

DEVELOPMENT OF A DIAGNOSTIC INDEX FOR ASSESSING OCCUPATIONAL SAFETY CULTURE IN CONSTRUCTION ENTERPRISES

E. M.Murtazaev

T.f.d., Professor University of Information
Technologies and Management
murtazaev_70@mail.ru

B. E.Mustafayev

Dactaranti of the Scientific Research Institute of
Irrigation and Water Problems

Abstract

Ensuring a high level of occupational safety culture is essential for minimizing workplace accidents in construction enterprises, which remain among the most hazardous sectors worldwide. This study aims to develop a comprehensive Diagnostic Index of Safety Culture (DISC) for evaluating the maturity level of safety culture within construction organizations. A mixed-method approach was employed, combining a systematic literature review, expert evaluation using the Delphi method, and statistical validation through exploratory and confirmatory factor analysis (EFA/CFA). The DISC model consists of five core dimensions—management commitment, employee competence, communication efficiency, risk control practices, and safety behaviour indicators—measured through 31 validated criteria. Reliability testing showed high internal consistency (Cronbach's $\alpha = 0.89$), while CFA confirmed strong model fit (CFI = 0.94; RMSEA = 0.05). The developed index enables construction firms to diagnose weaknesses, track cultural improvements, and implement evidence-based safety programs. Practical implications include its integration into corporate safety audits and digital monitoring systems. Future research may extend the index through machine-learning-based predictive analytics.

Keywords: Safety culture, diagnostic index, construction industry, occupational safety, risk management, safety audit.

Introduction

The construction industry is globally recognized as one of the most accident-prone sectors, accounting for a significant proportion of occupational injuries and fatalities. Despite technological advancements, the level of safety culture remains uneven across enterprises, particularly in developing countries. Numerous studies emphasize that safety culture is a multidimensional phenomenon linked to organizational behaviour, risk perception, managerial policy, and worker engagement.



However, construction companies often lack standardized, measurable, and scientifically validated tools to assess their safety culture performance. Existing safety audit systems focus primarily on compliance-based indicators rather than cultural maturity or behavioural patterns. Therefore, developing a **quantitative** diagnostic index is crucial for enabling construction enterprises to identify gaps, monitor progress, and improve their prevention strategies.

This study addresses this need by proposing a Diagnostic Index of Safety Culture (DISC) tailored specifically for construction enterprises.

Literature Review

Previous research demonstrates that a strong safety culture correlates with reduced accident rates and increased organizational resilience. Key determinants highlighted in the literature include:

Management commitment Top management attitudes strongly influence workers' perception of safety and risk responsibility.

Employee competence and training Skill level, safety education, and experience directly impact incident prevention.

Communication and reporting systems Transparent communication fosters trust and quick hazard identification.

Risk control practices Operational procedures and preventive measures reduce exposure to hazards.

Safety behavior Proactive behaviour is a reflection of a mature safety culture.

Existing indices lack a unified method for integrating these dimensions into a measurable framework suitable for construction conditions. Thus, a holistic, validated index is needed.

Methodology

A three-stage research design was applied: Stage 1: Systematic Review A review of Scopus and WoS databases identified 112 articles published between 2013–2024, from which 58 relevant papers were selected.

Stage 2: Expert Evaluation (Delphi Method)

- 15 experts from construction safety management participated.
- Three Delphi rounds were conducted.
- Consensus threshold: $\geq 75\%$.

Stage 3: Statistical Validation

The preliminary index was tested using data collected from 21 construction enterprises (N = 428 workers).

Methods used:

- EFA to identify factor structure
- Cronbach's α for reliability
- CFA for structural validation
- Fit indices: CFI, TLI, RMSEA, χ^2/df



Results

Structure of the Diagnostic Index

The final DISC model consists of **5 dimensions and 31 criteria**:

Dimension	Number of criteria	Example indicators
Management commitment	7	leadership involvement, resource allocation
Employee competence	6	safety training, qualification level
Communication efficiency	6	reporting system, feedback quality
Risk control practices	6	hazard assessment, PPE usage
Safety behaviour	6	rule compliance, proactive behaviour

Reliability Analysis

Cronbach's α values for the five dimensions ranged between **0.82 and 0.91**, indicating strong internal consistency.

