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Recent Trends and Challenges in Project Management of Oil and Gas Projects: A Systematic Review

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Abstract

The oil and gas sector is one of the most capital-intensive and risk-prone industries, requiring advanced practices project management to ensure successful delivery. In recent years, digital technologies and sustainability, digital twins, and environmental, social, and governance (*ESG*) principles have become central to project governance.

The existing paper presents a systematic literature review of number of peer-reviewed publications from 2014 to 2024, examining the evolution of project management strategies in oil and gas megaprojects. With an emphasis on the Iraqi environment, the current paper uses a qualitative-analytical technique to synthesize recent developments in oil and gas project management. It identifies three dominant trends: the hybridization of management frameworks, the increasing in adoption of digital platforms, and the integration of *ESG* performance indicators.

The findings also highlight persistent challenges in developing regions, including institutional immaturity, inconsistent *ESG* application, and failed digital transitions. The main conclusion provided from the study that Iraq's oil and gas project management has structural problems, particularly when it comes to integrating modern methods and digital tools into a challenging institutional structure. Final, paper is recommending maturity-based models, context-specific *ESG* scorecards, and structured digital roadmaps to improve project outcomes.

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1. Introduction

The oil and gas industry remains the cornerstone of many national economies, particularly in developing countries such as Iraq, where hydrocarbons account for over 90% of government revenues [1]. As the global energy landscape shifts toward de-carbonization, sustainability, and digitalization, oil and gas project management faces increasing complexity and scrutiny [2]. Iraq's energy sector, marked by legacy infrastructure, geopolitical instability, and limited diversification, urgently requires adaptive strategies that balance production efficiency with environmental and governance standards [3].

In this context, managing oil and gas projects is no longer confined to traditional cost-schedule-performance dimensions. Instead, it has evolved into a multidisciplinary challenge that intersects with digital transformation initiatives, environmental-social-governance (*ESG*) compliance, and hybridized project delivery models [2], [4]. These shifts reflect the changing expectations from stakeholders ranging from international investors to local communities—and demand more flexible, transparent, and accountable project frameworks.

Yet, despite the availability of international frameworks and digital tools, Iraq continues to experience persistent delays, budget overruns, and weak stakeholder alignment across major upstream and midstream projects [5]. These shortcomings are exacerbated by institutional fragmentation, limited technical capacity, and outdated project governance models [6].

The existing paper addresses a significant gap in both practice and literature by systematically reviewing contemporary project management approaches in the oil and gas industry, with a focus on Iraq. It evaluates the integration of digital systems, hybrid methodologies (Agile–Waterfall), and *ESG* governance models, aiming to provide a synthesized framework that aligns with the country's national energy strategy through 2030 and beyond [4]. It adopts a qualitative-analytical method, drawing from peer-reviewed literature, government reports, and industry case studies spanning 2014–2024. By assessing the interplay between management innovation and operational realities, the paper contributes to both academic discourse and policy planning in resource-constrained contexts. This relationship is conceptually illustrated in **Fig.1**, which maps the integration of hybrid project methodologies, digital tools, and *ESG* frameworks within Iraq's energy sector transformation.

