Risk management of human resources in gas development projects (case study: Isfahan Gas Company)

Extended Abstract

Introduction: Human resource risk management plays a critical role in ensuring the safety, efficiency, and long-term sustainability of gas development projects. The oil and gas industry, as a high-risk sector, is prone to numerous incidents that can have severe human, environmental, financial, and reputational consequences. In Iran, one of the top five countries in oil and gas reserves, extensive gas projects such as South Pars and provincial distribution systems necessitate comprehensive risk management approaches. The Isfahan Gas Company, as a project-oriented organization, faces significant human resource-related risks that may affect operational performance and competitiveness. This study aims to identify, evaluate, and prioritize critical human resource risks in gas development projects to improve safety performance and reduce incident recurrence, using a fuzzy-based multi-criteria decision-making approach integrated with Failure Mode and Effects Analysis (FMEA).

Materials and Methods: This applied research was conducted as a descriptive-survey study on 33 HSE representatives of the Isfahan Gas Company. Potential risks were first identified through literature review, expert interviews, and the Lawshe content validity method, resulting in classification into six major groups. A hybrid approach combining the Best–Worst Method (BWM) for weighting evaluation criteria, fuzzy Analytical Hierarchy Process (FAHP) for prioritizing incidents, and the integrated Grey Relational Analysis–VIKOR method under a fuzzy environment was employed. The Failure Mode and Effects Analysis (FMEA) technique was used to calculate the fuzzy risk priority numbers (FRPN), incorporating severity (S), occurrence (O), and detection (D) scores on a scale of 1–10. Defuzzification was applied to determine final risk rankings. The analysis considered four main evaluation criteria—human, financial, environmental, and organizational reputation impacts.

Results: The analysis identified “falling from height” (FRPN: 0.3332) as the highest priority risk, followed by “object collision” (FRPN: 0.2735), “caught between two objects” (FRPN: 0.2396), and “falling objects” (FRPN: 0.1537). Statistical evaluation revealed that engineering and combined control measures significantly reduced both the probability and severity of high- and medium-risk hazards, while non-engineering controls alone were insufficient to achieve meaningful reductions. For example, combined interventions lowered the mean probability of occurrence from 3.07 to 2.07 and mean hazard severity from 4.2 to 3.2.

Discussion and Conclusion: The findings confirm that human resource-related risks, particularly work-at-height incidents, are dominant in gas development projects. Implementing structured risk management frameworks, employing specialized safety personnel, enforcing clear work-at-height guidelines, and delivering targeted safety training can significantly mitigate these risks. The study also demonstrates that fuzzy FMEA is more effective than traditional methods in managing uncertainty and capturing expert judgment. Moreover, integrating engineering controls with administrative measures yields the highest safety performance improvements. Given the high-risk nature of the gas industry, proactive human resource risk management is essential to safeguard personnel, ensure project continuity, and protect environmental and organizational interests.

Keywords: Risk management, Human resources, Gas development projects, Failure Mode and Effects Analysis, Fuzzy logic, Safety performance.