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Using the Delphi Method to Identify Causes of High Suicide Rates among Construction Workers

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Abstract

Suicide rates among construction workers remain significantly higher than those observed in most other occupational sectors, yet the contributing factors are not well integrated into construction safety education or professional practice. Traditional safety approaches primarily emphasize physical hazards and regulatory compliance, while psychosocial and organizational contributors to suicide risk remain insufficiently examined. Unlike prior epidemiological studies, this work provides expert-derived prioritization, employing a modified Delphi method to systematically identify and prioritize factors associated with elevated suicide risk among construction workers.

A multidisciplinary panel of 30 experts in the United States from construction safety, engineering, mental health, labor, regulatory agencies, and industry participated in a three-round Delphi process. Round 1 used open-ended qualitative elicitation to identify contributing factors. Round 2 applied quantitative ratings using a 10-point Likert scale to assess perceived impact and consensus. Round 3 required experts to rate the most influential factors to establish relative priority.

Results indicate that depression emerged as the most critical proximal risk factor, achieving high priority and strong consensus despite being infrequently mentioned in initial qualitative responses. Other high-priority contributors included personal life stressors, substance abuse, financial instability, and post-traumatic stress among veterans, reflecting the interaction between individual vulnerability and occupational stressors. Organizational and lifestyle factors, such as demanding schedules, work conditions, limited career pathways, lack of health insurance, and insufficient workplace appreciation, were perceived as more distal or chronic contributors.

The findings reinforce that suicide risk in construction is multifactorial and cumulative. From an engineering education and practice perspective, the study highlights the need to broaden construction safety frameworks to incorporate mental health awareness, psychosocial risk management, and workforce sustainability.

Keywords: Delphi; construction worker; suicide; cause; mental health

1 Introduction

The construction industry consistently reports one of the highest suicide rates among all occupational sectors in the United States [1]. Based on the 2021 National Vital Statistics System (NVSS), major U.S. industry suicide rates show construction with 56.0 suicides per 100,000 male workers and 10.4 suicides per 100,000 female workers [2]. All industries (civilian noninstitutionalized working population) report 32.0 per 100,000 males and 8.0 per 100,000 females, as shown in Figure 1. Specifically, construction was second only to mining, quarrying, and oil & gas extraction in overall industry suicide rates [2]. In 2021, almost a fifth (17.9%) of deaths by suicide with a reported industry code were in construction, despite construction workers accounting for only 7.4% of the workforce [1]. Male construction workers accounted for a majority (97.8%) of suicide deaths.

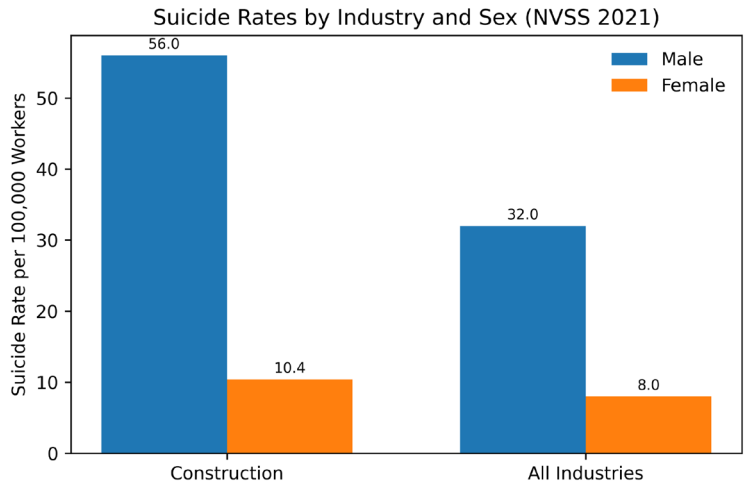


Figure 1: Suicide rate comparison.

Recent national surveillance data indicate that suicide deaths among construction workers far outnumber fatalities caused by traditional workplace hazards, underscoring suicide as a critical but often under-recognized safety issue [3]. While physical safety risks in construction have been extensively studied and addressed through engineering controls and regulatory frameworks, the underlying psychosocial and organizational contributors to suicide risk remain less systematically examined [4]. Indeed, Construction work is characterized by a unique combination of stressors, including job insecurity, physically demanding labor, long and irregular work hours, chronic pain and injury, and a workplace culture that often discourages help-seeking behaviors [5]. These conditions may interact with personal and social factors, such as financial strain, substance use, and family stress, to increase vulnerability to mental health crises [6], [7]. Despite growing awareness of these challenges, existing research on construction-related suicide risk is fragmented across public health, psychology, and occupational safety disciplines, limiting the development of coordinated prevention strategies.

