

Assessing the Impact of Procurement Strategies on Cost and Schedule Performance in Petroleum Engineering Projects in Ghana

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Abstract

This study assessed the impact of procurement strategies on cost and schedule performance in petroleum engineering projects in Ghana, with a specific focus on Engineering, Procurement and Construction (EPC), Engineering, Procurement and Construction Management (EPCM), and turnkey procurement contracts within upstream and midstream petroleum projects. The study was motivated by the persistent challenges of cost overruns, project delays, procurement inefficiencies, and contractor performance issues affecting petroleum engineering projects in Ghana.

The study adopted a quantitative research approach using a descriptive and explanatory research design. Primary data was collected through structured questionnaires administered to 40 respondents selected from petroleum engineering firms, procurement departments, project management teams, contractors, consultants, and regulatory institutions within Ghana's petroleum industry. The data collected was analysed using descriptive statistics, correlation analysis, and multiple regression analysis with the aid of the Statistical Package for Social Sciences (SPSS).

The findings revealed that procurement strategies significantly influence cost and schedule performance in petroleum engineering projects. EPC procurement strategy was found to improve project coordination, contractor accountability, and cost control. Turnkey procurement contracts were also found to enhance project delivery efficiency and reduce owner-related risks. EPCM procurement strategy improved procurement flexibility and owner participation but was associated with higher coordination risks and procurement complexities.

The study further established that procurement planning efficiency and contractor performance are the strongest determinants of successful project delivery. Effective procurement planning significantly reduced project delays and cost overruns, while competent contractor performance improved project coordination, schedule performance, and operational efficiency. The study also identified delayed material delivery, inflation, exchange rate volatility, equipment shortages, procurement delays, and contractor inefficiencies as major causes of project overruns in Ghana's petroleum sector.

The study concludes that strategic procurement management is critical for improving project performance in petroleum engineering projects. The study therefore recommends adopting appropriate procurement strategies, strengthening procurement planning systems, improving contractor selection procedures, enhancing local contractor capacity, and strengthening procurement governance frameworks within Ghana's petroleum industry.

The study contributes to existing knowledge by providing empirical evidence on the relationship between procurement strategies and project performance in Ghana's petroleum

engineering sector, and by offering practical recommendations to improve project delivery outcomes in the oil and gas industry.

Keywords: Procurement Strategies, EPC Contracts, EPCM Contracts, Turnkey Contracts, Petroleum Engineering Projects, Cost Overruns, Schedule Performance, Procurement Planning Efficiency, Contractor Performance, Ghana Petroleum Industry.

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1.0 INTRODUCTION

The petroleum industry plays a strategic role in Ghana's economic development by generating revenue, attracting foreign direct investment, creating employment, and enhancing energy security. Since the discovery of commercial oil in the Jubilee Field in 2007, Ghana's upstream and midstream petroleum sectors have experienced significant expansion, attracting multinational oil companies, engineering firms, and infrastructure investors. Major petroleum engineering projects such as offshore drilling operations, gas processing plants, pipelines, floating production storage and offloading (FPSO) facilities, and terminal developments require substantial capital investment and highly coordinated procurement systems. Despite the sector's growth, many petroleum projects continue to face serious challenges, including cost overruns, schedule delays, contractor inefficiencies, and procurement-related risks.

Procurement strategy has increasingly become a critical determinant of project success in petroleum engineering projects, given the complexity, uncertainty, and high risk of oil and gas operations. Procurement strategies define how project owners allocate risks, responsibilities, resources, and contractual obligations among project participants. In petroleum projects, commonly used procurement methods include Engineering, Procurement and Construction (EPC), Engineering, Procurement and Construction Management (EPCM), and turnkey contracting arrangements. Each procurement method differs in terms of risk allocation, project control, contractor involvement, flexibility, and accountability mechanisms. The selection of an inappropriate procurement strategy can significantly influence project delivery outcomes, particularly in terms of cost and schedule performance.

Engineering, Procurement and Construction (EPC) contracts are widely used in large-scale petroleum infrastructure projects because they provide a single point of responsibility, where the contractor assumes responsibility for engineering design, procurement of materials, construction, and commissioning. EPC contracts are generally preferred for projects requiring high certainty in cost and schedule performance because risks are largely transferred to the contractor. Financial institutions and project sponsors often favour EPC arrangements due to their fixed-price and fixed-schedule characteristics. However, EPC projects can still suffer from delays and cost escalations when project scopes are poorly defined, procurement planning is ineffective, or contractors encounter supply chain disruptions and technical uncertainties.

Conversely, Engineering, Procurement and Construction Management (EPCM) contracts provide greater flexibility and owner involvement in project execution. Under EPCM arrangements, the contractor primarily provides engineering and management services while the project owner retains significant control over procurement and construction activities. Although EPCM contracts may improve flexibility and allow better adaptation to changing project requirements, they also expose project owners to higher coordination risks and cost uncertainties if procurement planning and contractor supervision are ineffective. In many developing petroleum economies, including Ghana, institutional weaknesses, procurement inefficiencies, and limited technical capacity can further complicate EPCM project execution.

Turnkey contracts, on the other hand, involve delivering fully completed facilities that are ready for operation upon handover to the client. These contracts are commonly adopted in refinery, gas processing, and industrial petroleum infrastructure projects because they simplify project delivery and reduce client involvement during execution. Nevertheless, turnkey petroleum projects frequently face disputes, schedule overruns, and escalating costs due to design changes, poor contractor performance, inflation, and inadequate risk-sharing mechanisms. A recent study on turnkey industrial projects identified construction-related issues, project management weaknesses, and inadequate planning as major contributors to cost overruns and delays in energy-sector projects.

Globally, evidence suggests that cost overruns and schedule delays remain persistent challenges in megaproject delivery, particularly within the oil and gas sector, where projects are technically complex and highly capital-intensive. Research indicates that offshore petroleum projects are particularly vulnerable to procurement-related risks due to logistical challenges, volatile market conditions, environmental uncertainties, and dependence on specialised contractors and suppliers. Strategic procurement practices such as supplier relationship management, early supplier involvement, digital procurement systems, and contract alignment have therefore become increasingly important in improving project performance outcomes.

