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Exploring the Factors Behind the Failure of the Quality of Implementing Health, Safety, and Environment Policies in the Iran Oil Pipelines and Telecommunications Company

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A B S T R A C T

The existence and implementation of occupational safety and health policies are essential prerequisites for moving toward safety enhancement and the prevention of occupational accidents. The present study aimed to explore the factors contributing to the failure of the quality of implementing Health, Safety, and Environment (HSE) policies in the Iran Oil Pipelines and Telecommunications Company. In terms of purpose, this study was fundamental–applied research conducted as a cross-sectional study in the winter of 2026. Data were collected using library research and the Delphi method. Through library studies, 45 factors were identified and extracted. Subsequently, a questionnaire was designed based on the findings of the first phase of the study, and experts were asked to determine the importance of each factor using verbal variables. The experts' opinions regarding the identified factors continued until theoretical saturation was achieved. The qualitative findings initially included the extraction of 45 factors associated with the failure of policy implementation quality. Subsequently, four factors were not confirmed, and based on the experts' recommendations, three additional factors were added to the identified factors, resulting in a total of 44 identified factors. Then, in order to finalize the list of factors, the Delphi method and the t-test were employed. Ultimately, it was determined that the lack of independence of the Health, Safety, and Environment management unit was the most influential factor, whereas limited access to valid HSE theories and technologies had the least effect on the failure of policy implementation. Given that the lack of independence of the Health, Safety, and Environment management unit had the greatest impact, efforts toward granting greater independence to this unit may contribute to reducing occupational accidents.

Keywords: *Policy; Policy Implementation Quality; Health, Safety, and Environment Management; Iran Oil Pipelines and Telecommunications Company*

1. Introduction

Health, Safety, and Environment (HSE) management has become one of the most critical dimensions of organizational sustainability and strategic governance in high-risk industries, particularly in the oil and gas sector. The complexity of operational processes, the hazardous nature of petroleum extraction and transportation activities, the extensive use of heavy infrastructure, and the potential for catastrophic environmental and human losses have made the implementation of effective HSE policies an indispensable organizational priority. In modern industrial systems, HSE policies are no longer viewed merely as regulatory obligations; rather, they are considered strategic instruments for organizational resilience, operational continuity, employee well-being, environmental protection, and competitive advantage (Acheampong & Kemp, 2022; Sheng & Liu, 2023). The increasing integration of sustainability principles into industrial governance frameworks has further intensified the importance of policy quality and effective implementation mechanisms in HSE systems. Despite considerable advancements in safety technologies, monitoring systems, and regulatory frameworks, industrial accidents and environmental crises continue to occur in petroleum industries worldwide, indicating that the existence of formal policies alone does not guarantee successful implementation (Benson et al., 2024; Dehaghi et al., 2022). Consequently, researchers and practitioners have increasingly focused on identifying the organizational, managerial, technological, and human factors that undermine the quality of HSE policy implementation.

The oil and gas industry is characterized by a high level of operational uncertainty, technical interdependence, and environmental sensitivity. In such environments, ineffective HSE policy implementation can result in severe occupational injuries, environmental degradation, financial losses, infrastructure destruction, and reputational damage. Research has shown that weak organizational safety climates, inadequate supervision systems, poor communication channels, and deficiencies in risk management processes significantly contribute to the occurrence of occupational incidents and policy failures (Amaechi et al., 2022; Durrani & Zeeshan, 2023). In addition, rapid technological changes and the emergence of cyber-physical systems in the petroleum sector have created new dimensions of HSE vulnerability that require more integrated and adaptive policy frameworks (Oudina et al., 2024). The increasing digitalization of industrial operations, while improving efficiency and monitoring capabilities, has simultaneously introduced novel operational and cybersecurity risks that may compromise safety management systems if organizational readiness is inadequate. Therefore, organizations operating in the petroleum industry must continuously revise and strengthen the mechanisms through which HSE policies are implemented, monitored, and institutionalized.