From an engineering education and practice perspective, this gap is particularly consequential. Engineers, construction managers, and safety professionals play a central role in shaping work environments, project schedules, and organizational cultures that influence worker well-being [8], [9]. However, formal education and training programs in construction and safety engineering have traditionally emphasized physical hazards and compliance-based safety management, with comparatively limited attention to mental health, psychosocial risk factors, and suicide

prevention [10], [11]. As a result, future professionals may be underprepared to recognize and address the complex, non-physical risks that contribute to worker harm.

Current empirical studies and systematic reviews consistently identify employment precarity and job insecurity, physically demanding work with high injury and chronic pain prevalence, long and irregular work hours, financial strain, and limited access to stable healthcare as key contributors to psychological distress in the construction workforce [4], [5], [12]. Additionally, industry-specific cultural norms emphasizing masculinity, self-reliance, and toughness have been shown to discourage help-seeking and mental health disclosure, further exacerbating suicide risk [3], [6], [7]. However, despite robust epidemiological evidence documenting elevated suicide rates among construction workers, the literature lacks consensus on the relative importance, causal pathways, and interactions among these factors. Most existing studies are cross-sectional or descriptive, vary widely in the measurement of psychosocial exposures, and rarely integrate organizational, economic, cultural, and health dimensions into unified explanatory models, leaving the mechanisms underlying elevated suicide risk in construction incompletely understood [13], [14], [15], [16].

Therefore, the purpose of this study is to systematically identify and prioritize factors contributing to high suicide rates among construction workers using a modified Delphi Method. By combining qualitative elicitation with quantitative consensus-building, the study seeks to (1) confirm the relative importance of established risk factors reported in the literature, (2) uncover under-recognized or emerging contributors identified by experts, and (3) provide an evidence-informed foundation to support targeted interventions, workforce training, and curriculum development. Moreover, the Delphi method, in particular, enables structured synthesis of multidisciplinary expertise in contexts where empirical data are incomplete or difficult to obtain. By iteratively refining expert judgments, the method facilitates the identification and prioritization of factors that may not be fully captured through traditional surveys or injury databases. In the context of construction suicide, such an approach allows for the integration of insights from safety practitioners, mental health professionals, engineers, and industry stakeholders.

Building on the need for a structured understanding of suicide risk in construction, the implications of this study extend directly to engineering education and professional preparation. Construction engineering and safety curricula have traditionally emphasized physical hazards, regulatory compliance, and technical control measures, with comparatively limited integration of psychosocial risk management and mental health awareness. Yet engineers and project managers shape schedules, resource allocation, supervision practices, and workplace culture, system-level decisions that directly influence worker well-being. By systematically identifying and prioritizing suicide-related risk factors, this study seeks to provide an evidence-informed foundation for expanding construction safety education to incorporate mental health literacy, psychosocial hazard recognition, and workforce sustainability as core components of professional competency.

2 Methodology

This study employed a modified Delphi Method to systematically identify and prioritize factors contributing to elevated suicide risk among construction workers. A three-round Delphi process was adopted to integrate qualitative exploration with quantitative prioritization while minimizing groupthink through anonymous participation. The modified design combined open-ended

qualitative elicitation (Round 1) with iterative quantitative rating and ranking (Rounds 2 and 3). The overall workflow of the Delphi process is illustrated in Figure 2.

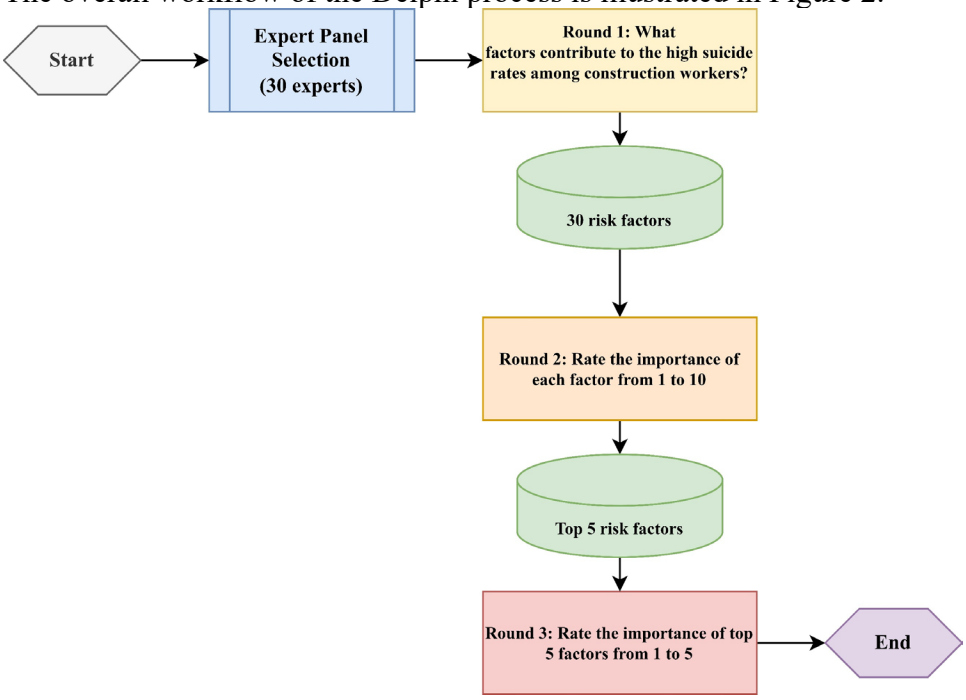


Figure 2: Methodology framework.