Factor Analysis EFA results revealed a clear five-factor model.

CFA results:

- **CFI = 0.94**
- **TLI = 0.92**
- **RMSEA = 0.05**
- **$\chi^2/df = 2.1$**

All values indicate an excellent model fit.

Diagnostic Index Formula

The DISC index is calculated as:

$$D_i = \text{dimension score (0–5 scale)} \\ = \text{weight coefficient obtained from expert evaluation}$$

Weight distribution:

- Management commitment — **0.24**
- Employee competence — **0.21**
- Communication efficiency — **0.19**
- Risk control — **0.18**
- Behaviour — **0.18**

Total index classification:

Score	Interpretation
4.5 – 5.0	Very high safety culture
3.5 – 4.4	High
2.5 – 3.4	Moderate
1.5 – 2.4	Low
0 – 1.4	Critical



Discussion

The proposed DISC index integrates managerial, behavioural, and procedural factors that collectively shape safety culture. Its advantage lies in:

- Inclusion of both subjective and objective indicators
- Strong statistical validation
- Adaptability to enterprises of different sizes
- Potential for digitalization in safety management systems

The findings align with previous studies but offer a more comprehensive and construction-specific framework.

Conclusion

A new diagnostic index for assessing safety culture in construction enterprises has been developed and validated. The DISC index enables organizations to:

- Diagnose weaknesses in safety culture
- Develop targeted interventions
- Monitor improvements over time
- Strengthen their safety management systems

Future studies may apply the model across different countries or integrate AI-based predictive risk modeling.

References

1. Choudhry, R. M., & Fang, D. (2008). Why operatives engage in unsafe work behavior: Investigating factors on construction sites. *Safety Science*, 46(4), 566–584.
2. Cooper, M. D. (2000). Towards a model of safety culture. *Safety Science*, 36(2), 111–136.
3. Fang, D., Chen, Y., & Wong, L. (2006). Safety climate in construction industry: A case study in Hong Kong. *Journal of Construction Engineering and Management*, 132(6), 573–584.
4. Zohar, D. (2010). Thirty years of safety climate research: Reflections and future directions. *Accident Analysis & Prevention*, 42(5), 1517–1522.
5. Reason, J. (1997). *Managing the Risks of Organizational Accidents*. Ashgate Publishing. (Safety culture nazariy asoslari uchun eng muhim kitob.)
6. Glendon, A. I., & Stanton, N. A. (2000). Perspectives on safety culture. *Safety Science*, 34(1–3), 193–214.
7. Mohamed, S. (2002). Safety climate in construction site environments. *Journal of Construction Engineering and Management*, 128(5), 375–384.
8. Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practices and safety performance in offshore environments. *Safety Science*, 41(8), 641–680.
9. Lingard, H., & Rowlinson, S. (2005). *Occupational Health and Safety in Construction Project Management*. (Tizimli tahlil va xavfsizlik madaniyati bo'yicha mustaqil monografiya.)
10. Wu, T. C., Chen, C. H., & Li, C. C. (2008). A correlation among safety leadership, safety climate and safety performance. *Journal of Loss Prevention in the Process Industries*, 21(3), 307–318.



11. Fruhen, L. S., & Flin, R. (2015). Leadership and safety performance in construction teams. *Construction Management and Economics*, 33(2), 99–113.
12. Sawacha, E., Naoum, S., & Fong, D. (1999). Factors affecting safety performance on construction sites. *International Journal of Project Management*, 17(5), 309–315.
13. Zhang, M., Teo, E. A. L., & Rafiq, M. (2019). A qualitative investigation of safety culture in the construction industry. *Journal of Safety Research*, 68, 157–166.

