite its importance, the current body of literature within construction lacks a systematic approach to determine the desired qualifications for construction safety personnel in terms of education, experience, and certification. To fill this gap in knowledge, the goal of the present study was to identify the desired qualifications of safety personnel in the US construction industry.

2. Literature Review

Qualified safety personnel are vital to achieving a higher-level construction safety culture [7]. Little research has been conducted on the qualifications of safety personnel in the construction industry [11,12]. Møller et al. found that several elements shape the desired competencies of a safety coordinator in construction, such as creativity and innovation, being detail-oriented, persistence in implementing proper safety practices, and sociability [17]. Most studies focused primarily on the safety training of construction safety personnel [18] while underestimating the importance of other key qualifications, namely education, experience, and certification of construction safety personnel.

Moreover, safety managers are expected to identify, evaluate, and mitigate hazardous conditions on the job site and develop a comprehensive work-specific safety management plan that includes practices, procedures, and policies to measure, audit, and evaluate the effectiveness of such a plan [19]. The primary goal of a safety plan is to ensure that construction workers perform their tasks safely and constantly follow established safety rules and procedures [20]. These critical responsibilities of safety personnel require substantial knowledge and expertise in occupational health and safety [11,21]. Having a well-qualified safety representative onsite can significantly influence the overall safety performance of a project by improving hazard recognition and the safety risk mitigation process [14].

In the reviewed body of literature, safety qualifications in the US are mainly classified into three key aspects: (1) education, (2) experience, and (3) certification [19], but as previously explained, there are no specific standards/guidelines for the desired qualifications of safety personnel in the US construction industry. The American Society of Safety Professionals (ASSP) Employer's Guide to Hiring a safety professional provides some general guidelines that are not specific to construction [19]. Table 1 illustrates the recommended qualifications for safety personnel in the general industry. The "general

industry" is a term used by the Occupational Health and Safety Administration (OSHA) to refer to all industries not included in agriculture, construction, or maritime [22]. Accordingly, the recommended qualifications for safety personnel are, in many ways, not applicable to the construction industry as the positions described and certifications required do not apply to the construction industry. For instance, Certified Loss Control Specialist (CLCS) and Certified Fire Protection Specialist (CFPS) are rarely acquired by safety professionals/practitioners working in the general industry.

Table 1. Desired qualifications for safety personnel (Data from [19]).

Position	Education	Experience	Certification
Safety Entry-Level Position	4- or 2-year degree	Previous internship experience	Not required (GSP recommended)
Safety Practitioner/ Technician Technologist	4- or 2-year degree	3 years of relevant work experience	OHST, CLCS, or CHST, or GSP, ASP
Safety Manager/Senior Technical Specialist	4-year degree	5–7 years of relevant work experience	CSP, CIH, CFPS, CHMM, or PE
Safety Director/Senior Position	Bachelor's degree or higher	8–10 years of relevant experience	CSP, CIH, CFPS, CHMM, or PE
Safety Executive Level Position	Bachelor's degree or higher	More than 10 years of relevant experience	CSP, CIH, CFPS, CHMM, or PE

Note: GSP = Graduate Safety Practitioner, OHST = Occupational Health and Safety Technologist, CLCS = Certified Loss Control Specialist, CHST = Construction Health and Safety Technician, ASP = Associate Safety Professional, CSP = Certified Safety Professional, CIH = Certified Industrial Hygienist, CFPS = Certified Fire Protection Specialist, CHMM = Certified Hazardous Materials Manager, PE = Professional Engineer.

The specific objective of the present study was to identify the qualifications of safety personnel that are specific to the US construction profession with respect to education, experience, and certification. The subsequent subsections describe the importance of these three elements of qualifications (education, experience, and certification) for safety personnel. It should be acknowledged that other countries that defined the qualifications of construction safety personnel, for instance, the International Safety and Health Construction Coordinators Organisation (ISHCOO) based in Europe, identified certain requirements that fall into three main categories (knowledge, skills, and responsibility) for safety and health personnel in construction [23].

2.1. Education of Safety Personnel

Education is an essential element of employee qualifications. To distinguish education from other requirements, such as training, Haslam et al. defined education as "high-level knowledge and skills (in the aspects of engineering and safety that are) transferable to different situations [24]. Education equips individuals with the ability to analyze a situation (e.g., identify and analyze a hazardous condition) and respond accordingly (e.g., develop and implement a hazard mitigation plan)." Safety candidates who obtained their education from programs accredited by reputable accreditation establishments should be ideally preferred over other candidates.