2.1 Expert Panel Selection

A purposive sampling strategy was adopted to recruit a multidisciplinary panel of experts with direct knowledge relevant to construction work, occupational safety, and mental health. In Delphi research, panel quality is determined by expertise and diversity rather than statistical representativeness. Accordingly, participants were selected based on their ability to provide informed professional judgment on suicide risk factors within the construction context.

To ensure credibility and substantive expertise, the following inclusion criteria were applied:

i. A minimum of five years of professional experience in construction, safety management, occupational health, mental health counseling, labor representation, or regulatory oversight;
ii. Direct engagement with construction workers or workforce well-being issues;
iii. Willingness to participate in all three Delphi rounds to maintain response continuity.

The five-year experience threshold was selected to ensure participants had sufficient exposure to industry practices and workforce challenges to provide informed judgments. Because suicide risk in construction is a multifactorial issue involving psychosocial, organizational, and occupational dimensions, the panel was intentionally composed of professionals from diverse but relevant domains, including construction safety managers, engineers, project managers, mental health and environmental health practitioners, union representatives, regulatory professionals, and family members of experienced construction workers. This multidisciplinary composition enhances consensus robustness by integrating perspectives across operational, managerial, and clinical contexts.

A total of 35 experts were initially contacted, and 30 completed all three Delphi rounds. Delphi methodological literature commonly recommends panel sizes ranging from approximately 15 to 35 participants for heterogeneous expert groups, emphasizing expertise and diversity over

statistical representativeness. Therefore, the final panel size of 30 aligns with established best-practice guidance while ensuring sufficient disciplinary breadth and depth of insight. Participant anonymity was maintained throughout the study to reduce conformity pressure and social desirability bias, which are recognized concerns in consensus-based methodologies.

2.2 Delphi Procedure

2.2.1 Round 1: Qualitative Elicitation

In Round 1, experts participated in individual, semi-structured interviews conducted via telephone, online meeting, or in person. Participants responded to the open-ended research question and were encouraged to draw on professional experience and observations. The overarching research question guiding this study is: *What factors contribute to the high suicide rates among construction workers?*

In the Delphi design, this research question was operationalized directly as the Round 1 qualitative elicitation prompt. Therefore, participants were asked this question verbatim during interviews. This approach is consistent with established Delphi methodology, where the primary research question often serves as the initial open-ended inquiry to generate a comprehensive range of expert-informed factors before subsequent rounds of structured evaluation and prioritization.

In addition, this question was intentionally broad to capture psychosocial, organizational, and occupational dimensions of suicide risk, while allowing experts to introduce novel perspectives not previously emphasized in existing research. Responses were anonymized and transcribed verbatim.

Qualitative data were analyzed using content analysis. Similar responses were grouped, duplicate factors were consolidated, and emergent factors not previously emphasized in the literature were retained. The output of Round 1 was a consolidated list of 30 contributing factors, which formed the basis for subsequent quantitative rounds.

2.2.2 Round 2: Quantitative Rating

In Round 2, experts rated each of the 30 contributing factors using a 10-point Likert scale, where 1 indicated the highest perceived impact on suicide risk, and 10 indicated the lowest. Participants were invited to provide brief explanatory comments to contextualize their ratings.

Descriptive statistics were calculated to assess both perceived importance and consensus. Median values were used to indicate factor importance, while the interquartile range (IQR) was used to assess variability in expert opinion. A priori consensus thresholds were defined as:

i. Median ≤ 3 (high perceived impact);
ii. IQR ≤ 2 (high agreement among experts).

In addition, mean scores were calculated to identify the top five factors for further ranking in Round 3.

2.2.3 Round 3: Final Ranking

In Round 3, experts were presented with the five highest-ranked factors identified in Round 2 and asked to rank them from most to least impactful using a 5-point ranking scale, where 1 indicated the highest perceived impact, and 5 indicated the lowest.

While Round 2 established relative importance and consensus using rating-based statistics (mean, median, and IQR), factors with similarly low scores remained clustered in priority. Round 3 was therefore designed to require forced ranking among the five highest-rated factors,

enabling clearer differentiation and hierarchical ordering. This step allows identification of the single most critical proximal contributor, which cannot be fully resolved through rating statistics alone in Round 2.

