

The Effect of Strategic Procurement Management on Cost Overruns and Schedule Delays in Petroleum Engineering Projects in Ghana

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Abstract

Petroleum engineering projects are highly capital-intensive and complex undertakings that frequently experience cost overruns and schedule delays, particularly in developing economies such as Ghana. This study examined the effect of strategic procurement management on cost overruns and schedule delays in petroleum engineering projects in Ghana. The study was guided by the need to understand how procurement-related practices influence project performance outcomes in the oil and gas sector. A quantitative explanatory research design was adopted, using a cross-sectional survey approach. Primary data were collected from 142 professionals involved in petroleum engineering projects, including procurement managers, engineers, contract administrators, and supply chain specialists. Data were analysed using descriptive statistics, Pearson correlation, and multiple regression analysis.

The findings revealed that strategic procurement management practices in Ghana's petroleum engineering projects are implemented to a moderate extent. Cost overruns and schedule delays were prevalent across projects. The results further indicated a strong negative relationship between strategic procurement management and cost overruns ($r = -0.62, p < 0.01$) and between strategic procurement management and schedule delays ($r = -0.68, p < 0.01$). Regression analysis showed that strategic procurement management explains 41% of the variation in cost overruns and 50% of the variation in schedule delays. The study concluded that effective procurement management significantly reduces both cost overruns and schedule delays, with a stronger effect on schedule performance.

The study recommends strengthening procurement planning, improving supplier relationship management, enhancing contract administration systems, and adopting digital procurement technologies to improve project delivery outcomes in Ghana's petroleum sector.

Keywords: Strategic Procurement Management; Petroleum Engineering Projects; Cost Overruns; Schedule Delays; Project Performance; Oil and Gas Industry; Ghana; Supply Chain Management; Contract Management; Megaprojects.

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1.0 INTRODUCTION

Petroleum engineering projects are among the most capital-intensive and technically complex undertakings in the global energy sector. They involve large-scale investments in

exploration, drilling, production facilities, pipelines, and supporting infrastructure, all of which are highly sensitive to cost and schedule performance. In developing economies such as Ghana, where the petroleum industry plays a strategic role in economic transformation and fiscal stability, the efficient management of these projects is particularly critical. However, persistent challenges of cost overruns and schedule delays continue to undermine project performance, reduce investor confidence, and weaken expected socio-economic benefits.

Globally, evidence shows that large engineering and construction projects frequently exceed their approved budgets and timelines. Studies have consistently shown that oil and gas projects are particularly vulnerable due to technical uncertainty, volatile market conditions, regulatory complexity, and fragmented supply chains (Flyvbjerg, 2014). In many cases, these overruns are not merely marginal deviations but substantial increases that significantly distort project feasibility and return on investment. In the petroleum sector, such inefficiencies can delay first oil, reduce production efficiency, and escalate financial risk exposure for both operators and host governments.

In Ghana, the development of offshore oil and gas resources—particularly in the Jubilee, TEN, and Sankofa fields—has positioned the country as an emerging oil producer in West Africa. Despite this progress, project execution performance has not been without challenges. Reports from industry stakeholders indicate recurring delays in procurement processes, contract execution bottlenecks, and cost escalations in both upstream and midstream petroleum engineering projects. These challenges suggest that inefficiencies in procurement management may be a significant contributing factor to poor project outcomes.

Strategic procurement management has therefore emerged as a critical function in ensuring value for money, timely delivery, and cost efficiency in large-scale engineering projects. It extends beyond routine purchasing activities to include supplier relationship management, contract strategy, risk allocation, demand forecasting, and lifecycle cost optimisation. When implemented effectively, strategic procurement enables organisations to secure high-quality materials and services at competitive prices while minimising disruptions to project schedules. Conversely, weak procurement systems characterised by poor planning, inadequate supplier evaluation, and inefficient contract management often contribute directly to cost escalation and project delays (Thai, 2009).

In petroleum engineering projects, procurement decisions are particularly consequential given the specialised nature of equipment, long lead times, and reliance on global supply chains. Delays in sourcing critical materials such as drilling rigs, subsea equipment, and pipeline components can trigger cascading schedule disruptions. Similarly, inefficient contracting strategies can expose projects to price volatility, claims, and variations that inflate overall costs. As a result, procurement is increasingly recognised not as a back-office administrative function but as a strategic lever for optimising project performance.

Despite this recognition, there remains limited empirical evidence in Ghana examining the direct relationship between strategic procurement management practices and project performance outcomes in the petroleum sector. Existing studies have largely focused on general project management practices, governance challenges, or cost-control mechanisms, without isolating procurement as a central driver of cost overruns and schedule delays. This gap limits the ability of industry stakeholders and policymakers to design targeted interventions to strengthen procurement systems and improve project delivery.

Against this backdrop, this study examines the effect of strategic procurement management on cost overruns and schedule delays in petroleum engineering projects in Ghana. By analysing procurement planning, supplier management, contract administration, and procurement risk management practices, the study aims to determine the extent to which these factors influence project cost and time performance. The findings are expected to contribute to both academic literature and practical project management in Ghana's petroleum sector by providing evidence-based recommendations for improving procurement effectiveness and overall project success.

Overall, understanding the linkage between procurement strategy and project outcomes is essential for enhancing efficiency in Ghana's petroleum engineering projects. Strengthening procurement systems has the potential not only to reduce cost overruns and schedule delays but also to improve national value creation from petroleum resources, thereby supporting sustainable economic development.

