International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 18(13s) 2026 pp. 1201-1209
https://doi.org/10.70917/ijcisim-2026-4159
Article

Development of a Preventive Culture in Occupational Health and Safety to Reduce Occupational Risks in a Construction Company, Cañete-2025.

Diana Carolina Talenas Soto[1], José Alfonzo Talenas Soto[1], Ronald Fernando Dávila Laguna[1]

[1] Master's Program in Occupational Health and Safety, Postgraduate School, Universidad César Vallejo, Callao, Peru.
Diana Carolina Talenas Soto
Email: dtalenas@ucvvirtual.edu.pe
ORCID: 0009-0005-0828-9376
José Alfonzo Talenas Soto
ORCID: 0009-0001-7319-3689
Ronald Fernando Dávila Laguna
ORCID: 0000-0001-9886-0452
Corresponding Author: Diana Carolina Talenas Soto

Abstract: This research is aligned with Sustainable Development Goal 8 (Decent Work and Economic Growth) and aimed to analyze the effect of developing a preventive culture in Occupational Health and Safety on the reduction of occupational risks in a construction company located in Cañete, Peru. Methodologically, it applied a quantitative approach through a longitudinal, pre-experimental design, using instruments such as an ISO 45001 checklist, the Fine-Kinney matrix and the Elmeri observation system, based on a census of bi-weekly risk records. Descriptive results showed an increase in the Visible Leadership Index from 38% to 92%, and proactive incident reporting rose from 0.06 to 0.30 cards per worker. Inferential analysis revealed that the improvement in organizational culture was statistically significant according to the Wilcoxon test ($p = 0.028 < 0.05$). Regarding specific hazards, physical incident rates fell from 50% to 24%, musculoskeletal injuries declined by up to 71%, and the adoption of certified anchorages for mechanical hazards rose to 92%. It is concluded that the systematic cultivation of a preventive culture can reduce operational risk levels by more than 85%. The study demonstrates that the management of human factors is a primary determinant of operational safety within the construction sector.
Keywords: workplace safety; construction industry; accident prevention; occupational health; risk management.

1. INTRODUCTION

The management of occupational health and safety in the construction industry is an essential element for safeguarding the health and integrity of workers. A company that effectively establishes a culture of prevention can substantially reduce incidents, health problems and operational failures1. This initiative is aligned with SDG 8 on Decent Work and Economic Growth, seeking to transform attitudes toward safety practices within the construction sector through an organized process that fosters a culture of prevention2.

Globally, safe and healthy working conditions are recognized as an essential right, a principle endorsed by the International Labour Organization (ILO) and the World Health Organization (WHO). Global statistics leave no room for doubt that a serious problem exists: more than 2.9 million people die each year from work-related causes, and another 395 million suffer non-fatal accidents that result in permanent sequelae3. In several regions, construction has one of the highest accident rates in Europe and Asia; this sector represented 22.5% of the fatal occupational accidents reported in the EU in 2021, even under continuous regulatory improvement4. In Poland, around 600 confirmed accidents were reported in the defined reference period, mainly related to falls, impacts and environmental failures5. In Asia, countries such as South Korea show an accident rate of 27.1%, indicating that barriers still hinder the establishment of a culture that promotes prevention6. According to ILO publications, high labour informality and weak institutional frameworks for occupational safety increase workers' exposure to physical and ergonomic risks7.

In 2022, the Ministry of Labour and Employment Promotion reported 16,458 occupational accidents, a 4% increase over the previous year, with a predominant concentration in the manufacturing, construction and mining sectors8. This trend is particularly worrying given the existence of OSH Law No. 29783 and a National Plan for the prevention of occupational risks for the 2022-2026 period8.

Thus, many Peruvian construction companies regard workplace safety as an operational cost rather than a strategic investment. This perception leads to poor planning, insufficient resources and unsafe conditions arising from the absence of standardized procedures, poor task design and a lack of continuous training9. For instance, in Trujillo a construction micro- and small enterprise recorded 82 accidents in 2023 — the most recurrent being contusions from overexertion (25%), impacts and collisions (15%) and falling objects (10%) — with a safety-management compliance rate of only 37%10. Similarly, in Lima a study found that initial compliance with the ISO 45001:2018 standard among construction companies was 16.95%, owing to deficiencies in hazard identification, the lack of defined guidelines and the absence of training records; however, after optimizing the system, safety-culture scores rose to 73.83%, showing that structured management can effectively strengthen a preventive culture within the sector11.

