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Designing a Foresight Framework for Proactive Contractual Claims Management in EPC Projects in Iran's Oil and Gas Industry: A Hybrid Approach Based on Scenario Planning, Delphi, and Causal Layered Analysis

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ABSTRACT

Contractual claims management in engineering, procurement, and construction (EPC) projects in Iran's oil and gas industry has traditionally followed a reactive and post-event approach, whereby contract specialists primarily identify, document, and quantify claims after a dispute has occurred. This approach imposes substantial financial, time-related, and legal costs on the parties in an environment characterized by geopolitical uncertainties, exchange-rate volatility, sanctions-related constraints, and the rapid evolution of digital contract management technologies. This study aims to develop a proactive framework for claims management by drawing on the literature and tools of futures studies. To this end, a hybrid approach integrating Global Business Network (GBN) scenario planning, a three-round Delphi method, and Causal Layered Analysis (CLA) was employed. The findings indicate that the two driving forces of sanctions intensity and stability and digital maturity of contract management have the greatest influence and uncertainty regarding the future of contractual claims. Based on these drivers, four future scenarios were developed, along with a set of robust strategies, including the implementation of an integrated digital documentation system, the development of flexible contractual clauses, and the establishment of an early-warning claims monitoring team. The proposed framework can provide a practical foundation for owner and contractor companies in Iran's oil and gas industry to transition from reactive claims management toward a proactive and foresight-oriented approach.

1. INTRODUCTION

Over the past two decades, Iran's oil and gas industry has hosted large-scale engineering, procurement, and construction (EPC) projects characterized by substantial investment volumes, extensive technical complexity, and multi-year time horizons. These characteristics are regarded in the international project management literature as

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defining features of industrial megaprojects, which are inherently high-risk and highly vulnerable to cost and schedule overruns [1]. These characteristics, combined with the volatile political and economic environment arising from international sanctions, exchange-rate fluctuations, and restricted access to foreign technologies and suppliers, have created a fertile context for disputes and contractual claims between owners and contractors. The prevailing practice among Iranian companies is for contract administration and claims departments to initiate the identification and preparation of claim cases after the occurrence of delays, changes in the scope of work, or disruptions to project activities. This approach has also been recognized in the international literature as the dominant and often costly model of claims management, largely stemming from inadequate contemporaneous documentation and the late identification of claim-generating factors [2].

In contrast, Futures Studies provides frameworks and tools that enable the identification of drivers of change, the construction of alternative future scenarios, and the formulation of robust strategies before events occur. Despite the extensive application of futures studies in Iran's energy policy-making, no systematic linkage has yet been established between futures-oriented tools and the specialized domain of contractual claims management in EPC projects. This study seeks to integrate three distinct yet complementary futures methodologies Global Business Network (GBN) scenario planning, the Delphi method, and Causal Layered Analysis (CLA) to develop a framework for transitioning from reactive claims management to proactive claims management in EPC projects within Iran's oil and gas industry.

The central research question is: Which future drivers will have the greatest influence and uncertainty regarding the emergence of contractual claims in this industry, and how can strategies be designed based on the resulting scenarios to achieve acceptable performance across a broad range of plausible futures?

2. THEORETICAL FOUNDATIONS AND LITERATURE REVIEW

2.1. Claims Management in EPC Projects

A contractual claim can be defined as a formal request by one of the contracting parties for financial compensation, an extension of time, or both, arising from an event beyond the claiming party's reasonable control. Research has shown that the root causes of claims can generally be classified into three broad categories: communication problems and deficiencies in information flow and documentation; ambiguities and deficiencies in contractual documents; and shortcomings in project management, including planning and site management. These factors interact with one another and often generate a chain of rework, delays, and ultimately contractual claims [2]. Conventional claims management approaches have primarily focused on post-event identification and documentation. However, more recent research has demonstrated that the implementation of centralized digital information repositories, particularly within a Building Information Modeling (BIM) environment, can shift the identification and substantiation of extension-of-time claims from a reactive to a proactive mode [7].