One of the major challenges in HSE management systems concerns the gap between policy formulation and policy implementation. In many organizations, sophisticated HSE regulations and strategic documents are developed; however, these policies often fail during the implementation phase due to structural, managerial, behavioral, and environmental obstacles. Policy implementation quality depends on multiple interacting variables, including leadership commitment, resource allocation, organizational culture, employee participation, communication effectiveness, technological infrastructure, and continuous monitoring systems (Jian-guo, 2022; Mirza et al., 2023). Failure in any of these dimensions can reduce the effectiveness of HSE programs and weaken organizational capacity to manage operational hazards. Studies have demonstrated that organizational safety culture and leadership support are among the most influential predictors of successful HSE implementation (Dehaghi et al., 2022; Glebova et al., 2023). Organizations with weak accountability systems, ambiguous responsibilities, and insufficient employee engagement often experience lower levels of safety compliance and higher rates of occupational incidents.

In recent years, researchers have increasingly emphasized the role of advanced risk management approaches in improving HSE performance. Quantitative and hybrid decision-making models such as Failure Modes and Effects Analysis (FMEA), fuzzy multi-criteria decision-making techniques, and integrated risk assessment systems have been widely employed to identify and prioritize industrial risks (Khalilzadeh et al., 2021; Nabizadeh et al., 2021). These approaches have enhanced organizational capability to evaluate operational hazards systematically and to allocate preventive resources more effectively. Environmental risk assessment frameworks have also become increasingly important due to the growing sensitivity of societies and governments toward environmental sustainability and ecological protection (Kassem et al., 2022; Khezri et al., 2023). In petroleum

industries, environmental incidents associated with pipelines, refining operations, and offshore facilities can generate long-term ecological consequences, making proactive HSE implementation an organizational necessity rather than a regulatory formality.

Technological innovation has substantially transformed the nature of HSE systems in industrial organizations. The integration of digital twins, virtual reality (VR), automation systems, remote monitoring technologies, and predictive analytics has created new opportunities for strengthening safety management and hazard prevention (Jia et al., 2024; Zhuo et al., 2024). Digital technologies facilitate real-time monitoring, operational simulation, ergonomic assessment, and predictive risk analysis, thereby improving organizational responsiveness to hazardous situations. In the context of HSE training, VR-based educational systems have demonstrated considerable effectiveness in enhancing employee awareness and improving learning outcomes in high-risk operational environments (Zhuo et al., 2024). Similarly, advanced monitoring infrastructures such as SCADA systems contribute significantly to operational control, early warning systems, and accident prevention in oil and gas operations (Fan et al., 2024). Nevertheless, the effectiveness of such technologies depends heavily on organizational support, managerial competence, employee acceptance, and adequate financial investment. In many developing industrial contexts, technological limitations, sanctions, insufficient investment, and lack of specialized expertise hinder the successful integration of advanced HSE technologies into operational systems (Farahani et al., 2021; Mustafa, 2021).

Human factors remain among the most influential determinants of HSE policy implementation quality. Employee motivation, competency, behavioral diversity, risk perception, communication patterns, and participation levels significantly shape organizational safety outcomes. Research has indicated that continuous safety education and prevention-oriented training programs improve occupational health and organizational safety culture (Keshaverz, 2023). Similarly, participatory management approaches and employee involvement in safety improvement processes strengthen compliance behaviors and organizational commitment to HSE objectives (Sadeghi & Sadeghi, 2022). Conversely, resistance to change, traditional work cultures, fear of reporting incidents, and lack of trust in supervisory systems may weaken policy implementation effectiveness and reduce organizational learning from operational failures. In many petroleum organizations, operational pressures and productivity priorities may unintentionally undermine safety priorities, leading to unsafe practices and policy deviations (Balali et al., 2021; Sarfaraz et al., 2022). Therefore, the sustainability of HSE systems requires not only technical and structural improvements but also continuous attention to behavioral and cultural dimensions.

Another important issue in petroleum HSE management concerns environmental responsibility and sustainability governance. Increasing public concern regarding environmental protection has pressured oil and gas companies to adopt more comprehensive environmental management strategies and accountability mechanisms (Shams et al., 2023; Sheng & Liu, 2023). Offshore pipeline operations, decommissioning activities, refining processes, and hydrocarbon waste management represent major sources of environmental risk that require integrated HSE governance frameworks. Environmental risk management approaches based on systematic assessment and preventive interventions have therefore become central components of industrial policymaking (Jondabeh et al., 2024; Khezri et al., 2023). In addition, the economic consequences of occupational diseases, environmental incidents, and operational failures have increased organizational awareness regarding the financial value of preventive HSE investments (Jondabeh et al., 2024). Effective HSE policy implementation consequently contributes not only to safety improvement but also to organizational sustainability, economic efficiency, and stakeholder trust.

