

WORKER WELL-BEING, SUICIDE, AND LEAN CONSTRUCTION – UNRAVELLING THE GLOBAL SILENT KILLER

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ABSTRACT

Contemporary studies reveal that suicide rates in the construction industry have soared in the past two decades. Suicide in the industry is an international form of social waste that threatens the pursuits of lean theory. This study aims to advance the IGLC body of repertoire by i) providing an in-depth analysis of the status of the well-being of construction workers along with corresponding suicide patterns on a *global* scale based on contemporary studies, ii) establishing a connection between lean construction and industry-specific suicide risk factors and proposing a relevant framework for mitigating social waste, iii) proposing methods for intervention and future research for advancement. A total of 20 contemporary studies were carefully selected to be synthesized for this semi-systematic literature review. The CARE framework was proposed as a guideline for mitigating social waste. This paper promotes critical international cooperation and action and advances the concept of social waste within lean theory.

KEYWORDS

Lean construction; suicide; waste; respect for people; mental health

INTRODUCTION

Although limited, there has been an increasing number of published studies regarding the rising concern about the well-being of construction workers. This is largely due to the alarming rates of suicide that have been unveiled in the past decade. Suicide rates increased by 33% among the U.S. working-age population in the last two decades, where construction had the *second-highest* suicide rate among major industry groups and the *highest* out of all major occupational groups (Sussell et al., 2023). In Australia, the rate of suicide was reported to be nearly *doubled* compared to non-construction sectors (Tijani et al., 2023). While the U.S. and Australia have been the lead contributors in reporting national suicide reports, many other countries have reported similar trends in their respective industries. In 2020, the renowned Chartered Institute of Building (CIOB) initiated a worldwide investigation into the psychological well-being and suicide among construction workers (still ongoing), which has since reported high levels of stress, suicidal

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ideation, and poor mental health training (Barnett, 2020). Suicide in the construction industry is an international problem that remains unresolved at this present time (Tijani et al., 2023).

SOCIAL WASTE IN LEAN CONSTRUCTION

The concept of ‘waste’ in lean construction has interestingly developed over the past two decades. Ohno’s theory of the seven wastes was a starting point from which greater awareness was made of less tangible concepts such as human potential and Koskela’s ‘Making do’ waste (Sarhan 2017). Waste in lean theory can take on many forms, and the implications of suicide are no exception. The abrupt loss of an employee’s life is a significant detriment to the efficiency and economy of a project. One Australian study attempted to quantify the annual economic cost of suicide, which totaled about \$61.26 million (Tijani et al., 2023). Another paper suggests the idea that sources of stress in construction projects may be classified as ‘social wastes’ (Sarhan et al., 2023). Social waste essentially interweaves with process wastes and physical wastes in lean. Unhealthy and unsafe practices at the corporate, group, and individual levels may lead to unanticipated delays, inefficiencies, and unproductivity. Factors leading to suicide embody this idea of ‘social waste,’ and are less easy to quantify. It is important to note that suicide is a “complex multilevel process” and while various intervention methods have been proven somewhat effective, further research is required (including non-industry related) to enhance precision in treating different profiles of individuals (Martinez et al., 2020). Empirical research specific to construction employees on this topic is scarce and demands more progress.

THE SIGNIFICANCE OF WELL-BEING AND SOCIAL WASTE

The dimensions of the triple bottom line of sustainability – people, planet, and profit – are interdependent (Solaimani et al., 2020). One IGLC paper dichotomizes between the ‘hard’ model, reflecting utilitarian instrumentalism, and the ‘soft’ model, reflecting developmental humanism. The latter model of ‘empowerment and commitment’ is critical for a bright, sustainable industry future. Lean thinking becomes anorexic when its core or the people suffer when supporting a regressive culture of HRM (Green, 2000). Respect for people is a critical component of lean sustainability and must be balanced with economic and environmental ambitions. If left unbalanced, lean practices are essentially at risk of becoming unreasonable or ineffective, especially when human practitioners of these methods suffer. In advancing the lean construction theology, it is vital to do so with caution in considering the various complications surrounding the well-being of individuals.

RESEARCH GAP AND OBJECTIVES

This study aims to address the rising suicide rates in the industry and advance the lean construction body of repertoire by better understanding the patterns of suicide and developing the idea of social waste within lean construction. As such, the primary objectives of this study include the following:

Provide an in-depth analysis of the status of the well-being of construction workers along with corresponding suicide patterns on a *global* scale based on contemporary studies.