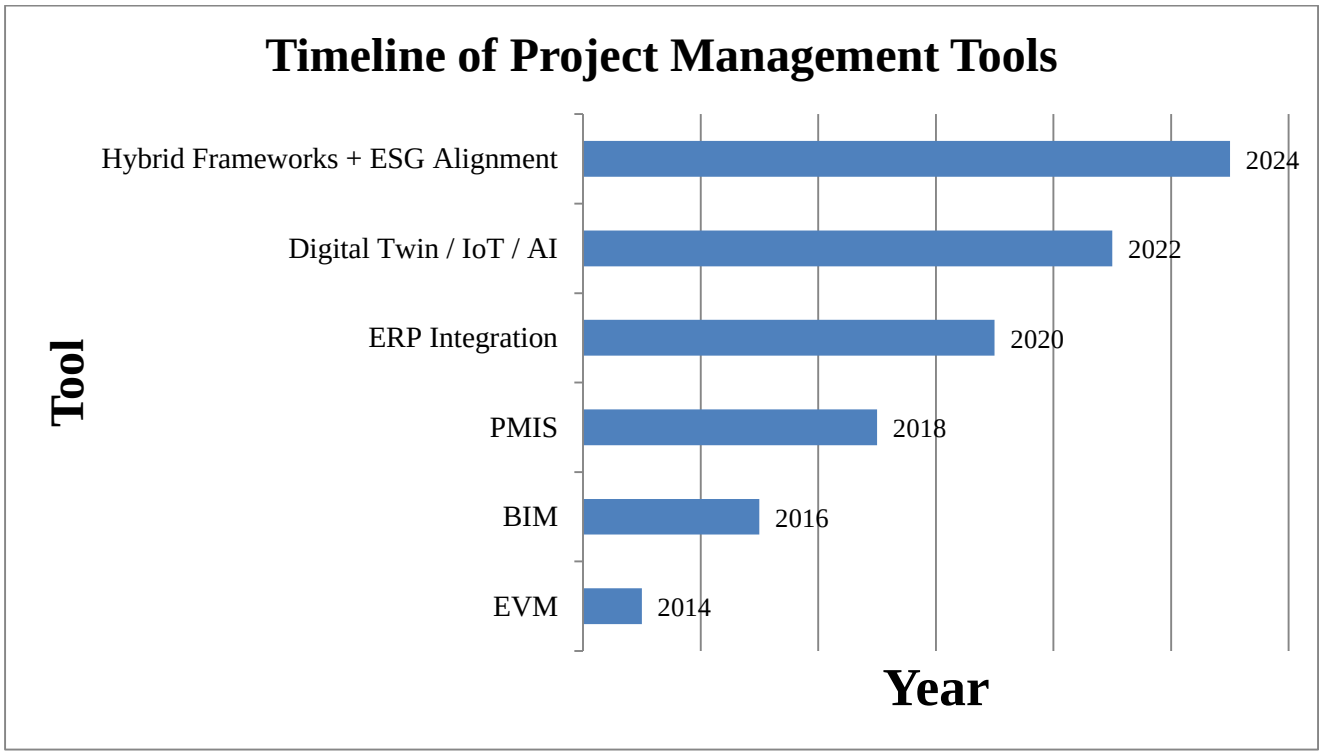

Figure 1: Timeline of Project Management Tools in Oil and Gas (2014–2024).

2. Literature Review

Project management in the oil and gas sector has evolved significantly over the past two decades due to heightened complexity, geopolitical risks, and increasing sustainability demands. Numerous studies have examined the limitations of traditional project delivery models, such as the Waterfall approach, in handling the dynamic and uncertain environments characteristic of large-scale energy projects [7]. As illustrated in **Fig.2**, global trends demonstrate a steady shift toward hybridized project models that combine the structured sequencing of Waterfall with the flexibility of Agile**.**