2.3 Ethical Considerations

In this study, participation was voluntary, and informed verbal consent was obtained from all participants before data collection. To protect confidentiality, participants were identified only by numerical codes, and no personally identifiable information was retained in the dataset. All study materials and data were stored on password-protected devices accessible only to the research team.

This study was reviewed and approved by the Institutional Review Board (IRB) at Indiana State University under Project Number 2372602-2, confirming that all procedures met ethical standards for research involving human subjects.

3 Results and discussion

3.1 Panel Experts

The study included a diverse group of experts from various fields. 30 participants were invited to take part through phone calls and in-person/online meetings. Specifically, of 35 experts, 5 did not respond to phone calls to meet for Round 1, leaving 30 experts who participated in the study. Of the 30 experts who completed all three Delphi rounds, 7 were project managers, 6 engineers, 6 safety managers, 4 mental health professionals, 3 union or labor representatives, 2 regulatory professionals, 1 environmental health specialist, and 1 family member of a construction worker. There were 16 men and 14 women aged 35 to 68. All participants lived in the United States and worked in their profession for at least 5 years.

3.2 Round 1: Identification of Contributing Factors

In Round 1, experts responded to an open-ended question regarding factors contributing to high suicide rates among construction workers. A sample record of the answer was as follows:

- *Traveling is one of the risk factors that I feel contributes to construction suicide. From what I know, they typically go from job to job, away from home, leaving family behind. Being away from them causes them to drink frequently. Also, in the field, they have to maintain a macho attitude, which prevents them from speaking to other co-workers.*

Content analysis of interview responses produced an initial list of 30 contributing factors (Table 1), encompassing personal, occupational, and organizational domains.

Table 1: Frequency of Risk Factors Mentioned by Experts.

Rank	Contributing Factors	Frequency Mentioned
1	Financial Struggles	17
2	Demanding Work Schedules	12
3	Work Conditions	10
4	Project Deadlines	7
5	Substance Abuse	7
6	Isolation	6
7	Struggles in personal life	4
8	Macho Attitude	4
9	Witnessing fatalities / serious injury	3
10	Gender	3
11	Depression	2
12	Limited mental health resources	2
13	Traveling for work	2
14	Ex-Military	2
15	Physical injuries	2
16	No work-life balance	2
17	No paid time off	2
18	Mental health issues	2
19	No health insurance	2
20	No career path after aging	2
21	Passed over for jobs	2
22	Cultural differences	1
23	Sleep deprivation	1
24	Burnout	1
25	Environmental hazards	1
26	Age	1
27	Pressures to stay within budget	1
28	Access to lethal means	1
29	No appreciation on the job	1
30	Not eating healthy	1

The results suggest that elevated suicide risk in construction is driven by a combination of interacting occupational and psychosocial stressors rather than a single dominant cause. First, financial struggles (17 mentions), the most frequently mentioned factor, reflect the economic instability and income volatility inherent in project-based construction work and may act as a persistent background stressor that heightens vulnerability during periods of personal or occupational strain. Subsequently, demanding work schedules (12 mentions) and challenging work conditions (10 mentions) further point to the role of work organization, long and irregular hours, physical fatigue, and chronic stress in eroding coping capacity over time. Similarly, the frequent co-mention of project deadlines and substance abuse highlights how production pressure may contribute to maladaptive coping behaviors that exacerbate mental health risk.
In addition to factors well documented in the literature, experts identified five under-recognized factors that were either absent or minimally discussed in prior research:

i. Lack of health insurance;
ii. Limited career pathways with aging;

iii. Perceived favoritism or nepotism;
iv. Lack of appreciation at work;
v. Unhealthy eating patterns.

These emergent factors suggest that suicide risk in construction may extend beyond traditionally cited stressors and include structural and career-related concerns that warrant further investigation.

3.3 Round 2: Quantitative Rating and Consensus Analysis

In Round 2, experts rated the 30 contributing factors using a 10-point Likert scale. Statistical analysis focused on measures of central tendency (mean, median) and dispersion (IQR) to evaluate both perceived impact and level of agreement, as shown in Table 2.

Table 2: Descriptive statistics for suicide risk factors.