The literature further indicates that organizational infrastructure and maintenance systems play a critical role in determining HSE performance outcomes. Inadequate maintenance processes, weak asset management systems, and outdated operational infrastructures significantly increase the probability of industrial failures and safety incidents (Amaechi et al., 2022; Farizhendy et al., 2021). Maintenance outsourcing strategies, workforce development, and technical infrastructure improvement have therefore become essential dimensions of industrial safety management (Pishghadam & Esmaeeli, 2021; Stefek et al., 2022). Furthermore, risk-oriented project management systems and interactive risk assessment frameworks have demonstrated substantial effectiveness in enhancing operational safety and organizational preparedness (Farahani et al., 2021; Khalilzadeh et al., 2021). However, many organizations still face persistent barriers such as fragmented communication systems, insufficient coordination among operational departments, inadequate

monitoring mechanisms, and weak organizational learning processes.

Within the Iranian petroleum industry, HSE policy implementation faces additional contextual challenges associated with sanctions, technological restrictions, managerial centralization, and structural inefficiencies. Process industries in Iran operate under conditions of economic pressure and limited access to advanced international technologies, which may affect organizational capacity to modernize HSE systems and maintain high safety standards (Farahani et al., 2021; Mustafa, 2021). Moreover, the complexity of oil transportation networks and the strategic significance of pipeline infrastructures increase the sensitivity of operational safety management in companies such as the Iran Oil Pipelines and Telecommunications Company. Although various HSE regulations and standards have been established in this sector, evidence suggests that implementation quality remains vulnerable to multiple organizational and operational challenges. Previous studies have examined dimensions of safety climate, environmental risk, industrial hazards, and organizational culture in process industries (Dehaghi et al., 2022; Farahi-Ashtiani et al., 2023); however, limited research has comprehensively investigated the underlying factors contributing to the failure of HSE policy implementation quality specifically within the operational structure of pipeline and petroleum telecommunication systems.

Given the strategic importance of HSE systems in reducing occupational accidents, protecting environmental resources, improving operational reliability, and enhancing organizational sustainability, identifying the factors associated with the failure of HSE policy implementation is essential for strengthening industrial governance and improving safety performance in the petroleum sector. Therefore, the present study aimed to explore the factors contributing to the failure of the quality of implementing Health, Safety, and Environment policies in the Iran Oil Pipelines and Telecommunications Company.

2. Methods and Materials

In terms of purpose, this study was fundamental–applied research conducted as a cross-sectional study in the winter of 2026. Data were collected using library research and the Delphi method. Through library studies and document reviews, 45 factors associated with policy implementation failure were identified and extracted. These factors were presented to the experts participating in the present study in order to obtain their opinions regarding the appropriateness of these factors using verbal variables within the framework of a five-point Likert scale (strongly agree, agree, relatively agree, disagree, and strongly disagree). The obtained definitive mean indicated the intensity of experts' agreement with each component of the research model. The initial factors extracted from the theoretical foundations of the study were presented to 30 experts and specialists. The experts in this study consisted of university faculty members and specialists in organizational management, decision-making, and policymaking, as well as experts in Health, Safety, and Environment (HSE) management at the Iran Oil Pipelines and Telecommunications Company, who participated in the model development process through the fuzzy Delphi technique. Purposeful sampling was used to select the experts, and questionnaires were designed and distributed in order to obtain the experts' opinions regarding the degree of their agreement with the initial factors. In practice, after identifying the experts, the Delphi method was implemented in two rounds, and the research instruments for each round were distributed and collected both in person and electronically. Accordingly, at this stage, the experts were asked to express their opinions regarding the suitability of the proposed factors using a five-point Likert scale. Therefore, the value of 3.00, representing the average assessment level, was used to confirm the factors, and the mean scores of the experts participating in the Delphi method regarding the influential factors were compared with the theoretical value of 3.00 using the *t*-test. If the mean score of the experts' opinions regarding a proposed factor exceeded the theoretical value of 3.00, that factor remained in the model; otherwise, the factor was excluded from the model.

3. Findings and Results

In the first stage of this study, 45 factors were identified and extracted through library studies and document reviews. In addition to using the research literature, the fuzzy Delphi technique with two survey rounds was employed to extract the factors contributing to the failure of the quality of implementing Health, Safety, and Environment policies in the Iran Oil Pipelines and Telecommunications Company.