2.2. Relevant Futures Studies Methods

Global Business Network (GBN) scenario planning is one of the most recognized approaches for constructing future scenarios based on two key drivers with the highest levels of influence and uncertainty. In a study specifically conducted in the context of Iran's energy industry, the integration of the Delphi method, PEST analysis, and Cross-Impact Analysis (CIA) within the GBN framework identified foreign investment, external economic sanctions, and growth in domestic energy consumption as key drivers and critical uncertainties. Based on these factors, three scenarios technology-driven development, stagnation, and self-sufficiency were developed for the future of Iran's energy sector, and robust strategies were evaluated across all three scenarios. The study demonstrated that economic and political factors, particularly sanctions, would constitute the most significant drivers shaping the future of Iran's energy industry [3]. The present framework extends this logic of scenario construction and robust strategy assessment from the macro level of the energy industry to the micro level of contractual claims management.

Causal Layered Analysis (CLA), developed by Sohail Inayatullah, examines a phenomenon across four layers: the litany, consisting of observable events and trends; the systemic or structural layer, encompassing underlying social, economic, and political causes; the worldview and discourse layer, comprising the fundamental assumptions held by the parties; and the myth and metaphor layer, which reflects the deeper unconscious imagery and narratives associated with the phenomenon [4]. This methodology is employed not merely for prediction but also for opening up spaces for critical reflection and designing alternative futures. In the present study, CLA is used to explore the culture and underlying narratives of contractual claims within each scenario.

The Delphi method, as an iterative process for collecting and converging the judgments of a panel of experts, has been widely employed in construction management research. For example, it has been used to develop a performance framework for construction contract administration through a two-round Delphi panel involving owners, consultants, and contractors, resulting in the identification and prioritization of 93 key operational factors across eleven project management domains [5]. The application of Delphi in construction management research is considered particularly appropriate for achieving expert consensus on complex and data-constrained issues because of its iterative nature and its capacity to provide controlled feedback between successive rounds [6].

2.3. Research Gap

A review of the literature indicates that research on contractual claims has predominantly focused on identifying causes, statistically analyzing historical data, and developing computational methods for compensation and damages assessment, thereby adopting a largely retrospective orientation [2]. In contrast, futures studies research on Iran's energy sector has primarily remained at the macro level of industry policy-making and has not sufficiently addressed the operational level of contract and claims management in EPC projects [3, 8, 9]. The present study seeks to bridge these two domains by addressing the existing gap between strategic foresight and operational claims management.

3. Research Methodology

This study is applied in terms of its objective and adopts a qualitative-exploratory approach with a mixed-methods design. The research was conducted in five stages, as presented in Table 2. The statistical population consisted of experts with at least 10 years of professional experience in contract administration, contract review, and claims management within owner and contractor companies involved in EPC projects in Iran’s oil and gas industry. Using purposive and snowball sampling, an expert panel comprising 18 specialists in contract administration, legal affairs, and value engineering was selected. Table 1 presents the professional composition and work experience of the expert panel.

Table 1. Professional Composition and Work Experience of the Expert Panel (n = 18)

Expert Profile	Number	Percentage
Contract Administration and Claims Specialist	7	38.9%
Project Manager / Contract Manager	4	22.2%
Legal and Contract Arbitration Specialist	3	16.7%
Value Engineering and Risk Management Specialist	4	22.2%
More than 15 years of work experience	11	61.1%
10–15 years of work experience	7	38.9%
Experience in owner-side projects	10	55.6%
Experience in contractor-side projects	8	44.4%

3.1. Research Procedure

The research was conducted through five sequential stages, as summarized in Table 2.

Table 2. Research Stages

Stage	Content and Approximate Timeframe
Documentary Review and Identification of Drivers	Review of claims records from selected EPC projects and development of an initial list of drivers based on the **STEEP framework**
Three-Round Delphi Panel	Validation and prioritization of the identified drivers by a panel of 15–20 experts in contract administration, legal affairs, and value engineering; calculation of **Kendall's coefficient of concordance**
GBN Scenario Planning	Selection of the two key drivers from the **uncertainty–impact matrix** and development of four alternative future scenarios
Causal Layered Analysis (CLA)	Examination of each scenario across four layers: **litany, systemic/structural, worldview, and myth/metaphor**
Development of Robust Strategies	Assessment of the **robustness** of strategies across the four scenarios and final prioritization of the proposed framework

The methodological design was intended to combine expert-based validation, scenario-based exploration of alternative futures, and deep causal and narrative analysis. Accordingly, the Delphi process was used to identify and prioritize the most influential future drivers, while the GBN framework was employed to construct alternative scenarios based on the interaction of the most influential and uncertain drivers. Subsequently, CLA was applied to examine the deeper structural, discursive, and cultural dimensions underlying each scenario. Finally, the proposed strategies were evaluated across all four scenarios to identify those demonstrating the greatest degree of robustness under different future conditions.