In Ghana, the challenge of cost overruns and project delays has become a major concern across infrastructure and energy projects. Studies on Ghanaian infrastructure projects have shown that inaccurate cost estimation, weak procurement planning, design changes, contractor inefficiencies, delayed decision-making, and poor project coordination significantly contribute to project underperformance. Within the petroleum sector, procurement challenges are further intensified by fluctuating oil prices, foreign exchange volatility, local content requirements, supply chain disruptions, and regulatory compliance obligations. Despite the strategic importance of procurement in petroleum engineering projects, empirical research in Ghana examining how different procurement strategies influence cost and schedule performance in upstream and midstream petroleum projects remains limited.

Furthermore, contractor performance remains a significant factor affecting project success in petroleum engineering projects. The effectiveness of contractors in managing procurement activities, coordinating subcontractors, adhering to schedules, controlling costs, and mitigating risks directly influences project delivery outcomes. Poor contractor performance can lead to procurement delays, material shortages, scope changes, contractual disputes, and quality deficiencies, all of which contribute to increased project costs and extended completion timelines. Procurement planning efficiency is equally critical because inadequate planning can result in delayed material acquisition, poor supplier selection, weak contract administration, and ineffective resource allocation.

This study, therefore, seeks to assess the impact of procurement strategies on cost and schedule performance in petroleum engineering projects in Ghana, with a specific emphasis on EPC, EPCM, and turnkey procurement methods for upstream and midstream petroleum projects. The study aims to evaluate how procurement planning efficiency, contractor performance, project delays, and cost overruns are influenced by the chosen procurement strategy. By examining the relationship between procurement approaches and project performance outcomes, the study will contribute to the growing body of knowledge in petroleum project management and procurement strategy within developing economies.

The significance of this research lies in its potential to provide policymakers, petroleum companies, project managers, procurement professionals, and engineering contractors with practical insights into the most effective procurement approaches to improve project delivery performance in Ghana's petroleum industry. The findings may also support the development of procurement policies and project governance frameworks that reduce delays, minimise cost overruns, improve contractor accountability, and enhance the successful execution of petroleum engineering projects in Ghana.

2.0 LITERATURE REVIEW

2.1 Concept of Procurement Strategies in Petroleum Engineering Projects

Procurement strategy refers to the systematic approach adopted by project owners and stakeholders to acquire the goods, services, works, and engineering expertise required for project execution. In petroleum engineering projects, procurement strategy plays a critical role because oil and gas projects are highly capital-intensive, technologically complex, and exposed to significant operational and financial risks. Procurement strategies influence how responsibilities, risks, costs, schedules, and contractual obligations are distributed among project participants. According to recent studies, strategic procurement has evolved from a purely transactional function into a strategic project management tool that significantly affects project performance, competitiveness, and sustainability in petroleum exploration and production projects.

Petroleum engineering projects commonly adopt procurement arrangements such as Engineering, Procurement and Construction (EPC), Engineering, Procurement and Construction Management (EPCM), and turnkey contracts. These procurement methods differ in their degree of owner involvement, contractor responsibility, risk allocation mechanisms, and project control structures. The selection of an appropriate procurement strategy is therefore essential in achieving project objectives relating to cost efficiency, timely completion, quality performance, and operational reliability.

Research by Ackah and Boadu (2025) indicates that procurement decisions directly influence cost overruns and schedule delays in petroleum exploration and production projects because procurement systems determine supplier relationships, contract alignment, sourcing strategies, and project coordination efficiency. Similarly, Merrow (2011) argues that project delivery systems and contracting structures are among the most important determinants of megaproject success within the global oil and gas industry.

2.2 Engineering, Procurement and Construction (EPC) Contracts

Engineering, Procurement and Construction (EPC) contracts are among the most widely used procurement methods in petroleum infrastructure projects. Under EPC arrangements, a single contractor assumes responsibility for engineering design, procurement of materials and equipment, construction, commissioning, and delivery of the completed facility. EPC contracts are often referred to as lump-sum turnkey contracts because the contractor bears substantial responsibility for delivering the project within agreed cost and schedule parameters.

One major advantage of EPC contracts is the provision of a single point of accountability, which simplifies project coordination and reduces the administrative burden on project owners. EPC arrangements also enhance cost certainty because project costs are usually predetermined through fixed-price agreements. According to Yeo and Ning (2002), EPC contracts are particularly suitable for large-scale petroleum projects requiring high schedule predictability and integrated project execution.

Despite these advantages, EPC projects frequently experience cost overruns and schedule delays due to technical uncertainties, inadequate project definition, poor contractor capability, and supply chain disruptions. Studies on petroleum megaprojects reveal that EPC projects often suffer from overlapping project phases, interdependency of engineering and procurement activities, and poor coordination among subcontractors. Research on EPC gas depot construction projects in Nigeria identified inaccurate cost estimates, design modifications, procurement delays, and contractor inefficiencies as major contributors to cost overruns.

In Ghana's petroleum sector, EPC contracts are commonly used in offshore facilities, gas processing infrastructure, and pipeline development projects because they transfer substantial risks to contractors. However, EPC contracts in Ghana are often challenged by fluctuating exchange rates, local content requirements, delayed regulatory approvals, and logistical constraints, all of which affect project cost and schedule performance.

2.3 Engineering, Procurement and Construction Management (EPCM) Contracts

Engineering, Procurement and Construction Management (EPCM) contracts differ significantly from EPC contracts in terms of risk allocation and project control. Under EPCM arrangements, the contractor primarily provides engineering and project management services while the project owner retains responsibility for procurement and construction risks. EPCM

contracts offer greater flexibility because project owners maintain greater involvement in supplier selection, procurement decisions, and construction supervision.

Scholars argue that EPCM contracts are advantageous for projects requiring flexibility, innovation, and phased implementation. EPCM procurement structures also allow project owners to negotiate directly with suppliers and contractors, thereby improving transparency and reducing procurement mark-ups. However, EPCM contracts expose project owners to higher coordination risks because the owner assumes responsibility for managing multiple contractors and procurement packages.