From a practical standpoint, a research study is justified when it directly helps to resolve a problem or, at least, proposes strategies that contribute to its resolution12. Methodologically, research is justified when it proposes a new method or a structured strategy to generate valid and reliable knowledge13. Theoretically, a study is justified when its purpose is to generate reflection and academic debate about existing knowledge, confront a theory or contrast empirical results12. Finally, from a social perspective, justification arises when the investigation addresses social problems that directly affect a group of people, prioritizing the most vulnerable populations13. Accordingly, the general objective of this study was to determine the effect of developing a preventive culture in Occupational Health and Safety on the reduction of occupational risks in a construction company in Cañete, together with three specific objectives addressing physical, ergonomic and mechanical risks.

2. METHODS

2.1 Study Design and Population

The study was classified as applied, with a quantitative approach and a longitudinal, pre-experimental design with pretest and posttest measurements, using the same workforce as its own control group under an explanatory scope11,14,15,3. The unit of analysis was the specific occupational risk registered across the construction fronts in Cañete, requiring strict documentary verification of field records (Job Safety Analysis [JSA] and operational checklists). Population and sample coincided through a census-based approach that included all valid entries recorded every two weeks. The temporal boundary consisted of 12 symmetrical bi-weekly periods: six pretest periods (November 2025 to January 2026) and six posttest periods (March 2026 to May 2026), separated by February 2026, which was dedicated exclusively to deploying the preventive-culture program.

2.2 Research Instruments

Data were gathered through structured direct field observations and operational reviews16. A checklist aligned with the international standard ISO 45001:2018 was used to evaluate the preventive culture (independent variable)11. Bi-weekly formats were developed on the basis of the mathematical constructs of its five dimensions17: Management Commitment, Worker Participation, Proactive Approach, Systemic Integration and Continuous Learning.

The specific monitoring formats used to assess occupational risks (dependent variable) followed three basic operational dimensions18: physical risks, ergonomic risks and mechanical risks. Task-level assessments were underpinned by risk priority numbers computed with the Fine-Kinney algorithm (RPN = Consequence × Exposure × Probability) and by the percentage of safe behaviours observed in the field, recorded per 100 interactions using the Elmeri observation system18.

2.3 Data Collection Procedure

Data traceability was ensured through direct auditing of equipment pre-use sheets, medical logs for lower-back pain, labour-hour counts and physical safety cards collected from field drop boxes across the symmetric bi-weekly blocks. Coordination was maintained with the project engineering staff and the OSH committee throughout the collection process.

2.4 Data Analysis

Data analysis was performed with SPSS version 28 and Microsoft Excel. Descriptive statistics used comparative bi-weekly means and standard deviations. Normality was verified with the Shapiro-Wilk test ($\alpha = 0.05$). Symmetrical distributions were analyzed with the parametric paired Student's t-test; asymmetrical patterns that rejected normality were contrasted with the non-parametric Wilcoxon signed-rank test.

3. RESULTS

1. Preventive Culture and Operational Control Data (ISO 45001)

The initial baseline assessment (pretest) revealed severe structural deficiencies in the contractor's safety management, which were significantly corrected during the posttest phase following program execution in February 2026.

Table 1. Descriptive statistics for the dimensions of preventive culture (pretest vs. posttest) (N = 6).

Preventive culture dimension / phase	Minimum	Maximum	Mean	Std. deviation
Management Commitment (Pretest)	0.00	0.75	0.3750	0.26220
Management Commitment (Posttest)	0.75	1.00	0.9167	0.12910
Worker Participation (Pretest)	0.03	0.09	0.0600	0.02530
Worker Participation (Posttest)	0.23	0.36	0.3017	0.04875
Proactive Prevention Approach (Pretest)	0.13	0.64	0.3550	0.17097
Proactive Prevention Approach (Posttest)	0.91	0.96	0.9400	0.01789
Prevention Integration (Pretest)	0.33	0.67	0.4433	0.13880
Prevention Integration (Posttest)	0.67	1.00	0.9167	0.13866
Learning & Continuous Improvement (Pretest)	0.31	0.50	0.4283	0.07360
Learning & Continuous Improvement (Posttest)	0.87	0.94	0.8967	0.02503
Global ISO 45001 Compliance (Pretest)	0.00	0.50	0.3333	0.25820
Global ISO 45001 Compliance (Posttest)	0.75	1.00	0.9167	0.12910