Rank	Risk Factor	Mean	Median	Mode	Std Dev	IQR
1	Substance abuse	2.23	2.0	2	2.17	3.00
2	Depression	2.53	1.0	1	2.34	2.00
3	Financial struggles	2.87	2.0	2	1.94	1.00
4	Struggles in personal life	2.97	2.0	2	2.56	4.75
5	Ex-Military	3.37	3.0	1	2.40	4.00
6	Mental health issues	3.50	2.5	1	2.79	4.75
7	Physical injuries	3.77	4.0	3	2.36	3.00
8	Witnessing fatalities / serious injury	3.93	3.0	1	2.86	4.50
9	Macho attitude	4.07	4.0	3	2.05	2.00
10	Isolation	4.47	5.0	5	2.22	3.50
11	Limited mental health resources	4.80	4.5	5	2.56	2.75
12	Access to lethal means	5.20	4.5	1	3.75	7.00
13	Burnout	5.20	5.0	5	2.73	5.00
14	Demanding work schedules	5.27	5.0	5	2.64	4.75
15	No work-life balance	5.43	4.5	4	2.56	4.75
16	Age	6.13	5.5	8	2.60	4.00
17	Cultural differences	6.20	6.5	9	2.57	3.75
18	Environmental hazards	6.40	7.0	7	2.99	4.75
19	Gender	5.67	5.0	4	2.35	4.00
20	Project deadlines	6.63	7.0	7	2.39	3.75
21	No appreciation on the job	6.70	7.0	5	2.69	4.00
22	Traveling for work	6.73	7.0	7	2.13	2.00
23	Pressures to stay within budget	6.77	7.0	8	2.71	3.00
24	Passed over for jobs	6.93	7.5	9	2.86	4.50
25	No career path after aging	7.17	7.0	8	2.71	3.75
26	No paid time off	7.23	7.0	8	2.99	5.00
27	No health insurance	7.27	7.0	8	2.61	4.75
28	Work conditions	7.43	8.0	9	2.71	3.00
29	Sleep Deprivation	7.53	8.0	9	2.99	5.00
30	Not eating healthy	7.60	8.0	9	2.71	3.75

The rankings indicate that experts perceive suicide risk in construction as driven primarily by proximal, individual-level vulnerabilities, with substance abuse, depression, and financial struggles emerging as the highest-priority factors, reflected by the lowest mean ranks and strong

agreement across median and mode values. A second tier of factors, including personal life struggles, ex-military background with Post-Traumatic Stress Disorder (PTSD), broader mental health issues, physical injuries, and exposure to traumatic events, was viewed as important but with greater variability, suggesting less consensus on their relative impact. In contrast, organizational, structural, and lifestyle factors such as demanding schedules, project deadlines, work conditions, lack of work–life balance, limited career pathways, lack of benefits, sleep deprivation, and unhealthy eating were consistently ranked lower, indicating they are perceived as chronic or indirect contributors rather than immediate triggers.

Moreover, compared with Table 1, the results reveal a clear divergence between how often factors are mentioned and how severely they are perceived as suicide risk contributors, as shown in Figure 3. Using the predefined consensus criteria (median ≤ 3 and IQR ≤ 2), two factors reached strong consensus:

i. Depression (median = 1.0, IQR = 2.0);
ii. Financial struggles (median = 2.0, IQR = 1.0).

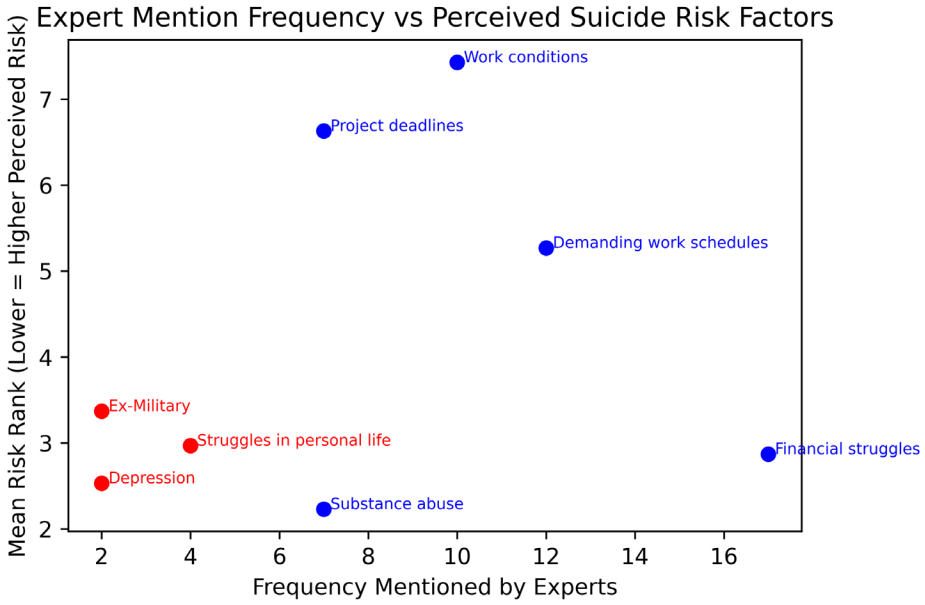


Figure 3: Comparison between the top 5 mentioned and top 5 rated factors.