2.2. Experience of Safety Personnel

In a practical field, such as occupational health and safety, work experience is an essential element of employee qualifications. Higher education may only qualify individuals to obtain an entry-level job in their desired field [25]. To be able to play a more effective role and manage occupational health and safety on a project, work experience is needed [25]. For example, a safety intern will not be given any primary safety duties instantly, and their role could be initially limited to assisting team members with the coordination and preparation of work activities until some level of work experience is accumulated. Research has shown that assigning experienced safety personnel to a construction project results in

lower possibilities of accidents [7,12,26]. Experience provides knowledge on safety best practices, rules, and procedures and can also equip safety personnel with a valuable skills kit for managing and mitigating workplace hazards [27]. Experience as the practice of knowing compared to an educational degree for receiving knowledge is a significantly more critical element that defines qualified personnel [17].

2.3. Certification of Safety Personnel

Certification is frequently awarded after finishing a set of training courses and/or passing a certain exam that requires extensive preparations. A certification in a specific field provides evidence that an individual meets the standards of competence and possesses the required practical knowledge in the field of interest [28]. Training provides "directive instruction as to how an act should be performed" [24]. It ensures that individuals have the ability to critically analyze a specific situation in the workplace and implement certain procedures and policies to fully address the situation [11,24]. Moreover, due to continuous changes in construction technology and practices, new emerging hazards, more effective prevention methods, and updated standards and regulations, safety personnel need to update their safety knowledge and expertise on a regular basis [29]. Other benefits of safety certification include improving the organization's image/reputation. This enhanced image/reputation can help attract skilled employees and provides assurance to project owners that the organization prioritizes safety. To achieve safety maturity, construction organizations are recommended to sponsor and provide opportunities to obtain and maintain professional safety licensing and certification [30].

3. Methods

The objective of the present study was to identify the qualifications of safety personnel in the construction industry with respect to education, experience, and certification. To achieve the study objective, the Delphi method was adopted. The Delphi method is a collaborative, multiround survey technique used to obtain feedback from subject-matter experts referred to as a panel of experts [30]. It is considered a reliable method for collecting insights from a panel of experts and has been widely utilized successfully in construction research [31–36]. The subsequent section highlights the strengths and weaknesses of the Delphi method.

3.1. Strengths and Weaknesses of the Delphi Method

The Delphi method is a valuable tool for making managerial decisions in various fields, including construction research. It is a structured process that involves multiple rounds of data collection from a group of experts, with the goal of reaching a consensus or generating new ideas. One of the main strengths of this method is the expert input it provides. The Delphi method enables the gathering of expert opinions from individuals who have extensive knowledge and experience in the construction industry. This input can be invaluable in helping researchers make informed decisions and recommendations. In addition, the Delphi method is effective in facilitating consensus building among experts with diverse opinions and perspectives. This can lead to better decision-making outcomes in construction research. Another advantage that may be helpful in research is anonymity; the Delphi method allows experts to provide input anonymously, which can encourage honesty and reduce the influence of dominant personalities or biases. The Delphi method provides high level of flexibility and can be adapted to suit a range of research questions, and contexts. It can be used in both qualitative and quantitative research and can be modified to include different types of data collection techniques. Its findings are heavily weighted because multiple rounds of data collection and feedback are carried out, which allows researchers to refine their questions and hypotheses based on the expert input received.

That being said, the weaknesses of the Delphi method should be acknowledged. This method can be time-consuming, as it typically involves multiple rounds of data collection and feedback. This can lead to delays in research timelines. The Delphi method can also be

subject to biases, such as expert selection bias or groupthink, which can affect the quality of the data collected. This point is discussed in more detail in the "Limitations" section of this manuscript. In many cases, findings from the Delphi research may not be generalizable beyond the specific context of the research study, and therefore a validation study may be required. The input received may be limited to the expertise of the selected experts and may not represent the broader population. There is also a lack of face-to-face interaction as this method does not involve face-to-face meetings, which may limit the richness of the data collected and make it difficult to understand the nuances of expert opinions. In other words, the Delphi method can limit discussion and thought exchange among experts.

In summary, while the Delphi method has several strengths in the context of construction research, such as the ability to gather expert input, facilitate consensus building, and provide a flexible iterative process, it also has some weaknesses that need to be considered when using the method in research studies. The research team carefully considered these weaknesses and addressed them in the study by following specific guidelines for the use of the Delphi method in construction research. In addition, the research involved a validation study used to improve the reliability of the Delphi panel findings and ensure that the study is generalizable throughout the US construction industry.

3.2. Research Procedure for Delphi Technique

In the present study, a panel of potential experts was selected. Next, a certain procedure described subsequently was used to confirm that the panel members are in fact experts in their field. Then, a multiround questionnaire was used to identify the qualifications of construction safety personnel. It should be mentioned that the questionnaires used were pilot-tested with five experts to ensure that questions are appropriate, easy-to-understand, and consistent with technical terms used in the questionnaire. Provided feedback was integrated into the questionnaire before sending it to the expert panel.