The metrics in Table 1 show that the average Visible Leadership Index (VLI) rose from 38% to 92%, eliminating critical gaps such as the 0% level observed in the third pretest bi-week. Voluntary hazard submissions (Incident Reporting Index, IRI) increased from 0.06 to 0.30 cards per worker, reflecting the internalization of safe practices. Likewise, field-finding closure efficiency (PCF) improved from 35.50% to 94.00%. Alignment with the Annual Safety Plan (APAP) progressed from 44.33% to 91.67%, while structured safety training (OHS-HW) rose from 42.83% to 89.67%, ensuring more than two hours of technical instruction every two weeks per operator. Global compliance with the ISO 45001 framework advanced from 33% initially to 92% in the final measurement.

2. Occupational Risk Dimension Data

Assessment of the dependent-variable metrics reveals a systematic reduction of hazard exposure across the active construction tasks.

Table 2. Descriptive statistics for the dimensions of occupational risk (pretest vs. posttest) (N = 6).

Occupational risk dimension / phase	Minimum	Maximum	Mean	Std. deviation
Physical Incident Rate (PIR — Pretest)	0.30	0.73	0.4983	0.17971
Physical Incident Rate (PIR — Posttest)	0.08	0.35	0.2400	0.09633
Musculoskeletal Injury Rate (MIR — Pretest)	94.70	182.75	142.3600	37.02221
Musculoskeletal Injury Rate (MIR — Posttest)	0.00	138.89	41.4350	50.99934
Mechanical Risk Exposure (Pretest) *	0.73	1.00	0.8150	0.09772
Mechanical Risk Exposure (Posttest) *	0.00	0.25	0.0833	0.10328

Note. * Evaluated inversely as exposure to the unsafe condition (percentage of tasks executed without certified anchorage setups). MIR is expressed as injuries per 200,000 hours worked.

The descriptive metrics in Table 2 indicate that the average Physical Incident Rate (PIR) decreased from 49.83% to 24.00%. Concurrently, the Musculoskeletal Injury Rate (MIR) declined by 71%, from a baseline mean of 142.36 to 41.43 injuries per 200,000 hours worked. Regarding the mechanical dimension, the Percentage of Certified Anchorages (PCA) rose from a baseline mean of 19% to 92% across the posttest blocks, effectively lowering active unsafe exposure from a critical 81.50% to a residual 8.33% of uncertified height tasks.

At the specific operational level, risk-priority-number mitigations exceeded 85% for all high-potential tasks, including deep footing excavations (2 m), which fell from 1,500 points (high risk) to 30 points (low risk); concrete vibration and brick disc-cutting, which declined from 1,500 to 45 points; and awkward postures during overhead ceiling-conduit installation, which decreased from 2,400 to 360 points — confirming the field effectiveness of the implemented operational controls.

3. Inferential Analysis and Hypothesis Testing

Contrast of the general hypothesis. The Shapiro-Wilk test yielded significance levels of $p = 0.130$ for the pretest and $p = 0.029$ for the posttest. Because the posttest value fell below the $\alpha = 0.05$ threshold, the non-parametric Wilcoxon signed-rank test for paired samples was applied.

Table 3. Wilcoxon signed-rank test for overall occupational risk values.

Analytical pair	Rank classification	N	Mean rank	Sum of ranks	Z / Asymp. Sig. (2-tailed)
Occupational Risks (Posttest) − Occupational Risks (Pretest)	Negative ranks	6[a]	3.50	21.00	−2.201[b]
	Positive ranks	0[b]	0.00	0.00	0.028

	Ties	0[c]	—	—	
	Total	6			

Note. [a] Posttest < Pretest; [b] based on positive ranks; [c] Posttest = Pretest.