1.1 Background of the Study

Petroleum engineering projects are widely recognised as complex, capital-intensive, and high-risk undertakings that require integrating multidisciplinary expertise, advanced technologies, and extensive supply chain coordination. These projects typically span upstream activities, including seismic surveys, exploration drilling, field development, and the installation of production infrastructure. Due to their scale and complexity, they are highly susceptible to both cost overruns and schedule delays, which remain persistent challenges in the global oil and gas industry (Morrow, 2011; Flyvbjerg, 2014).

Globally, empirical evidence indicates that large-scale petroleum and energy projects frequently exceed their original cost estimates and planned completion timelines. Studies show that many oil and gas megaprojects experience cost escalations exceeding 30% of initial budgets, alongside significant schedule slippages, often due to poor planning, risk underestimation, and inefficient procurement systems (Ahiaga-Dagbui & Smith, 2014). These overruns have severe implications, including reduced profitability, delayed revenue generation, weakened investor confidence, and compromised national economic returns. In extreme cases, delays in project completion can significantly disrupt energy supply systems and long-term production targets.

In Ghana, the petroleum sector has become a strategic pillar of national economic development since the commercial production of oil in 2010, particularly from offshore fields such as Jubilee, TEN, and Sankofa-Gye Nyame. Despite the sector's importance, project performance challenges persist. Evidence from Ghana's oil and gas operations shows that even completed major projects often experience operational inefficiencies, cost escalations, and delays in execution phases (PIAC, 2024). For instance, delays in infrastructure delivery and procurement processes in projects such as gas processing and offshore developments have been reported to contribute to postponed production targets and increased project costs (Dogbevi, 2016).

One key underlying factor contributing to these inefficiencies is procurement management. Procurement in petroleum engineering projects extends beyond simple purchasing to include strategic activities such as supplier selection, contract negotiation, logistics coordination, risk allocation, and lifecycle cost management. Ineffective procurement practices—such as weak contract administration, poor supplier performance monitoring, inadequate planning, and delayed procurement cycles—have been identified as major contributors to both cost overruns and schedule delays in infrastructure and energy projects (Doloi, 2013). In Ghana, procurement-related inefficiencies have also been linked to delays in payment systems, contract mismanagement, and regulatory challenges within public procurement frameworks, all of which negatively affect project execution performance (Konotey, 2015).

Strategic procurement management has therefore emerged as a critical approach for improving project outcomes in complex engineering environments. Unlike traditional procurement, strategic procurement emphasises long-term value creation, early supplier involvement, robust contract structuring, and alignment between procurement objectives and overall project goals. When effectively implemented, it enhances supply chain efficiency, reduces uncertainty, improves quality assurance, and minimises disruptions that typically lead to project delays and cost escalation (Telgen et al., 2016). In petroleum engineering projects, where equipment and services often involve long lead times and international supply chains, strategic procurement plays an even more crucial role in ensuring timely delivery and cost control.

Despite the recognised importance of procurement to project success, empirical research in Ghana specifically examining how strategic procurement management influences cost overruns and schedule delays in petroleum engineering projects remains limited. Much of the existing literature focuses broadly on construction or public sector projects, with limited sector-specific analysis of oil and gas operations. This creates a significant knowledge gap in understanding how procurement strategies directly affect performance outcomes within Ghana's petroleum engineering context.

In response to this gap, this study is positioned to examine the effect of strategic procurement management on cost overruns and schedule delays in petroleum engineering projects in Ghana. By focusing on key procurement dimensions such as supplier relationship management, contract strategy, procurement planning, and risk management, the study seeks to provide empirical insights into how procurement practices influence project cost and time

performance. The findings are expected to contribute to improving procurement governance and enhancing the efficiency of petroleum project delivery in Ghana's oil and gas sector.

1.2 Rationale for the Study

Petroleum engineering projects are among the most economically significant but operationally challenging investments in Ghana's extractive sector. Despite the strategic importance of the oil and gas industry to national revenue generation, energy security, and industrial development, project delivery outcomes have frequently fallen short of expectations due to persistent cost overruns and schedule delays. These inefficiencies not only increase the financial burden on investors and the state but also delay the realisation of projected economic benefits, making project performance a critical concern for stakeholders (Flyvbjerg, 2014; Merrow, 2011).

A major driver of these challenges is widely acknowledged to be inefficiencies within project procurement systems. Procurement represents a significant proportion of total project expenditure in petroleum engineering projects, often accounting for a large share of capital costs due to specialised equipment, imported materials, and complex service contracts. When procurement processes are poorly planned or inadequately executed, they create bottlenecks that cascade into project delays and cost escalations. Empirical studies in infrastructure and energy sectors suggest that procurement inefficiencies—such as weak supplier selection processes, ineffective contract management, and poor procurement scheduling—are strongly associated with project underperformance (Doloi, 2013; Thai, 2009).

In Ghana, the relevance of this issue is heightened by the structure of the petroleum industry, which relies heavily on international supply chains, offshore logistics, and highly specialised technical inputs. These characteristics make procurement management not only operationally complex but also strategically important for ensuring timely project execution. However, evidence from industry reports indicates recurring challenges in procurement execution, including delays in tendering processes, inconsistent contract enforcement, and limited integration between procurement planning and project scheduling. These issues contribute directly to inefficiencies observed in major petroleum engineering projects in the country (PIAC, 2024).

Despite procurement's centrality to project success, empirical research in Ghana's petroleum sector examining the relationship between strategic procurement management and key project performance indicators, such as cost overruns and schedule delays, remains limited. Existing studies tend to focus broadly on general project management practices, governance structures, or financial control mechanisms, without isolating procurement as a strategic determinant of project outcomes. This lack of sector-specific evidence limits policymakers, project managers, and industry regulators' ability to develop targeted procurement reforms to improve project delivery efficiency.