In the first stage, an initial list of change drivers is developed through a documentary review of claims records from selected projects and a review of the relevant literature, based on the STEEP framework (political, economic, social, technological, and environmental factors). In the second stage, these drivers are presented to the expert panel through three rounds of the Delphi questionnaire. The importance and uncertainty of each driver are assessed using a Likert scale, and the degree of consensus among the experts is examined by calculating Kendall's coefficient of concordance (Kendall's W). The process continues until a satisfactory level of agreement is achieved or all three rounds are completed, consistent with procedures adopted in previous studies on contract and claims management to establish expert consensus [5, 6].

In the third stage, the two drivers with the highest combined scores for impact and uncertainty are extracted from the two-dimensional impact–uncertainty matrix and used as the basis for constructing four alternative future scenarios using the GBN scenario-planning method, following the methodological approach previously applied to scenario development in Iran's energy industry [3]. In the fourth stage, each of the four scenarios is examined using Causal Layered Analysis (CLA) across its four layers litany, systemic/structural, worldview, and myth/metaphor to reveal, beyond observable events, the deeper assumptions and narratives that shape claims-related behavior under each future scenario [4].

In the fifth stage, a set of potential claims management strategies is developed, and the Robustness Score of each strategy under each of the four scenarios is assessed by the expert panel. This process makes it possible to identify strategies that maintain acceptable performance across a broad range of plausible futures and are therefore considered more robust for proactive contractual claims management.

4. PROPOSED FRAMEWORK (FINDINGS)

4.1. Drivers of Change

The documentary analysis and the first round of the Delphi process revealed five major categories of drivers affecting the future of contractual claims in EPC projects in Iran's oil and gas industry, as presented in Table 3. The prominent position of sanctions as a political driver is consistent with previous research on Iran's energy industry, which has identified sanctions and foreign investment as among the most critical uncertainties shaping the sector [3].

Table 3. Five Major Categories of Drivers Affecting the Future of Contractual Claims

STEEP Dimension	Identified Drivers	Type of Impact on Claims
Political	Sanctions intensity and stability; regional geopolitical developments; government exchange-rate policies	Delays in procurement; payment suspension; **Force Majeure** claims
Economic	Exchange-rate and inflation volatility; access to financial resources and financing	**Price-escalation claims**; payment-delay claims
Social	Shortage of specialized contract and claims personnel; brain drain	Inadequate documentation; increased disputes over contract interpretation
Technological	BIM maturity and digital tools; data analytics and artificial intelligence for progress-payment monitoring	Reduction in design-uncertainty-related claims; greater transparency of project records
Environmental	ESG requirements and international environmental standards	Work stoppages; scope-change claims arising from environmental compliance requirements

Table 4 presents the quantitative results of the three-round Delphi panel. The mean impact and uncertainty scores for each driver in the third round, together with their corresponding standard deviations, are reported. The convergence trend of the expert panel, based on Kendall's coefficient of concordance (Kendall's W), is also presented in Figure 1. The continuous increase in Kendall's W from 0.31 in the first round to 0.71 in the third round indicates that the expert panel achieved a strong level of consensus, and consequently, the Delphi process was concluded after the third round.

Table 4. Quantitative Results of the Three-Round Delphi Panel

Driver	Mean Impact (Round 3)	SD	Mean Uncertainty (Round 3)	SD
D1 – Sanctions Intensity and Stability	4.6	0.48	4.4	0.52
D2 – Digital Maturity of Contract Management	4.3	0.41	4.1	0.45
D3 – Exchange-Rate and Inflation Volatility	3.9	0.55	3.3	0.58
D4 – Shortage of Specialized Claims Personnel	3.2	0.62	2.6	0.60
D5 – Environmental/ESG Requirements	2.5	0.70	3.0	0.65
Overall Panel Kendall's W	Round 1: 0.31	Round 2: 0.52	Round 3: 0.71	Level of Agreement: Strong

The results indicate that D1 (Sanctions Intensity and Stability) and D2 (Digital Maturity of Contract Management) occupy the most prominent positions in terms of both impact and uncertainty. These two drivers were therefore selected as the critical uncertainties for the subsequent GBN scenario-planning stage. Their selection provides the basis for constructing four alternative futures representing different combinations of sanctions conditions and levels of digital maturity in contractual management.