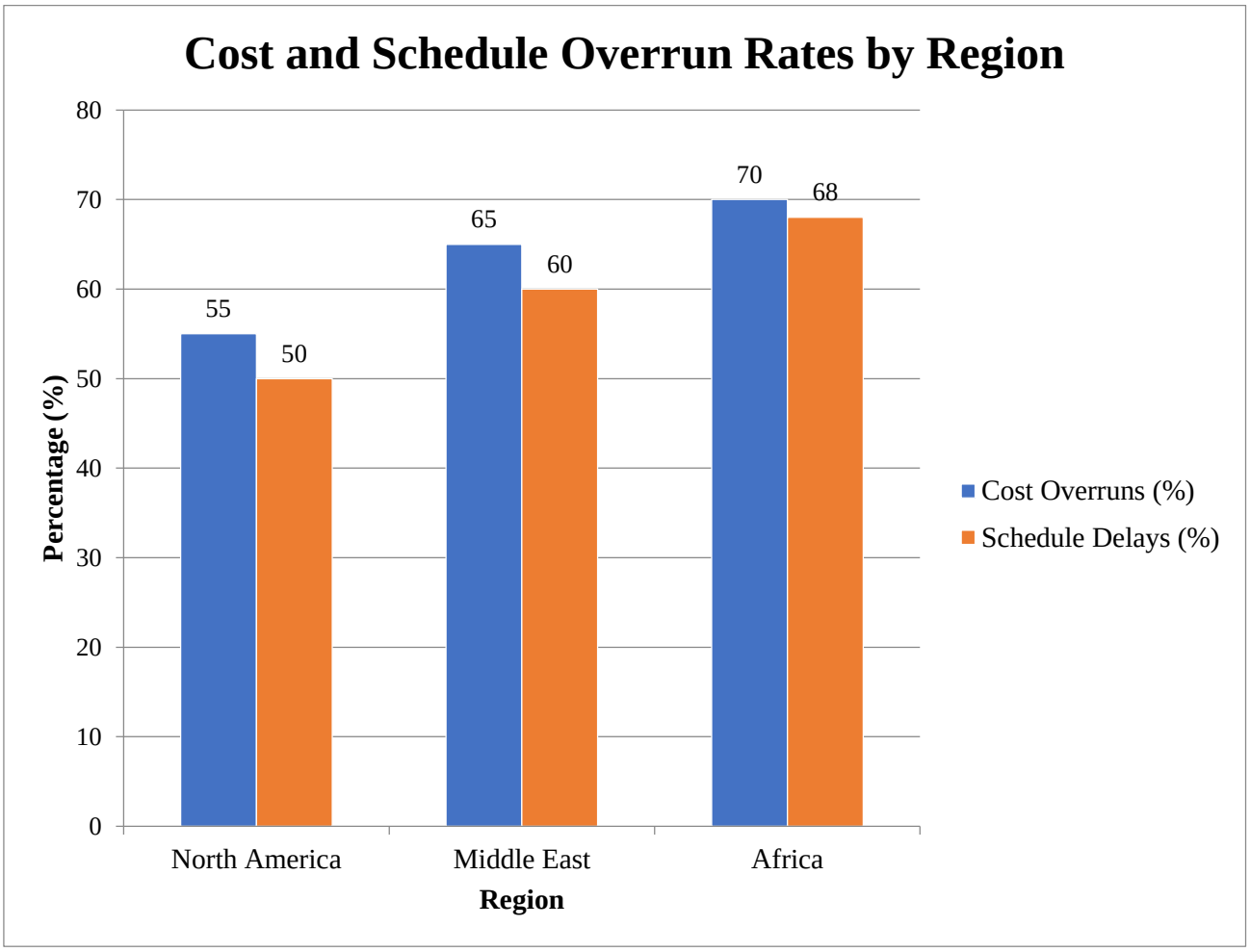

Figure 2: Cost Overruns and Schedule Delays by Region in Oil and Gas Projects.

In Iraq, literatures remain limited but growing. As noted in [8], governance gaps and misaligned policy frameworks are the primary causes of cost overruns and project delays. Similarly, [3] highlight the lack of integration between technical planning and financial management as a root cause of failure in midstream projects. The systemic inefficiencies in procurement and contracting across Iraq's oil sector are further documented in [9]. Recent global literature emphasizes the adoption of hybridized project methodologies combining Agile and Waterfall models to accommodate both structure and flexibility [10,11]. In high risk environments like Iraq, this approach is particularly relevant, allowing for iterative progress monitoring while maintaining regulatory compliance.

The role of digital transformation in project performance is increasingly emphasized. The International Energy Agency reports that the adoption of digital tools, including remote monitoring, predictive analytics, and integrated data platforms, has improved capital efficiency by up to 20% in oil and gas megaprojects globally [12]. However, implementation in Iraq remains limited, with infrastructural and cybersecurity constraints being major barriers. **Fig.3** highlights the gap in adoption of digital systems and *ESG* frameworks between Iraqi projects and global benchmarks.

ESG frameworks have also entered the discourse on energy project success. *ESG* compliance is no longer seen as a corporate social responsibility add-on but rather a performance enabler and risk mitigator [2]. In Iraq, efforts to integrate *ESG* remain in early phases, often driven by international operators rather than local institutions [1,13]. Collectively, the reviewed literature reveals a global shift toward integrated, technology enabled, and sustainability conscious project management in the oil and gas sector. Nonetheless, the contextual challenges of Iraq require a localized synthesis of these global models balancing modern tools with institutional realities.

