



AI-Supported Contract Management and Claims Prevention in Oil and Gas Capital Projects: A PMI-CPMAI Aligned Governance Framework

Maryam Alyammahi, Khalid Aljasmi, Zayed Aldhanhani, Mounir El Khatib*

Hamdan bin Mohammed Smart University, School of Business and Quality Management, Dubai, UAE

*Corresponding Author

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ABSTRACT

Oil and gas capital projects frequently experience claims, disputes, and contractual conflicts due to project complexity, multiple stakeholders, and reactive contract management practices. Artificial Intelligence (AI) offers new capabilities for contract risk identification, compliance monitoring, and early detection of potential claims through predictive analytics and natural language processing. However, the effectiveness of AI depends on the presence of appropriate governance mechanisms that ensure accountability, transparency, and reliable decision-making. This study examines the role of AI in improving contract management and claims prevention within Engineering, Procurement, and Construction (EPC) projects using the PMI-Cognitive Project Management for AI (CPMAI) framework. The study proposes a CPMAI-aligned governance framework that integrates AI-driven contract intelligence with structured oversight and risk management processes. The findings are expected to demonstrate that AI, when supported by effective governance, can enhance contractual compliance, reduce claims, and improve project performance in oil and gas capital projects.

1. INTRODUCTION

Among the many complex and high-risk projects are capital projects in the oil and gas sector. These projects are associated with Engineering, Procurement, and Construction (EPC) contracts and are characterized by the involvement of several international contractors, lengthy execution, and high capital investment [1]. Within such organizations as ADNOC, contract management is foundational to project success, as it serves the purpose of sustaining budget constraints, schedule adherence, and containment of risk [2].

Oil and gas projects are plagued by disputes and delays, even when contract management is involved [3]. This can be attributed to poor communication, management, and resolution of project risks and changes [4]. This is exacerbated

by the imbalance of contractual obligations and poorly crafted contracts [5]. Many project management methodologies advocate for reliance on document review, audits, and management as risks, but there is little to no emphasis on their integration [6].

Artificial Intelligence (AI) has become a critical component of project management [7]. Machine learning and natural language processing (NLP) have transformed the oil and gas sector through their ability to analyze contracts and identify and monitor project metrics and risks in real-time [8]. With the use of optimal predictive analytics, oil and gas companies are able to balance contract management's reactive and predictive aspects [9]. Insights from AI are only as good as the actions that are taken as a result of the objectives AI

accomplishes [10]. If the integration lacks order and the balance of vaunted management structures, then the AI is poorly placed [11]. PMI, in pursuit of balance in management and comprehensive control in AI, created the cognition factor in AI contract lifecycle management [12].

This study aims to examine the potential the integration of AI can have to improve the steps of claim prevention management of contracts in the context of oil and gas capital projects, within the parameters of the CPMAl governance framework. The focus of the research is on the enhancement of risk management processes through the application of AI and the influences of structured governance on the outcomes of AI-induced decisions.

1.1. Research Aim and Objectives

To investigate the integration of AI with CPMAl governance frameworks and its potential in ameliorating contract management and claims prevention processes within the oil and gas sector.

• Objectives

1. Identify and analyze the major drivers of claims and conflicts in gas and oil engineering, procurement, and construction (EPC) projects.
2. Evaluate the contribution of artificial intelligence in contract risk identification and contract monitoring.
3. Examine how efficiently governance frameworks impact the AI integration process.
4. Develop a claims prevention framework within the confines of CPMAl.

1.2. Problem Statement

The Engineering, Procurement, and Construction (EPC) contracts in oil and gas capital projects are systematically designed; however, there are still claims, disputes, and delay reduction challenges. In large-scale projects, these issues exist in companies such as ADNOC, where, first, there are many participants; second, complex project conditions; and, lastly, a complex contractual framework [13].

The main challenge of these projects is that management of contracts is still in a traditional model. Much of this is done through manual document reviews, and management judgment is relied on to make the necessary compliance

decisions [14]. Therefore, the contractual risks are either overlooked or are only identified when these disputes and claims arise. As a result of this, there are huge financial losses, and all stakeholders have to deal with scheduling disruptions and a damaged relationship [15].