Establish a connection between lean construction and industry-specific suicide risk factors and propose a relevant framework for mitigating social waste.

Propose methods for intervention and future research for advancement.

Few studies have undertaken the feat of corroborating and synthesizing research of this nature among construction workers on a *global* scale. Raising awareness of the silent killer and its deadly potential may act as a critical catalyst for international cooperation and action. In addition, there are currently no studies that have established a relationship between industry-specific risk factors for suicide and lean theory. This paper aims to reinforce the concept of respect for people as a core tenet of lean construction in revamping the prevailing conceptualization of waste in the IGLC community. While this study may not be entirely comprehensive, it will serve as a key starting point for future research and fuel global retaliation for the industry's silent killer.

RESEARCH METHOD

Considering the volume and diverse nature of the research regarding well-being and suicide in the construction industry, a semi-systematic review approach was selected for this literature review. Snyder states, "This type of analysis can be useful for detecting themes, theoretical perspectives, or common issues within a specific research discipline or methodology or for identifying components of a theoretical concept" (Snyder, 2019). This study was not meant to be entirely comprehensive. The following steps were taken:

1. Form the research question(s) and objective(s).
2. Create appropriate parameters and identify/mitigate any biases.
3. Consult an expert college librarian to enhance the research framework and database selection.
4. Assess and apply the research framework.
5. Synthesize and discuss the selected sources to fulfill the primary objectives.

First, it should be noted that biases include, i) the intuitive selection of papers based on title, relevance to the research objectives, and current relevance by a single individual, and ii) the exclusion of papers written in any language other than English. To mitigate bias in the selection of sources for analysis, the Brigham Young University Library Online Database was utilized for all sources with the careful selection of keywords, in correspondence with an expert librarian. Selection bias was mitigated as this database excludes sorting articles by popularity.

Alongside input from the librarian, the following search keys were primarily utilized to conduct this analysis (where n indicates the number of hits): "construction worker*" AND mental health ($n=325$), "construction worker*" AND suicide ($n=139$), "construction worker*" AND well-being ($n=361$), "construction worker*" AND suicide AND "risk factor*" ($n=52$), "lean construction" AND health ($n=42$), and "lean construction" AND people ($n=34$). Only peer-reviewed journals published during the last five years were considered. The biased, intuitive screening process consisted of the following steps: 1) Titled Screening, 2) Abstract Screening, and 3) Full-Text Screening. First, any article title deemed irrelevant to the study was omitted. Next, the abstract of each article was reviewed, and 50 articles were selected for full-text review. Of these 50 articles, 20 were synthesized to answer the primary objectives. The 20 key sources were intuitively prioritized based on novelty, strength of findings, and relevance to the study objectives. Articles that were redundant in content were omitted. The next section critically summarizes the selected sources based on this biased screening process.