The computed asymptotic significance ($p = 0.028$) fell below the predetermined significance level ($\alpha = 0.05$), leading to rejection of the null hypothesis (H_0). Consequently, the research hypothesis was accepted, indicating that fostering a preventive culture reduces overall occupational risks within the construction company.

Contrast of specific hypothesis 1 (physical risks). The data were normally distributed according to the Shapiro-Wilk test ($p = 0.421$ pretest and $p = 0.600$ posttest), so Student's t-test was used.

Table 4. Paired-samples t-test for physical risk metrics.

Paired contrast / dimension	**Mean diff.**	**N**	**Std. dev.**	**Std. error**	**t**	**Sig. (2-t)**
Pretest Physical − Posttest Physical	0.25833	6	0.15289	0.06242	4.139	0.009

The mean difference between phases was statistically significant ($t = 4.139$, $p = 0.009 < 0.05$; Cohen's $d = 1.69$). Specific hypothesis 1 was accepted, validating a real reduction of physical incident exposure across the worksites.

Contrast of specific hypothesis 2 (ergonomic risks). Because of the skewed distribution of the posttest ergonomic block ($p = 0.030$), the hypothesis was contrasted with the non-parametric Wilcoxon test.

Table 5. Wilcoxon signed-rank test for the ergonomic risk dimension.

Analytical pair	**N**	**Mean rank**	**Sum of ranks**	**Z**	**Asymp. Sig.**
Posttest Ergonomic − Pretest Ergonomic (negative ranks)	6	3.50	21.00	−2.201[b]	0.028

The inferential check yielded $p = 0.028$ (< 0.05), rejecting the null hypothesis and confirming that the cultural intervention minimized musculoskeletal injury trends.

Contrast of specific hypothesis 3 (mechanical risks). The Shapiro-Wilk test indicated normality ($p = 0.085$ pretest and $p = 0.131$ posttest); accordingly, the paired Student's t-test was appropriate.

Table 6. Paired Student's t-test for the mechanical risk dimension.

Paired contrast / dimension	**Mean diff.**	**N**	**Std. dev.**	**Std. error**	**t**	**Sig. (2-t)**
Pretest Mechanical − Posttest Mechanical	0.73167	6	0.12734	0.05199	14.070	0.000

The test produced $p = 0.000$ ($p < 0.001$; Cohen's $d = -5.75$), indicating with high statistical certainty that standardizing work practices and enforcing technical height parameters reduced mechanical-risk events in the field.

4. Economic-Financial Evaluation of the Proposal

The financial assessment contrasted the total cost of the plan (S/ 15,900.00 for certified lifelines, heavy-duty harnesses, drop boxes and specialist training fees) with the reduction in overrun costs arising from non-prevention and concealed accident expenses, yielding a consistent net saving of S/ 4,500.00 per month. Applying a monthly Cost of Opportunity of Capital (COK = 10%) over a six-month evaluation period, the following profitability indicators were obtained:

Net Present Value (NPV / VAN): NPV = S/ 3,698.68. Because the NPV is positive, the cultural program is economically justified and creates incremental liquid value for the company.

Internal Rate of Return (IRR / TIR): IRR = 17.60% monthly, a return that significantly exceeds the minimum required hurdle rate (COK = 10%).

Benefit-Cost Ratio (B/C): B/C = 1.23, meaning that for every sol invested in the preventive culture the company recovered its capital and secured an additional S/ 0.23 of clear savings from avoided structural overcosts.

4. DISCUSSION

The findings confirmed that the development of a preventive culture is directly related to a systematic decrease in risk levels. The Visible Leadership Index (VLI) grew from 38% in the pretest to 92% in the posttest. This increase is important because, as highlighted by Tappura et al.19, management commitment is a main driver of safety culture, since executive behaviour mirrors the standards adopted by technical staff. The Wilcoxon test verified a statistically significant difference (p = 0.028) and the null hypothesis was rejected.