Another huge challenge is that there are no proper structures of governance that make the integration of the risk management framework and the control structures synergistic [16]. Even when risks are identified, the absence of such structures makes sure that these identifications are unlikely to be escalated and responded to in a timely manner [17]. An artificial construct such as this is the reactive nature of such contract management frameworks.

AI has the potential to predict risks and provide control frameworks that allow decisions to be made in real time [18]. However, there are many gaps in governance, the reliability of the outputs of control systems, the quality of the control systems, and the clarity of the roles of the control systems in the frameworks in oil and gas projects [19]-[22].

Thus, the focal point of this study is the advancement of systems to identify, interpret, and proactively respond to the risks present in contracts, as opposed to the existence of contractual risks, particularly when sophisticated technological tools such as AI are persistently utilized [23]-[27].

This study seeks to mitigate this problem by understanding the role of AI in researching contractual management within the context of a structured governance framework that relates to the Cognitive Project Management for AI (CPMAI) model of the Project Management Institute.

1.3. Research Questions

- To what extent may AI enhance risk identification and monitoring in the management of contracts?
- How do governance frameworks optimally employ AI to mitigate claims?

2. LITERATURE REVIEW

2.1 Contractual Risks and Claims in Oil and Gas Projects

The oil and gas sector is burdened by tricky and uncertain capital projects [28]. In addition to technical issues and participant interdependencies, many studies have suggested

that the main sources of contractual risk are the ambiguous scope and poor risk distribution, ineffective communication, and lack of coordination among project participants [29]-[34]. These risks are major sources of many disputes and claims, especially in the EPC contracts, where the partitioning of tasks among the stakeholders is at play [35]-[38].

In EPC contracts in oil and gas capital projects, the likelihood of cost and time overruns is high [39]. This is attributed to inadequate project management and a deeper vested interest in performance [40]-[44]. Additionally, [45] posit that the integration of high-volume data in a project coupled with the continued marginalization and complexity of project management renders conventional contract management ineffective.

2.2 Artificial Intelligence in Contract Management

The convergence of artificial intelligence and contract management has been significant [46]. With natural language processing (NLP), contracts can be automatically analyzed, and discrepancies and risks, including harmful risks and gaps in performance obligations, can be detected [47]. Predictive analytics on project cost and time risk and claims can also be advanced by machine learning algorithms through the analysis of previously completed projects [48]-[53].

Contrary to the accepted position among scholars that "AI is a passive agent in the injured contract management process," there are hints that performance-based analysis, coupled with predictive analytics, can significantly, marginally improve the ability of practitioners to augment judgments and make informed decisions [54]-[60]. For instance, the performance of modern contractor management systems has improved to the extent that they can automatically flag likely contractual breaches by contractors when there is a sustained/performance sub-par breach. Breach of contracts by contractors is a significant source of concerns [61][62].

Despite these positive observations, the integration of AI into project management is still stunted primarily due to various data-driven issues, ranging from data quality, lack of incorporation trust, and other integration concerns [63]-[68]. This illustrates the urgency for a governance framework directed toward structure.

2.3 AI and Risk Management Procedures

Risk management is a pivotal part of project management and involves a series of procedures of risk identification, risk analysis, risk response planning, and risk monitoring [69]. AI is most effective and of most impact in risk identification and risk monitoring and management in project management [70]-[74].

AI is vastly beneficial to project management in risk identification due to the ability to establish order from chaos by analyzing data, thus being able to establish patterns for risk early (i.e., first-order risk) [75]-[79]. AI is also beneficial to risk monitoring because it allows management of the project to intervene as needed because of the ability to predict the performance and, in turn, the outcome of the project [80].

Research has demonstrated that organizations that incorporate artificial intelligence into their risk management practices improve their net positive risk and rational decision-making and, as such, focus on the quality of the products of the organization [81]-[86]. On the downside, however, the efficacy of AI highly depends on the integration of the company's risk and governance processes to which it is related.