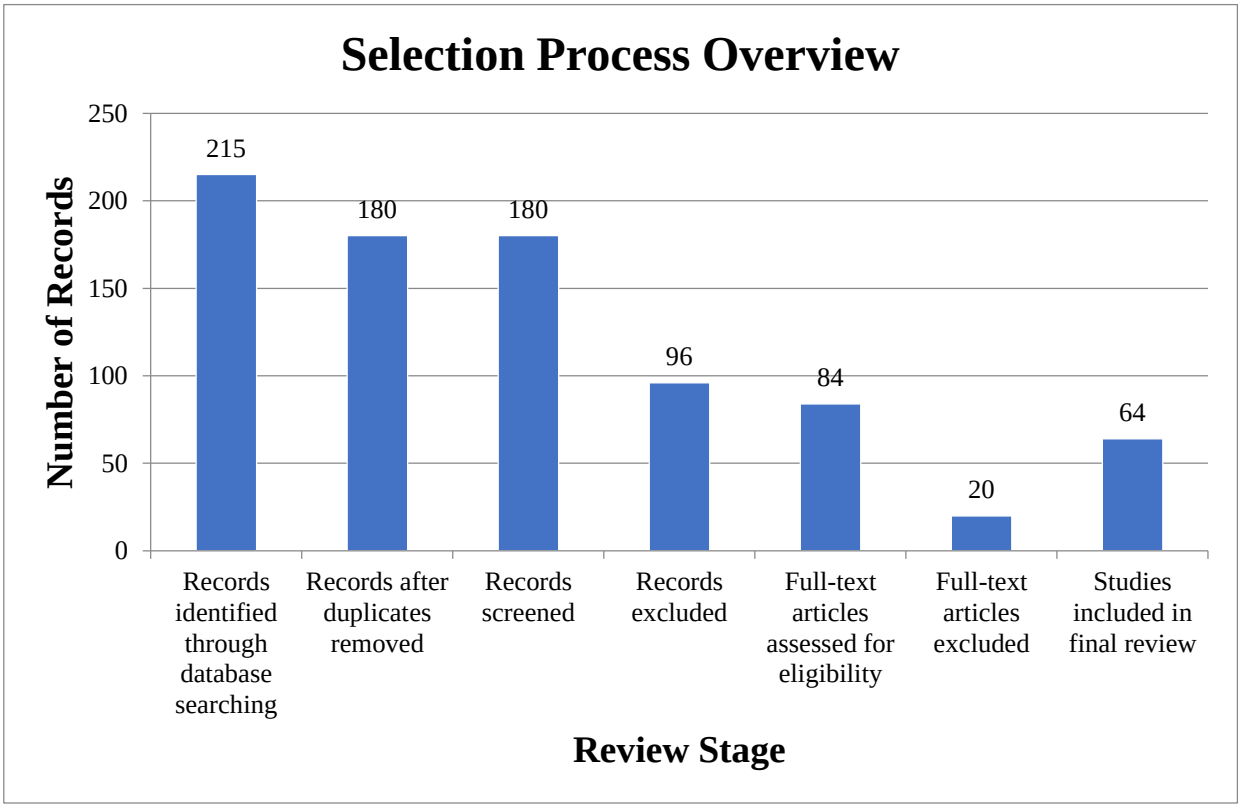

Figure 3: Histogram of the Selection Studies Processes.

3. Theoretical Background

This study is grounded in a hybrid theoretical framework that synthesizes concepts from project management theory, digital transformation models, and ESG governance literature. The integration of these frameworks is essential to understanding the multifaceted nature of modern oil and gas project environments.

At its core, the research draws on the Project Management Triangle (time–cost–scope), but expands it to include agility, stakeholder adaptability, and sustainability as critical dimensions in volatile environments [14,15]. The emergence of hybrid project management models is combining Waterfall's structure with Agile's flexibility forms a foundational pillar for this study, particularly relevant in Iraq's semi-stable context [10,16]. The digital transformation component is guided by the Technology-Organization–Environment (*TOE*) Framework, which explains how internal and external factors affect digital adoption in complex sectors [17,18].