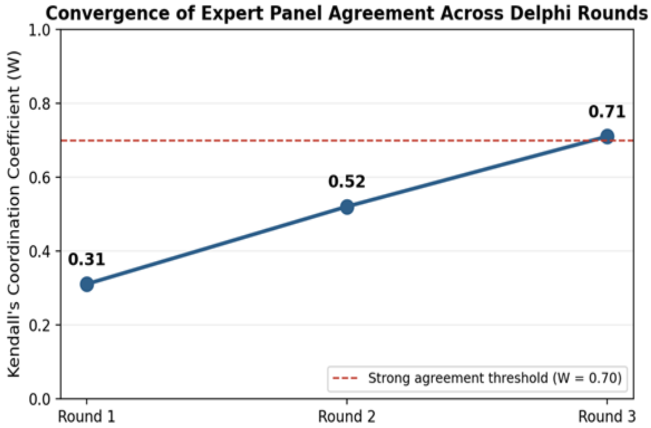

Fig. 1. Trend of Expert Panel Consensus Convergence across the Three Delphi Rounds Based on Kendall's Coefficient of Concordance

To select the two pivotal drivers for scenario development, the mean impact and uncertainty scores of each driver from the third Delphi round were plotted in a two-dimensional impact–uncertainty matrix (Figure 2). As shown, the two drivers "Sanctions Intensity and Stability" (D1) and "Digital Maturity of Contract Management" (D2) are positioned in the upper-right quadrant of the matrix, representing the area of high impact and high uncertainty. Accordingly, these two drivers were selected as the primary axes for scenario construction.

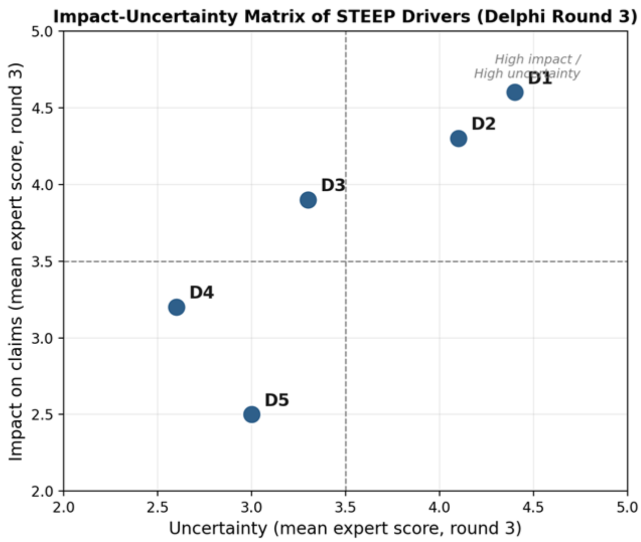

Fig. 2. Impact–Uncertainty Matrix of STEEP Drivers Based on the Third-Round Delphi Panel Scores

Among these drivers, "Sanctions Intensity and Stability" and "Digital Maturity of Contract Management" received the highest combined impact–uncertainty scores in the Delphi matrix and were therefore selected as the two primary axes for scenario development.

4.2. Future Claims Scenarios

By cross-mapping the two key drivers, four future scenarios for claims management in EPC projects in Iran's oil and gas industry were developed. Table 5 presents the dominant claims pattern and the myth/metaphor layer of each scenario, as derived through the four-layer framework of Causal Layered Analysis (CLA) [4].