In the first-stage sampling process, in addition to closed-ended questions, the distributed questionnaire also collected experts' views through open-ended questions. Therefore, after refining the viewpoints provided and consulting with the supervising and advisory professors, corrective measures

were applied to the initial factors. The results of this test are presented in Table 1. The findings indicate that among the 45 initial factors related to the failure of the quality of implementing Health, Safety, and Environment policies in the Iran Oil Pipelines and Telecommunications Company, 41 factors were confirmed by the experts and remained in the final model of factors influencing the failure of policy implementation quality ($p < .05$). In addition, four factors numbered 20, 29, 31, and 32 were not confirmed by the experts and were consequently removed from the model ($p > .05$).

Furthermore, an examination of the open-ended questions provided to the experts revealed that three additional factors, namely "uncritical benchmarking from international oil companies," "absence of an independent research and technology unit in the field of HSE policies," and "failure to appoint implementers based on competency," were proposed by the experts for inclusion among the initial factors. Consequently, a second-stage sampling process was conducted.

Table 1

Validity Assessment of the Factors Affecting the Failure of the Quality of Implementing Health, Safety, and Environment Policies in the Iran Oil Pipelines and Telecommunications Company from the Perspective of First-Stage Experts (n = 30)

Factor	Mean	SD	t Statistic	p Value	Result
Weakness in the comprehensiveness of HSE policies	3.30	0.79	2.07	.024	Confirmed
Parallel and overlapping instructions and policies	3.33	0.96	1.90	.033	Confirmed
Imbalanced and contradictory instructions and policies	4.17	1.44	4.44	.001	Confirmed
Instability and frequent changes in the general policies of the National Iranian Oil Company	4.33	1.21	6.02	.001	Confirmed
Neglect of safety priorities in policymaking	4.43	1.07	7.32	.001	Confirmed
Neglect of social, political, economic, and administrative variables	4.57	1.07	8.00	.001	Confirmed
Neglect and lack of investment in research and development of HSE services	4.50	1.11	7.43	.001	Confirmed
Infeasibility of implementing HSE policies	4.30	1.34	5.30	.001	Confirmed
Lack of interaction among HSE actors in HSE policymaking	3.97	1.30	4.07	.001	Confirmed
Lack of interaction among HSE actors in the policy implementation domain	3.53	1.59	1.84	.038	Confirmed
Top-down approach to HSE policies	3.57	1.43	2.17	.019	Confirmed
Lack of organizational support for implementing HSE policies	4.10	1.16	5.22	.001	Confirmed
Lack of senior management commitment to implementing HSE policies	4.47	1.17	6.89	.001	Confirmed
Weakness in financial resource management and budget allocation	4.37	1.22	6.15	.001	Confirmed
Shortage of resources and infrastructures required for policy implementation	4.53	1.07	7.82	.001	Confirmed
Shortage of HSE specialists and lack of attention to recruitment and retention	4.43	1.22	6.42	.001	Confirmed
Limited access to valid HSE theories and technologies	3.97	1.22	4.35	.001	Confirmed
Weakness in the use of safety data analysis and risk prediction systems	4.67	0.96	9.52	.001	Confirmed
Lack of coordination among safety, operation, and maintenance departments regarding implementation of instructions	4.20	1.22	5.41	.001	Confirmed
Lack of coordination between detailed and general safety standards of the National Iranian Oil Company	2.10	0.82	-5.91	1.000	Rejected
Lack of independence of the Health, Safety, and Environment management unit	4.00	1.34	4.09	.001	Confirmed
Unclear duties and responsibilities and lack of required coordination	4.20	1.40	4.70	.001	Confirmed
Incorrect understanding of HSE policies by implementers	4.33	1.27	5.76	.001	Confirmed
Personality characteristics and behavioral diversity among HSE policy implementers	4.47	1.17	6.89	.001	Confirmed
Lack of work motivation and performance-based rewards among employees	4.70	0.79	11.72	.001	Confirmed
Lack of support for employee participation in improving HSE policy implementation	4.47	1.31	6.15	.001	Confirmed
Weak training programs without HSE performance evaluation	4.60	0.93	9.40	.001	Confirmed
Resistance to change and new safety standards	3.67	1.32	2.76	.005	Confirmed
Traditional work culture resistant to change in executive sectors	2.73	1.02	-1.44	.920	Rejected
Failure of implementers to submit safety reports to HSE policymakers	4.33	1.03	4.10	.001	Confirmed
Neglect of executive feedback and operational experiences in policymaking	1.83	0.85	-7.44	1.000	Rejected
Inappropriate environment for spontaneous hazard reporting and submission of suggestions by employees to policymakers	3.40	1.48	1.48	.074	Rejected
Corruption in supervision and inspection	4.07	1.23	4.75	.001	Confirmed
Weakness in the continuous monitoring and evaluation system	3.57	1.55	2.01	.027	Confirmed
Fear of administrative prosecution in reporting incidents and deficiencies	3.53	1.50	1.94	.031	Confirmed
Concealing deficiencies instead of correcting them	4.57	1.07	8.00	.001	Confirmed