2.4 Governance and the CPMAI Framework

The CPMAI framework designed by the Project Management Institute is a structured framework for AI integration into project management [87]. CPMAI advocates for lifecycle governance, which ensures that AI outcomes are integrated into the decision-making rational process in the G-PD of a company for which the order was given [88]-[92]. The governance frameworks are critical component infrastructures in the project management systems that define the governance structures, clarify the interfaces and processes, and delineate the points of escalation in case of management of contracts. CPMAI governance advocates for lifecycle governance to ensure that AI outcomes are integrated into the decision-making rational process in the G-PD of a company for which the order was given [2][93][94].

Research has proven that effective governance fosters the acceptance and impact of AI through enhanced accountability and transparency of the processes and systems [95]-[99].

2.5 Industry Trends and Best Practices

There is a rise in the use of AI in the oil and gas industry mainly due to costs and risk factors. Companies are using AI in areas of predictive analytics, digital twins, and automated compliance monitoring.

Best practices involve:

- AI integration with project controls systems
- Clear governance structures
- Continuous training and skill development
- AI and Human Integration

These practices emphasize the need for perspective and structural governance to focus on advancing with technology.

3. THEORETICAL FRAMEWORK

A multi-theoretical lens is applied for understanding the possible improvement of claims avoidance and the management of contracts through the use of artificial intelligence (AI) in the management of oil and gas capital projects [100]-[104]. The framework incorporates Transaction Cost Economics (TCE), the Risk Governance school of thought, and a technology-enabled decision support paradigm of the Project Management Institute, CPMI.

This framework helps us understand

- Where and why contracts become inefficient.
- Where and why risk emerges and develops
- How governance impacts decisions
- How AI improves project outcomes.

3.1 Transaction Cost Economics (TCE)

Transaction cost economics, a concept founded by Oliver E. Williamson (1985), explained the cost of managing contracts in relations of a complex system caused by the incomplete contracting of the system [105]-[110].

Oil and gas projects in the realm of contracting and managing of Engineering, Procurement, and Construction (EPC) contracts result in the inclusion of numerous stakeholders, high and lengthy uncertainty, and additional lengthy duration to the engagement, thereby applying an unwanted and increasing cost of transactions through:

- Costs toward monitoring and compliance
- Costs toward the effort of coordinating
- Costs toward displacement

In this research, we are proposing that inefficient management of contracts is the source of the increasing cost of transactions ever caused by the

delayed detection of risks and the implementation of inefficient engagement, such as manual [111].

AI helps to improve this by:

- Facilitating the analysis of contracts through automation
- Improving engagement through transparency
- Supporting the earlier detection of risks

Thus, through TCE we are offered the economic case for the use of AI in the domain of improving the efficiency and the management of contracts.

3.2 Risk Governance Theory

The Risk Governance Theory posited by Terje Aven (2016) focuses on the manner in which organizations manage their risks through clear and codified structures and systems [112]-[115].

In oil and gas ventures, risks are likely to be both technical and contractual or organizational. Good governance encompasses the following:

- Preemptive risk identification
- Definitive roles and responsibilities
- Proactive escalation and response

In this research, risks are often identified but not acted upon due to governance insufficiencies.

AI aids risk governance through:

- Real-time insights
- Targeted risk monitoring
- Early detection of patterns

But without governance, AI insights are not likely to be used. This delineates the need to combine AI and a rational governance system.

3.3 CPMI and AI-Enabled Decision-Making

To relate AI functionalities and governance, a technology-enabled decision-making approach, which is consistent with the Project Management Institute's CPMI framework, is taken [116]-[120]. CPMI guarantees:

- AI outputs correspond with project verdicts.
 - Responsibilities and roles are determined
 - Risk escalation is methodically defined.
- In this study, CPMI bridges the gulf between AI insights and decision-making by ensuring that AI-identified risks are acted upon [121][122].

3.4 Integrated Framework

The interdependence of the three perspectives is as follows:

- TCE outlines the need for a decline of inefficiencies in contract management

- Risk governance theory outlines the need for systematic risk handling.
- CPMIAI outlines the need for effective and governed AI implementation.