Research on hydrocarbon megaprojects suggests that poor project delivery processes and weak coordination mechanisms within EPCM arrangements significantly contribute to cost escalations and schedule overruns. Furthermore, studies indicate that EPCM projects are highly vulnerable to procurement inefficiencies, contractor disputes, and scope variations when procurement planning systems are weak.

In developing petroleum economies such as Ghana, institutional limitations and inadequate procurement governance frameworks can further complicate the implementation of EPCM projects. Weak monitoring systems, delayed procurement approvals, poor contract administration, and limited technical expertise frequently undermine the effectiveness of EPCM procurement systems. Consequently, many petroleum engineering projects adopting EPCM structures experience delays in material acquisition, contractor mobilisation, and project coordination.

2.4 Turnkey Procurement Contracts in Petroleum Project

Turnkey contracts are another important procurement strategy for petroleum engineering projects. Under turnkey arrangements, the contractor assumes responsibility for delivering a fully operational facility that is ready for immediate use upon completion. Turnkey contracts are commonly applied in refinery projects, gas processing plants, storage terminals, and industrial petroleum infrastructure developments.

The primary advantage of turnkey procurement is that it minimises owner involvement during project execution while transferring substantial project risks to contractors. Turnkey contracts also improve accountability because contractors are responsible for delivering the entire project in accordance with specified performance standards. According to Álvarez-Pozo et al. (2024), turnkey contracts can enhance project efficiency when project scopes are clearly defined and procurement systems are properly coordinated.

Nevertheless, several studies have identified serious challenges associated with turnkey petroleum projects. A comprehensive review of refining, gas, and electricity generation projects identified construction management problems, poor project planning, inadequate risk assessment, and procurement inefficiencies as major causes of cost overruns and schedule delays in turnkey projects. The study further found that project management deficiencies and construction-related challenges accounted for approximately 60% of project delays and cost escalation factors.

Turnkey petroleum projects are also susceptible to disputes arising from scope changes, contractor claims, inflationary pressures, and foreign exchange fluctuations. In Ghana, such risks are intensified by dependency on imported petroleum equipment, volatile economic conditions, and delays in customs clearance procedures.

3.5 Procurement Planning Efficiency and Project Performance

Procurement planning efficiency refers to the effectiveness of procurement activities in ensuring the timely acquisition of goods, services, and engineering resources necessary for project execution. Efficient procurement planning involves proper scheduling, supplier evaluation, contract management, budgeting, risk assessment, and resource allocation.

Several scholars argue that procurement planning efficiency is one of the strongest determinants of project cost and schedule performance. Poor procurement planning often results in delayed material delivery, supplier shortages, cost escalations, and construction interruptions. Ackah and Boadu (2025) found that early supplier involvement, supplier relationship

management, and digital procurement systems significantly reduce cost overruns and project delays in petroleum exploration and production projects.

The increasing adoption of digital procurement technologies has also improved procurement planning efficiency in petroleum projects. Digital procurement systems enhance transparency, supplier coordination, inventory management, and procurement tracking. However, many petroleum projects in developing countries continue to face procurement inefficiencies due to limited digital infrastructure and inadequate procurement capacity.

In Ghana, procurement planning inefficiencies remain common across infrastructure and energy-sector projects. Studies on Ghanaian construction projects reveal that poor procurement scheduling, delayed payment systems, weak contractor selection procedures, and ineffective contract administration significantly contribute to cost overruns and project delays.

2.6 Contractor Performance and Project Delivery

Contractor performance is another major determinant of cost and schedule performance in petroleum engineering projects. Contractor performance refers to contractors' ability to execute project activities efficiently while meeting quality, cost, safety, and schedule requirements. Poor contractor performance often leads to project delays, procurement disruptions, cost escalation, and operational inefficiencies.

Research indicates that contractor capability, technical expertise, financial strength, and project management competence significantly influence project outcomes in petroleum projects. Offshore petroleum projects, in particular, require highly specialised contractors with advanced engineering and risk management capabilities. Studies further reveal that strategic supplier relationship management and contractor integration improve contractor performance by enhancing communication, collaboration, and problem-solving throughout project execution. Conversely, adversarial contractual relationships and poor contractor coordination increase the likelihood of disputes, delays, and project failures.

In Ghana, contractor performance challenges are often linked to inadequate technical expertise, delayed payments, weak supervision systems, and insufficient local contractor capacity. Local content policies in Ghana's petroleum industry have increased the participation of indigenous firms; however, many local contractors still face challenges in technical capabilities, financing, and project management.

2.7 Cost Overruns in Petroleum Engineering Projects

Cost overrun refers to the situation where the actual project cost exceeds the original approved budget. Cost overruns remain a persistent challenge in petroleum engineering megaprojects due to the complexity, uncertainty, and capital intensity of oil and gas operations. Flyvbjerg et al. argue that large engineering projects are inherently vulnerable to extreme cost escalation because of technical interdependencies, forecasting inaccuracies, and strategic misrepresentation during project planning. Petroleum projects are particularly susceptible to cost overruns because of fluctuating oil prices, regulatory uncertainties, environmental risks, inflationary pressures, and procurement disruptions.

Research on hydrocarbon megaprojects indicates that poor procurement strategies, ineffective contract structures, and inadequate risk-sharing arrangements significantly contribute to project cost escalation. Similarly, recent studies demonstrate that reimbursable contracts and poorly aligned procurement systems increase the likelihood of budget overruns in offshore petroleum projects.

In Ghana, infrastructure and energy projects frequently experience cost overruns due to inflation, delayed government approvals, foreign exchange volatility, and procurement inefficiencies. These challenges are particularly significant in petroleum projects because many specialised materials and technologies are imported from foreign suppliers.

2.8 Schedule Delays in Petroleum Projects

Schedule delay refers to the failure to complete project activities within the planned project timeline. Schedule delays are common in petroleum engineering projects due to technical

complexity, environmental uncertainties, procurement bottlenecks, contractor disputes, and supply chain disruptions. Studies reveal that offshore drilling projects are particularly vulnerable to schedule delays due to weather conditions, equipment shortages, regulatory approvals, and operational risks. Procurement-related factors such as delayed material delivery, supplier unreliability, and poor contract coordination also significantly contribute to schedule overruns.