These findings align with Saik et al.17, who demonstrated through mathematical modelling that organizational risk declines progressively as safety culture matures, moving from a 95.2% risk increase at the indifference stage to 6.0% at the interdependence stage. The observed reduction in risk priority numbers — from high levels (up to 1,500 points in the Fine-Kinney matrix) to low levels below 63 points — supports the exponential-mitigation theory grounded in cultural maturity. The results also concur with Casas11, who showed that implementing structured frameworks under ISO 45001 elevates safety compliance from a critical baseline of 16.95% to a highly satisfactory 73.83%. Methodologically, this improvement was achieved by linking executive leadership to active worker involvement, which raised the Incident Reporting Index (IRI) from 0.06 to 0.30. As Al-Bayati16 noted, a safety culture expressed through the visible actions of upper management has a far greater impact on overall performance than isolated individual behaviours.

The reduction of the Physical Incident Rate (PIR) from 50% to 24% was parametrically validated for the first objective using Student's t-test (p = 0.009), with a substantial effect size (Cohen's d = 1.69). Extreme noise and segmental vibration encountered during concrete pouring were effectively mitigated through preventive maintenance and planned worker rotation. This aligns with ILO guidelines3, which state that adverse physical environments and thermal stress on construction sites require ongoing field verification of regulatory thresholds to minimize accidents. It also corroborates Villacís and Llumiquinga20, who demonstrated that engineering controls of environmental hazards and repetitive-task loads provide significant health protection when exposure exceeds permissible limits.

With respect to the second specific objective, the study achieved a 71% reduction in the Musculoskeletal Injury Rate (MIR), from an average of 142.36 to 41.43. This decline was confirmed by the Wilcoxon test (p = 0.028) and resulted from ongoing learning initiatives that increased occupational health and safety training hours (OHS-HW) from 43% to 90%. Training covered correct hygienic postures and the mandatory use of mechanical aids for transporting cement sacks and handling blocks at mid-height. This aligns with Sorensen et al.21, who found that work intensity and labour organization directly affect physical well-being. The Elmeri field-observation tool further enabled supervisors to correct unsafe postures promptly, preventing them from developing into medical-leave cases.

Finally, the third specific objective showed a dramatic improvement in safety for work at heights: the Percentage of Works at Height with Certified Anchorages (PCA) increased from 19% to 92%. Student's t-test confirmed that this change was highly significant (p = 0.000), with a large effect size (Cohen's d = −5.75). The intervention removed the technical improvisation that had produced a 0% compliance rate in the sixth pretest bi-week. This finding is consistent with Bria et al.22, who stated that reducing fatal accidents caused by unsafe acts requires the optimization of standardized operating procedures and strict enforcement of regulatory compliance. It also agrees with Aybar and García10, who reported that rigorous supervision and technical strengthening of certified anchorages and lifelines markedly diminish mechanical risks. Incorporating OHS criteria into the planning of critical tasks turned the use of certified equipment from an optional practice into a non-negotiable engineering requirement.

What worked in this program was that field actions addressed the root causes identified in the project's problem tree. Operational inefficiencies and structural overcosts that had previously reduced project profitability were eliminated through standardized inspections and visible management involvement. The study was conducted in accordance with ILO safety protocols and maintained academic integrity throughout. Moreover, the clear anti-reprisal policy governing the reporting system (IRI) allowed for transparent data that accurately reflected true worksite conditions. In sum, the PCF rose from 35% to 94%, verifying that proactive response capabilities lower hazard severity and promote safe, sustainable working environments, in agreement with Carpio et al.23.

4.1 Limitations

Several limitations should be acknowledged. The pre-experimental design, without an independent control group, does not allow full empirical control of all concurrent external variables, so residual seasonal or workload effects cannot be entirely ruled out. The census covered a single construction company over 12 bi-weekly periods, which yields a small number of aggregated observations (N = 6 per phase) and limits the generalization of the results to other firms or regions. The observation window does not capture the long-term stability of the cultural change in the face of workforce turnover. Nevertheless, the census-based approach eliminated selection bias within the organization, and the magnitude of the effect sizes, the consistency of improvement across the three dimensions and the convergence with prior international evidence strengthen the inference that the observed change was attributable primarily to the intervention. Future studies with quasi-experimental designs, control groups and longer follow-up are recommended to confirm these findings.

5. CONCLUSIONS

The adoption of a preventive safety culture in Occupational Health and Safety proved to be a highly effective approach, markedly reducing overall occupational risks in construction (p = 0.028). The intervention achieved a Visible Leadership Index of 92%, increased proactive incident reporting to 0.30 cards per worker, raised finding-closure rates to 94% and improved overall ISO 45001 compliance to 92%.