This lens is vital for analyzing Iraq's challenges in deploying digital tools, such as real-time monitoring, cloud based data systems, and integrated scheduling platforms. In parallel, *ESG* integration is conceptualized using the Triple Bottom Line (*TBL*) theory, which emphasizes that long-term project success must simultaneously generate economic value, social equity, and environmental responsibility [2,19]. The relevance of this theory is growing in the Iraqi oil sector due to increased regulatory expectations and stakeholder scrutiny, particularly in areas impacted by environmental degradation and community displacement.

The combined theoretical lens hybrid project logic, *TOE* digital adoption model, and *TBL* sustainability perspective provides a robust basis for analyzing the dynamic interplay between technical execution, institutional constraints, and sustainable development objectives in Iraq's oil and gas projects.

4. Methodology

The existing paper employs a qualitative–analytical methodology aimed at synthesizing recent advancements in oil and gas project management, with a specific focus on the Iraqi context. The qualitative approach enables the integration of theoretical perspectives, policy documents, and empirical evidence to build a comprehensive understanding of the challenges and opportunities facing the sector.

4.1 Data Sources

The plots of existing paper are made and collected from multiple sources of secondary data, including:

1. Peer-reviewed academic literature published between 2014 and 2024.
2. Industry reports from organizations such as the International Energy Agency (IEA) [12,20], World Bank [21], and Iraq Petroleum Sector Reports [22].
3. Governmental publications, especially from Iraq's Ministry of Oil (MoO) [4] and Ministry of Planning (MoP) [23].
4. Case studies from upstream and midstream oil projects implemented in Iraq between 2016 and 2023.

This combination ensures data triangulation, enhancing the reliability and relevance of findings [24].

4.2 Data Collection and Analysis

Data were collected through systematic review methods and expert-informed filtering. The study applied content analysis and thematic coding to categorize findings into three core dimensions:

1. Hybrid Project Methodologies
2. Digital Transformation Capabilities
3. ESG Governance Practices

Comparative analysis was conducted between Iraqi project conditions and global benchmarks to identify gaps and derive insights. Visual tools (figures and charts) were also used to illustrate adoption trends, cost-risk patterns, and conceptual linkages.

4.3 Research Boundaries and Limitations

The existing paper focuses primarily on Iraq, many of its findings are transferable to other resource-constrained and politically unstable environments. However, limitations include:

1. Absence of primary data (e.g., interviews, surveys).
2. Potential publication bias in case study sources.
3. Incomplete transparency in some government-reported project data.

Despite these constraints, the methodological design supports a high level of analytical validity and theoretical generalizability [25].

4.4 Justification for Iraq as a Case Study

Iraq presents a unique combination of characteristics—heavy oil dependence, complex stakeholder dynamics, and institutional fragility—making it a critical case for testing hybrid project management models. Its national energy strategy [4] calls for digitalization and *ESG* alignment, offering a timely context for applied research.

.5. Results and Analysis

The analysis reveals that Iraq's oil and gas projects consistently face multidimensional challenges that undermine delivery timelines and budgetary expectations. Despite access to substantial hydrocarbon reserves and a strong global demand for Iraqi crude, project execution remains hindered by systemic inefficiencies. The following paragraphs will show the explaining about Iraqi oil and gas sectors challenges and economic analysis.

5.1 Cost Overrun and Schedule Delay

Analysis of documented project outcomes between 2016 and 2022, including reports from Iraq's Ministry of Oil and the International Project Management Group [26], reveals that the majority of large-scale oil infrastructure projects suffered both budget overruns and delivery delays.

As illustrated in **Fig.4**, the dominant factor contributing to cost and time overruns is procurement related delay, accounting for approximately (34%) of total project risk occurrences. This is followed by contractor miss-coordination (19%), regulatory and permitting challenges (15%), and political instability or site disruptions (14%). Additional contributors include change orders and design modifications (12%) and logistical or weather-related delays (6%).

These proportions underscore the structural nature of inefficiencies in Iraq's oil sector. Similar findings are reported in [5], which notes that weak contract enforcement and fragmented oversight further amplify these risk factors.