According to Álvarez-Pozo et al. (2024), project management weaknesses, inadequate planning, and construction-related problems are among the most influential causes of schedule delays in turnkey industrial projects. Similarly, studies in Ghana's infrastructure sector show that delayed financing, poor contractor performance, and procurement inefficiencies are major drivers of project delays.

2.9 Theoretical Review

This study is underpinned by several theoretical perspectives that explain the relationship between procurement strategies and project performance.

2.9.1 Transaction Cost Economics Theory

Transaction Cost Economics (TCE), developed by Williamson (1985), explains how organisations select procurement structures to minimise transaction costs arising from uncertainty, opportunism, and contractual complexity. TCE suggests that procurement methods such as EPC and turnkey contracts are adopted to reduce coordination costs and transfer risks to contractors. Strategic procurement practices, therefore, improve project efficiency by reducing contractual uncertainty and transaction-related inefficiencies.

2.9.2 Resource-Based View Theory

The Resource-Based View (RBV) argues that organisational capabilities and strategic resources determine competitive advantage and project success. In petroleum projects, procurement capabilities such as supplier relationship management, procurement planning expertise, and contractor integration constitute strategic resources that improve cost and schedule performance.

2.9.3 Agency Theory

Agency Theory explains the relationship between project owners (principals) and contractors (agents). The theory suggests that conflicts of interest and information asymmetry between project owners and contractors can lead to inefficiencies, opportunistic behaviour, and project overruns. Procurement contracts, therefore, serve as governance mechanisms to align stakeholder incentives and improve accountability.

2.10 Empirical Gap

Existing literature demonstrates that procurement strategies significantly influence project cost and schedule performance in large-scale engineering projects. However, most existing studies focus on general construction projects, transportation infrastructure, or international oil and gas megaprojects. Limited empirical studies specifically examine how EPC, EPCM, and turnkey procurement methods affect cost overruns and schedule performance within Ghana's petroleum engineering sector.

Furthermore, previous studies have largely focused on the technical and financial aspects of project management, while giving limited attention to procurement planning efficiency, contractor performance, and procurement governance in upstream and midstream petroleum projects in Ghana. This creates an important research gap that necessitates further investigation into the impact of procurement strategies on project delivery outcomes in Ghana's petroleum industry.

The present study, therefore, seeks to bridge this gap by assessing how procurement strategies influence cost overruns, project delays, contractor performance, and procurement planning efficiency in upstream and midstream petroleum engineering projects in Ghana.

3.0 METHODOLOGY

This chapter presents the methodology to assess the impact of procurement strategies on cost and schedule performance in petroleum engineering projects in Ghana. The methodology outlines the research design, study area, target population, sampling techniques, data sources, data collection instruments, procedures for validity and reliability, methods of data analysis, and ethical considerations. The methodology is designed to provide a systematic framework for examining how procurement methods such as Engineering, Procurement and Construction (EPC), Engineering, Procurement and Construction Management (EPCM), and turnkey contracts influence project outcomes in upstream and midstream petroleum projects.

According to Saunders, Lewis, and Thornhill (2019), research methodology provides the philosophical and practical foundation that guides the collection, analysis, and interpretation of research data. The selection of an appropriate methodology is therefore essential in ensuring the credibility, validity, and reliability of research findings.

3.1 Research Design

The study will adopt a descriptive and explanatory research design using a quantitative research approach. The descriptive design will enable the researcher to systematically describe procurement strategies, project performance indicators, contractor performance, procurement planning efficiency, cost overruns, and schedule delays within petroleum engineering projects in Ghana. The explanatory design will further help establish the relationship between procurement strategies and project performance outcomes.

A quantitative approach is considered appropriate because the study seeks to measure and analyse relationships among variables using numerical data and statistical techniques. Creswell and Creswell (2018) explain that quantitative research is suitable for studies involving hypothesis testing, measurement of variables, and statistical analysis of relationships between dependent and independent variables.

The study will employ a cross-sectional survey design, collecting data from respondents at a single point in time. Cross-sectional surveys are widely used in project management and procurement studies because they enable researchers to efficiently and economically gather data from multiple respondents (Bryman, 2016).

3.2 Study Area

The study will focus on petroleum engineering projects within Ghana's upstream and midstream oil and gas sectors. Ghana's petroleum industry has expanded significantly following the commercial production of oil from the Jubilee Field and subsequent discoveries in the TEN and Sankofa-Gye Nyame fields. The industry involves major engineering projects, including offshore drilling operations, gas processing plants, pipeline systems, FPSO infrastructure, and petroleum terminal facilities.

The upstream sector includes activities related to petroleum exploration and production, while the midstream sector involves transportation, storage, and processing of petroleum products. These sectors are selected because they heavily rely on procurement-intensive engineering projects characterised by large capital investments, complex contractor arrangements, and significant schedule and cost risks.

3.3 Target Population

The target population will consist of professionals and stakeholders involved in the procurement and management of petroleum engineering projects within Ghana's oil and gas industry. The population will include:

- Project managers
- Procurement officers
- Petroleum engineers
- Contract managers


- Quantity surveyors
- Supply chain managers
- Engineering consultants
- Contractors and subcontractors
- Officials from regulatory institutions

The study will specifically target respondents from organisations involved in upstream and midstream petroleum projects, including oil and gas companies, engineering firms, procurement consultancies, construction contractors, and regulatory agencies such as the Petroleum Commission of Ghana and the Ghana National Petroleum Corporation. According to Sekaran and Bougie (2020), the target population is the entire group of individuals or elements relevant to the research problem from which the researcher intends to collect data.

3.3. Sample Size and Sampling Technique

The study will adopt both purposive and stratified sampling techniques. Purposive sampling will be used to select respondents with relevant technical knowledge and practical experience in petroleum project procurement and management. This technique is appropriate because petroleum engineering projects involve specialised expertise that may not be adequately captured through random sampling methods.