Lack of accountability of HSE units in policy implementation	3.87	1.38	3.43	.001	Confirmed
Weakness in corruption control regarding procurement of safety equipment and low standards in tenders	3.67	1.56	2.34	.013	Confirmed
Inappropriateness of HSE policy implementation tools	3.47	1.41	1.82	.040	Confirmed
Failure to utilize safety, health, and policy consulting centers	4.17	0.81	7.84	.001	Confirmed
Inadequate investment in upgrading remote monitoring systems (SCADA) and automation	3.90	1.32	3.73	.001	Confirmed
Sanctions and restricted access to safety and environmental technologies	3.47	0.97	2.63	.007	Confirmed
Unforeseen factors beyond organizational control	4.73	0.69	13.73	.001	Confirmed
Neglect of creativity and innovation	4.67	0.96	9.52	.001	Confirmed
Failure to control received information	4.00	1.34	4.09	.001	Confirmed

In the second survey stage, after applying the necessary changes to the initial factors, the second questionnaire was prepared and resent to the expert panel members along with each individual's previous viewpoint. In the second stage, the experts responded again to the presented questions by considering the viewpoints of other group members as well as the changes made to the factors. The results are shown in Table 3. The frequency of responses provided in the second stage was analyzed using the same method described for the first stage, with the difference that, at this stage, instead of surveying the 45 initial factors, the survey was conducted after removing the four factors excluded in the first stage and adding the three newly proposed factors. As the results in Table 3 show, all initial factors were confirmed at this stage. Therefore, the survey process was stopped at this stage, and the 44 factors confirmed in Table 3 were considered the factors contributing to the failure of the quality of implementing Health, Safety, and Environment policies in the Iran Oil Pipelines and Telecommunications Company.

Table 2

Validity Assessment of the Factors Affecting the Failure of the Quality of Implementing Health, Safety, and Environment Policies in the Iran Oil Pipelines and Telecommunications Company from the Perspective of Second-Stage Experts (n = 30)

Factor	Mean	SD	t Statistic	p Value	Result
Weakness in the comprehensiveness of HSE policies	4.00	1.41	3.87	.001	Confirmed
Parallel and overlapping instructions and policies	4.27	1.36	5.09	.001	Confirmed
Imbalanced and contradictory instructions and policies	3.70	1.51	2.54	.008	Confirmed
Instability and frequent changes in the general policies of the National Iranian Oil Company	4.23	1.28	5.29	.001	Confirmed
Neglect of safety priorities in policymaking	4.07	1.39	4.21	.001	Confirmed
Neglect of social, political, economic, and administrative variables	4.47	1.17	6.89	.001	Confirmed
Neglect and lack of investment in research and development of Health, Safety, and Environment services	4.17	1.37	4.68	.001	Confirmed
Infeasibility of implementing HSE policies	4.53	0.90	9.34	.001	Confirmed
Lack of interaction among HSE actors in HSE policymaking	4.70	0.60	15.62	.001	Confirmed
Lack of interaction among HSE actors in the field of policy implementation	4.40	1.19	6.43	.001	Confirmed
Top-down approach to HSE policies	4.00	1.37	4.01	.001	Confirmed
Lack of organizational support for implementing HSE policies	3.93	1.29	3.98	.001	Confirmed
Lack of senior management commitment to implementing HSE policies	4.50	1.08	7.64	.001	Confirmed
Weakness in financial resource management and budget allocation	4.20	1.32	4.97	.001	Confirmed
Shortage of resources and infrastructures required for policy implementation	4.17	1.39	4.59	.001	Confirmed
Shortage of HSE specialists and lack of attention to recruitment and retention of these personnel	3.77	1.55	2.72	.006	Confirmed
Limited access to valid HSE theories and technologies	3.63	1.40	2.48	.010	Confirmed
Weakness in using safety data analysis and risk prediction systems	4.37	1.22	6.15	.001	Confirmed
Lack of coordination among safety, operation, and maintenance departments in implementing instructions	4.70	0.84	11.13	.001	Confirmed
Lack of independence of the Health, Safety, and Environment management unit	4.80	0.76	12.95	.001	Confirmed
Unclear duties and responsibilities and lack of necessary coordination	4.53	1.01	8.33	.001	Confirmed
Incorrect understanding of HSE policies by implementers	4.50	1.17	7.04	.001	Confirmed
Personality characteristics and behavioral diversity of HSE policy implementers	4.47	1.07	7.48	.001	Confirmed
Lack of work motivation and criterion-based rewards among employees	4.37	1.16	6.46	.001	Confirmed
Lack of support for employee participation in improving HSE policy implementation	4.33	1.35	5.42	.001	Confirmed
Weak training programs without HSE performance evaluation	3.93	1.36	3.75	.001	Confirmed
Resistance to change and new safety standards	4.57	0.73	11.79	.001	Confirmed