Table 5. Dominant Claims Pattern and Myth/Metaphor Layer of Each Scenario

Scenario	Status of the Two Key Drivers	Dominant Claims Pattern	Myth/Metaphor Layer (CLA)
Transnational Collaboration Prosperity	Declining sanctions; high digital maturity	Complex technical claims arising from the integration of new technologies with foreign partners	**“Contract as Partnership”**
Smart Self-Sufficiency	Increasing sanctions; high digital maturity	Reduction in execution-related claims through data transparency; increase in localization and domestic-sourcing claims	**“Technology as a National Shield”**
Return of Foreign Contractors	Declining sanctions; low digital maturity	Traditional delay and scope-change claims under FIDIC contracts	**“Claims as Bargaining”**
Claims Crisis and Liquidity Blockage	Increasing sanctions; low digital maturity	Accumulation of financial and liquidity-related claims and an increase in arbitration disputes	**“Claims as a War of Attrition”**

The Causal Layered Analysis indicates that in scenarios characterized by low digital maturity, regardless of the sanction’s environment, the dominant metaphor of claims remains “bargaining” or even “war of attrition.” In contrast, in scenarios characterized by high digital maturity, the prevailing worldview shifts from confrontation toward collaboration and data-driven transparency. This finding suggests that investment in digital contract management infrastructure has effects that extend beyond operational efficiency; it can also transform the prevailing culture and narrative underlying owner–contractor relationships.

4.3. Proposed Robust Strategies

Based on the experts’ assessment of the robustness of the strategies across the four scenarios, the following five strategies received the highest robustness scores and were therefore identified as the core components of the proposed framework:

1. Implementation of an integrated digital contract documentation system based on Building Information Modeling (BIM) and a Common Data Environment (CDE) for the real-time recording of events affecting project time and cost. This approach has been identified in recent research as a centralized information repository for substantiating extension-of-time claims [7].

2. Development of flexible contractual clauses for force majeure and price escalation, tailored to different scenarios of sanctions and exchange-rate volatility, rather than relying on rigid and conventional contractual provisions.

3. Establishment of a Claims Early-Warning Team tasked with identifying early indicators of project deviation before they develop into formal contractual claims.

4. Deployment of digital document management and data analytics systems for continuous monitoring of payment statements, project schedules, and project correspondence in order to identify emerging claims patterns and reduce the likelihood of claim rejection due to inadequate supporting documentation. The effectiveness of this approach in standardizing claims documentation processes and facilitating arbitration proceedings has been demonstrated in previous research [10].

5. Periodic joint foresight workshops involving owners and contractors to reconsider the prevailing worldview underlying the contractual relationship and reduce the discursive gap between the parties, in accordance with the principles of Causal Layered Analysis.

The findings of this study differ substantially from the existing claims management literature, which has predominantly focused on post-event identification of causes and quantitative methods for calculating damages [2]. The approach proposed in this study, by contrast, identifies the contextual drivers that may give rise to claims and develops strategies aligned with plausible future conditions before claims formally emerge. Furthermore, the findings demonstrate that insights from macro-level futures studies of Iran’s energy sector particularly the central role of sanctions and foreign investment as strategic drivers [3] can also be traced at the micro level of contract and claims management and can provide a basis for operational decision-making by EPC companies. From a methodological and technological perspective, the alignment of the proposed framework with growing evidence concerning the role of digital technologies in reducing claims and facilitating their substantiation [7, 10] indicates that the proposed robust strategies are not merely hypothetical but are also supported by evidence and experience from the global construction industry.

5. CONCLUSIONS AND RECOMMENDATIONS

This study integrated three futures-oriented tools GBN scenario planning, the Delphi method, and Causal Layered Analysis (CLA) to develop a framework for transitioning from reactive claims management to proactive claims management in EPC projects within Iran's oil and gas industry. The findings demonstrated that "Sanctions Intensity and Stability" and "Digital Maturity of Contract Management" are the two key drivers shaping the future of contractual claims. Based on these drivers, four alternative future scenarios and five robust strategies were identified.

For future research, the following directions are recommended:

(a) The proposed framework should be validated using a larger quantitative dataset comprising actual claims records from EPC projects in Iran's oil and gas industry;

(b) an artificial intelligence-based software tool should be designed and tested for the early detection of claims indicators based on the proposed framework; and

(c) the framework should be replicated and further evaluated in other segments of the oil and gas industry, including upstream and petro-refining projects.

Declaration

We acknowledge that we used ChatGPT to enhance the academic writing of our manuscript while ensuring the originality and integrity of our work.

Transparency Statement

The data supporting this study are available upon reasonable request to the corresponding author, subject to ethical and confidentiality considerations.

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Declaration of Interest

The authors declare that they have no competing interests.

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