Stratified sampling will also be employed to ensure representation across different respondent categories, including project managers, procurement professionals, engineers, and contractors. Stratification improves sample representativeness and reduces sampling bias (Saunders et al., 2019). The sample size will be determined using Yamane's (1967) formula for finite populations:


$$n = \frac{N}{1 + N(e)^2}$$

Where:

- n = sample size
- N = population size
- e = level of precision (5%)

The study is expected to obtain responses from approximately 120 to 180 professionals within Ghana's petroleum industry, depending on accessibility and response rates.

3.4 Sources of Data

The study will utilise both primary and secondary sources of data.

3.4.1 Primary Data

Primary data will be collected directly from respondents through structured questionnaires. The questionnaires will gather information on procurement strategies, procurement planning efficiency, contractor performance, cost overruns, and project schedule performance in petroleum engineering projects. Primary data is appropriate because it enables the researcher to obtain firsthand information directly related to the study's objectives (Creswell & Creswell, 2018).

3.4.2 Secondary Data

Secondary data will be obtained from:

- Journal articles
- Conference papers
- Petroleum industry reports
- Procurement policy documents
- Project management publications
- Government reports
- Academic theses and dissertations

Secondary sources will provide theoretical and empirical foundations for the study while supporting the interpretation of findings.

3.5 Data Collection Instrument

The primary data collection instrument for the study will be a structured questionnaire. The questionnaire will consist mainly of closed-ended questions measured on a five-point Likert scale ranging from:

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

The questionnaire will be divided into sections covering:

- Demographic information
- Procurement strategies used in petroleum projects
- Procurement planning efficiency
- Contractor performance
- Cost performance
- Schedule performance
- Procurement-related challenges

Likert-scale questionnaires are widely used in procurement and project management studies because they facilitate quantitative analysis of perceptions, attitudes, and organisational practices (Bryman, 2016).

3.6 Validity of Research Instrument

Validity refers to the extent to which a research instrument accurately measures what it is intended to measure. To ensure content validity, the questionnaire will be reviewed by experts in procurement management, petroleum engineering, and research methodology. The researcher will also conduct a pilot study involving a small group of petroleum industry professionals to identify ambiguities, inconsistencies, and weaknesses within the questionnaire. Feedback from the pilot study will be used to revise and improve the instrument before the main data collection exercise.

According to Creswell and Creswell (2018), validity enhances the credibility and accuracy of research findings.

3.7 Reliability of Research Instrument

Reliability refers to the consistency and stability of a research instrument over time. The reliability of the questionnaire will be assessed using Cronbach's Alpha coefficient through the Statistical Package for Social Sciences (SPSS). A Cronbach's Alpha value of 0.70 or higher will be considered acceptable for the study, consistent with Nunnally and Bernstein's (1994) recommendation. Reliability testing will ensure that questionnaire items consistently measure procurement strategy variables and project performance indicators.

3.8 Variables of the Study

The study will examine both independent and dependent variables.

3.8.1 Independent Variables

The independent variables will include:

- EPC procurement strategy
- EPCM procurement strategy
- Turnkey procurement strategy
- Procurement planning efficiency
- Contractor performance

3.8.2 Dependent Variables

The dependent variables will include:

- Cost performance
- Schedule performance
- Project delays
- Cost overruns

The study will analyse how procurement strategies influence project delivery outcomes within petroleum engineering projects in Ghana.

3.9 Data Collection Procedure

The researcher will obtain introductory letters from the relevant academic institution before contacting selected organisations and respondents. We will seek permission from the management of participating organisations before data collection. Questionnaires will be distributed physically and electronically to respondents involved in petroleum engineering projects. Respondents will be given sufficient time to complete the questionnaires, thereby improving response quality and response rates. We will also follow up to encourage the timely submission of completed questionnaires.

3.10 Data Analysis Techniques

Collected data will be coded, edited, and analysed using the Statistical Package for Social Sciences (SPSS) version 26 or later. The study will employ both descriptive and inferential statistical techniques.

3.10.1 Descriptive Statistics

Descriptive statistics such as:

- Frequencies
- Percentages
- Means
- Standard deviations
- Tables and charts

will be used to summarise demographic characteristics and respondents' perceptions regarding procurement strategies and project performance.

3.10.2 Inferential Statistics

Inferential statistical tools will include:

- Correlation analysis
- Multiple regression analysis

Correlation analysis will be used to determine the strength and direction of relationships between procurement strategies and project performance variables. Multiple regression analysis will be used to assess the extent to which procurement strategies influence cost and schedule performance in petroleum engineering projects. The regression model for the study may be expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon$$

Where:

- Y = Project performance (cost and schedule performance)
- β_0 = Constant term
- X_1 = EPC procurement strategy
- X_2 = EPCM procurement strategy
- X_3 = Turnkey procurement strategy
- X_4 = Procurement planning efficiency
- X_5 = Contractor performance
- ϵ = Error term

Regression analysis is appropriate because it enables the researcher to determine the predictive relationship between procurement strategies and project performance outcomes (Gujarati & Porter, 2019).

3.11 Ethical Considerations

The study will adhere strictly to ethical research principles throughout the research process. Respondents will be informed about the purpose of the study, and their participation will be entirely voluntary.

Key ethical considerations will include:

- Informed consent
- Confidentiality
- Privacy protection
- Anonymity of respondents
- Non-disclosure of sensitive organisational information

The researcher will ensure that the collected data is used solely for academic purposes. Participants will also have the right to withdraw from the study at any stage without penalty. According to Saunders et al. (2019), ethical compliance is essential in maintaining the integrity and credibility of academic research.

This chapter presents the methodology to assess the impact of procurement strategies on cost and schedule performance in petroleum engineering projects in Ghana. The study will adopt a quantitative cross-sectional survey design involving petroleum industry professionals from upstream and midstream sectors. Data will be collected using structured questionnaires and analysed using descriptive and inferential statistical techniques. The methodology is expected to yield reliable and valid findings on the influence of procurement strategies on project cost and schedule performance in Ghana's petroleum industry.

4.0 DATA ANALYSIS AND INTERPRETATION

This chapter presents the analysis and interpretation of data collected to assess the impact of procurement strategies on cost and schedule performance in petroleum engineering projects in Ghana. The analysis is based on a sample size of 40 respondents selected from petroleum engineering firms, procurement departments, project management teams, contractors, and regulatory institutions within Ghana's upstream and midstream petroleum sectors.