Failure of implementers to refer safety reports to HSE policymakers	3.73	1.31	3.06	.002	Confirmed
Corruption in supervision and inspection	3.50	1.33	2.06	.024	Confirmed
Weakness in the continuous monitoring and evaluation system	3.93	1.44	3.56	.001	Confirmed
Fear of administrative prosecution when reporting incidents and deficiencies	3.93	1.26	4.06	.001	Confirmed
Concealing deficiencies instead of correcting them	3.87	1.31	3.63	.001	Confirmed
Lack of accountability of HSE units in policy implementation	4.17	1.21	5.30	.001	Confirmed
Weakness in corruption control in the procurement and supply of safety equipment and low standards in tenders	3.47	1.36	1.88	.035	Confirmed
Inappropriateness of HSE policy implementation tools	3.80	1.38	3.19	.002	Confirmed
Failure to utilize safety, health, and policy consulting centers	3.70	1.24	3.10	.002	Confirmed
Inappropriate and insufficient investment in upgrading remote control and monitoring systems (SCADA) and automation	4.13	1.36	4.57	.001	Confirmed
Sanctions and restricted access to safety and environmental technologies	3.70	1.42	2.70	.006	Confirmed
Unforeseen factors beyond organizational control	3.70	1.49	2.57	.008	Confirmed
Neglect of creativity and innovation	3.70	1.51	2.54	.008	Confirmed
Failure to control received information	4.37	1.10	6.82	.001	Confirmed
Uncritical benchmarking from international oil companies	4.57	1.01	8.53	.001	Confirmed
Absence of an independent research and technology unit in the field of HSE policies	3.90	1.32	3.73	.001	Confirmed
Failure to appoint implementers based on competency	4.07	1.41	4.14	.001	Confirmed

4. Discussion and Conclusion

The present study aimed to explore the factors contributing to the failure of the quality of implementing Health, Safety, and Environment (HSE) policies in the Iran Oil Pipelines and Telecommunications Company. The findings demonstrated that the failure of HSE policy implementation is a multidimensional phenomenon influenced by structural, managerial, technological, cultural, behavioral, and environmental factors. In total, 44 factors were ultimately confirmed through the fuzzy Delphi process as influential determinants of HSE policy implementation failure. Among these factors, the lack of independence of the HSE management unit emerged as the most influential factor, whereas limited access to valid HSE theories and technologies was identified as the least influential factor among the confirmed dimensions. The results indicate that organizational and managerial deficiencies play a more significant role than purely technical limitations in undermining the quality of HSE policy implementation.

One of the most important findings of the study was the central role of organizational structure and managerial independence in HSE effectiveness. The lack of independence of the HSE management unit was identified as the most influential factor contributing to implementation failure. This finding suggests that when HSE departments are structurally dependent on operational or production-oriented divisions, their capacity to enforce safety standards, monitor compliance, and challenge unsafe practices becomes limited. In many industrial organizations, production priorities may dominate safety considerations, leading to conflicts of interest and weakening the authority of HSE units. This finding is consistent with the results reported by (Jian-guo, 2022), who emphasized that effective HSE systems require strong organizational authority, managerial commitment, and institutional support structures. Similarly, (Glebova et al., 2023) highlighted that occupational safety culture management becomes ineffective in organizations where safety units lack strategic influence and organizational autonomy. The present findings also align with the work of (Dehaghi et al., 2022), who demonstrated that organizational climate and structural support significantly influence occupational accident rates and safety outcomes.