SUMMARY OF SOURCES

Table 1: Overview of the 20 Relevant Studies Reviewed

**All selected studies below have been peer-reviewed and are randomly listed below*

Title, Source & Reference	Type	Primary Location(s) of Study/Relevance	Primary Author(s) & Relevant Year	Study Participants/Results
CDC: MMWR (Vol. 72, Issue 50)	Statistical Analysis	United States	Sussell, Aaron; Peterson, Cora; Li, Jia; Miniño, Arialdi; Scott, Kenneth; Stone, Deborah (2021)	The suicide rate among the U.S. working-age population has increased dramatically; rates are particularly higher among construction-related occupations and industries
International Journal of Construction Management (Vol. 23, Issue 10)	Literature Review	Australia, USA, New Zealand, Finland, Sweden, UK	Tijani, Bashir; Falana, Justina; Jin, Xiaohua; Osei-Kyei, Robert (2023)	Various suicide risk factors, economic costs, and intervention methods were identified and analyzed based on prominence
Journal of Sustainability (Vol. 14, Issue 20)	Systematic Literature Review	Australia, Hong Kong, South Africa, and Other Countries	Newaz, Mohammad; Giggins, Helen; Ranasinghe, Udara (2022)	A total of 100 risk factors and 76 preventative strategies representing individual level, workgroup level, and organizational level were identified
Healthcare (Vol. 12, Issue 5)	Systematic Literature Review	Nepal, Netherlands, South Africa, Australia, USA, China, South Korea, Singapore, Malaysia, Bangladesh, India, Myanmar, Thailand, Philippines	Winkler, Rachel; Middleton, Campbell; Remes, Olivia (2024)	The prevalence of depression, mental stress, anxiety, suicide, and PTSD were assessed based on existing literature
American Journal of Industrial Medicine (Vol. 65, Issue 5)	Statistical Analysis	United States	Dong, Xiuwen; Brooks, Raina; Brown, Samantha; Harris, Williams (2022)	One-third of male construction workers in the US experienced psychological distress (n=12,034); age, working circumstances, and substance abuse were significant factors for distress and suicidal ideation
Safety Science (Vol. 159)	Quantitative Analysis	China	Zhang, Shang; Sunindijo, Riza; Frimpong, Samuel; Su, Zhenwen (2023)	A total of 336 (95%) valid responses were obtained from construction employees working across 60 Chinese cities; stressors and coping strategies related to mental health issues were assessed
International Journal of Occupational Safety and Ergonomics (Vol. 28, Issue 4)	Mixed Study	Palestine	Aisheh, Yazan; Tayeh, Bassam; Alaloul, Wesam; Almalki, Ali (2022)	70 respondents along the Gaza strip were chosen using a random stratified sampling method; the application of lean construction techniques can be impeded by a lack of knowledge, complexity, and misconceptions

Table 1: Overview of the 20 Relevant Studies Reviewed (cont.)

**All selected studies below have been peer-reviewed and are randomly listed below*

Title, Source & Reference	Type	Primary Location(s) of Study/Relevance	Primary Author(s) & Relevant Year	Study Participants/Results
Crisis (Vol. 45, Issue 1)	Systematic Review	United States, Australia, UK, Italy, Sweden, Finland	Tyler, Simon; Hunkin, Hugh; Pusey, Kelly; Gunn, Kate; Clifford, Bob; McIntyre, Heather; Procter, Nicholas (2024)	In conjunction with analyzing suicide rates and risk, a series of personal and industry drivers of suicide were identified
Journal of Engineering, Design, and Technology (Vol. 18, Issue 4)	Quantitative Analysis	Ghana	Williams, Justice; Fugar, Frank; Adinyira, Emmanuel (2020)	250/357 selected participants responded to and returned the given questionnaire; utilizing the Guttman Scale analysis, it was observed that Ghana's construction industry is at the first level (pathological stage)
BMC Public Health (Vol. 24, Issue 1851)	Mixed Study	Nigeria	Oladosu, Ayomide; Chanimbe, Timothy (2024)	Among 686 participants, the average MCS score was borderline low and it was observed that social reciprocity has a positive effect on worker HRQoL
BMC Public Health (Vol. 24, Issue 1263)	Longitudinal Quantitative Study	Ireland	O'Donnell, Shane; Egan, Tom; Clarke, Nicholas; Richardson, Noel (2024)	A total of 1,585 male construction workers completed the survey across 52 construction sites spread across three of the four Irish provinces; suicidal ideation was prevalent and some associated factors were identified
Building Research & Information (Vol. 51, Issue 4)	Systematic Literature Review	United States, Australia, UK, and other countries	Rotimi, F.E.; Burfoot, M.; Naismith, N.; Mohaghegh, M.; Brauner, M (2023)	The review was viewed through the following three lenses: challenges, consequences, and wellbeing outcomes; several themes and their prevalence across the various papers were highlighted
The European Journal of Public Health (Vol. 30, Issue 2)	Census-Based Cohort Study	Italy	Alicandro, Gianfranco; Bertuccio, Paola; Sebastiani, Gabriella; Vecchia, Carlo; Frova, Luisa (2020)	A total of 1,068,653 construction workers were compared to other populations; it was observed that construction workers are high at risk of dying from external causes, including falls and suicide
Plos One (Vol. 19, Issue 7)	Qualitative Study	Sweden	Aurelius, Kristina; Söderberg, Mia; Wahlström, Viktoria; Waern, Margda; LaMontagne, Anthony; Aberg, Maria (2024)	A total of 43 males participated, including 11 individual interviews and 7 focus group interviews; this group consisted of workers (n=22), managers (n=10), and union representatives (n=11); five major themes were identified
Archives of Suicide Research (Vol. 28, Issue 3)	Statistical Analysis	United States	Stack, Steven (2024)	Roofers' suicides were far more apt than other suicides to have a known substance or alcohol problem that contributed to their suicide

Table 1: Overview of the 20 Relevant Studies Reviewed (cont.)