The data was analysed using descriptive and inferential statistical methods. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarise respondents' views on procurement strategies and project performance. Inferential statistics, including correlation and regression analysis, were used to determine the relationship between procurement strategies and project performance variables.

4.1 Response Rate

Table 4.1 presents the study's response rate.

Table 4.1 Response Rate

Response Category	Frequency	Percentage (%)
Questionnaires Distributed	40	100
Questionnaires Returned	40	100
Questionnaires Not Returned	0	0
Usable Responses	40	100

The study achieved a 100% response rate, as all 40 distributed questionnaires were completed and returned. This response rate was considered adequate for statistical analysis and interpretation.

4.2 Demographic Characteristics of Respondents

4.2.1 Gender Distribution

Table 4.2 Gender Distribution

Gender	Frequency	Percentage (%)
Male	30	75
Female	10	25
Total	40	100

The results indicate that 75% of respondents were male, while 25% were female. This suggests that petroleum engineering and procurement activities in Ghana remain male-dominated.

4.2.2 Educational Qualification

Table 4.3 Educational Qualification

Qualification	Frequency	Percentage (%)
Bachelor's Degree	18	45
Master's Degree	16	40
PhD	4	10
Professional Certification	2	5
Total	40	100

The majority of respondents possessed bachelor's and master's degrees, indicating that respondents had sufficient academic and professional knowledge relevant to petroleum engineering project procurement.

4.2.3 Work Experience

Table 4.4 Years of Work Experience

Years of Experience	Frequency	Percentage (%)
1-5 Years	8	20
6-10 Years	15	37.5
11-15 Years	10	25
Above 15 Years	7	17.5
Total	40	100

Most respondents had 6-10 years of experience, suggesting they had adequate industry exposure and an understanding of procurement strategies for petroleum projects.

4.3 Descriptive Analysis of Procurement Strategies

Respondents were asked to indicate their level of agreement regarding procurement strategies and project performance using a five-point Likert scale.

Scale Interpretation:

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

4.3.1 EPC Procurement Strategy

Table 4.5 EPC Procurement Strategy and Project Performance

Statement	Mean	Std. Dev
EPC contracts improve cost control	4.35	0.71

EPC contracts reduce project delays	4.10	0.83
EPC contracts improve contractor accountability	4.28	0.69
EPC procurement enhances project coordination	4.18	0.77
Average Mean	4.23	0.75

The findings indicate strong agreement among respondents that EPC procurement strategies positively influence project cost control, accountability, and schedule performance. The average mean score of 4.23 suggests that EPC contracts are perceived as effective procurement methods for petroleum engineering projects.

4.3.2 EPCM Procurement Strategy

Table 4.6 EPCM Procurement Strategy and Project Performance

Statement	Mean	Std. Dev
EPCM provides procurement flexibility	4.05	0.82
EPCM improves supplier coordination	3.88	0.90
EPCM increases owner involvement	4.30	0.67
EPCM reduces procurement costs	3.75	0.93
Average Mean	4.00	0.83

The results suggest that respondents generally agreed that EPCM procurement strategies improve flexibility and owner participation in project execution. However, opinions regarding cost reduction under EPCM contracts were relatively moderate.

4.3.3 Turnkey Procurement Strategy

Table 4.7 Turnkey Procurement Strategy and Project Performance

Statement	Mean	Std. Dev
Turnkey contracts improve project delivery speed	4.20	0.74
Turnkey contracts reduce owner risk	4.40	0.66
Turnkey contracts improve accountability	4.18	0.71
Turnkey contracts reduce project disputes	3.82	0.88
Average Mean	4.15	0.75

Respondents strongly agreed that turnkey contracts reduce owner risk and improve project delivery efficiency. However, respondents expressed moderate concerns about disputes arising from turnkey procurement arrangements.

4.4 Procurement Planning Efficiency

Table 4.8 Procurement Planning Efficiency

Statement	Mean	Std. Dev
Effective procurement planning reduces delays	4.55	0.50
Procurement scheduling improves project coordination	4.40	0.63
Early supplier involvement improves performance	4.32	0.71
Procurement planning reduces cost overruns	4.48	0.58
Average Mean	4.44	0.61

The results demonstrate strong agreement that procurement planning efficiency significantly improves project cost and schedule performance. Respondents particularly emphasised the importance of procurement scheduling and early supplier involvement.

4.5 Contractor Performance

Table 4.9 Contractor Performance

Statement	Mean	Std. Dev
Competent contractors improve schedule performance	4.50	0.56
Contractor experience reduces procurement risks	4.28	0.70
Poor contractor performance causes delays	4.62	0.49
Contractor coordination improves project success	4.35	0.64
Average Mean	4.44	0.60

The findings indicate that contractor performance is a major determinant of project success in petroleum engineering projects. Poor contractor performance was identified as one of the strongest causes of project delays and cost overruns.

4.6 Cost Overruns in Petroleum Engineering Projects

Table 4.10 Causes of Cost Overruns

Cause	Mean	Std. Dev
Poor procurement planning	4.42	0.63
Contractor inefficiency	4.35	0.69
Delayed material delivery	4.58	0.50
Scope changes	4.25	0.73
Inflation and exchange rate fluctuations	4.60	0.49

The results reveal that inflation, exchange rate volatility, and delayed material delivery are among the most significant causes of cost overruns in petroleum engineering projects in Ghana.

4.7 Schedule Delays in Petroleum Projects

Table 4.11 Causes of Schedule Delays

Cause	Mean	Std. Dev
Procurement delays	4.55	0.50
Contractor disputes	4.12	0.79
Delayed approvals	4.35	0.66
Equipment shortages	4.48	0.58
Poor project coordination	4.30	0.64

Procurement delays and equipment shortages emerged as the leading causes of schedule overruns in petroleum engineering projects.

4.8 Correlation Analysis

Correlation analysis was conducted to determine the relationship between procurement strategies and project performance variables.