5.2 Project Risk Dynamics in the Iraqi Context

The country's volatile security environment and policy inconsistency exacerbate these risks. Unlike projects in stable Gulf Cooperation Council (*GCC*) countries, Iraqi project managers often operate in an environment lacking centralized governance and effective monitoring systems [12]. Even digitalization initiatives aimed at reducing these risks face challenges in terms of infrastructure, skilled labor, and institutional buy in [6].

International best practices highlight the importance of front-end planning (*FEP*) and modularization to reduce delays; however, these tools are inconsistently applied in Iraq's oil sector [2]. Furthermore, contract misalignment particularly in Build-Operate-Transfer (*BOT*) and technical service agreements contributes to delays and scope creep.

5.3 Benchmarking Against Global Standards

When compared to global benchmarks, Iraqi oil projects show lower integration of digital dashboards, risk prediction tools, and *ESG*-linked performance incentives. For instance, over 80% of upstream projects in Norway, Canada, and the *UAE* utilize predictive scheduling algorithms and real-time tracking platforms [12], while in Iraq, this figure remains below 25%.

These comparative insights highlight the urgency of adopting integrated project management systems, enhancing pre-contract planning, and establishing independent oversight bodies to ensure project transparency and performance accountability.

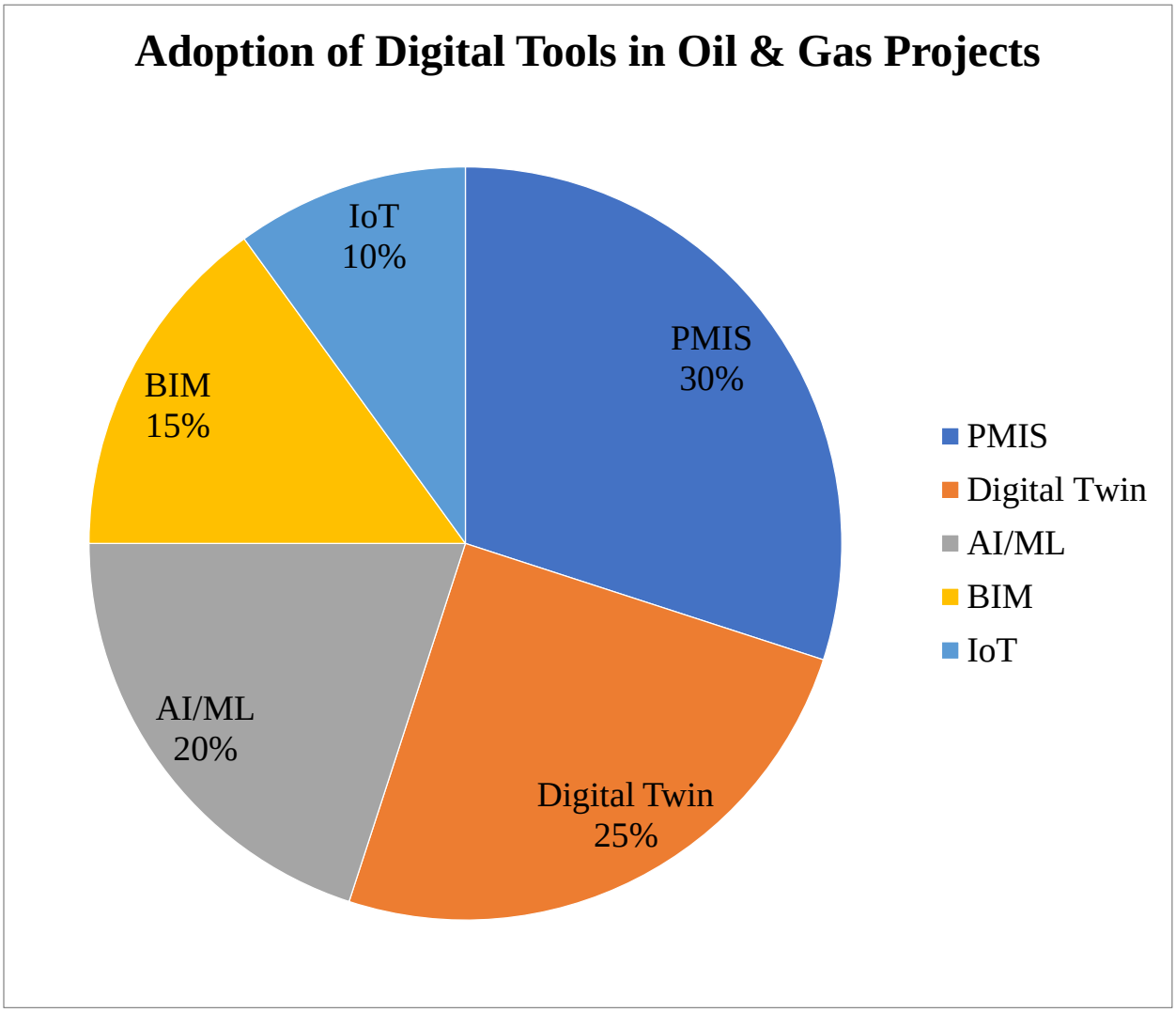

Figure 4: Adoption Share of Digital Tools in Oil and Gas Projects.

6. Discussion

The findings of this study reveal systemic gaps in Iraq's oil and gas project management, particularly in integrating modern methodologies and digital tools within a challenging institutional environment. The persistence of cost overruns and delays reflects not only operational inefficiencies but also deep-rooted structural barriers.

A comparative analysis shows that Iraq diverges significantly from global best practices, as international oil and gas megaprojects are increasingly governed by performance-linked contracts, digital dashboards, and *ESG* benchmarks, while Iraqi projects continue to rely on traditional, centralized control structures. This reliance is linked to weak enforcement capacity and a legacy culture resistant to transparency and decentralization.

The limited uptake of digital tools such as integrated scheduling systems, cost-tracking platforms, and AI-based risk modeling further restricts the ability of project managers to predict and mitigate deviations. This issue extends beyond technology, as it also reflects organizational weaknesses, including the lack of cross-functional coordination and leadership alignment. Digital transformation requires not only investment in tools but also institutional commitment, which is often missing in Iraq's public-sector project entities.