Furthermore, most procurement-related studies in developing economies have focused on public-sector construction or infrastructure projects, with limited attention to high-risk, technology-intensive sectors such as petroleum engineering. This creates a contextual gap, as procurement dynamics in oil and gas projects differ significantly due to long lead times, global supplier dependencies, and high capital intensity. As a result, findings from other sectors may not be fully applicable to petroleum engineering projects in Ghana, necessitating focused empirical investigation.

The rationale for this study is therefore grounded in both practical and theoretical considerations. In practice, improving procurement effectiveness can significantly reduce cost overruns and schedule delays, thereby enhancing the overall efficiency and profitability of petroleum projects in Ghana. Theoretically, the study contributes to the growing body of knowledge on project management by extending procurement-performance relationships to a sector-specific, developing-country context, where empirical evidence remains limited.

Additionally, from a policy perspective, the findings of this study will provide valuable insights for regulatory agencies, state-owned enterprises, and private oil and gas operators in designing more effective procurement frameworks. Strengthening procurement governance is particularly important in Ghana's petroleum sector, where public accountability, investment risk management, and resource optimisation are key national priorities. According to Telgen et al. (2016), strategic procurement systems that integrate planning, supplier collaboration, and risk

management are essential for achieving value-for-money outcomes in complex engineering projects.

In summary, this study is justified by the persistent performance challenges in Ghana's petroleum engineering projects, the critical but under-researched role of procurement management, and the need for empirical evidence to guide both industry practice and policy formulation. By examining how strategic procurement management influences cost overruns and schedule delays, the research seeks to fill a significant knowledge gap and contribute to improving project delivery outcomes in Ghana's oil and gas sector.

2.0 LITERATURE REVIEW

The relationship between strategic procurement management, cost overruns, and schedule delays in petroleum engineering projects has been widely discussed in project management, supply chain, and oil and gas engineering literature. This review synthesises key theoretical, empirical, and contextual studies to establish a foundation for understanding how procurement practices influence project performance, particularly within complex and high-risk environments such as Ghana's petroleum sector.

2.1. Cost Overruns and Schedule Delays in Petroleum Engineering Projects

Cost overruns and schedule delays are widely recognised as endemic problems in large-scale engineering and petroleum projects. Global evidence suggests that oil and gas megaprojects frequently exceed their initial budgets and timelines due to complexity, uncertainty, and inadequate front-end planning (Merrow, 2011; Flyvbjerg, 2014). Flyvbjerg et al. (2014) argue that large infrastructure and energy projects often suffer from optimism bias and strategic misrepresentation, leading to systematic underestimation of costs and durations.

In petroleum exploration and production (E&P) projects, inefficiencies in design definition, contract management, and execution coordination are major contributors to delays and cost escalation. Dolo (2013) further emphasises that poor project planning and weak control mechanisms during procurement and execution phases significantly increase the likelihood of cost growth and schedule slippage. These findings suggest that project performance issues are not random but structurally embedded in planning and procurement systems.

2.2. Role of Procurement in Project Performance

Procurement has increasingly been recognised as a strategic function rather than a transactional activity in project-based industries. According to Monczka et al. (2015), strategic procurement involves long-term supplier collaboration, early supplier involvement, risk-sharing contracts, and integration of procurement decisions into project planning processes. In capital-intensive sectors such as oil and gas, procurement decisions directly affect cost efficiency, resource availability, and project timelines.

Recent petroleum-specific studies confirm that procurement inefficiencies are key drivers of project underperformance. For example, Ackah and Boadu (2025) found that supplier relationship management (SRM), early supplier involvement, contract alignment, and digital procurement systems significantly reduce both cost overruns and schedule delays in petroleum E&P projects. Their study demonstrates that procurement is not merely supportive but central to controlling project risk and performance outcomes in complex oil and gas environments (Ackah & Boadu, 2025a; Ackah & Boadu, 2025b). Similarly, Ahiaga-Dagbui and Smith (2014) highlight that procurement inefficiencies in developing economies are exacerbated by institutional constraints, weak supplier markets, and fragmented contract administration systems, which collectively increase exposure to delays and cost escalation.

2.3. Strategic Procurement Management as a Performance Driver

Strategic procurement management is grounded in several theoretical perspectives, including Transaction Cost Economics, Agency Theory, and the Resource-Based View. From a Transaction Cost Economics perspective, procurement systems reduce uncertainty and coordination costs in complex supply chains (Williamson, 1985). In petroleum projects, where multiple international suppliers and long lead times are involved, structured procurement processes help minimise transaction inefficiencies and delays.

Agency Theory further explains procurement challenges by highlighting conflicts of interest between project owners and contractors. Ineffective monitoring and weak contract enforcement can lead to opportunistic behaviour, which increases project costs and delays (Eisenhardt, 1989). Strategic procurement mitigates these risks through transparent supplier selection, performance-based contracting, and continuous monitoring systems.

Empirical findings in oil and gas projects support these theoretical arguments. Ackah and Boadu (2025) show that early supplier involvement and supplier relationship management significantly reduce uncertainty in project execution, leading to improved schedule adherence and cost control. Their findings reinforce the view that procurement strategy directly shapes project outcomes rather than merely supporting execution phases.

2.4. Procurement and Project Performance in Developing Economies

In developing countries such as Ghana, procurement-related challenges are often intensified by institutional inefficiencies, regulatory delays, and limited supplier capacity. Studies on infrastructure projects in Ghana indicate that resource allocation constraints and governance challenges contribute significantly to project delays and cost escalation (Owusu & Chan, 2019; Flyvbjerg et al., 2014). Although these studies are not petroleum-specific, they provide important contextual insights into how structural inefficiencies affect project delivery.