Parametric analysis showed that proactive control of noise, vibration and solar radiation produced a statistically significant decline in physical incidents (p = 0.009; Cohen's d = 1.69). The preventive program lowered the bi-weekly Physical Incident Rate across active work fronts from a baseline average of 50% to 24%.

The cultural intervention yielded a 71% reduction in the Musculoskeletal Injury Rate (MIR), from a baseline average of 142.36 to 41.43 injuries per 200,000 hours worked. This biomechanical improvement was statistically validated (p = 0.028) and was driven by an increase in technical training hours (from 43% to 90%) coupled with the ergonomic redesign of material-handling tasks.

Promoting a preventive culture effectively controlled critical mechanical hazards during work at heights, increasing the use of certified anchorage systems from 19% to 92%. Inferential analysis confirmed this improvement as highly significant (p = 0.000), indicating that incorporating safety parameters into early task planning eliminates improvisation and unsafe field practices.

RECOMMENDATIONS

Executive leadership within the construction firm should formalize the bi-weekly leadership walkarounds implemented during this study to secure the lasting sustainability of the safety system and prevent a recurrence of cultural indifference. Active managerial presence remains the principal driver of internal motivation and behavioural modelling for site personnel.

The Occupational Health and Safety department should mandate the use of High-Risk Work Permits (PETAR) and certified lifelines for all activities carried out at height or in deep excavations. Sustaining the rise in certified-anchorage use from 19% to 92% requires a zero-tolerance approach to in-field technical improvisation.

Regulatory bodies in the construction sector should replicate this cultural-intervention model within small and medium-sized enterprises that lack substantial OHS departments. Integrating safety criteria into daily task planning shows that compliance with ISO 45001 can be raised from 33% to 92% in an economically viable manner.

Future researchers should design field evaluations with observation windows extending beyond the 12 bi-weekly periods analyzed here to assess the long-term stability of cultural change in the face of workforce turnover. Comparative studies should also examine the rate of adoption of safe behaviours between traditional construction methods and industrial modular systems.

AUTHOR CONTRIBUTIONS

Talenas Soto, Diana Carolina: conceptualization of the study, pre-experimental methodological design, field safety audits, descriptive and inferential statistical processing in SPSS, and writing of the original draft.

Talenas Soto, José Alfonzo: operational coordination of the field-intervention program, collection of technical safety records (JSA, high-risk permits, bi-weekly logs), coding of the safe-tamping procedure, execution of operator training sessions, and critical review of the final manuscript.

Dávila Laguna, Ronald Fernando: theoretical and conceptual guidance in the construction of the study's framework, contribution to the development and presentation of the results, and participation in the critical review and approval of the final version.

ETHICAL CONSIDERATIONS

This article presents findings from a research initiative approved by the Ethics Committee of Universidad César Vallejo. Written authorization was obtained from the construction company for the confidential use of site-operation data. All information on incidents, accidents, injuries and observations of safe and unsafe behaviour was fully anonymized through alphanumeric coding to protect worker identities, in accordance with a strict non-reprisal policy that ensured ongoing job security.

ACKNOWLEDGMENTS

The authors thank the project engineers, foremen, safety brigade members, members of the OSH committee and the entire active construction workforce in Cañete for their participation in the leadership walkarounds and safety workshops. They also acknowledge the Postgraduate School of Universidad César Vallejo for providing the academic support and statistical tools needed to complete this study.

CONFLICTS OF INTEREST

The authors declare that they have no economic, institutional, professional or personal conflicts of interest related to the development, analysis or publication of the results presented in this article.