The Delphi process fundamentally relies on the panel of experts; therefore, careful selection of the panel members is essential [37]. To carefully select members of the panel and ensure that they are subject-matter experts, a two-step process was undertaken. First, the research team identified a list of over 40 individuals believed to be potential safety experts. The individuals were selected for multiple reasons including if they were members of well-known safety associations/organizations/committees, such as the American Society of Safety Professionals (ASSP) and ASCE CI Construction Safety Committee. Second, the potential experts were contacted and asked if they would like to voluntarily participate in the study. No incentives or rewards were given to the individuals in return for their participation. Eighteen individuals agreed to participate in the study. Afterward, information was collected from the participants, and a qualification analysis relying on previous research [38] was objectively performed to determine if the participants were subject-matter experts and qualified for inclusion in the study panel. This two-step process ensured that the study panel consisted of experts on the study topic and achieved a high level of reliability and validity in the study findings. The subsequent section describes the qualification process in detail.

3.3. Expert Panel Selection

As previously mentioned, 18 potential experts agreed to participate in the study. To ensure that they had the necessary qualifications and qualified for inclusion in the study panel as experts, the research team collected information on the qualifications of the 18 potential experts following guidelines from previous research on the topic [38]. A point system adapted from Hallowell and Gambatese [38] that was used by multiple prior research studies [39–41] was adopted. The point system utilized in the process is described in Table 2. Hallowell and Gambatese indicated that a minimum score of 11 points should be acquired in order for an individual to be labeled as an expert in their field [38]. To raise the bar and be conservative, the research team decided to (1) use a threshold of 15 points in order to label individuals as experts, (2) eliminate any individual who has less than 10 years

of professional work experience even if they obtained a score of 15 points, and (3) only include individuals with higher education (Bachelor's degree or higher) in the study panel.

Table 2. Point system metric to qualify panelists.

Criteria	Points
Education	
Bachelor's degree (BS) or equivalent	4 points
Master's degree (MS) or equivalent	6 points
Doctor of philosophy (PhD) or equivalent	10 points
Experience	1 point per year
Certification/Professional Registration	3 points (each certificate/registration)
Chair of a committee	3 points (each)
Member of a committee	1 point (each)
Peer-reviewed journal article	2 points (each)
Conference presentation	0.5 point (each)

To qualify the potential experts, a set of questions soliciting information on the education, credentials, experience, training, etc., of the participants was developed and included in the first round of the Delphi process. After collecting the responses, the potential experts were evaluated based on the point system described hereinabove. Table 3 shows the qualifications of the panelists along with the points obtained. Three participants were eliminated from the study. Panelist #2 and Panelist #10 did not have a higher education and were, therefore, eliminated from the expert panel. Panelist #3 only had one year of professional experience and was, therefore, eliminated from the expert panel as well. The remaining 15 panelists had all obtained the required education (bachelor's degree or higher), experience (10 years or more of professional experience), and qualifications (scored 15 points or more) and were, therefore, qualified for inclusion in the expert panel utilized for the present study.

Table 3. Qualifications of the Delphi panelists.

Panelist	Job Title	Education	Experience (Years)	Professional Registration/Certificate	Committee Chair (Count)	Committee Member (Count)	Articles (Count)	Conference Presentation (Count)	Points Earned
Panelist #1	Safety manager	Bachelor's degree (BS)	25	-	1	3	-	6	38
Panelist #2	Owner	High school	24	-	1	1	-	-	28
Panelist #3	Vice president	Master's degree (MS)	1	-	1	2	-	-	12
Panelist #4	PE	Master's degree (MS)	27	PE	-	1	2	-	41
Panelist #5	Safety manager	Bachelor's degree (BS)	25	CHST	-	3	-	-	35
Panelist #6	Safety manager	Bachelor's degree (BS)	10	PE	-	-	-	2	18
Panelist #7	Safety consultant	Doctor of Philosophy (PhD)	44	CHST	2	2	-	101	115.5
Panelist #8	Safety manager	Bachelor's degree (BS)	12	CHST/CSP	1	1	-	5	28.5
Panelist #9	Safety manager	Bachelor's degree (BS)	30	CSM/CSMC	1	3	3	3	53.5
Panelist #10	Safety manager	High school	26	-	-	3	-	-	29
Panelist #11	Safety president	Master's degree (MS)	12	CHST/CSP	-	3	-	3	28.5
Panelist #12	Safety manager	Bachelor's degree (BS)	15	CHST	-	2	-	25	36.5