**All selected studies below have been peer-reviewed and are randomly listed below*

Title, Source & Reference	Type	Primary Location(s) of Study/Relevance	Primary Author(s) & Relevant Year	Study Participants/Results
International Journal of Occupational Safety and Ergonomics (Vol. 29, Issue 3)	Literature Review and Quantitative Study	China	Gao, Min; Wu, Xiuyu; Fang, Yanqing (2023)	Data was collected from 710 employees across 300 construction projects; employees' cognitive competence can positively influence construction safety performance via organizational lean construction competence
Construction Economics and Building (Vol. 21, Issue 3)	Mixed Study	United States	Demirkesen, Sevilay; Sadikoglu, Emel; Jayamanne, Eshan (2021)	A total of 17 interviews were conducted; most employees do not feel psychologically safe in traditional and lean projects due to heavy workload and other pressures
Journal of Cleaner Production (Vol. 248)	Comprehensive Review	Global	Solaimani, Sam; Sedighi, Mohamad (2020)	Data was synthesized based on the triple bottom line of sustainability and phases of construction
Buildings (Vol. 14, Issue 8)	Quantitative Study	Brazil	Neto, Ernani; Gonçalves, Leticia; Moreira, Felipe; Santana, Wylliam; Maués, Luiz (2024)	A total of 376 responses were obtained from 17 Brazilian companies; factors of satisfaction and commitment significantly influence worker well-being
Sustainability (Vol. 17, Issue 2)	Mixed Study	Middle East	Ruzieh, Abdulla (2025)	23 logistics challenges, 18 solutions, and 8 critical success factors were analyzed for their collective impact on sustainability in construction; the critical role of lean methodologies was emphasized

DISCUSSION OF DATA AND THEMES

SUICIDE PATTERNS ACROSS THE GLOBAL INDUSTRY

According to the Mates in Construction, construction workers are eight times more likely to die from *suicide* than from an *accident* at work (Tijani et al., 2023). Such trends are not exclusive to Australia. A global review unveiled a 7–11% prevalence of PTSD, a 10–38% prevalence of depression, a 19–42% prevalence of anxiety, and a 21–60% prevalence of moderate to severe psychological distress in construction workers around the world (Winkler et al., 2024), which matches similar findings from the CIOB (Barnett, 2020). A common finding across all studies is that moderate to severe psychological distress was strongly associated with suicide. Regarding the prevalence of suicidal ideation, studies unveiled ratios of 2.5% (n=10,601,900) (Dong et al., 2022) and 10.2% (n=1,585) (O'Donnell et al., 2024). These rates challenge the longstanding view that physical risks are the primary issue of construction worker well-being and suggest that psychological factors have been and are becoming increasingly prevalent. A large cohort study

from Italy observed that an excess of suicide mortality rates due to heightened financial difficulties and job instability experienced in the last decade may have exacerbated pre-existing major depressive and anxiety disorders in workers (Alicandro et al., 2020). The elevated risk of suicide due to the highly stressful nature of the industry may be amplified by significant periods of domestic uncertainty and economic depression.

Correlations have emerged in well-being and associated suicide rates among the various demographics and subgroups of workers. In the United States, psychological distress and suicidal ideation were more prevalent among younger workers, and in contrast, lower among male Hispanic construction workers. In addition, being married was associated with lower serious psychological distress, yet the impact on suicidal ideation was not significant (Dong et al., 2022).

Other quantitative studies corroborate these findings, including one from Ireland (O'Donnell et al., 2024), Nigeria (Oladosu & Chanimbe, 2024), and China (Zhang et al., 2023). Another paper discusses how “women, ethnic minorities, and those of migrant status, may be at an increased risk of poor mental health,” however, this has yet to gain traction in terms of quantitative evidence (Rotimi et al., 2023).

Multiple studies suggest that certain trades and subgroups of workers may experience a higher risk for suicide risk factors. Construction laborers had a much higher suicide rate than construction managers (Sussell et al., 2023). Interestingly, a follow-up study unveiled two factors that distinguished the suicides of roofers from others. “37.6% of roofers’ suicides involved a drug or alcohol problem, which was significantly more than 23.6% of other suicides...Roofers’ suicides were more apt to be marked by an intimate partner problem than other suicides, 36.7% vs 27%” (Stack, 2024). These findings have multiple implications and do not necessarily pinpoint the underlying factor behind these patterns. Varying natures of work within the industry may contribute to the level of risk experienced by workers. On the other hand, different subgroups of the industry may attract particular social profiles of workers. In any case, a single industry culture cannot be generalized across varying groups of construction workers.