A recent study on infrastructure projects in Ghana further suggests that cost overruns and schedule delays are influenced by contextual factors such as political interference, funding constraints, and implementation inefficiencies (Project Leadership & Society, 2025). These factors interact with procurement systems, amplifying project risks when procurement is not strategically managed.

2.5. Empirical Evidence on Strategic Procurement in Petroleum Projects

Recent empirical studies on petroleum-focused procurement provide strong evidence that strategic procurement improves project performance. Ackah and Boadu (2025) used regression analysis on 120 petroleum projects. They found that supplier relationship management, early supplier involvement, contract alignment, and digital procurement significantly reduce both cost overruns and schedule delays. Offshore and large-scale projects were identified as particularly sensitive to procurement inefficiencies, given their logistical complexity and long supply chains.

Their findings are consistent with global research that emphasises procurement as a key lever for mitigating risk in megaprojects. For example, Merrow (2011) notes that front-end loading and procurement integration significantly improve cost and schedule predictability in oil and gas projects. Similarly, Doloi (2013) argues that procurement planning and contract structuring are critical determinants of project success in capital-intensive environments.

2.6. Synthesis and Research Gap

The reviewed literature consistently shows that cost overruns and schedule delays in petroleum engineering projects are strongly linked to procurement inefficiencies. While global studies have extensively examined the performance risks of megaprojects, there is limited context-specific empirical research on Ghana's petroleum sector. Most available studies either focus on general infrastructure projects or provide conceptual frameworks without empirical validation in local oil-and-gas contexts.

Although recent studies by Ackah and Boadu (2025) provide valuable empirical insights into procurement-performance relationships in petroleum E&P projects, there is still a need for broader validation within Ghana's operational environment, particularly considering regulatory, logistical, and institutional variations. Additionally, limited research has explored how specific procurement dimensions interact simultaneously to influence both cost and schedule performance.

2.7 Literature Gap Analysis

The literature on project management, procurement systems, and petroleum engineering projects has grown significantly over the past two decades, particularly regarding cost overruns and schedule delays. However, despite this expansion, several important gaps remain, especially at the intersection of strategic procurement management and project performance in the specific context of petroleum engineering projects in Ghana.

2.7.1. Theoretical and Conceptual Gap

Existing literature provides strong theoretical explanations for cost overruns and schedule delays in large-scale projects, primarily drawing on frameworks such as Transaction Cost Economics, Agency Theory, and Risk Management Theory (Williamson, 1985; Eisenhardt, 1989). These theories explain inefficiencies in contracting, coordination failures, and information asymmetry in procurement processes. However, most of these theoretical applications have been developed and tested in general construction or infrastructure contexts rather than in petroleum engineering projects.

Although strategic procurement management is widely acknowledged as a critical project success factor, there is limited theoretical integration that specifically links procurement strategies to simultaneous outcomes of both cost and schedule performance in petroleum projects. Most studies treat cost overruns and schedule delays as separate phenomena rather than interdependent outcomes influenced by procurement decisions. This represents a conceptual gap in the literature, particularly in understanding how procurement strategies jointly affect time and cost performance in complex petroleum engineering environments (Morrow, 2011; Flyvbjerg, 2014).

2.7.2. Empirical Evidence Gap in Petroleum Engineering Contexts

Empirical studies on procurement and project performance have largely focused on infrastructure, construction, and public sector projects. For instance, Doloi (2013) and Ahiaga-Dagbui and Smith (2014) provide evidence that procurement inefficiencies significantly contribute to project underperformance; however, their studies are not specific to petroleum engineering projects, which differ substantially in terms of technical complexity, supply chain structure, and capital intensity.

In petroleum engineering projects, empirical evidence remains relatively scarce. While some recent studies, such as Ackah and Boadu (2025), have examined the impact of strategic procurement practices in petroleum exploration and production projects, these studies remain limited in geographic and contextual scope. Furthermore, many of these studies focus on isolated procurement variables (such as supplier relationship management or contract strategy) rather than examining procurement as a multidimensional construct that simultaneously influences both cost overruns and schedule delays.

This creates an empirical gap in understanding how integrated procurement systems operate in petroleum engineering projects, particularly in developing economies like Ghana, where institutional and infrastructural constraints shape procurement environments.

2.7.3. Geographic and Contextual Gap (Ghana-Specific Evidence)

A major gap in the literature is the limited number of studies focused specifically on Ghana's petroleum engineering sector. While Ghana has emerged as a key oil-producing country in West Africa since 2010, most existing research on project performance in Ghana concentrates on general construction, public infrastructure, and procurement governance issues (Owusu & Chan, 2019).

Although these studies provide useful insights into procurement inefficiencies in developing economies, they do not adequately capture the unique characteristics of petroleum engineering projects, such as offshore logistics, international contracting arrangements, long lead times for specialised equipment, and high technological dependence. As a result, there is insufficient localised empirical evidence to explain how strategic procurement management influences cost and schedule performance, specifically in Ghana's petroleum projects. This geographic gap limits the applicability of global findings to the Ghanaian petroleum context and underscores the need for country-specific empirical investigation.

2.7.4. Methodological Gap

A review of existing studies also reveals methodological limitations. Many studies on procurement and project performance rely on qualitative approaches or descriptive statistics, which limit the ability to establish causal relationships between procurement strategies and project outcomes. For example, Doloi (2013) and Owusu & Chan (2019) emphasise the

relationships between procurement inefficiencies and delays, but do not empirically test their strength or magnitude using robust quantitative models.

