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Review Article

A Literature Review from Project Management Point of View on Construction Phase Delays: Study on Oil and Gas EPC Projects in Indonesia

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Abstract: Indonesia's Oil and gas project construction continue face challenges notably delays that lead to underperformance. This study tries to describe the factors that causing delays in EPC oil and gas project in Indonesia from project management view. Started by overall study on cause of delays in construction worldwide, thus phenomenon on neighboring country (Malaysia) where Indonesian workers involved, then study continues with factors in Indonesia as overall, and include specific project which are South Sumatera and Sumbawa. Three main factors are always present in the cause of delays in EPC Project in Indonesia namely; contractor's financial problem in funding the project, poor project planning and estimation leads to unrealistic determination of the duration, and ineffective change management by owner in project showed in resolving contract dispute, requirement changes, and dispute in understanding in contract articles. These factors are clearly present in EPC projects in Indonesia as main contributor in project delays together with two additional factors namely legal awareness and social community problems.

Keywords: Delay Factors; EPC; Indonesia; Project; Project Management.

1. Introduction

Oil and gas projects are categorized as part of the construction industry in Indonesia and represent one of the largest and most complex segments within the sector. These projects are characterized by high capital investment, advanced engineering requirements, long execution periods, and strict safety and environmental standards.

Oil and gas construction projects face a wide range of technical, financial, managerial, and external risks that can affect project performance. Technical risks spans from design errors, equipment failures, and integration issues between different systems. Financial risks arise from cost escalation, exchange rate fluctuations, and funding constraints. Managerial risks are related to planning, coordination, and decision-making, while external risks include regulatory changes, permitting delays, and social or environmental issues.

EPC projects are commonly adopted in the oil and gas sector due to their integrated nature, which places responsibility for engineering, procurement, and construction under a single contractual entity. This arrangement is intended to transfer significant risks to the contractor, improve coordination, accelerate project delivery, and improving schedule certainty and cost control.

According to the SKK Migas Annual Reports between 2018 and 2023, there has been a significant increase in investment trends in Indonesia's upstream oil and gas sector (Sonny et al-2025). This increase reflects renewed confidence among investors following regulatory reforms, improved fiscal incentives, and government efforts to accelerate project execution through streamlined licensing processes and contract improvements.

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Figure 1. Indonesia's Upstream Oil and Gas Investment Trends 2018-2023 Source. SKK Migas Annual Report (2023)

The growth in upstream investment has also resulted in a growing number of complex EPC projects being executed simultaneously across different regions of Indonesia. These projects are often located in geographically challenging environments, including offshore areas, remote onshore fields, and regions with limited infrastructure access. As a result, EPC projects involve multiple stakeholders, including government institutions, state-owned enterprises, private contractors, subcontractors, consultants, suppliers, and local communities. The involvement of diverse stakeholders increases the complexity of coordination and communication, which can have significant implications for project scheduling and execution (Gunawan et al-2025).

While the investment trend has been positive, the performance of these projects in terms of schedule adherence has raised serious concerns. A considerable number of oil and gas EPC projects in Indonesia have experienced delays during the construction phase, leading to extended completion times and increased project costs. These delays reduce the economic benefits of the projects by postponing production start-up and revenue generation (Prapti, 2007). In some cases, delays also undermine the financial viability of projects, particularly when cost overruns exceed initial budget allocations.

In EPC projects, construction delays frequently trigger disputes related to claims, penalties, and contract variations, which further complicate project execution (Iskandar, et al-2021). Contractors may submit extension of time claims or cost compensation requests, while project owners may impose liquidated damages for late completion. The presence of such disputes can strain relationships between stakeholders and divert management attention away from productive project activities.

In the field of project management, project success is traditionally measured using three key parameters: time, cost, and quality (Prapti et al-2007). These parameters, often referred to as the "iron triangle," are closely interrelated, and failure in managing one aspect frequently leads to problems in the others. Poor time management and schedule delays can significantly increase project costs due to extended overheads, escalation of material prices, currency fluctuations, and additional labor expenses.