Workers in developing countries seemingly experience lesser standards of well-being and may be at a higher risk for suicide. The limited amount of research on suicide is unsettling. One survey from Ghana revealed the Ghanaian construction industry to be at the first level or pathological stage of the safety maturity ladder, which implies a lackadaisical culture of disregard for safety measures (Williams et al., 2020). This is concerning, as workers in developing countries are at a significant disadvantage in protecting their general health and safety compared to those in first-world countries. These disadvantages they face may naturally lead to increased psychological issues. A mixed study from Nigeria calculated the mean mental components summary (MCS) score to be 51.71 among workers (n=686), which was near the cutoff core for poor good health (Oladosu & Chanimbe, 2024).

RISK FACTORS FOR SUICIDE

Table 2 synthesizes a list of key risk factors for suicide from the 20 studies based on significant quantitative and qualitative observations. Other potential risk factors not incorporated in the table do not indicate their irrelevance in the industry; Table 2 merely represents a higher prevalence of research and evidence on the listed factors. The organization of the table is derived from one study

which explains that “the individual level mainly focuses on factors that are subject to individual beliefs, personal attitudes, behavior, and lifestyle...[the workgroup] cluster encompasses factors that arise due to the collaborative functioning of workgroups during construction projects...the organizational level includes factors related to overall work conditions, work systems and policies, and procedures associated with the organization that impeded employees’ mental health” (Newaz et al., 2022).

Table 2: Commonly Identified Risk Factors for Suicide Based on 20 Selected Studies (Table organization derived from Table 1 in Newaz et al., 2022)

**The following are listed in no particular order*

Individual Level	Workgroup Level	Organizational Level
1.1 Poor Work and Family Life Balance	2.1 Communication and Cooperation Between Group Members and Superiors	3.1 Pressures to Reduce Timescales on Projects / Critical Time Constraints
1.2 Overworking	2.2 Low Task Autonomy	3.2 Job Role Conflicts
1.3 Job/Financial Insecurity	2.3 Low Support from Direct Supervisor, Managers, and Superiors	3.3 Lack of Training and Learning Opportunities
1.4 Lack of Job Promotion	2.4 Low Social Support from Colleagues	3.4 High Work Speed and Quantity
1.5 Alcohol and Other Substance Abuse	2.5 Workplace Bullying	3.5 Lack of Feedback Mechanism
1.6 Lack of Help-Seeking	2.6 Staff Shortages	3.6 Poor Working Conditions

CARE - A LEAN FRAMEWORK FOR MITIGATING SOCIAL WASTE

Based on the findings in suicide patterns and risk factors above, CARE was developed as a guideline for mitigating social waste and promoting worker well-being. It is a theoretical, flexible, and interdependent framework that may apply to policymakers, stakeholders, and top-down company and worker management. Additional testing will be required through empirical research to further develop and solidify this model. Table 3 presents each component of this framework accompanied by a brief description and relevant risk factor(s).

Table 3: Components of CARE

Component	Brief Description
CREATE	Establish a plan, culture, resources, etc. that promotes worker well-being
ADJUST	Make changes and refine the plan based on observations and/or a feedback loop
REACH OUT	While maintaining professional boundaries, connect with others on a personal level
EDUCATE	Raise awareness and implement suitable methods for developing worker competency in lean principles and worker well-being

First and foremost, a type of structure involving the promotion of worker well-being must be in place. Multiple studies found that lean construction practices addressing process and physical wastes had a positive impact on the psychological and general well-being of workers (Demirkesen et al., 2021, Aisheh et al., 2022, and Gao et al., 2023). As such, effective structures are not limited to exclusively and explicitly addressing social waste. For example, implementing lean strategies to reduce time on projects may relieve the pressure felt by employees (refer to risk factor 3.1 from Table 2). Methods addressing physical and process-type waste are interrelated with methods addressing social waste. In the creation of structure, it is important to consider the various patterns in suicide that have been identified.