Table 3. *Cont.*

Panelist	Job Title	Education	Experience (Years)	Professional Registration/Certificate	Committee Chair (Count)	Committee Member (Count)	Articles (Count)	Conference Presentation (Count)	Points Earned
Panelist #13	Safety manager	Bachelor's degree (BS)	28	-	-	1	-	1	33.5
Panelist #14	Safety engineer	Bachelor's degree (BS)	20	-	-	1	-	-	25
Panelist #15	Safety manager	Bachelor's degree (BS)	39	OSHT/CHST	2	2	-	10	62
Panelist #16	Vice president	Master's degree (MS)	30	CHST/CSP	-	-	-	12	48
Panelist #17	Safety and risk advisor	Bachelor's degree (BS)	25	CHST/CSP/ ARM/CPCU	-	1	-	50	67
Panelist #18	Vice president	Doctor of Philosophy (PhD)	25	-	-	-	1	15	44.5

4. Results

This section of the manuscript describes the survey rounds performed as part of the Delphi process.

4.1. Round 1: Identification of Qualifications for Construction Safety Personnel

After selecting a panel of qualified experts, a round of Delphi process was carried out. In this survey round, the expert panel was asked to determine the minimum qualifications needed (education, experience, and certificate) for three typical construction safety positions (safety entry position, safety professional position, and safety manager position). To be specific, the expert panelists were asked to determine the minimum education, years of professional experience, and certification required for construction safety personnel holding one of the three safety positions described hereinabove. Table 4 shows the questions asked to the panel of experts on the desired qualifications of construction safety personnel based on the position held.

Table 4. Desired qualifications for construction safety personnel.

Position	Education	Experience	Certification
	Select the Minimum Education Required	**Select the Minimum Years of Relevant Experience Required**	**Select the Most Appropriate Certification(s) Required for Each Position**
Entry Safety Position (or equivalent)	☐ High school ☐ Apprenticeship ☐ 2-year degree ☐ 4-year degree ☐ Bachelor's degree ☐ Graduate degree	☐ Internship experience ☐ 1–3 years of experience ☐ 3–5 years of experience ☐ 5–7 years of experience ☐ 8–10 years of experience ☐ 10+ years of experience	☐ No certification required ☐ Construction Health and Safety Technician (CHST) ☐ Graduate Safety Practitioner (GSP) ☐ Occupational Health and Safety Technologist (OHST) ☐ Certified Safety Professional (CSP) ☐ Certified Industrial Hygienist (CIH) ☐ Professional Engineer (PE) ☐ Other, please specify _____
Safety Professional Position (or equivalent)	☐ High school ☐ Apprenticeship ☐ 2-year degree ☐ 4-year degree ☐ Bachelor's degree ☐ Graduate degree	☐ Internship experience ☐ 1–3 years of experience ☐ 3–5 years of experience ☐ 5–7 years of experience ☐ 8–10 years of experience ☐ 10+ years of experience	☐ No certification required ☐ Construction Health and Safety Technician (CHST) ☐ Graduate Safety Practitioner (GSP) ☐ Occupational Health and Safety Technologist (OHST) ☐ Certified Safety Professional (CSP) ☐ Certified Industrial Hygienist (CIH) ☐ Professional Engineer (PE) ☐ Other, please specify _____

Table 4. *Cont.*

Position	Education	Experience	Certification
	Select the Minimum Education Required	**Select the Minimum Years of Relevant Experience Required**	**Select the Most Appropriate Certification(s) Required for Each Position**
Safety Manager Position (or equivalent)	☐ High school ☐ Apprenticeship ☐ 2-year degree ☐ 4-year degree ☐ Bachelor's degree ☐ Graduate degree	☐ Internship experience ☐ 1–3 years of experience ☐ 3–5 years of experience ☐ 5–7 years of experience ☐ 8–10 years of experience ☐ 10+ years of experience	☐ No certification required ☐ Construction Health and Safety Technician (CHST) ☐ Graduate Safety Practitioner (GSP) ☐ Occupational Health and Safety Technologist (OHST) ☐ Certified Safety Professional (CSP) ☐ Certified Industrial Hygienist (CIH) ☐ Professional Engineer (PE) ☐ Other, please specify _____