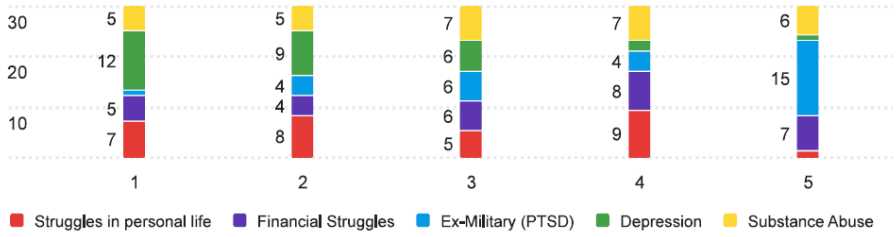
Importantly, although struggles in personal life, depression, and ex-military background/PTSD were mentioned less frequently by experts, they were rated as relatively more important contributors to suicide risk, as reflected by their low mean ranks and early placement in the severity ordering. This pattern indicates that while these factors may be less salient in spontaneous discussion, experts view them as high-impact, proximal risk factors when explicitly evaluated, highlighting a potential blind spot in prevailing construction safety and prevention discourse.

On the other hand, demanding work schedules and project deadlines occupied an intermediate position, with moderate to high mention frequency but substantially worse mean risk ranks, reflecting recognition of organizational pressures without agreement on their direct causal proximity to suicide. Notably, work conditions were frequently cited yet ranked lowest in perceived risk severity, suggesting they are viewed as distal or indirect contributors. Factors such

as struggles in personal life and ex-military background clustered at low frequency and moderate risk, highlighting population-specific vulnerabilities that may be under-recognized in broader discourse.

3.4 Round 3: Final Ranking of Key Contributing Factors

In Round 3, experts ranked the top five factors by importance identified in Round 2. Results demonstrated convergence toward a clear priority ordering, as shown in Figure 4.



Field	1	2	3	4	5
Struggles in personal life	7	8	5	9	1
Financial Struggles	5	4	6	8	7
Ex-Military (PTSD)	1	4	6	4	15
Depression	12	9	6	2	1
Substance Abuse	5	5	7	7	6

Figure 4: Rank of the top 5 risk factors.

First, depression stands out as the most strongly prioritized factor, with 12 respondents rating it as 1 (most important) and the majority of remaining responses clustered at low importance levels, indicating high consensus on its critical role in suicide risk. Struggles in personal life also show a clear skew toward high importance, with most ratings concentrated in levels 1–4 and relatively few low-importance ratings, suggesting it is viewed as a significant proximal risk when explicitly evaluated. In contrast, financial struggles and substance abuse display more evenly distributed ratings across the scale, reflecting their recognition as widespread and chronic stressors but with less agreement on their immediacy as suicide triggers. Moreover, ex-military status (PTSD) exhibits a polarized pattern, with a large concentration at the least important level (15 experts rated 5) when compared with the other four. This is quite different from the rating in Round 2, with a low mean (3.37).

Overall, experts converged on the view that depression represents the most critical proximal risk factor in construction worker suicide, with many other occupational, personal, and structural stressors acting as contributing or precipitating factors that intensify depressive symptoms, thereby increasing suicide risk.

3.5 Contrast with Prior Explanations in Literature

Prior research on suicide risk in construction has often emphasized occupational and structural explanations, including long and irregular work hours, job insecurity and income volatility, physically demanding work and injury/chronic pain, and psychosocial hazards embedded in project-based employment and organizational climate. Systematic reviews and meta-analysis consistently highlight these work-organization stressors as major correlates of psychological

distress and suicide-related outcomes in construction settings [4], [5], [9]. In addition, industry cultural norms (e.g., masculinity, self-reliance) have been noted as barriers to help-seeking and mental health disclosure, potentially amplifying risk when workers experience distress [6], [15]. Our Delphi results both align with and refine these prevailing explanations. Consistent with prior literature, experts recognized financial instability and occupational pressures as important contributors; however, when systematically rated and prioritized, the panel converged most strongly on depression as the highest-priority proximal risk factor, alongside substance abuse and personal life stressors. In contrast, work conditions, project deadlines, and other organizational factors were generally ranked as more distal or chronic contributors. This pattern suggests a pathway in which structural stressors (e.g., demanding schedules, job insecurity, limited benefits) may elevate risk primarily by exacerbating mental health vulnerabilities and reducing coping capacity, rather than acting as immediate triggers on their own. This distinction is important for construction engineering education and practice: it implies that effective prevention requires not only improving work organization and psychosocial hazard management (as emphasized in prior studies [8], [9]) but also building competence in recognizing and responding to depressive symptoms and related mental health crises as part of comprehensive safety practice.