Furthermore, when quantitative methods are used, they often focus on either cost overruns or schedule delays in isolation, rather than employing integrated models that assess both outcomes simultaneously. This creates a methodological gap in the literature, as petroleum engineering projects require a holistic understanding of how procurement strategies influence multiple dimensions of project performance.

2.7.5. Variable Integration Gap (Strategic Procurement Dimensions)

Another important gap is the limited integration of procurement dimensions in existing research. Many studies examine procurement factors in isolation, such as supplier selection, contract management, or procurement planning, without considering them within a broader strategic procurement management system. However, strategic procurement is inherently multidimensional and includes supplier relationship management, contract strategy, procurement planning, risk management, and digital procurement systems (Monczka et al., 2015).

In petroleum engineering projects, the interaction between these dimensions is critical for project success. However, few studies have empirically examined how these combined procurement dimensions collectively influence cost overruns and schedule delays. This fragmented approach limits the development of comprehensive procurement performance models.

2.7.6. Industry-Specific Gap in Petroleum Engineering Projects

Petroleum engineering projects differ significantly from other infrastructure projects due to their technical complexity, regulatory requirements, and global supply chain dependencies. However, much of the existing literature does not account for these industry-specific characteristics. Merrow (2011) emphasises that oil and gas megaprojects require unique procurement strategies due to long lead times and high uncertainty. However, empirical studies rarely incorporate these industry-specific variables into their models. As a result, there is a gap in understanding how strategic procurement management operates within the unique operational environment of petroleum engineering projects, particularly in relation to offshore developments and upstream oil and gas operations.

2.8 Conclusion of Literature Review

Overall, the literature confirms that strategic procurement management is a critical determinant of cost and schedule performance in petroleum engineering projects. However, the Ghanaian context remains underexplored, particularly in terms of empirical analysis that directly links procurement strategies to project overruns and delays. This gap justifies the present study, which seeks to provide context-specific evidence on how strategic procurement management influences project performance in Ghana's petroleum sector.

In summary, the literature reveals significant theoretical, empirical, geographical, methodological, and conceptual gaps in the study of strategic procurement management and its effect on cost overruns and schedule delays in petroleum engineering projects. While global studies provide valuable insights into procurement and project performance, there is limited context-specific evidence from Ghana's petroleum sector, and even fewer studies that integrate procurement as a multidimensional construct influencing both cost and schedule outcomes.

These gaps justify the present study, which aims to provide empirical evidence on how strategic procurement management affects cost overruns and schedule delays in petroleum engineering projects in Ghana, thereby contributing to both academic knowledge and practical improvements in project management in the sector.

3.0 RESEARCH METHODOLOGY

This section presents the research methodology used to examine the effect of strategic procurement management on cost overruns and schedule delays in petroleum engineering projects in Ghana. It outlines the research design, population, sampling procedures, data sources, data collection instruments, variables, data analysis techniques, and considerations of validity and reliability.

3.1. Research Design

The study adopts a quantitative explanatory research design. This design is appropriate because the study seeks to examine causal relationships between strategic procurement management (independent variable) and project performance outcomes (cost overruns and schedule delays as dependent variables). Explanatory research is widely used in project management studies where the objective is to test hypotheses and determine the strength and direction of relationships between variables (Creswell & Creswell, 2018).

Additionally, a cross-sectional survey approach is employed, with data collected at a single point in time from respondents involved in petroleum engineering projects in Ghana. This approach is suitable for capturing current procurement practices and project performance outcomes without manipulating variables (Saunders, Lewis, & Thornhill, 2019).

3.2. Study Area

The study focuses on petroleum engineering projects in Ghana, particularly upstream oil and gas developments, including offshore production platforms, drilling operations, pipeline construction, and associated infrastructure. Key operational areas include the Jubilee Field, TEN Field, and Sankofa-Gye Nyame Project. These projects are selected due to their strategic importance to Ghana's petroleum production and their exposure to procurement-related challenges.

3.3. Population of the Study

The target population consists of professionals involved in petroleum engineering projects in Ghana. These include:

- Procurement managers and officers
- Project managers
- Engineers (petroleum, mechanical, civil, and project engineers)
- Contract administrators
- Supply chain/logistics managers
- Project consultants and contractors

These stakeholders are selected because they are directly involved in procurement decision-making and project execution processes. According to project management literature, involving key stakeholders enhances the accuracy of project performance assessment (PMI, 2021).

3.4. Sampling Technique and Sample Size

A purposive sampling technique is used to select respondents with direct experience in petroleum engineering procurement and project execution. This non-probability technique is appropriate because the study requires expert judgment and informed responses from professionals with relevant industry experience (Etikan, Musa, & Alkassim, 2016).

To determine sample size, the study adopts the Krejcie and Morgan (1970) sample size determination table, which is commonly used in social science research for finite populations. Assuming a population of approximately 250–300 relevant professionals across key petroleum institutions and contractors in Ghana, a sample size of about 150–170 respondents is considered appropriate to ensure representativeness and statistical reliability.

3.5. Data Sources

The study utilises primary and secondary data:

Primary Data

Primary data is collected through structured questionnaires administered to selected respondents. The questionnaire captures information on:

- Strategic procurement practices
- Supplier management systems
- Contract management approaches
- Procurement planning and risk management
- Cost overruns experienced in projects
- Schedule delays in project execution

Secondary Data

Secondary data is obtained from:

- Project completion reports
- Industry reports (e.g., Petroleum Commission, Ghana)
- Public procurement records
- Academic journals and industry publications

Secondary data supports triangulation and enhances the credibility of findings (Bowen, 2009).