Before discussing the results of this round of the survey, it is necessary to clarify to the reader the differences among a safety entry position, a safety professional, and a safety manager. A safety entry position is an individual that aims to assist a project superintendent and other safety personnel in managing the safety program within a project. Some of the responsibilities for an entry-level position include maintaining record keeping, coordinating training for employees, managing safety data sheets, providing safety talks, conducting walk-through safety inspections, and administering safety investigation program [19]. A safety professional is a process-type person assigned to lead an individual project. The responsibilities of a safety professional include, among others, providing safety training to employees, performing job hazard analyses, implementing safety measures to protect employees and mitigate workplace hazards, approving hot-work/cold-work/confined-space permits, and leading emergency management responses [19]. A safety manager is an individual that oversees corporate operations and works with senior management within an organization to ensure organizational compliance with safety laws, rules, and regulations. Safety managers typically mentor safety professionals and lead them in career advancement. The responsibilities of a safety manager include, among others, designing and implementing a safety management program, facilitating regulatory visits, developing and providing safety trainings, evaluating safety programs and implementing corrective actions, developing and managing safety budgets, and managing workers' compensation claims [19].

With respect to education, 60% (9 out of 15 panelists) of the expert panel indicated that a high-school diploma should be required for a safety entry position. Two experts (13.33%) indicated that an apprenticeship program should be required. Similarly, 13.33% (2 out of 15 panelists) of the expert panel indicated that a 2-year degree/program is required, and the same percentage selected a bachelor's degree as the minimum education requirement for a safety entry position. Regarding years of minimum experience required for a safety entry position, 80% (12 out of 15 panelists) of the expert panel selected 1–3 years. Only 20% (3 out of 15 panelists) of the expert panel said an internship experience could be adequate for an individual holding a safety entry position. Concerning the certification required for a safety entry position, 100% of the expert panel indicated that no certification is required for this position. That being said, a few panelists said that an OSHA 500 course or an OSHA 10 h training could be a plus.

For the safety professional position, 40% (6 out of 15 panelists) of the expert panel indicated that a 4-year or bachelor's degree should be required. A total of 4 out of 15 panelists (26.66%) said that a 2-year program degree/program is adequate. The same percentage (26.66%) suggested that a high-school diploma is acceptable, and only one panelist (6.67%) said an apprenticeship program should be acceptable as well. Regarding years of professional experience, there was higher consensus on these questions. To be specific, 73.33% (10

out of 15 panelists) said 3–5 years should be set as a requirement for safety professionals. A total of 2 panelists (13.33%) indicated that 5–7 years of experience should be required. Only 1 panelist (6.66%) was less-demanding than most of the panelists selecting 1–3 years as an acceptable experience, while 1 panelist (6.66%) demanded that safety professionals have 8–10 years of professional experience. With respect to certification requirements, 66.66% (10 out of 15 panelists) of the expert panel said a graduate safety practitioner (GSP) certification or construction health and safety technician (CHST) certification could be required, while 33.34% (5 out of 15 panelists) indicated that no certification should be required.

For the safety manager position, slightly higher qualifications were recommended by the expert panel. Concerning the minimum education level required, 53.34% (8 out of 15 panelists) of the experts recommended a 4-year or bachelor's degree. Three experts (20%) said a two-year program/degree could be adequate, and four experts (26.66%) selected lower requirements indicating that even a high-school diploma could be adequate if combined with passion and prior experience. With respect to prior experience, 46.66% (7 out of 15 panelists) of the expert panel stated that 5–7 years of professional experience is adequate for safety managers. A total of 6 (40%) out of the 15 panelists demanded 8–10 years of experience, while 2 panelists considered 3–5 years of experience adequate for successful safety managers. For certification requirements, the frequency of responses was as follows: ten experts (66.67%) selected CHST as a required certification for safety managers; eight experts (53.33%) selected certified safety professional (CSP); five experts (33.33%) selected GSP; three experts (20%) stated "no certification required"; and two experts (13.33%) selected occupational health and safety technologist (OHST). It should be noted that some participants selected more than one certification as an alternative requirement for other certifications.

4.2. Round 2: Panel Feedback on Identified Qualifications for Construction Safety Personnel

Relying on the responses collected from the previous Delphi round (Round 1), a list of initially desired qualifications for three safety positions (safety entry, safety professional, and safety manager) was developed as shown in Table 5. It should be noted that the initially desired qualifications were selected based on the frequency of responses. That is, higher responses from the prior round of the Delphi process were selected as initially desired qualifications for construction safety personnel.

Table 5. Initial qualifications for construction safety personnel.

Position	Required Education	Required Experience	Required Certification
Entry Safety (or equivalent)	High-school diploma	1–3 years	No certification required
Safety Professional (or equivalent)	Bachelor's or equivalent 4-year degree	3–5 years	CHST or GSP
Safety Manager (or equivalent)	Bachelor's or equivalent 4-year degree	5 years or more	CHST or CSP

To validate the findings and ensure a high consensus among the panelists, the findings were given back to the expert panel members, and they were asked to declare if they agree or disagree with the findings shown in Table 4. Moreover, the expert panel members were asked to justify their responses in case they disagreed with the findings. In this round of the survey, only 13 panelists answered the questions and provided feedback. Two panelists did not respond to the survey and decided to opt out from the study. This is not uncommon in Delphi studies as some of the panelists drop out of the course of the study for multiple reasons including being busy or unavailable at the time of the survey [31–35].

