

Risk Identification And Analysis In Engineering, Procurement, And Construction (EPC) Projects At Mining Facilities By PT. XYZ

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Abstract.

Risk management in Engineering, Procurement, and Construction (EPC) projects within the mining sector is critical to ensure project success and avoid potential disruptions. PT. XYZ, a company engaged in mining infrastructure development, faces a variety of risks ranging from technical and logistical challenges to external and environmental uncertainties. This study aims to identify and analyze the risks present in EPC projects carried out by PT. XYZ. The research begins with risk identification through expert interviews and document analysis, followed by a qualitative risk analysis based on the Project Management Body of Knowledge (PMBOK) framework to assess the probability and impact of each risk. The findings reveal several high-priority risk factors that require focused attention in future project planning. This study is expected to provide valuable insights into risk conditions in EPC projects and contribute to better risk-informed decision-making processes for PT. XYZ.

Keywords: Risk Analysis; Risk Identification; EPC; Mining and PMBOK.

I. INTRODUCTION

The construction sector plays a vital role in Indonesia's economic growth, contributing 9.14% to the national GDP in 2022 (BPS, 2022). With over 197,000 construction companies and a completed project value exceeding IDR 1,400 trillion, the industry faces fierce competition while offering broad employment opportunities. However, complex project scopes and challenging execution environments often lead to delays and inefficiencies. This is particularly true for Engineering, Procurement, and Construction (EPC) projects in the mining sector, which integrate multiple disciplines under a single contract. As the Indonesian construction industry is projected to grow by 11.9% annually until 2030 (Next Move Strategy Consulting, 2023), there is an urgent need for structured risk management practices to mitigate potential setbacks. This study focuses on PT. XYZ, a contractor that has operated in the mining EPC sector since 2013. Between 2020 and 2022, PT. XYZ completed 28 mining infrastructure projects but experienced significant delays due to factors such as scope changes, procurement bottlenecks, and adverse weather conditions.

These disruptions not only affect project timelines but also inflate costs and strain stakeholder relationships. The company's recurring delay issues underscore the necessity for an actionable, structured risk management approach tailored to the unique challenges of mining EPC projects. To address these issues, this study aims to (1) identify risk factors within EPC mining projects handled by PT. XYZ, and (2) analyze the risk management process currently applied in these projects. A qualitative research approach was employed through document analysis and in-depth interviews with project managers and key stakeholders. These methods enabled a comprehensive mapping of potential risks and an evaluation of how PT. XYZ currently assesses and responds to those risks, based on the Project Management Body of Knowledge (PMBOK) framework (PMI, 2017). Preliminary findings reveal that delays in PT. XYZ's EPC projects are largely attributable to unanticipated changes in scope, logistical inefficiencies, inadequate coordination among project teams, and external factors such as extreme weather and difficult terrain.

These issues are exacerbated by the absence of a standardized risk management system. Moreover, internal teams often rely on informal communication and reactive measures, resulting in limited foresight and preparedness. As such, a proactive risk planning approach becomes critical to anticipate, evaluate, and address project risks effectively (Turner, 2009; Kerzner, 2017). This study contributes by providing an in-

depth understanding of risk conditions in EPC mining projects and evaluating the strengths and gaps in PT. XYZ's existing risk management practices. Unlike previous research that often focuses on risk in general construction projects, this study specifically highlights the risk dynamics unique to mining EPC environments. The findings are expected to assist PT. XYZ—and other contractors operating in similar settings—in improving early risk detection, prioritizing high-impact risks, and formulating more structured risk response strategies in future projects (PMI, 2017; Hillson, 2009).

II. METHODS

This study employed a qualitative-descriptive approach to explore risk identification and analysis in EPC projects within the mining sector, using PT. XYZ as a case study. A qualitative method was selected to investigate risk events and current risk handling practices in-depth, aligning with the exploratory nature of risk research in complex project environments (PMI, 2017; Kerzner, 2017). This approach aimed to examine how PT. XYZ identifies and analyzes risks in its projects, using established frameworks such as the PMBOK® Guide Sixth Edition as a reference. The primary unit of analysis was the project team of PT. XYZ, consisting of 24 personnel directly involved in the execution of mining EPC projects. Out of this group, 18 respondents were selected using purposive sampling based on their direct engagement in project planning and risk handling. All selected individuals had at least two years of experience managing or supporting EPC project activities, ensuring the reliability and depth of the qualitative data collected. To guide the risk analysis process, this study referred to the first three steps of the PMBOK® Guide risk management framework: plan risk management, identify risks, and perform qualitative risk analysis (PMI, 2017).