In addition, the underdeveloped *ESG* integration within Iraq's energy governance presents both risks and opportunities. While international oil companies operating in Iraq increasingly report *ESG* metrics for stakeholder assurance, local project management structures seldom embed these frameworks internally. This gap may lead to reputational risks, reduced investment attractiveness, and lower long-term project value. Furthermore, a review of Iraq's national energy strategy highlights contradictions between policy objectives and project execution, where plans for digital infrastructure development and environmental stewardship are hindered by budgetary constraints, fragmented mandates, and leadership turnover.

Overall, these insights emphasize the need for a comprehensive reform pathway that considers project management, digitalization, and governance as interdependent elements rather than isolated initiatives. Strengthening Iraq's project management ecosystem requires better alignment of institutional mandates, empowerment of mid-level management, and embedding of digital and *ESG* capabilities across all project phases.

7. Conclusions

The main key points are concluded from the existing paper are:

1. The current paper uses a qualitative-analytical approach to summarize new developments in oil and gas project management, with an emphasis on the Iraqi setting.
2. Most significant Iraqi oil infrastructure projects experienced both delivery delays and budget overruns according to cost and time overruns, contractor miss-coordination, regulatory and permitting challenges, political instability or site disruptions, change orders and design modifications, and logistical or weather-related delays.
3. The dangers are increased by the unstable security environment and inconsistent policies of the nation. In contrast to projects in the stable GCC, Iraqi project managers frequently work in a setting devoid of efficient monitoring mechanisms and centralized control
4. Iraqi oil projects exhibit less integration of digital dashboards, risk prediction tools, and ESG-linked performance incentives in comparison to international standards.
5. Globally, project management trends increasingly favor hybridized methodologies, digitally enabled decision-making, and sustainability-oriented performance systems.
6. There are structural flaws in Iraq's oil and gas project management, especially with regard to incorporating contemporary techniques and digital technologies into a difficult institutional framework.
7. Although these reforms require time, political will, and capacity building, they represent a pathway toward sustainable development, improved fiscal efficiency, and stronger stakeholder trust.

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