After collecting the responses, it was found that (1) all the panel members agreed with the qualifications for the entry safety position, and (2) only 53.85% (7 out of 13 panelists) of the panel agreed with the qualifications for the safety professional and safety manager positions. The level of agreement (consensus) is presented in Table 6. The consensus level is believed to be relatively low for a Delphi study as Delphi studies usually aim for high

consensus levels [30,37,42]. When those who disagreed with the findings were asked about the reason behind their disagreement, they stated that using the term "required" is "too strong and sets a high bar for the industry." One of the panelists stated "I fully agree with the above [Table 4] being great goals to aim for but [I] also think saying some of these are minimums or required is too strong of a stance. Requiring the 4-year degree for the safety professional position is a strong threshold that will be hard in the industrial construction environment and would eliminate quite a few great safety professionals already in the workforce pool. Again, [the identified qualification is] a great goal but I don't feel it is realistic when you consider skill sets and many clients looking for contractor to staff their projects with safety professionals with like experience holding more weight than education". Another panelist wrote "three or four letters after your name does not mean much in the field [if you do not have the required experience]. Companies who look exclusively for CSPs or CHSTs may only be getting a book smart person who has no concept of what he or she is applying for. [It is highly recommended but should not be required that safety personnel possess a certification.] While employed, it would be beneficial for a company to put their safety personnel through certification courses after they have worked in the field and understand their certification will be applicable towards the goals of their job". Another panelist indicated that he supports the findings of the study, but, as a safety manager, he feels that he may not be always able to uphold to these standards as minimums and be successful in staffing projects with the best people for the job. He indicated that some of the requirements are too high for some sectors of the industry.

Table 6. Agreement of the panel on the initial qualifications for construction safety personnel.

Position	Required Education	Required Experience	Required Certification	Agreement (Consensus)
Entry Safety (or equivalent)	High-school diploma	1–3 years	No certification required	100%
Safety Professional (or equivalent)	Bachelor's or equivalent 4-year degree	3–5 years	CHST or GSP	53.85%
Safety Manager (or equivalent)	Bachelor's or equivalent 4-year degree	5 years or more	CHST or CSP	53.85%

4.3. Round 3: Achieving Consensus on Qualifications for Construction Safety Personnel

As evident from the comments and feedback, some members of the expert panel did not agree that the qualifications presented in Table 5 should be mandatory or required for construction safety personnel. Instead, they believed that these qualifications are important goals to aim for and should be recommended, not required. Accordingly, another round of the Delphi process was carried out. The purpose of this survey round was to achieve consensus on the survey findings. Because seeking additional participants did not make sense, the research team simply conducted another round of Delphi (i.e., the third round) with the same group of participants to ensure a high level of consensus among the study panel. To better clarify this procedure and make it clear to the readers that the research team did not seek to collect additional participants in the third round of Delphi, this text was added.

In this additional survey round, the research team kept the qualifications as they were but changed the term "required" to "recommended" as the panelists indicated in their comments and feedback. Table 7 shows the level of agreement (consensus) of the panelists on the revised qualifications for construction safety personnel. The results indicate that (1) all the panel members agreed with the recommended qualifications for the safety entry position; (2) 84.62% of the panel members (11 out of 13 panelists) agreed with the recommended qualifications for the safety professional position; and (3) 92.31% of the panel members (12 out of 13 panelists) agreed with the qualifications for the safety manager position. The results of this round of the Delphi method reveal a high consensus level within the expert panel on the desired qualifications (education, experience, and certification) for

construction safety personnel. Therefore, the findings of the final Delphi round shown in Table 7 were adopted by the present study because consensus among the panel members was reasonably high.

Table 7. Agreement of the panel on the revised qualifications for construction safety personnel.

Position	Recommended Education	Recommended Experience	Recommended Certification	Agreement (Consensus)
Entry Safety (or equivalent)	High-school diploma	1–3 years	No certification required	100%
Safety Professional (or equivalent)	Bachelor's or equivalent 4-year degree	3–5 years	CHST or GSP	84.62%
Safety Manager (or equivalent)	Bachelor's or equivalent 4-year degree	5 years or more	CHST or CSP	92.31%

It should be noted that, based on the feedback from the panel of experts, education can be in any field related to construction safety, and, in the same manner, experience can be in any aspect of the construction industry, not specific to occupational safety. To be specific, 93.34% (14 out of 15 panelists) of the expert panel said that education could be in any closely related field to construction safety, such as civil engineering, construction engineering, construction management, and environmental engineering. Similarly, 86.67% (13 out of 15 panelists) of the expert panel stated that experience can be related to construction in general and does not have to be specific to construction safety.