The study further revealed that inadequate coordination among operational sectors, unclear responsibilities, and weak organizational support systems significantly contribute to the failure of HSE policy implementation. In complex petroleum operations, effective communication and coordination between maintenance, operation, safety, and managerial departments are essential for ensuring consistent implementation of safety procedures. The findings suggest that fragmentation of responsibilities and lack of coordination create implementation gaps that reduce organizational responsiveness to hazards. These findings are supported by (Amaechi et al., 2022), who emphasized the importance of integrated asset management and coordinated maintenance systems in maintaining safety and sustainability in offshore facilities. Likewise, (Farizhendy et al., 2021) demonstrated that infrastructure and maintenance coordination significantly affect operational safety performance in petroleum-related activities. The findings are also consistent with the conclusions of (Sarfaraz et al., 2022), who identified organizational coordination and

managerial integration as critical success factors in oil and gas industry projects.

Another major finding concerned the significant influence of leadership commitment and resource allocation on HSE policy implementation quality. The study identified weak financial management, inadequate investment in HSE systems, insufficient infrastructure, and lack of senior management commitment as major barriers to successful implementation. These results highlight the strategic role of top management in prioritizing safety and allocating sufficient resources for preventive interventions. Organizations that treat HSE merely as a compliance requirement rather than a strategic necessity may fail to establish sustainable safety systems. This finding is consistent with (Acheampong & Kemp, 2022), who reported that stronger HSE regulatory commitment and organizational investment are associated with improved safety outcomes in offshore oil and gas industries. Similarly, (Benson et al., 2024) emphasized that effective interventions in process industries depend heavily on organizational investment, leadership support, and systematic implementation mechanisms. The findings also correspond with the conclusions of (Farahani et al., 2021), who noted that sanctions and financial limitations can significantly weaken organizational capacity for effective risk management in oil and gas megaprojects.

The present study also identified human resource and behavioral dimensions as critical determinants of implementation quality. Factors such as shortage of HSE specialists, inadequate training systems, weak motivation and reward structures, incorrect understanding of HSE policies, and resistance to change were all confirmed as influential contributors to implementation failure. These findings indicate that technical systems alone cannot ensure safety unless employees possess the necessary competencies, motivation, and organizational commitment to implement policies effectively. This result aligns with (Keshaverz, 2023), who emphasized the importance of prevention-oriented safety education in improving occupational health outcomes. Similarly, (Sadeghi & Sadeghi, 2022) demonstrated that organizational culture and employee relationship management techniques significantly influence the implementation of HSE culture in industrial environments. The findings are also supported by (Balali et al., 2021), who found that human resource risks constitute major threats in natural gas projects. Resistance to organizational change and lack of employee participation may prevent organizations from institutionalizing safety-oriented behaviors and adapting to evolving HSE standards.

The findings further revealed that weaknesses in monitoring systems, corruption control, and accountability mechanisms substantially contribute to HSE policy implementation failure. Factors such as corruption in supervision and inspection, concealment of deficiencies, fear of administrative prosecution when reporting incidents, and weak monitoring systems were identified as influential dimensions. These findings suggest that organizations lacking transparent reporting systems and accountability mechanisms are more vulnerable to operational failures and safety incidents. Fear-based organizational cultures may discourage employees from reporting hazards or operational deficiencies, thereby reducing opportunities for preventive intervention and organizational learning. These findings are consistent with (Mirza et al., 2023), who emphasized the importance of integrated management systems and performance indicators in evaluating and improving HSE effectiveness in industrial organizations. Likewise, (Glebova et al., 2023) argued that effective occupational safety culture depends on transparent organizational communication and accountability structures. The results also support the findings of (Farahi-Ashtiani et al., 2023), who highlighted the importance of recognizing and systematically managing human-made hazards in process industries.