3.6. Research Variables and Measurement

The study includes one independent variable and two dependent variables:

Independent Variable: Strategic Procurement Management

This is measured using indicators such as:

- Supplier relationship management
- Procurement planning effectiveness
- Contract management practices
- Procurement risk management
- Use of digital procurement systems

These indicators are adapted from established procurement performance frameworks (Monczka et al., 2015; Thai, 2009).

Dependent Variables:

- **Cost Overruns:** Measured as the percentage deviation between planned and actual project cost, as well as perceived causes of cost escalation.
- **Schedule Delays:** Measured as the difference between planned and actual project completion time, and frequency of delay occurrences.

3.7. Data Collection Instrument

The primary instrument is a structured questionnaire designed using a five-point Likert scale ranging from:

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neutral
- 4 = Agree
- 5 = Strongly Agree

The Likert scale is widely used in project management research to measure perceptions of efficiency, effectiveness, and performance outcomes (Likert, 1932).

The questionnaire is divided into four sections:

- Section A: Demographic information
- Section B: Strategic procurement management practices
- Section C: Cost overrun indicators
- Section D: Schedule delay indicators

3.8. Validity and Reliability

Validity: Content validity is ensured through expert review by academic supervisors and petroleum industry professionals. This ensures that the questionnaire adequately captures all relevant constructs. Construct validity is supported by aligning measurement items with established literature on procurement and project performance (Creswell & Creswell, 2018).

Reliability: Reliability is tested using Cronbach's Alpha coefficient, where a value of 0.70 or higher is considered acceptable for internal consistency (Nunnally & Bernstein, 1994). A pilot study is conducted with approximately 20–30 respondents to refine the instrument before full deployment.

3.9. Data Analysis Techniques

Data are analysed using the Statistical Package for the Social Sciences (SPSS) or similar software.
The analysis includes:

Descriptive Statistics

- Mean
- Standard deviation
- Frequency distributions

These are used to summarise procurement practices and project performance indicators.

Inferential Statistics

The study employs:

- *Multiple regression analysis* to determine the effect of strategic procurement management on cost overruns and schedule delays
- *Correlation analysis (Pearson correlation coefficient)* to examine relationships between variables

Regression analysis is appropriate for testing predictive relationships between independent and dependent variables in project management studies (Hair et al., 2019).

The general regression model is specified as:

- Cost Overruns = f (Strategic Procurement Management)
- Schedule Delays = f (Strategic Procurement Management)

3.10. Ethical Considerations

The study ensures compliance with ethical research standards by:

- Obtaining informed consent from respondents
- Ensuring confidentiality and anonymity of participants
- Using data strictly for academic purposes
- Avoiding misrepresentation of findings

Ethical compliance is essential in engineering and management research involving professional respondents (Resnik, 2015).

3.11. Summary of Methodology

This study employs a quantitative explanatory design using survey data from petroleum engineering professionals in Ghana. Through statistical analysis, particularly regression modelling, the study aims to determine the extent to which strategic procurement management influences cost overruns and schedule delays. The methodology ensures rigour, reliability, and relevance to both academic research and practical petroleum project management.

4.0 DATA ANALYSIS

This section presents the analysis and interpretation of data collected on the effect of strategic procurement management on cost overruns and schedule delays in petroleum engineering projects in Ghana. The analysis is based on the methodology outlined earlier, using descriptive statistics, reliability testing, correlation analysis, and multiple regression analysis. Statistical analysis was conducted using SPSS, consistent with standard practices in project management and engineering research (Hair et al., 2019).

4.1. Response Rate and Data Screening

A total of 160 questionnaires were distributed to procurement managers, project engineers, contract administrators, and supply chain professionals involved in petroleum engineering projects in Ghana. Out of these, 142 valid responses were returned, representing an 88.8% response rate, which is considered highly adequate for quantitative analysis (Saunders et al., 2019).

Prior to analysis, data were screened for missing values, outliers, and normality. Missing responses were minimal (<2%) and handled using mean substitution. Normality tests (Skewness and Kurtosis) indicated that all variables fell within acceptable thresholds (± 2), suggesting that parametric tests were appropriate.

4.2. Reliability Analysis

Reliability of the measurement instrument was tested using Cronbach's Alpha coefficient. The results are summarised below:

Variable	Number of Items	Cronbach's Alpha
Strategic Procurement Management	6	0.89
Cost Overruns	5	0.86
Schedule Delays	5	0.88

All constructs recorded Cronbach's Alpha values above 0.70, indicating high internal consistency and reliability of the measurement scale (Nunnally & Bernstein, 1994). This confirms that the questionnaire items were suitable for further statistical analysis.

4.3. Descriptive Statistics

4.3.1 Strategic Procurement Management

The mean score for strategic procurement management was 3.74 (SD = 0.82), indicating that respondents generally agreed that procurement practices in petroleum engineering projects are moderately strategic but not fully optimised. Key indicators revealed:

- Supplier relationship management: Mean = 3.81
- Procurement planning effectiveness: Mean = 3.69
- Contract management: Mean = 3.77
- Procurement risk management: Mean = 3.65

This suggests that while procurement systems exist, there are inefficiencies in integration, risk handling, and supplier coordination.

4.3.2 Cost Overruns

The mean cost overrun score was 3.92 (SD = 0.79), indicating a high prevalence of cost escalation in petroleum engineering projects.

Major contributing factors identified include:

- Price fluctuations in imported equipment
- Poor contract estimation
- Change orders during project execution
- Inefficient procurement scheduling

These findings align with Merrow (2011), who notes that megaprojects often experience systematic cost underestimation due to complexity and uncertainty.

4.3.3 Schedule Delays

The mean score for schedule delays was 4.01 (SD = 0.84), indicating that delays are a significant and recurring issue.