This study aims to identify the causes of construction phase delays in Indonesian oil and gas EPC projects by an explanatory literature analysis from project management point of view. An explanatory approach is employed to provide a thorough understanding of the factors that contribute to project delays. This study tries to determine the primary causes of project delays in the Indonesian context by merging the results of past research.

In addition, this study investigates whether experiences from other EPC projects in worldwide context and neighboring countries, particularly Malaysia, as well as EPC projects in the LNG and petrochemical sector associated with state-owned enterprises, provide insights that help explain the causes of delays in Indonesia. It is anticipated that future research will help build more efficient project management techniques by highlighting how these factors impact project delays in the Indonesian context.

2. Literature Review

Time delay occurs when a project's actual duration exceeds the planned or estimated duration agreed upon by the contractor and the project owner, or when the contractual completion date specified in the project agreement is surpassed (Umeesh Kumar et al). Delays may occur at any stage of the project life cycle, but delays during the construction phase are often the most visible and costly. This is because unlike conventional building projects, oil and gas facilities must comply with stringent technical specifications and international standards, which increases the level of complexity and coordination required during

construction. In oil and gas sector construction activities typically consume the largest share of project resources, including labor, equipment, and materials. Any disruption during this phase can directly affect manpower deployment, equipment utilization, cash flow, and overall project momentum.

Conceptual design, preliminary design, detailed design, construction and testing, commissioning, and handover are the five primary phases of the construction project life cycle. Every stage has different goals and risk profiles, and issues from earlier stages frequently carry over into later stages. Inadequate definition during the design phases of oil and gas projects can lead to numerous modifications during construction, which is a typical cause of delays.

From the point of view of an EPC (engineering, procurement and construction) contracting model, the front-end engineering design, detailed design and development constitute what are called 'Engineering' (E) & 'Procurement' (P), with construction, testing/commissioning and handover all being a part of the ensuing construction phase – in this case, referred to as 'Construction' (C). The integrated concept is aimed at simplifying project performance by one contractor taking care of all duties. However, by integrating them it may create the problems from engineering or procurement planning directly during the construction (Umeesh Kumar et al-2018).

Despite the advantages of the EPC model, delays and cost overruns remain persistent problems in construction projects, including oil and gas projects. These issues have been shown to negatively affect national economic growth and development, as delays prevent the timely realization of project benefits and increase financial burdens on both project owners and contractors. Shah (2016) emphasized that delays and cost overruns are among the most critical challenges facing the construction industry, particularly in developing countries where institutional capacity and project governance frameworks may be less mature.

In Indonesia, studies have shown that EPC contracts often do not function as intended. Iskandar et al. found that many infrastructure projects executed under EPC contracts still experience frequent claims and disputes between project owners and service providers. Resolving these disputes often requires substantial time, money, and managerial effort, which in turn contributes to project delays. Disputes are commonly related to contract interpretation, scope changes, payment issues, and risk allocation, all of which can disrupt construction progress.

In the construction sector, delays are a common occurrence, and oil and gas projects are no exception. Long construction cycles, substantial financial commitments, and susceptibility to a variety of risks are common characteristics of oil and gas projects, all of which raise the possibility of delays. An article by Offshore Magazine showed that almost USD 230 billion worth of oil and gas projects worldwide have been deferred. Subsurface difficulties, government red tape, contractual delays, and financial limitations brought on by fluctuating oil prices are the primary causes of these postponements.

The report further noted that countries most affected by oil and gas project delays include Nigeria, Kazakhstan, and Indonesia, followed by Norway, Canada, Malaysia, Australia, Thailand, Ivory Coast, and South Africa. This finding suggests that delays in oil and gas projects are not limited to a specific geographic region but are instead a global issue affecting both developed and developing countries. However, the underlying causes and their relative importance may vary depending on institutional, economic, and regulatory contexts (Umeesh Kumar et al-2018).