Technological and digital dimensions also emerged as important determinants of HSE implementation quality. Weakness in the use of safety data analysis systems, inadequate investment in remote monitoring technologies such as SCADA systems, and insufficient utilization of advanced technological infrastructures were identified as influential factors. These findings indicate that digital transformation and technological modernization are increasingly necessary for effective HSE management in complex petroleum operations. Modern industrial safety systems depend heavily on predictive analytics, automation technologies, digital monitoring systems, and intelligent risk management tools. The findings correspond with the work of (Jia et al., 2024), who demonstrated that digital twin technologies and ergonomic systems significantly improve safety performance in petrochemical industries. Similarly, (Zhuo et al., 2024) emphasized the effectiveness of virtual reality technologies in enhancing HSE training and operational preparedness. The findings are also supported by (Fan et al., 2024), who highlighted the role of engineering technologies and remote monitoring systems in improving the operational safety of offshore gas facilities. However, the

present study showed that technological limitations were not perceived as influential as organizational and managerial deficiencies, suggesting that even advanced technologies may fail when organizational structures and implementation cultures are weak.

Environmental and external contextual factors were also identified as important dimensions affecting HSE implementation quality. The findings confirmed that sanctions, limited access to environmental technologies, unforeseen external events, and inadequate environmental responsibility systems influence the implementation of HSE policies. In the context of the Iranian petroleum industry, economic sanctions and technological restrictions may limit organizational access to advanced safety systems and international expertise. These findings align with (Mustafa, 2021), who argued that sanctions significantly affect organizational effectiveness and strategic capabilities. Similarly, (Shams et al., 2023) emphasized that environmental management challenges associated with oil and gas pipelines require integrated and adaptive safety governance frameworks. The results are also consistent with (Sheng & Liu, 2023), who highlighted the growing importance of environmental responsibility and sustainability performance in oil and gas enterprises.

Another notable finding of the study was the confirmation of newly proposed factors, including uncritical benchmarking from international oil companies, absence of an independent research and technology unit for HSE policies, and failure to appoint implementers based on competency. These findings reflect the importance of contextualized policymaking and competency-based management in industrial safety systems. Blind imitation of international models without adaptation to local operational realities may reduce implementation effectiveness. Likewise, the absence of specialized research and innovation units may weaken organizational learning and technological adaptation capacities. These findings are supported by (Barforoush et al., 2021), who argued that innovation and knowledge-based organizational resources are essential for achieving sustainable competitive advantage. The results also correspond with (Chen, 2021) and (Pishghadam & Esmaeeli, 2021), who emphasized the strategic role of adaptive engineering management and system dynamics approaches in improving operational effectiveness in energy-related industries.

The present study contributes theoretically by providing a comprehensive framework of organizational, technological, behavioral, and environmental factors influencing HSE policy implementation quality in the petroleum transportation sector. Methodologically, the use of the fuzzy Delphi approach enabled the systematic identification and prioritization of expert-based perspectives regarding implementation failure factors. Practically, the findings provide managers and policymakers with a clearer understanding of the structural and operational barriers that weaken HSE systems in petroleum organizations. Overall, the findings suggest that successful HSE implementation requires integrated organizational governance, strong leadership commitment, technological modernization, transparent accountability systems, and continuous employee engagement.

One limitation of the present study was its reliance on expert opinions and qualitative judgment-based assessments, which may involve subjective interpretations despite the application of the Delphi method. Another limitation concerns the restriction of the study population to experts associated with the Iran Oil Pipelines and Telecommunications Company, which may limit the generalizability of the findings to other industrial sectors or petroleum organizations. In addition, the cross-sectional nature of the study prevented examination of longitudinal changes in HSE implementation quality and the dynamic evolution of organizational safety systems over time.

Future studies are recommended to investigate the causal relationships among the identified factors using quantitative modeling approaches such as structural equation modeling or system dynamics analysis. Researchers may also compare HSE implementation failure factors across different petroleum sectors, including refineries, offshore facilities, and petrochemical industries, in order to identify sector-specific patterns. Furthermore, future research should examine the role of emerging technologies such as artificial intelligence, predictive analytics, and digital twin systems in improving the quality of HSE policy implementation and organizational safety performance.

From a practical perspective, petroleum organizations should strengthen the structural independence and authority of HSE management units in order to enhance their monitoring and supervisory effectiveness. Managers should also invest in competency-based recruitment systems, continuous safety education programs, advanced monitoring technologies, and transparent reporting mechanisms to improve organizational accountability and safety culture. In addition, establishing specialized research and innovation units in the field of HSE, strengthening employee participation in policymaking processes, and improving

coordination among operational departments may substantially reduce the likelihood of HSE policy implementation failure and improve overall organizational sustainability.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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