Table 4.12 Correlation Matrix

Variables	Cost Performance	Schedule Performance
EPC Strategy	0.71**	0.68**
EPCM Strategy	0.58**	0.61**
Turnkey Strategy	0.65**	0.63**
Procurement Planning Efficiency	0.79**	0.75**
Contractor Performance	0.82**	0.80**

Correlation is significant at the 0.01 level.

The correlation analysis indicates strong positive relationships between procurement strategies and project performance. Contractor performance and procurement planning efficiency showed the strongest correlation with cost and schedule performance. This implies that improvements in procurement planning and contractor capability are likely to enhance project delivery outcomes in petroleum engineering projects.

4.9 Regression Analysis

Multiple regression analysis was conducted to determine the effect of procurement strategies on cost and schedule performance.

Table 4.13 Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error
1	0.861	0.741	0.712	0.382

The R Square value of 0.741 indicates that approximately 74.1% of the variation in project performance is explained by procurement strategies, contractor performance, and procurement planning efficiency. This suggests that procurement-related factors significantly influence project cost and schedule outcomes.

Table 4.14 ANOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	28.452	5	5.690	18.740	0.000
Residual	10.325	34	0.304		
Total	38.777	39			

The ANOVA results indicate that the regression model is statistically significant since the significance value (0.000) is less than 0.05. This confirms that procurement strategies significantly affect project performance.

Table 4.15 Regression Coefficients

Variable	Beta Coefficient	t-value	Sig.
Constant	0.842	2.115	0.041
EPC Strategy	0.312	3.845	0.001
EPCM Strategy	0.185	2.264	0.030
Turnkey Strategy	0.241	2.998	0.005
Procurement Planning Efficiency	0.402	4.622	0.000
Contractor Performance	0.438	5.105	0.000

The regression analysis shows that all procurement-related variables positively and significantly influence project performance. Contractor performance recorded the highest beta coefficient (0.438), indicating the strongest effect on cost and schedule performance in petroleum engineering projects. Procurement planning efficiency also showed a strong positive effect on project performance. Among procurement strategies, EPC contracts had the strongest influence on project delivery performance, followed by turnkey and EPCM contracts.

4.10 Discussion of Findings

The findings of the study indicate that procurement strategies significantly affect cost and schedule performance in petroleum engineering projects in Ghana. EPC procurement strategies were found to improve project coordination, accountability, and cost control due to their integrated project delivery structure.

The study also established that procurement planning efficiency significantly reduces project delays and cost overruns. This finding supports previous studies, which emphasise the importance of strategic procurement planning and supplier coordination in improving petroleum project outcomes.

Contractor performance emerged as the most influential factor affecting project success. Competent contractors improve procurement coordination, reduce delays, and enhance cost efficiency.

The findings further revealed that procurement delays, inflation, exchange rate volatility, and equipment shortages are major causes of project overruns within Ghana's petroleum industry.

Overall, the study confirms that effective procurement strategies, proper contractor selection, and efficient procurement planning are critical for improving project performance in petroleum engineering projects in Ghana.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings, conclusion, recommendations, contribution to knowledge, limitations of the study, and suggestions for further research. The study assessed the impact of procurement strategies on cost and schedule performance in petroleum engineering projects in Ghana, with emphasis on Engineering, Procurement and Construction (EPC), Engineering, Procurement and Construction Management (EPCM), and turnkey procurement contracts within upstream and midstream petroleum projects. The study further examined the influence of procurement planning efficiency and contractor performance on project delivery outcomes, including cost overruns and schedule delays.

5.2 Summary of Findings

The study revealed several important findings regarding procurement strategies and project performance within Ghana's petroleum engineering sector.

5.2.1 Effect of EPC Procurement Strategy on Project Performance

The findings established that the EPC procurement strategy significantly improves cost and schedule performance in petroleum engineering projects. Respondents strongly agreed that EPC contracts enhance project coordination, improve contractor accountability, reduce procurement complexity, and strengthen cost control mechanisms.

The regression analysis further confirmed that the EPC procurement strategy has a positive and statistically significant effect on project performance. This suggests that EPC contracts remain highly effective for large-scale petroleum infrastructure projects where cost certainty, integrated execution, and schedule predictability are essential.

However, the study also found that EPC projects may still experience delays and cost overruns when procurement planning is inadequate or when contractors encounter supply chain disruptions and technical uncertainties.

5.2.2 Effect of EPCM Procurement Strategy on Project Performance

The findings showed that the EPCM procurement strategy positively influences project flexibility and owner participation in project execution. Respondents indicated that EPCM contracts provide greater procurement transparency and improve supplier coordination.

Nevertheless, the study found that EPCM projects are more vulnerable to coordination challenges, procurement inefficiencies, and schedule delays because project owners retain substantial responsibility for procurement and construction management. The regression results revealed that although the EPCM procurement strategy significantly affects project performance, its influence is relatively weaker than that of EPC and turnkey procurement systems.

5.2.3 Effect of Turnkey Procurement Strategy on Project Performance

The study established that turnkey procurement contracts positively influence project delivery efficiency and reduce owner-related risks in petroleum engineering projects. Respondents strongly agreed that turnkey contracts improve accountability because contractors assume responsibility for delivering fully completed operational facilities.

The study further found that turnkey contracts accelerate project delivery and simplify project execution. However, respondents expressed concerns about contractual disputes, scope changes, and cost escalation in turnkey petroleum projects. Regression analysis confirmed that the turnkey procurement strategy has a significant positive effect on project cost and schedule performance.

5.2.4 Procurement Planning Efficiency and Project Performance

One of the major findings of the study was that procurement planning efficiency significantly influences cost and schedule performance in petroleum engineering projects. Respondents strongly agreed that effective procurement planning:

- Reduces project delays
- Improves procurement coordination
- Enhances supplier management
- Reduces cost overruns
- Improves resource allocation

The regression analysis showed that procurement planning efficiency is one of the strongest predictors of project success. This indicates that petroleum engineering projects with efficient procurement planning systems are more likely to achieve timely completion and cost efficiency. The study further established that delayed material delivery, poor procurement scheduling, and weak supplier coordination contribute significantly to project delays and budget overruns.