5. Validation

As indicated previously in this manuscript, the research process adopted was the Delphi technique, which by its nature relies heavily on the perception of subject-matter experts. Accordingly, it is possible that the research findings present some biases and subjectivity and may not be acceptable to a high proportion of industry stakeholders and be generalized across the entire US construction industry. To mitigate such a possibility, the research findings were tested and examined with feedback from industry experts who were, at the time of conducting the study, responsible for hiring and managing safety personnel in the construction industry. It should be noted that the study objective was to identify the qualifications of safety personnel in the US construction industry and was not to validate such findings. Because of this, the testing and validation of the findings will remain brief. The validation process followed the steps used by prior research to validate initial research findings in the construction industry [43].

Validating research findings with industry feedback can be an important step in ensuring that research is relevant, impactful, and actionable. Here are some general steps used to validate the research findings. First, the appropriate stakeholders who have the knowledge, expertise, and experience to provide feedback, such as safety professionals and safety managers, were identified. Second, the set of questions used to validate the research findings and collect feedback from the industry stakeholders was developed. Communicating the questions effectively and in a concise manner helped achieve the purpose of the validation process. Third, feedback was solicited through structured interviews and online questionnaires. Structured interviews were the first option, and only if the participants were not available for a structured interview was the alternative option (i.e., online questionnaire) adopted. Structured interviews were preferred due to their ability to allow for in-depth discussions in which they can help to identify areas where the research may need to be refined or improved. Four, the conclusion on the validation process was reported, and revisions were implemented into the research findings based on the feedback and recommendations of the abovementioned process. It is believed that following this validation process can effectively validate the research findings with industry feedback, ultimately leading to more impactful and actionable research that can better serve the needs of industry stakeholders.

Initially, the study aimed to obtain feedback from ten industry stakeholders but only nine individuals were able to participate. The individuals who participated were safety managers, safety presidents, and senior safety consultants, who, at some point in their career, were responsible for hiring and managing safety personnel at construction sites. The participants were highly experienced and educated. All of them have a bachelor's degree or higher degree in a related field to construction safety. The average professional experience in the field of construction and/or safety was 14 years. Five of the participants were interviewed through a structural set of questions after providing a description of the research that included a description of the study, study objective, methodology used, and research findings revealed. The remaining four participants were unable to participate in a one-to-one interview and therefore read the description of the research and answered the questions through an online questionnaire.

The result of the validation process is illustrated in Table 8 and indicates that there is a common belief among the industry stakeholders who participated in the validation process that the study is valid (i.e., there is a need for the study; the methodology used is appropriate; and the findings make sense and are reasonably implementable in practice with reasonable resources). One of the participants stated, "It is important to have specific qualifications for construction safety personnel to ensure a safe work environment. I see a great value of this study". Another participant stated, "Qualifications are necessary to ensure that construction safety personnel have the knowledge and skills to do their job effectively and therefore providing guidelines on what qualifications are useful for the industry is helpful".

Table 8. Validation questions and results.

Validation Criteria	Disagree				Neutral				Agree		Average
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**8.33**
Q1. There is a significant need for this study.	_	_	_	_	_	_	1	4	4	_	8.11
Q2. Objective, methodology, findings, and recommendations of the study are easy to follow and understand.	_	_	_	_	_	_	1	6	2	_	8.11
Q3. The recommended qualifications for construction safety personnel are acceptable to a large proportion of industry stakeholders.	_	_	_	_	_	1	3	3	2	_	7.66
Q4. The study findings and recommendations make sense and are consistent with the industry's direction.	_	_	_	_	_	1	4	4	_	_	7.33
Q5. The study recommendations can be implemented in practice with reasonable effort and resources.	_	_	_	_	1	1	3	3	1	_	7.22
Q6. The study makes a significant contribution to knowledge and/or practice in construction safety.	_	_	_	_	_	3	2	2	2	_	7.33
Q7. The study is a valuable reference for decision makers responsible for managing and hiring construction safety personnel.	_	_	_	_	_	_	3	4	2	_	7.88
Q8. I recommend continued development and further research on the topic.	_	_	_	_	_	_	1	5	3	_	8.22

However, one revision was found to be necessary as this statement from one of the participants clarifies: "While some qualifications may be helpful, they should not be mandatory. The term "required/recommended qualifications" should be re-considered". Two other participants emphasized a similar point, and another indicated that "while

qualifications may be important, they should not be the only consideration in hiring construction safety personnel". Based on the feedback received in the validation process, the use of the terms "required qualifications" and "recommended qualifications" was revised to "desired qualifications". This would better indicate that the identified qualifications are optional and desirable rather than required. Construction organizations can choose to revise the identified qualifications based on their needs and requirements.