No structure is guaranteed to be flawless upon its initial implementation. As such, adjustments to the structure will be required for optimization. The second principle ‘adjust’ highlights the importance of establishing a feedback loop within an organization. Worker well-being and suicide is a sensitive and personal issue that demands careful and effective communication between employees and management. An effective feedback loop will help expose specific needs, which will aid in applying appropriate resources and intervention methods. Table 4 presents a list of examples for enhancing a structure’s ability to specifically address social waste based on literature.

Table 4: List of Potential Structural Enhancements for Addressing Social Waste

**The following are listed in no particular order*

Providing social support
Promoting healthy coping strategies
Improving team design and communication
Implementing general health and well-being programs
Establishing flexibility in work schedules
Fostering a healthy culture and reducing harmful stigma in the workplace
Promoting help-seeking by increasing awareness
Increasing opportunities for career development
Providing education and support for substance abuse
Diversifying task autonomy
Enforcing zero-tolerance workplace bullying and harassment policies
Enhancing personal connections between employees and management

In ‘reaching out’ to workers, balance must be maintained among other standard initiatives of the industry. One empirical study warns that “excessive interpersonal interactions” may make it difficult for an organization to implement standardized measures (Gao, et al., 2023). As such, professional boundaries must be maintained when “reaching out” to other workers. Interpersonal interactions, however, are crucial and remain a thematic element in most of the studies from Table 1. This principle suggests a need for a cultural shift in the industry from worker independence to worker interdependence. One study determined that satisfaction and commitment significantly influence the overall well-being of construction workers, while the factors of contract model and engagement do not have a significant influence, suggesting a limitation of structure (Neto et al., 2024). Suicide risk factors such as 1.6 (lack of help-seeking) and 2.3 (low support from management) highlight the need for increased positive interactions within an industry marked by high stress, rigorous work, and tense relationships with other contracting parties and within

organizations. While positive relationships and interactions may be difficult due to conflicting incentives, they may ultimately prove beneficial by mitigating social waste in lean pursuits.

Lastly, developing and ensuring worker competency in lean principles and well-being mitigates social waste. Studies suggest standardized training, feedback systems, and other methods for pursuing this cause (Gao et al., 2023 and Aisheh et al., 2022). Suicide risk factors 2.1 (communication and cooperation between group members and superiors) and 3.3 (lack of training and learning opportunities) further highlight the need for developing worker competency.

FUTURE RESEARCH AGENDA

The proposed lean framework CARE acts as a core tenet of respect for people that may help advance the concept of social waste in lean theory. As this theoretical outline is based on a condensed semi-literature review, empirical data will be critical in legitimizing the connection between suicide risk factors and social waste and their necessity in lean practices. In accordance with the first principle ‘create,’ methods should be developed and tested for addressing the various suicide risk factors. Table 4 serves as a strong starting point for testing effective methods. Variances across multiple demographics should be studied to help understand which methods should be catered towards higher risk groups. In addition, the relationship between social waste generated from poor worker well-being and other factors needs to be further developed. The magnitude and degree of impact of social waste on the objectives of lean theory may be better understood through empirical research. Social waste generated by suicide risk factors is not readily quantifiable and requires further attention to develop some form of metric system. The CARE framework acts as a critical guideline that may influence policy to promote the health and performance of the construction industry.

CONCLUSION

This study advanced the IGLC body of repertoire by i) providing an in-depth analysis of the status of the well-being of construction workers along with corresponding suicide patterns on a *global* scale based on contemporary studies, ii) establishing a connection between lean construction and industry-specific suicide risk factors and proposing a relevant framework for mitigating social waste, and iii) proposing methods for intervention and future research. Suicide rates and related well-being data challenge the longstanding view that physical risks are the primary issue of worker safety and well-being and suggest that psychological factors are becoming increasingly prevalent and concerning. By corroborating multiple research papers, a global view of suicide risk factors and their impact on the industry was presented. Young and non-married workers, along with roofers and other construction laborers, were identified as high-risk groups. Workers in developing countries may be at a higher risk due to pathological safety cultures. Key risk factors for suicide were grouped into individual, workgroup, and organizational levels. Based on the identified risk factors, the CARE framework was proposed as a guideline for mitigating social waste and promoting worker well-being. A series of intervention methods were proposed based on key risk factors. This paper promotes international cooperation and action for addressing suicide risk factors that are prevalent in the construction industry and advances the concept of social waste in lean theory.

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