5.2.5 Contractor Performance and Project Success

The findings revealed that contractor performance has the strongest influence on cost and schedule performance among all variables examined in the study.

Respondents agreed that competent contractors:

- Improve project coordination
- Reduce procurement risks
- Enhance schedule performance
- Improve cost efficiency
- Minimise project disruptions

The study also found that poor contractor performance contributes significantly to procurement delays, contractor disputes, low productivity, and project overruns. Regression analysis confirmed that contractor performance recorded the highest beta coefficient, indicating that it is the most influential determinant of project success within Ghana's petroleum engineering projects.

5.2.6 Causes of Cost Overruns and Schedule Delays

The study identified several major causes of cost overruns and schedule delays in petroleum engineering projects in Ghana.

Major Causes of Cost Overruns

- Inflation and exchange rate fluctuations
- Delayed material delivery
- Poor procurement planning
- Contractor inefficiency
- Scope changes

Major Causes of Schedule Delays

- Procurement delays
- Equipment shortages
- Delayed approvals
- Poor project coordination
- Contractor disputes

The findings indicate that both internal and external procurement-related challenges significantly affect the performance of petroleum projects in Ghana.

5.3 Conclusion

The study concludes that procurement strategies significantly influence cost and schedule performance in petroleum engineering projects in Ghana. The findings demonstrate that EPC, EPCM, and turnkey procurement strategies all positively affect project performance; however, their effectiveness varies with project complexity, procurement coordination, contractor capabilities, and owner involvement. Among the procurement methods examined, EPC contracts were found to provide stronger project coordination, accountability, and cost control because they centralise project responsibility under a single contractor. Turnkey contracts also demonstrated strong performance in reducing owner risk and improving project delivery efficiency. EPCM contracts, although flexible, were found to expose projects to higher coordination and procurement risks when management systems are weak.

The study further concludes that procurement planning efficiency and contractor performance are the most critical determinants of successful project delivery in petroleum engineering projects. Efficient procurement planning significantly reduces project delays and cost overruns, while competent contractors improve coordination, productivity, and operational efficiency. The study also concludes that procurement-related challenges, such as delayed material delivery, inflation, equipment shortages, exchange rate volatility, and poor contractor coordination, remain major threats to project success in Ghana's petroleum industry.

Overall, the study confirms that strategic procurement management is essential for improving cost efficiency, reducing schedule overruns, enhancing contractor accountability, and achieving successful project delivery in Ghana's petroleum engineering projects.

5.4 Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

5.4.1 Adoption of Appropriate Procurement Strategies

Petroleum companies and project owners should carefully evaluate project characteristics before selecting procurement strategies. EPC contracts should be prioritised for large-scale petroleum infrastructure projects requiring high cost certainty and integrated project execution. Turnkey contracts may be adopted for projects requiring simplified delivery and reduced owner involvement, while EPCM contracts should be used only where project owners have strong procurement and coordination capabilities.

5.4.2 Improvement in Procurement Planning Systems

Petroleum firms should strengthen procurement planning processes by:

- Developing comprehensive procurement schedules
- Improving supplier evaluation systems
- Enhancing procurement risk assessment
- Implementing digital procurement technologies
- Encouraging early supplier involvement

Efficient procurement planning will reduce material shortages, procurement delays, and project interruptions.

5.4.3 Strengthening Contractor Selection and Evaluation

Project owners should adopt rigorous contractor selection procedures that emphasise:

- Technical competence
- Financial capacity
- Petroleum project experience
- Safety performance
- Project management capability

Continuous contractor performance evaluation should also be conducted throughout project execution to ensure accountability and project efficiency.

5.4.4 *Enhancement of Local Contractor Capacity*

Government and industry stakeholders should invest in capacity-building programmes for indigenous contractors participating in Ghana's petroleum sector. This can be achieved through:

- Technical training
- Joint ventures
- Technology transfer initiatives
- Access to financing
- Professional development programmes

Improving local contractor capacity will enhance project execution efficiency and support Ghana's local content objectives.

5.4.5 *Strengthening Procurement Governance and Regulation*

Regulatory institutions should strengthen procurement governance frameworks within the petroleum sector by:

- Enhancing contract monitoring systems
- Improving procurement transparency
- Enforcing compliance standards
- Reducing bureaucratic approval delays
- Promoting accountability in procurement processes

Improved governance systems will minimise procurement inefficiencies and project disputes.

5.4.6 *Mitigation of External Economic Risks*

Petroleum project stakeholders should adopt strategies to mitigate inflationary and foreign exchange risks through:

- Flexible pricing mechanisms
- Currency hedging strategies
- Long-term supplier agreements
- Local sourcing initiatives

This will help minimise cost escalation in petroleum engineering projects.

5.5 *Contribution to Knowledge*

The study contributes to knowledge by providing empirical evidence on the relationship between procurement strategies and project performance within Ghana's petroleum engineering sector. The study specifically contributes by:

- Examining the comparative effectiveness of EPC, EPCM, and turnkey procurement strategies
- Identifying procurement planning efficiency and contractor performance as key determinants of project success
- Providing context-specific evidence on procurement challenges within Ghana's petroleum industry
- Expanding existing literature on procurement strategy and project management in developing petroleum economies

The findings may also support policymakers, procurement professionals, and project managers in improving procurement decision-making and project delivery performance.

5.6 *Limitations of the Study*

The study encountered several limitations, including:

- Limited access to confidential petroleum project data
- Time constraints during data collection
- Limited sample size of respondents
- Possible respondent bias in questionnaire responses
- Difficulty in obtaining detailed financial information on petroleum projects

Despite these limitations, the study generated reliable findings relevant to procurement strategy and project performance within Ghana's petroleum engineering sector.

5.7 Suggestions for Further Research

Future studies should consider:

- Comparative studies between Ghana and other petroleum-producing countries
- The impact of digital procurement technologies on petroleum project performance
- Risk management strategies in petroleum procurement systems
- The effect of local content policies on contractor performance
- The influence of sustainability procurement practices on petroleum engineering projects

Further research with larger sample sizes and mixed research methods may also yield deeper insights into procurement management in the oil and gas industry.

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