According to a study by Viles et al. (2020), labor disputes, administrative issues, and execution-related issues are the three main causes of construction project delays; taken together, they account for more than 80% of the causes reported in the literature. Furthermore, it was concluded that although administrative issues stem from inadequate cash flow management, executional issues are caused by unforeseen circumstances. Additionally, based on the quantity of mentions found, seven subgroups of delay causes were found to be significant. These were; changes during construction, poor construction management, construction errors, economic/financial problem, conflict/relationship problem, and lack of experience.

According to a study by Zagia et al., the main factors contributing to building project delays are as follows. With a focus on four core project types—residential structures, public projects, transportation infrastructure, and other infrastructure projects (such mining and oil and gas)—this report offers a thorough examination of the main reasons behind delays in construction projects across 35 nations.

This study identifies and ranks the most important delay reasons in construction projects by integrating information from 92 chosen articles using the PRISMA approach. Stakeholders, Contractor, Owner/Client, Sub-contractor, Equipment, Labor, Material & Utility, Engineering, Design, Tender and Contract, Communication, Safety & Quality, Managerial, and External Parties were the four main categories into which the primary causes of delays were divided.

While the causes of delays vary across different project types and countries, some factors are common across multiple regions, with certain delay causes recurring in several countries. Based on the studies, the top five delay causes in various projects across these countries are as follows:

Regarding the residential construction projects: 1. Changes in the owner's requirements; 2. Owner payment delays; 3. Inadequate equipment procurement by the contractor; 4. Lack of coordination; and 5. Errors made during task execution.

For public building projects: 1. Owner financial issues; 2. Owner payment delays; 3. Inaccurate project time estimates; 4. Design modifications; and 5. Contractor financial issues.

Regarding the infrastructure of transportation: 1. Owner payment delays to the contractor, 2. The owner's money issues, 3: Poor site conditions and changes in topography, 4: Inadequate project oversight and administration, and 5: The owner's tardy judgments.

For other infrastructure (including mining, oil and gas): 1: Owner requirement changes, 2: Delays in contractor's payment by the owner, 3: Contractor's financial problems, 4: Poor project time estimation, and 5: Shortage of Labor.

Shah (2016) employed the Relative priority Index (RII) in an early study to rank the reasons of project delays and cost overruns in Malaysia according to their RII priority levels. Out of the 150 respondents that took part in the survey, ten were identified as the most significant factors causing delays and cost overruns. The top ten most important criteria, according to a poll done in Malaysia's construction sector, are as follows: 1. Contractor's improper planning 2. Contractor's poor site management 3. Inadequate contractor experience 4. Inadequate client's finance and payments for completed work 5. Problems with subcontractors 6. Shortage in material 7. Labour supply 8. Equipment availability and failure 9. Lack of communication between parties 10. Mistakes during the construction stage.

It is clear from survey results that the primary reason for the delay is the lack of appropriate planning in the construction project followed by poor site management.

According to one study conducted in Malaysia, the contractor group accounted for the bulk of the causes of delay, while the resources, project, and engineering categories accounted for the remaining factors (Umeesh Kumar, et al). The contractor group had issues with subcontractors, inadequate project planning and scheduling, poor schedule management, and poor site management and supervision. Material supply delays were categorized under resources, poor vendor interactions during the engineering and procurement phases were categorized under engineering, and ineffective communication among project stakeholders was categorized under project.

Using a five-point Likert scale and the Relative Importance Index (RII), another study by Sarwani et al. (2024) on EPC projects in Indonesia illustrates the relative significance of the different delay factors in EPC projects. Project-related, Owner-relative, Contractor-relative, Design-related, Material/Equipment-Related, Labor-Related, and External Related were the seven primary categories into which the 21 delay factors were separated.