Collectively, they articulate the manner in which AI can enhance contract management by improving efficiency, assisting in risk identification, and advancing decision-making.

4. RESEARCH METHODOLOGY (QUALITATIVE APPROACH)

This research design applies a qualitative explorative method to understand the role of artificial intelligence (AI) in contract management and the mitigation of claims in the context of the governance of oil and gas projects primarily involving capital expenditure.

The qualitative method is the most suitable approach given the need to understand the practices of professionals in the world, their attitudes, and the reasoning behind their actions. This is especially pertinent in areas where there are contract governance and risk-related issues. These challenges are intricate and demand the understanding of specific contexts, which is beyond the scope of quantitative approaches (Creswell and Creswell, 2018).

The research design is subdivided into three complementary components. It attempts to

- Undertake a systematic literature review. This is aimed at building a theoretical framework and establishing definitional constructs and variables underlying contract-related risks, use of AI, and governance.
- Place contextual Gaps that will integrate the theoretical framework in the oil and gas-related projects
- Create primary qualitative data through the use of semi-structured interviews with relevant professionals

This design of the study integrates both theoretical framework and practice in a way that breaks the gap in understanding of the role AI may play in the improvement of contract management.

5. DATA GATHERING

5.1 Data Collection Approach

This study opted for semi-structured interviews to discover useful data to answer research questions. The interviews were conducted primarily with professionals engaged with oil and gas

developments to understand their way and practice on contract management, risk identification, and AI usage within real projects. The interviews were administered to professionals within an industry where oil and gas projects are built to fully understand the impact of the subject on contract management, risk, and AI usage within the industry.

According to Kvale (2007), semi-structured interviews allow the interviewer to present structured questions but also allow the interviewee the freedom to express and explain fully in their own words.

5.2 Participant Selection

The study targeted professionals and decision-makers, where a purposive sampling technique was implemented.

To serve the objectives of the study, the research team conducted interviews with nine (9) management and engineering professionals.

- Project Management
- Contract Administration Engineering/Contract Administration
- Procurement and Commercial Management
- Engineering Controls Management (Project Controls)
- Legal/Claims Management

These roles shed a light and provided critical information from participants of each profession for their lane in the contract management ecosystem.

5.3 Justification of Sample Size

The rationality and utility of the study's sample of nine participants was grounded in a qualitative study where the focus lands on insight and not how many. Researchers such as (2019) hold that such a sample is justified, as long as participants' relevance and stakeholder function are preserved. The study reached a form of data saturation, evidenced by the convergence of patterns and themes articulated by the participants and a lack of novelty in insights to be gained from additional interviews.

5.4 Data Collection Process

Approximately 30 interviews were done virtually and in-person over 1 week. The 30-45 minute interviews were designed to capture the participants' lived experiences.

The interviews were designed to capture participants' views on a few key topics:

- Causes of claims and disputes
- Current contract management practices
- AI adoption and usage
- Governance and decision-making processes

All interviews were recorded and transcribed for a consistent analysis process.

5.5 Interview Guide

A semi-structured interview guide was used to retain interview consistency. Interview guides used questions that urged participants to elicit detail and connect to their practical experience. This was done with respect to the research objectives and their corresponding components. The interview guide was centered around five primary topics:

- **Contract Risk Identification**

Here participants were able to explain what they believed were the common causes of claims, at what stage they detected that the risk was emergent, and what the difficulty of that risk was.

- **Current Contract Management Practices**

This topic focused on the different strategies that were deployed to evaluate the effectiveness of the contract, their shortcomings, and their overall gaps.

- **AI Adoption and Usage**

Participants were able to explain their use of either AI or digital tools, the perceived gap of their effectiveness, and the challenges to their adoption and/or trust.

- **Governance and Decision-Making**

Participants articulated the process for escalating risk and gap governance, as well as the decision-making involved.

- **AI Integration and Improvement**

Using a more structured format, the interview guide balanced the opportunity for extensiveness in response with the research objectives to remain in scope.