References

1. Sadeghi H, Cheung CM, Yunusa-Kaltungo A, Manu P. A systematic review of occupational safety and health in modular integrated construction. Safety Science. 2025;189:106897.
2. United Nations. Sustainable Development Goal 8: Decent work and economic growth. New York: UN; 2023.
3. International Labour Organization. Heat at work: implications for safety and health — a global review of the science, policy and practice. Geneva: ILO; 2024.
4. Martínez-Aires MD, López-Alonso M, De La Hoz-Torres ML, Aguilar-Aguilera A, Arezes P. Occupational risk prevention in the European Union construction sector: 30 years since the publication of the Directive. Safety Science. 2024;177:106593.
5. Woźniak Z, Hoła B. The structure of near misses and occupational accidents in the Polish construction industry. Heliyon. 2024;10(4):e26410.
6. Keun Oh T, Jun Kwon Y, Oh B-H, Gwon Y-I, Yoon H-K. Suggestions for the safety coordinator's roles at each construction stage (client, designer, supervisor and contractor) to improve safety and health activities in South Korea. Safety Science. 2021;133:104994.
7. International Labour Organization. Overview of occupational safety and health in Latin America and the Caribbean: regional fact sheet. Lima: ILO; 2023.
8. Blas LE, Charqui BL, Huerta GB. Occupational safety and health: prevention of accidents and occupational diseases in Peru (2022). Llalliq. 2023;3(1):199-216. Available from: https://revistas.unasam.edu.pe/index.php/llalliq/article/view/1046
9. Aliaga JO, Avalos RMM, Bedoya JEM, Chuquilin COY. Occupational health and safety management and occupational risks in a construction company in Peru. South Florida Journal of Development. 2021;2(4):5195-5207.
10. Aybar Gonzales L, García Calvo JE. Implementation of an OHSMS — ISO 45001:2018 for accident reduction in a construction micro-enterprise, Trujillo 2023. Ciencia Latina Revista Científica Multidisciplinar. 2023;7(5):1253-1272.
11. Casas JEP. Occupational health and safety management system to improve safety culture in modular bridges. Latam Revista Latinoamericana de Ciencias Sociales y Humanidades. 2024;5(4):141-155.
12. Espinoza R, Sánchez M, Velasco M, Gonzales A, Romero R, Mory W. Methodology and statistics in scientific research. 1st ed. Lima: Puente Madero; 2023.
13. Arias J. Research design and methodology. 1st ed. Arequipa: Enfoques Consulting EIRL; 2021.
14. Naji GMA, Isha ASN, Mohyaldinn ME, Leka S, Saleem MS, Rahman SM, et al. Impact of safety culture on safety performance: mediating role of psychosocial hazard — an integrated modelling approach. International Journal of Environmental Research and Public Health. 2021;18(16):8568.
15. Castro Mejía PJ, Campos Coronel CS, Ancajima Gaona LE, Delgado Ventura JF, Flores Montero DH, Huilca Alcántara WE. Health and safety proposal to reduce risks in the construction of a school. Sustainability. 2023;15(21):15189.
16. Al-Bayati AJ. Impact of construction safety culture and construction safety climate on safety behavior and safety motivation. Safety. 2021;7(2):41.
17. Saik P, Tsopa V, Koriashkina L, Cheberiachko S, Deryugin O, Lozynskyi V. Influence of occupational safety culture on the occupational risk level in the organization. Frontiers in Public Health. 2025;13:1595869.

18. Chencheva OO, Sukach SV, Rieznik DV, Petrenko IC, Lashko YeYe, Hladiuk OM. Modern concept of occupational safety and health management with a risk-based approach. Municipal Economy of Cities. 2024;4(185):221-227.
19. Tappura S, Jääskeläinen A, Pirhonen J. Creation of satisfactory safety culture by developing its key dimensions. Safety Science. 2022;154:105849. https://doi.org/10.1016/j.ssci.2022.105849
20. Villacís W, Llumiquinga H. Control measures for occupational risks generated by environmental working conditions and postural load. Revista Colombiana de Salud Ocupacional. 2021;11(2):78-85.
21. Sorensen G, Dennerlein JT, Peters SE, Sabbath EL, Kelly EL, Wagner GR. The future of research on work, safety, health and wellbeing: a guiding conceptual framework. Social Science & Medicine. 2021;269:113593.
22. Bria TA, Chen WT, Muhammad M, Rantelembang MB. Analysis of fatal construction accidents in Indonesia — a case study. Buildings. 2024;14(4):1010. https://doi.org/10.3390/buildings14041010
23. Carpio-De Los Pinos AJ, González-García M de las N, Pentelhão LC, Baptista JS. Zero-risk interpretation in the level of preventive action method for health and safety on construction sites. International Journal of Environmental Research and Public Health. 2021;18(7):3534.