3.6 Limitations and Implementation Considerations

Several limitations should be acknowledged. First, the findings reflect structured expert judgment rather than causal inference derived from longitudinal or experimental data. While the Delphi method is appropriate for synthesizing multidisciplinary expertise in emerging or complex domains, the results represent perceived importance rather than statistically validated causal pathways. Second, the expert panel was limited to professionals working in the United States, which may limit generalizability to other national or cultural contexts. Third, although purposive sampling strengthens domain relevance, it may introduce selection bias. Finally, consensus thresholds in Delphi research involve interpretive judgment, and alternative criteria might yield slightly different prioritizations. Future empirical research is needed to test and quantify the relationships identified in this study.

In addition, although the prioritization of suicide risk factors provides guidance for intervention, practical constraints within the construction industry may limit implementation. Construction work is often project-based, geographically dispersed, and characterized by temporary employment arrangements, making sustained mental health programming difficult to coordinate. High workforce mobility and subcontracting structures may reduce continuity of care and limit organizational accountability. Moreover, cultural norms emphasizing toughness and self-reliance can discourage help-seeking behaviors, even when resources are available. Limited access to employer-sponsored health insurance, particularly among smaller contractors, further constrains formal mental health support. These structural realities suggest that suicide prevention efforts must be adaptable, embedded within existing safety frameworks, and supported by both industry leadership and regulatory guidance to achieve meaningful impact.

In the meantime, it is important to acknowledge the cultural and structural context within which mental health discussions occur in construction environments. The industry operates under significant financial pressure, tight project schedules, regulatory and liability constraints, and increasing demands related to sustainability and emerging technologies. Within a culture that often emphasizes toughness, rapid problem-solving, and productivity under stress, admitting psychological distress may carry stigma, and well-being initiatives may encounter resistance. In this context, framing mental health awareness solely as an individual issue may limit engagement. Instead, positioning mental health as a leadership, risk management, and workforce

performance concern may enhance acceptance and practical implementation within engineering and construction settings.

Lastly, the prioritization of suicide risk factors carries important policy implications. For employers and industry leaders, the findings suggest the need to integrate mental health awareness into existing safety management systems, including supervisor training to recognize early signs of depression and substance misuse. Contractors and project managers may also consider reviewing scheduling practices and support mechanisms that influence workforce stress. For unions and labor organizations, the results highlight the importance of expanding peer-support programs, confidential reporting systems, and member education initiatives that reduce stigma and encourage help-seeking. Regulatory agencies and professional bodies may further consider incorporating psychosocial risk management and suicide prevention into construction safety guidelines, training standards, and continuing education requirements. While policy reform alone cannot eliminate suicide risk, coordinated action across industry, labor, and regulatory domains can strengthen the systemic response to mental health challenges in construction.

4 Conclusion

This study applied a modified Delphi method to systematically identify and prioritize factors contributing to the persistently high suicide rates among construction workers. By integrating open-ended qualitative elicitation with iterative quantitative rating and ranking across three Delphi rounds, the study synthesized multidisciplinary expert judgment in an area where empirical data alone remain fragmented. The results confirm that suicide risk in construction is multifactorial, emerging from the interaction of individual vulnerabilities, psychosocial stressors, and broader occupational and organizational conditions rather than a single causal factor.

Across all rounds, depression emerged as the most critical proximal risk factor, achieving both high priority and strong consensus despite being infrequently mentioned during initial open-ended responses. This finding highlights a key insight of the Delphi process: latent mental health conditions may be under-recognized in informal discourse but are widely acknowledged as central when experts engage in structured comparison. Other high-priority contributors, including personal life stressors, substance abuse, financial instability, and post-traumatic stress among veterans, further illustrate how personal vulnerabilities intersect with occupational pressures to elevate suicide risk.

Importantly, the study also identified several under-recognized systemic and career-related factors, such as limited career pathways with aging, lack of health insurance, perceived lack of appreciation, and inadequate organizational support. Although these factors were ranked lower in perceived immediacy, their presence underscores how long-term structural conditions may compound vulnerability over time and remain insufficiently addressed by traditional construction safety frameworks focused primarily on physical hazards and regulatory compliance.

From an engineering education and practice perspective, these findings underscore the need to expand the definition of construction safety to include mental health, psychosocial risk management, and workforce sustainability. Incorporating these dimensions into construction engineering, management, and safety curricula can better prepare future professionals to recognize suicide risk as part of comprehensive occupational safety practice. While the Delphi method reflects expert judgment rather than causal inference, this study provides an evidence-informed foundation for future empirical research, targeted interventions, and educational reform aimed at reducing suicide risk and improving overall well-being in the construction workforce.

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References

[1] W. Harris, A. B. Trueblood, T. Yohannes, C. P. Rodman, and R. Rinehart, "Suicides among construction workers in the United States, 2021," *Am. J. Ind. Med.*, vol. 68, no. S1, pp. S144–S151, Mar. 2025, doi: 10.1002/ajim.23632.