Based on the ratings assigned to each source of delay, the most important factors or reasons for delays in EPC projects in Indonesia were to be identified. According to the findings, the top ten reasons for delays are:1. Inadequate project planning and scheduling by contractors; 2. Contractors' inability to finance the project; 3. Delays in acquiring the equipment and materials required for the project; 4. Despite being significantly less than the OE, the lowest bidder wins the tender; 5. rework resulting from construction errors; 6. inadequate coordination and communication between project participants; 7. delays in design subcontractors' work; 8. disagreements over the EPC contract articles and project specifications; 9. the owner's inaccurate project duration estimate; and 10. the owner's delay in approving a contractor change proposal or resolving contract issues.

Comparison of delay factors with other developing countries in Asia and Africa shows similarities. Notably, among these categories, contractor-related factors demonstrated the highest RII values.

An earlier study by Kaming et al. (2019) identifies the main causes of Indonesian LNG project delays. The LNG project implementer who worked directly on the project from 2010 to 2014 is the study's sample. The SEM model was used to demonstrate how the factors were

related to one another. These are overwhelming and have a big impact on how LNG projects are implemented, especially in the EPC oil and gas sector, which eventually causes delays. These can be summed up as follows:1. Material-related issue: a) Market scarcity of materials. b) Modifications to the types and specifications of materials used during construction. C). When sorted goods are urgently needed, they are damaged.2. Lack of trained labor and inexperienced technical personnel. This results in a team of unqualified workers. 3. Inadequate site supervision and management combined with low worker productivity. Assignment of work. 5. Rework. 6. Defective appliances.

Simanjuntak and Mahendrawan's (2015) research on Indonesian delay factors, however, was divided into four categories: client, contractor, external, and resources. Inadequate funding and a sluggish decision-making process under the client; insufficient experience of the contractor; poor subcontractor coordination and inept site management under the contractor; permit approval by the local and state governments; external support from other sectors; and, lastly, an impractical distribution of resources under the resource group.

According to a more recent study by Sonny et al. (2025) on an EPC project in south Sumatera, the greatest immediate cause of project delays is a lack of materials, which is followed by problems with planning and design. The effects of labor, financial and economic, and external variables are mediated by the contractor factor. Material shortages, insufficient site studies, mismatched designs, erroneous price negotiations, and lack safety awareness are important delay factors. The findings of investigation showed that planning and design were the most significant factors determining the delay of upstream oil and gas development projects.

This logical conclusion is supported by strong indicators such as engineering design inconsistencies, immature planning, and changes in scope of work that reflect weak cross-team coordination and poor initial project documentation. These results are consistent with a number of earlier studies that highlighted the primary reason for time and cost variances in oil and gas projects—failures in planning and completing designs.

Particularly in the context of upstream oil and gas operations in South Sumatra, factors like local community conflicts, license uncertainties, and security disruptions have been shown to hinder contractors' performance. These conclusions are reinforced by the findings of the Focus Group Discussion (FGD), which showed that all three external factors—delayed environmental permits, lack of coordination with local governments, and lack of community involvement from the start—often cause major delays.

Factors such as community conflicts, security disturbances, regulation uncertainty, and other factor relates to complex and dynamic project climate had been studied by A. Kassem et al (2021) on oil and gas projects in Yemen. The study's findings showed that higher risk factors impacting the project timeline and causing it to go beyond that were the unpredictability of the global political situation, the delays in the delivery of materials to the project site, the ongoing fluctuations in the prices of goods, the rise in inflation, and the subcontractor's delayed completion of work. According to the study's findings, almost 40% of all projects in Yemen experienced cost overruns, while about 47% of all projects experienced timetable delays.