6. DATA ANALYSIS

6.1 Analytical Method

Thematic analysis (Braun and Clarke 2006) was undertaken, as this method best fits the purpose of qualitative data pattern recognition.

6.2 Analysis Process

Analysis was conducted on the basis of the phases

below:

1. Data Familiarization

All the interview transcriptions were analyzed multiple times to appreciate participant responses and to help recognize the patterns.

2. Coding

Responses were examined, and statements were coded. Some of the most frequent codes were the following:

- Delayed risk feedback
- Manual review of contracts
- Poor communication
- Limited trust of AI
- Weak governance

3. Theme Development

Codes were collected together into larger categories to balance codes, and given the relatively small sample, strong participant response consistency was noted.

- Drivers of Contract Risk
- Shortcomings of Conventional Methods
- Possibilities and Gains of AI
- Governance Gap and Issues

4. Results Interpretation

Responses were almost the same across 9 respondents and were in concordance on the major issues that include

- Reactiveism of contract management
- Delayed risk feedback
- Underinvestment in AI
- Fiscal governance gaps

6.3 Strength of Findings Despite Sample Size

Despite the sample being small, the findings were noted to be robust on the basis of the below:

- Participant high-level competency
- Similar responses to the findings across multiple roles
- Discipline grouping
- Opens current literature

These serve to reinforce the conclusions drawn from the study and the findings.

7. FINDINGS AND DISCUSSION

This research leads to a deeper understanding of the interaction effect of challenges of contract management, the capabilities of AI, and the structures of governance in oil and gas capital projects. The analysis presents some important findings that respond to the research questions.

7.1 Root Causes of Claims and Disputes

The research reveals that the leading cause of claims in oil and gas projects is non-technical in nature and is linked to management and communication problems [123]. Participants noted that nebulous clauses in contracts, constant changes in scope, and lack of coordination among the parties involved largely cause the majority of the frequent disputes. Known risks have a tendency to go unaddressed and unreported during the entire course of the project [124]-[130]. Another prominent challenge is the late discovery of project-related risks, which may be associated with the mode of traditional contract management. The contract management functions are based on audits that are done at set intervals as agreed by the parties to the contract, which gives the risks an indeterminate amount of time to go unmanaged [131]. In some instances, unmanaged project-related risks have the ability to transform into disputes, which cause the project management teams to be forced to dip into critical project resources to mitigate the impact of the unmanaged risks.

7.2 Role of AI in Enhancing Contract Management

The findings suggest that AI has the potential to transform contract management. The capabilities of AI allow management teams to automate the analysis of contracts, which provides the teams with the ability to detect erroneous contract clauses as well as clauses associated with high levels of risks [132]. AI is also capable of performing predictive analysis, which allows the teams to monitor risks and suggest interventions based on historical data of the project.

Participants noted that AI performs better in improving the processes of risk identification and monitoring [133]. AI applications have the ability to analyze data associated with the project in real time to give the management teams the ability to identify and control the impact of the risk associated with the project [134].

Nonetheless, the results also accentuate the fact that AI is not the whole answer. Its value relies on its incorporation into the organizational frameworks and the utilization of its results in the organizational processes.

7.3. Governance Gaps and Challenges

One of the greatest outcomes of this research is the

presence of governance gaps and the limitations of the effectiveness of AI. A significant number of organizations do not have well-defined frameworks that guide them in the incorporation of AI insights in their processes. Thus, the existence of AI in the identification of risks is fairly meaningless, as most organizations lack a means to react to the identified risks that stem from the AI [135].

The lack of confidence in the AI systems is due to the severe financial and legal consequences of the decisions made. Thus, the AI systems are not utilized to their full potential.

The lack of a well-established framework of roles and responsibilities on the disposition of the AI systems results in protracted decisions and the absence of well-defined governance frameworks. This is an excellent opportunity for the implementation of CPM AI.

7.4. AI in Risk Management Processes

The research validates the fact that AI presents the greatest opportunities in the initial stages of the risk management processes, and mostly in the areas of risk identification and continuous risk monitoring. AI enables detection of risks in an incipient state, which is an imperative for the mitigation of risks and claims [136].