Interview questions were developed to explore these three domains, with a particular focus on risk categories frequently encountered in mining EPC projects, such as procurement delays, environmental uncertainties, and changes in project scope (Kerzner, 2017). In addition to interviews, data collection was conducted through a structured questionnaire distributed via digital platforms, enabling participation from the 18 selected respondents. The questionnaire explored various aspects of risk identification and analysis based on the PMBOK® framework. Informal interviews were also conducted with select team members to gather additional insights and clarify key trends. Although not recorded, essential points were noted manually and used to support the analysis. The study also examined internal project documents such as risk registers, progress reports, procurement logs, and stakeholder communication records. These secondary sources were used to validate and triangulate the data from interviews and questionnaires, ensuring consistency between reported practices and documented procedures. Special attention was given to recurring risks and historical patterns of unresolved issues to enrich the understanding of risk conditions in EPC mining projects.

III. RESULT AND DISCUSSION

This section presents and interprets the results of the risk analysis conducted on the EPC mining project at PT. XYZ. The discussion highlights key risk categories, dominant risk events, and proposed response strategies by integrating both structured documentation and qualitative feedback from selected respondents. Rather than listing each risk individually, the focus is placed on broader themes and their implications for risk governance in EPC project environments. Risk identification was conducted through internal document analysis and a structured digital questionnaire distributed to 18 personnel directly involved in the project. A total of 84 risks were identified and classified into nine major categories: Project Management, Logistics and Material, Human Resources, Health and Safety, Communication and Coordination, Environmental, Technical, External, and Financial.

Each risk was assessed using a dual-rating scale system: one for impact and one for frequency, in accordance with PMBOK® guidelines (PMI, 2017). The scoring results were then used to prioritize risks into levels of concern, with medium-level risks becoming the primary focus for further qualitative analysis. The six primary risks identified in this EPC mining facility project were selected based on their moderate risk scores following qualitative assessment. These risks represent the most significant potential

disruptions to project performance, particularly concerning schedule, cost, and quality targets. The details of these prioritized risks are presented in Table 4.1.

Table 4.1. Key Risks with Moderate Level Based on Qualitative Assessment.

No.	Risk Event	Risk Score	Rank	Risk Level
1	Repeated design changes requested by the project owner.	0.590	1	Moderate Risk
2	Design phase delays due to unmet client expectations.	0.590	2	Moderate Risk
3	Cost discrepancies between budget and estimates (related to material quality and process standards).	0.518	3	Moderate Risk
4	Misalignment between schedule and available resources.	0.445	4	Moderate Risk
5	Errors in ordering construction materials.	0.441	5	Moderate Risk
6	Material delivery delays due to remote project location.	0.431	6	Moderate Risk

These six risks were selected not only due to their relatively high risk scores within the moderate category but also based on their potential to create cascading effects across multiple project dimensions. For instance, repeated design changes and delays in the design phase can cause ripple effects that disrupt procurement timelines and construction sequences. Similarly, cost discrepancies and logistical issues such as material ordering errors or delivery delays are especially critical in remote mining operations where access and re-supply opportunities are limited. Further analysis of the six primary risks revealed interdependencies and recurring patterns that suggest structural vulnerabilities within PT. XYZ's project execution framework. For example, design-related issues consistently appear at the early stages and are often tied to misalignment with client expectations. Similarly, logistical problems tend to escalate due to the geographical remoteness of mining sites, limited supplier options, and inefficient internal coordination. Understanding these patterns can assist project teams in recognizing early warning signs and prioritizing improvement efforts in future projects.

IV. CONCLUSION

This study examined the identification and analysis of risks in Engineering, Procurement, and Construction (EPC) projects within the mining sector, using PT. XYZ as a case study. By applying a qualitative approach grounded in the PMBOK® Guide framework, the research explored how risks emerge, how they are perceived by project personnel, and how they impact project objectives such as time, cost, and quality. A total of 84 risk events were identified and classified into nine major categories: Project Management, Logistics and Material, Human Resources, Health and Safety, Communication and Coordination, Environmental, Technical, External, and Financial. Through qualitative risk analysis using a dual-rating scale for probability and impact, six risks were prioritized as having a moderate level of concern.

These included issues such as repeated design changes, delays in the design phase, and logistical disruptions due to remote site locations. The findings highlight that the most significant project risks often stem not only from technical complexity but also from managerial, logistical, and stakeholder-related factors. Misalignments between stakeholders, inadequate coordination, and resource limitations emerged as recurring themes. These risks have the potential to create cascading effects across multiple project phases, reinforcing the need for early identification and structured assessment. This research contributes to a deeper understanding of risk profiles in EPC mining projects by providing practical insight into how qualitative risk analysis can inform project planning and oversight. It underscores the value of integrating structured risk assessment processes into early project stages to improve foresight and preparedness. For practitioners, the study suggests the importance of:

1. Conducting comprehensive risk identification involving multiple stakeholder perspectives;
2. Utilizing qualitative assessment tools to prioritize risks and allocate resources efficiently;
3. Enhancing interdepartmental coordination to mitigate managerial and logistical risks early on.

Future research may expand on these findings by exploring the implementation phase of risk responses or by developing a full Risk Management Plan tailored to specific project environments. However, this study lays the groundwork by mapping the dominant risks and analyzing their impact—critical steps toward more effective risk governance in EPC mining projects.

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