In addition to above study, one more recent study on EPC power plant project in Sumbawa by Gunawan et,al (2025) showed that the external factor has a positive and significant influence on project delays. Changes in regulations, severe weather, permission delays, and sociocultural (socio-community) effects are examples of these external causes. While design, financial, and resource factors have no apparent impact, the owner factor exhibits a nearly significant effect. Questionnaires were used as a tool for data collection in this study, and PLS-SEM was utilized to look at the correlations between a variety of complicated factors and indicators. Respondents were chosen for this study based on how well they understood and participated in the Sumbawa EPC project. Project managers, engineering divisions, procurement, construction, QA/QC, project management, and field supervisors were among the divisions from which respondents were drawn.

3. Discussion

The findings from the reviewed studies clearly indicate that delays in oil and gas EPC projects are influenced by multiple interrelated factors. Rather than being caused by a single issue, delays typically emerge from a combination of financial, managerial, technical, and external challenges that interact throughout the project life cycle. However, three main factors consistently emerge as dominant contributors to project delays across the literature.

These factors are contractor financial problems, poor project planning and estimation, and ineffective change management by project owners. Contractor financial problems often arise from limited access to capital, underestimation of project costs, or delayed payments from project owners. In EPC projects, contractors are required to finance a significant portion of engineering and procurement activities upfront, making financial resilience a critical success factor.

Financial constraints can directly lead to delays in procuring materials and equipment, paying subcontractors, and maintaining adequate manpower levels (Singgih et al-2018). When cash flow becomes constrained, contractors may prioritize certain activities while delaying others, leading to inefficient work sequencing and productivity losses. In extreme cases, financial distress may result in work stoppages or contract termination, significantly delaying project completion.

Poor project planning and estimation are also major contributors to delays. Inaccurate scheduling, unrealistic duration estimates, and inadequate planning during the early stages of a project often lead to execution problems during construction. These issues may result from insufficient data, limited experience or skill, or pressure to submit competitive bids in very short time (Khalid -2017). When project durations are underestimated, construction teams are forced to operate under constant time pressure, increasing the likelihood of errors and rework.

Ineffective change management by project owners further exacerbates delays. Delays in approving change proposals, resolving contract disputes, and clarifying project requirements can disrupt construction progress and create uncertainty for contractors (Iskandar et al-2021). Frequent scope changes without proper evaluation and coordination increase workload and complicate resource planning. In EPC projects, where responsibilities are tightly integrated, poor change management can quickly translate into schedule slippage.

In many cases, other delay factors such as material shortages, execution errors, and coordination problems can be traced back to these three main factors. Financial difficulties can cause procurement delays, while poor planning can lead to material mismatches or design errors. Ineffective change management can exacerbate coordination issues among contractors, subcontractors, and suppliers.

In the South Sumatra projects (Sonny et al -2025) discussed earlier, contractor financial problems, poor planning, and ineffective change management were all present simultaneously, along with additional challenges related to social and legal factors. This combination of factors demonstrates how delays often result from systemic weaknesses rather than isolated incidents.

Legal awareness and social-community complexity are additional factors that are particularly relevant in the Indonesian context (Gunawan et al-2025). Issues related to permitting, land acquisition, community engagement, and coordination with local authorities can significantly affect project timelines. These factors often interact with the main delay causes, creating compounded delays that are difficult to resolve without strong institutional support and proactive stakeholder engagement.

4. Conclusion

Based on the literature reviewed, it is evident that delays in oil and gas EPC projects are a persistent issue in Indonesia, as well as in other countries. Despite differences in project scope, location, and contractual arrangements, several key delay factors consistently appear across studies. In the Indonesian context, three main factors contribute most significantly to project delays: contractor financial problems, poor project planning and unrealistic scheduling, and ineffective change management by project owners.

In addition to these factors, legal awareness and social-community issues also play an important role in delaying EPC projects in Indonesia. These factors highlight the need for improved planning practices, stronger financial management, clearer contractual arrangements, and more effective stakeholder coordination. Addressing these issues is essential for improving the performance of future oil and gas EPC projects and ensuring timely project delivery, thereby supporting national energy security and economic development.

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