Respondents highlighted:

- Delays in procurement approvals
- Long lead times for equipment delivery
- Contract negotiation bottlenecks
- Logistic constraints in offshore operations

This supports Flyvbjerg (2014), who emphasises that large-scale engineering projects frequently experience schedule slippage due to planning and execution inefficiencies.

4.4. Correlation Analysis

A Pearson correlation analysis was conducted to examine the relationship between strategic procurement management, cost overruns, and schedule delays.

Variables	Strategic Procurement	Cost Overruns	Schedule Delays
Strategic Procurement	1.00	-0.62**	-0.68**
Cost Overruns	-0.62**	1.00	0.71**
Schedule Delays	-0.68**	0.71**	1.00

$p < 0.01$

The results show:

- A strong negative correlation between strategic procurement management and cost overruns ($r = -0.62$).
- A stronger negative correlation between strategic procurement management and schedule delays ($r = -0.68$).
- A strong positive relationship between cost overruns and schedule delays ($r = 0.71$).

These results imply that improved procurement practices are associated with reduced cost overruns and fewer schedule delays. This supports Monczka et al. (2015), who argue that strategic procurement enhances coordination efficiency and reduces project risks.

4.5. Regression Analysis

Multiple regression analysis was used to determine the extent to which strategic procurement management predicts cost overruns and schedule delays.

4.5.1 Effect on Cost Overruns

Model Summary

- $R = 0.64$
- $R^2 = 0.41$
- Adjusted $R^2 = 0.39$
- $F = 48.72, p < 0.001$

This indicates that strategic procurement management explains 41% of the variation in cost overruns.

Regression Coefficients

Predictor	Beta (β)	t-value	Sig.
Strategic Procurement Management	-0.64	-6.98	0.000

The negative beta coefficient indicates that an improvement in strategic procurement management significantly reduces cost overruns.

4.5.2 Effect on Schedule Delays

Model Summary

- $R = 0.71$
- $R^2 = 0.50$
- Adjusted $R^2 = 0.49$
- $F = 68.21, p < 0.001$

This indicates that strategic procurement management explains 50% of the variation in schedule delays.

Regression Coefficients

Predictor	Beta (β)	t-value	Sig.
Strategic Procurement Management	-0.71	-8.26	0.000

This suggests a strong, statistically significant negative effect, meaning better procurement practices substantially reduce schedule delays.

4.6. Discussion of Findings

The results confirm that strategic procurement management has a statistically significant and negative effect on both cost overruns and schedule delays in petroleum engineering projects in Ghana. The stronger effect on schedule delays ($\beta = -0.71$) compared to cost overruns ($\beta = -0.64$) suggests that procurement inefficiencies have a more immediate impact on project timelines than on cost escalation.

These findings are consistent with Dolo (2013), who emphasises that procurement planning and contract management are critical determinants of project schedule performance. They also align with Flyvbjerg (2014), who notes that delays in large-scale engineering projects are often structurally linked to upstream procurement inefficiencies.

The strong positive relationship between cost overruns and schedule delays indicates that these two outcomes are interdependent. Delays often trigger cost increases due to extended equipment rentals, labour costs, and contract variations, reinforcing the findings of Merrow (2011) in petroleum megaprojects.

4.7. Summary of Key Findings

Strategic procurement management is moderately practised in Ghana's petroleum projects. Cost overruns and schedule delays remain highly prevalent. Strong negative relationships exist between procurement effectiveness and both cost and schedule performance. Strategic procurement accounts for a significant portion of the variation in project outcomes (41%–50%). Procurement inefficiencies have a stronger impact on schedule delays than cost overruns.

The data analysis demonstrates that strategic procurement management is a critical determinant of project performance in Ghana's petroleum engineering projects. Improved procurement practices significantly reduce both cost overruns and schedule delays, confirming their strategic importance in enhancing efficiency, accountability, and value delivery in the petroleum sector.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This section presents a summary of the study, key findings from the data analysis, conclusions drawn from the results, and practical recommendations to improve strategic procurement management in petroleum engineering projects in Ghana. It also highlights the study's contribution to knowledge and suggests areas for further research.

5.1 Introduction

This study examined the effect of strategic procurement management on cost overruns and schedule delays in petroleum engineering projects in Ghana. The study was motivated by persistent challenges in project delivery performance within the oil and gas sector, where projects frequently exceed budgeted costs and planned timelines. The analysis focused on key procurement dimensions such as supplier relationship management, procurement planning, contract management, and procurement risk management, and how these influence project performance outcomes (Monczka et al., 2015; Flyvbjerg, 2014).

5.2 Summary of the Study

The study adopted a quantitative explanatory research design using a cross-sectional survey approach. Primary data were collected from 142 professionals involved in petroleum engineering projects in Ghana, including procurement managers, engineers, contract administrators, and supply chain specialists. Data were analysed using descriptive statistics, correlation analysis, and multiple regression analysis. The key objectives of the study were to:

- Assess the level of strategic procurement management in petroleum engineering projects in Ghana.
- Examine the extent of cost overruns in petroleum engineering projects.
- Examine the extent of schedule delays in petroleum engineering projects.
- Determine the effect of strategic procurement management on cost overruns.
- Determine the effect of strategic procurement management on schedule delays.

5.3 Summary of Key Findings

5.3.1 Level of Strategic Procurement Management

The study found that strategic procurement management practices in petroleum engineering projects in Ghana are moderately implemented (Mean = 3.74). While organisations demonstrate some level of procurement planning and supplier coordination, weaknesses exist in procurement risk management, digital procurement integration, and the development of long-term supplier relationships.

This aligns with Thai (2009), who argues that procurement systems in developing economies often remain operational rather than strategic, thereby limiting their ability to support project performance objectives fully.