[2] A. Sussell, C. Peterson, J. Li, A. Miniño, K. A. Scott, and D. M. Stone, "Suicide Rates by Industry and Occupation-National Vital Statistics System, United States, 2021," ., vol. 72, no. 50, Dec. 2023, doi: 10.15585/mmwr.mm7250a2.

[3] "Suicide and Mental Health Challenges in the Construction Industry." Accessed: Jan. 04, 2026. [Online]. Available: https://www.nationalacademies.org/news/suicide-and-mental-health-challenges-in-the-construction-industry?utm_source=chatgpt.com

[4] C. A. P. C, N. J. M, and N. J. A, "Mental Ill-Health Risk Factors in the Construction Industry: Systematic Review," *J. Constr. Eng. Manag.*, vol. 146, no. 3, p. 04020004, Mar. 2020, doi: 10.1061/(ASCE)CO.1943-7862.0001771.

[5] S. Tyler, H. Hunkin, K. Pusey, K. Gunn, B. Clifford, and N. Procter, "Suicide in the Construction Industry: A Targeted Meta-analysis," *Archives of Suicide Research*, vol. 27, no. 4, pp. 1134–1146, Oct. 2023, doi: 10.1080/13811118.2022.2131488.

[6] S. O'Donnell, T. Egan, N. Clarke, and N. Richardson, "Prevalence and associated risk factors for suicidal ideation, non-suicidal self-injury and suicide attempt among male construction workers in Ireland," *BMC Public Health*, vol. 24, no. 1, p. 1263, 2024, doi: 10.1186/s12889-024-18483-0.

[7] D. V. Ross, D. S. Mathieu, M. R. Wardhani, M. J. Gullestrup, and D. K. Kõlves, "Suicidal ideation and related factors in construction industry apprentices," *J. Affect. Disord.*, vol. 297, pp. 294–300, Jan. 2022, doi: 10.1016/J.JAD.2021.10.073.

[8] H. Golzad, A. Teimoory, S. J. Mousavi, A. Bayramova, and D. J. Edwards, "Mental Health Causation in the Construction Industry: A Systematic Review Employing a Psychological Safety Climate Model," Oct. 01, 2023, *Multidisciplinary Digital Publishing Institute (MDPI)*. doi: 10.3390/buildings13102442.

[9] C. Sun, C. K. H. Hon, K. A. Way, N. L. Jimmieson, and B. Xia, "The relationship between psychosocial hazards and mental health in the construction industry: A meta-analysis," *Saf. Sci.*, vol. 145, p. 105485, Jan. 2022, doi: 10.1016/J.SSCI.2021.105485.

[10] T. T. Michael, "Construction Site Safety Roles," *J. Constr. Eng. Manag.*, vol. 128, no. 3, pp. 203–210, Jun. 2002, doi: 10.1061/(ASCE)0733-9364(2002)128:3(203).

[11] J. Hinze, S. Thurman, and A. Wehle, "Leading indicators of construction safety performance," *Saf. Sci.*, vol. 51, no. 1, pp. 23–28, Jan. 2013, doi: 10.1016/J.SSCI.2012.05.016.

[12] H. Golzad, A. Teimoory, S. J. Mousavi, A. Bayramova, and D. J. Edwards, "Mental Health Causation in the Construction Industry: A Systematic Review Employing a Psychological Safety Climate Model," *Buildings*, vol. 13, no. 10, 2023, doi: 10.3390/buildings13102442.

[13] A. Milner, H. Maheen, D. Currier, and A. D. LaMontagne, "Male suicide among construction workers in Australia: a qualitative analysis of the major stressors

precipitating death," *BMC Public Health*, vol. 17, no. 1, p. 584, 2017, doi: 10.1186/s12889-017-4500-8.

[14] B. Tijani, J. N. Falana, X. Jin, and R. Osei-Kyei, "Suicide in the construction industry: literature review," *International Journal of Construction Management*, vol. 23, no. 10, pp. 1684–1693, Jul. 2023, doi: 10.1080/15623599.2021.2005897.

[15] K. Aurelius, M. Söderberg, V. Wahlström, M. Waern, A. D. LaMontagne, and M. Åberg, "Perceptions of mental health, suicide and working conditions in the construction industry—A qualitative study," *PLoS One*, vol. 19, no. 7, pp. e0307433-, Jul. 2024, [Online]. Available: https://doi.org/10.1371/journal.pone.0307433

[16] S. Tyler *et al.*, "Disentangling Rates, Risk, and Drivers of Suicide in the Construction Industry: A Systematic Review," *Crisis*, vol. 45, no. 1, pp. 74–83, Jan. 2024, doi: 10.1027/0227-5910/a000885.