6. Contribution

The findings of the study provide a theoretical contribution to the body of knowledge on construction safety and present practical guidelines to assist industry stakeholders select qualified safety personnel for their projects—all of which is expected to reflect positively on the industry and contribute to a reduction in workplace injuries and fatalities throughout the construction industry. Existing literature on the topic, such as the ASSP Employer's Guide to Hiring a Safety Professional, does not discuss the qualifications of safety personnel in the context of construction projects. Instead, the existing body of literature provides some general guidelines that may not be applicable to the construction industry. For instance, the existing body of literature [19] recommends CLCS and CFPS certificates for safety professionals/practitioners. These certificates are not applicable to the construction industry and are rarely, if ever, attained by construction personnel. Accordingly, the present study provides insights on required qualifications for safety personnel that are directly applicable to the construction industry. This means that the present study complements ASSP The Employer's Guide to Hiring a Safety Professional [13] and previous research [11] on the topic. An improved selection of qualified construction safety personnel can contribute to avoiding jobsite accidents and is particularly crucial in critical times, such as a pandemic [44,45].

7. Limitations

The study has multiple limitations that should be acknowledged. First, the study relied on the perceptions of a panel of experts. Relying on the perception of individuals introduces potential bias and subjectivity in the study findings. That being said, it is believed that such bias and subjectivity were mitigated by the fact that the study panelists were carefully selected and vetted using certain requirements recommended by prior studies (described previously in this study) to ensure that they are subject-matter experts on the topic. Second, the findings of the Delphi study are sometimes criticized for being subjective and do not include empirical data collected from the field. To overcome this limitation, a validation study involving a questionnaire of industry stakeholders that aimed at validating the findings of the Delphi method was carried out. Third, the study may have revealed findings that are comfortable to managers and top management, and that are based on the opinion of the majority of the participants. It is possible that frontline employees may disagree, partially or fully, with the findings of the study.

Although the results of the Delphi process led to the identification of the desired qualifications for construction safety personnel, it should be acknowledged that predicting the future is a complex process. The research method used (i.e., Delphi method) has its limitation in predicting the future, and the desired qualifications provided by the present study may or may not be suitable for every single situation. The study findings provide a framework for decision making by offering some suggestions on the desired qualifications of construction safety personnel in the United States. Decision makers should consider the broader context and consult with relevant experts and stakeholders when making important decisions, such as hiring qualified construction safety personnel. The desired qualifications of construction safety personnel provided by the present study can serve as a starting point for decision making and can be refined and updated as new information emerges.

8. Conclusions

Construction as a profession suffers from high rates of incidents in the workplace. Prior research found that many of these incidents can be prevented by implementing an effective safety plan [12]. Safety personnel play a key role in the successful development and implementation of an effective safety plan. That being said, there is no consensus or guidelines on the desired qualifications (education, experience, and certification) for construction safety personnel holding different safety positions despite their importance. To fill this gap in knowledge, the goal of the present study was to identify the desired qualifications of safety personnel in the US construction industry and provide a way to qualify construction safety personnel.

To achieve the goal of the study, the Delphi process that consisted of four rounds of survey was utilized. Before distributing the survey, a panel of experts consisting of 15 members that are highly experienced was selected following guidelines from prior studies on how to select qualified subject-matter experts for a Delphi study. However, in subsequent rounds of the survey, 2 members of the panel opted out from the study leaving a panel of 13 experts, which was still adequate for the Delphi process based on prior studies [31,38,42].

The results of the Delphi process led to the identification of the desired qualifications for three safety positions in the construction industry—safety entry, safety professional, and safety manager. The desired qualifications included education level, number of professional years of experience, and certification/registration guidelines as shown in Table 9. Industry stakeholders, especially general contractors interested in achieving improved safety performance and attaining qualified safety personnel, can, fully or partially, adopt the findings of the present study to positively impact the output of their projects.

Table 9. Desired qualifications for construction safety personnel.

Position	Desired Education	Desired Experience	Desired Certification
Entry Safety (or equivalent)	High-school diploma	1–3 years	No certification required
Safety Professional (or equivalent)	Bachelor's or equivalent 4-year degree	3–5 years	CHST or GSP
Safety Manager (or equivalent)	Bachelor's or equivalent 4-year degree	5 years or more	CHST or CSP

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