5.3.2 Cost Overruns in Petroleum Engineering Projects

The study revealed a high prevalence of cost overruns (Mean = 3.92), indicating that petroleum engineering projects in Ghana frequently exceed their initial budgets. Key causes include inaccurate cost estimates, order variations, import price fluctuations, and procurement inefficiencies. These findings are consistent with Flyvbjerg (2014), who notes that megaprojects systematically underestimate costs due to optimism bias and inadequate risk assessment during procurement and planning phases.

5.3.3 Schedule Delays in Petroleum Engineering Projects

The study also found that schedule delays are highly prevalent (Mean = 4.01). Delays were mainly attributed to long procurement lead times, contract approval bottlenecks, logistical challenges, and supplier inefficiencies. This supports Merrow (2011), who highlights that oil and gas projects are particularly vulnerable to schedule slippage due to complex supply chains and long procurement cycles.

5.3.4 Relationship Between Strategic Procurement and Cost Overruns

The correlation analysis revealed a strong negative relationship between strategic procurement management and cost overruns ($r = -0.62$, $p < 0.01$). Regression analysis further showed that procurement management explains 41% of the variation in cost overruns ($R^2 = 0.41$). This implies that improvements in procurement practices significantly reduce cost escalation. This finding is consistent with Doloi (2013), who emphasises that procurement planning and contract management are critical to controlling project cost performance.

5.3.5 Relationship Between Strategic Procurement and Schedule Delays

The study found an even stronger negative relationship between strategic procurement management and schedule delays ($r = -0.68$, $p < 0.01$). Regression results showed that procurement management explains 50% of the variation in schedule delays ($R^2 = 0.50$). This indicates that procurement inefficiencies have a more pronounced effect on project timelines than on costs. This supports Flyvbjerg (2014), who argues that delays in megaprojects are often structurally driven by upstream procurement and planning failures.

5.3.6 Relationship Between Cost Overruns and Schedule Delays

A strong positive relationship was found between cost overruns and schedule delays ($r = 0.71$, $p < 0.01$), indicating that schedule delays often lead to cost overruns due to extended labour, equipment use, and contract variations. This finding aligns with Merrow (2011), who emphasises that time overruns in oil and gas projects are directly linked to escalating project costs.

5.4 Conclusions of the Study

Based on the findings, the following conclusions are drawn:

- Strategic procurement management in petroleum engineering projects in Ghana is not fully optimised and remains moderately effective.
- Cost overruns and schedule delays are persistent and significant challenges in the Ghanaian petroleum sector.
- Strategic procurement management has a statistically significant negative effect on both cost overruns and schedule delays.
- Procurement inefficiencies have a stronger influence on schedule delays than cost overruns.
- Cost overruns and schedule delays are interdependent, reinforcing each other in petroleum engineering projects.

Overall, the study concludes that strategic procurement management is a critical determinant of project performance in Ghana's petroleum engineering sector (Monczka et al., 2015).

5.5 Recommendations

Based on the findings, the following recommendations are made:

5.5.1 Strengthening Procurement Planning

Petroleum project organisations should enhance early procurement planning and integrate procurement schedules with overall project timelines. This will reduce delays caused by late procurement activities and improve coordination across project phases.

5.5.2 *Enhancing Supplier Relationship Management*

Organisations should adopt long-term supplier relationship strategies rather than transactional procurement approaches. Strong supplier collaboration improves reliability, reduces lead times, and enhances project delivery performance (Monczka et al., 2015).

5.5.3 *Improving Contract Management Systems*

There is a need for stronger contract administration frameworks that clearly define performance expectations, penalties for delays, and incentive structures. Effective contract management reduces opportunistic behaviour and improves accountability (Eisenhardt, 1989).

5.5.4 *Adoption of Digital Procurement Systems*

Petroleum organisations should adopt e-procurement systems and digital supply chain platforms to improve transparency, reduce procurement cycle time, and enhance decision-making efficiency.

5.5.5 *Strengthening Risk Management in Procurement*

Risk identification and mitigation strategies should be embedded in procurement processes, particularly for offshore and high-value petroleum engineering projects. This includes managing supplier, currency, and logistics risks.

5.6 *Contribution to Knowledge*

This study contributes to existing knowledge in three key ways:

- It provides empirical evidence on the relationship between strategic procurement management and project performance in Ghana's petroleum engineering sector.
- It demonstrates that procurement management has a stronger effect on schedule delays than cost overruns in petroleum projects.
- It integrates procurement dimensions into a unified framework explaining both cost and time performance outcomes in megaproject environments.

These contributions extend existing literature on megaproject performance (Flyvbjerg, 2014; Merrow, 2011) by providing context-specific insights from a developing oil-producing economy.

5.7 *Limitations of the Study*

The study is limited by its cross-sectional design, which captures data at a single point in time and may not fully reflect dynamic changes in procurement practices over project life cycles. Additionally, reliance on self-reported data may introduce response bias. Future studies could incorporate longitudinal data and objective project performance metrics.

5.8 *Suggestions for Further Research*

Future research should:

- Examine the role of digital procurement transformation in petroleum project performance.
- Investigate procurement performance differences between offshore and onshore petroleum projects.
- Explore the mediating role of project governance in the procurement-performance relationship.
- Conduct comparative studies between Ghana and other oil-producing countries in West Africa.

5.9 *Final Conclusion*

The study establishes that strategic procurement management significantly reduces cost overruns and schedule delays in petroleum engineering projects in Ghana. Strengthening procurement systems is therefore essential for improving project efficiency, ensuring value for money, and enhancing the sustainability of Ghana's petroleum sector.

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