To this end, the research validates the fact that AI presents the greatest opportunities in the initial stages of the risk improvement processes. AI provides the capability for the detection of risks in an incipient state, which is an imperative for the mitigation of risks and claims [137]. The research validates the fact that AI in the absence of effective governance mechanisms does not realize its full potential. The integration of AI in the organizations is enabled by the effective AI governance structures coupled with the alignment of AI capabilities and processes.

• **Recommendations**

From the conclusions drawn from the study, the following recommendations are offered:

• **Integration of AI into Contract Management Systems**

For organizations to stay competitive, it is important to embrace AI tools within contract management systems. Automated contract monitoring combined with AI constant analysis allows organizations to manage risk proactively

rather than rely on human capabilities to identify breaches of contract.

- **Adoption of CPMAI Governance Framework**

For AI systems to support decision-making, organizational boundaries must be defined. As such, organizations should consider adopting the CPMAI framework, which supports the definition of operating roles, level of responsibility, and decision-making structures.

- **Training and Capability Development**

In order to gain confidence in AI systems and use these systems to the full extent, project teams must be inceptioned in AI and its capabilities.

- **Data Governance Improvement**

Maintaining good quality data is essential in achieving accurate AI forecasts. Organizations must make an effort to improve the quality of data and management practices associated with data.

- **Human-AI Collaboration**

AI should always be used as a complement to human decision-making rather than a substitute. Decision-making that combines human reasoning and AI insights is always superior to decisions that rely on AI alone.

- **Limitations of the Study**

As with any piece of research, there are many aspects with which we should acknowledge the limitations of this research. After all, research with no limitations is not credible.

As a start, this research is based mainly on qualitative research and is based on only nine participants. While the research covered the major aspects and the data was 'saturated,' the results of the research would not be generalizable to all the contexts of oil and gas. The nature of the contractual structures, work environments, and the nature of the organization can all influence the results of the research.

Second, the research is based on self-generated interviews, which are the main sources of the data. Due to this, there is a high potential for the data to be biased. Primarily, the results originate from the perceptions and the experiences of the respondents informed by their organizational context. As a result, the findings may not be fully objective. The data was possibly the respondents' reluctance to discuss the 'sensitive' issues of the governance and the management of the contracts.

There is also a limit to the second overview of the project and the first-level contract. Due to the process of research, the oil and gas services for the contracts kept the researcher from examining the contracts and the exchanges of contracts. As a result, the professional researchers of the project, drawing from their professional judgment, contracted and answered the questions.

Finally, while the research entitled the roles of the AI in the management of contracts, the researcher noted that the respondents' level of management of AI was also low, meaning that the researcher could have requested other services with the control of AI. The researcher would not be entitled to full management of AI as a trained professional.

The limitations of this study include that it focuses on a narrow industry context (oil and gas capital projects). The findings may lack generalizability to other industries with different project structures and risk profiles. Nevertheless, the study may have findings that are applicable to other projects that possess a high level of complexity.

Importantly, the study adds to the existing literature by showing the theoretical importance of integrating AI with governance structures that aid in the management of contracts and the avoidance of claims.

8. CONCLUSION

This research illustrates AI's impact on the optimization of contract management processes on oil and gas capital projects. AI provides early risk detection, continuous monitoring, and predictive analytics. It allows management of contractual risks in a proactive as opposed to a reactive manner.

Along with the benefits of AI application in capital project management, the research emphasizes the application of AI in project management governance as a prerequisite to the delivery of optimal management processes. Management of AI systems in project governance frameworks ensures AI project management insights impact the project's senior stakeholders.

The CPMAI allows organizations to maximize the benefits of a decline in claim frequency and the enhancement of contract management processes for the capital projects.

To summarize, addressing the issue of contract management in a complex project environment is

possible with the convergence of potential AI capabilities and the governance systems. The positive impact of the proposed management processes on risk, contractual disputes, and lack of project delivery is felt in organizations with optimized capital management processes.

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