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Evaluation of the Planning and Control Process of Offshore Oil and Gas Platform Projects at the Engineering Stage with the Project Management Body of Knowledge (PMBOK) Approach, 6th and 7th Editions to Improve Time Performance

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Abstract

The oil and gas exploration process continues to be carried out in order to achieve the oil and gas production target. However, offshore oil and gas platform projects are often found to experience delays in completion. Therefore, a comprehensive evaluation of the project planning and control process is needed to improve project time performance, so that it can be completed according to target effectively and efficiently. This study focuses on the evaluation of offshore oil and gas platform project planning and control at the engineering stage using the approach in PMBOK Editions 6 and 7. This approach aims to identify the main activities in planning and control and evaluate the suitability of the process with the PMBOK guidelines. In addition, it is also to identify the dominant risk factors that affect project time performance. This study was conducted using a case study approach and qualitative analysis using secondary data from various literature and documents related to the project. This evaluation is expected to provide insight into the gap between theory and practice in the field and produce strategic recommendations to improve the effectiveness of offshore oil and gas platform project management.

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1 Introduction

The economies of the Middle East show significant variation. Economic conditions are greatly influenced by the country's role in the petroleum trade industry. The member states of the Arab Gulf Cooperation Council have experienced stable economic growth, especially in the financial sector. This is because the countries in the Persian Gulf region are major exporters of petroleum (Rystad Energy, 2023). In Qatar, major projects such as the expansion of LNG production capacity at Ras Laffan Industrial City demonstrate the country's commitment to maintaining its position as one of the world's largest LNG producers and exporters. Qatar plans to increase its LNG production capacity from 77 million tons per year to 126 million tons per year by 2027 (Oxford Business Group, 2022). An offshore platform (offshore rig) is a building structure equipped with drilling equipment, built at sea to support exploration and exploitation of natural resources such as oil and natural gas and functions for the exploration and production of oil and natural gas (Faizal, 2017).

Delays in offshore oil and gas projects in Arab countries often occur due to various complex reasons. When several contractors cannot coordinate their design and construction work well, it will result in significant design changes and delays (Ruqaishi & Bashir, 2015). The construction of offshore platforms is generally different from the construction of land-based structures. In land-based structures, the entire construction process starting from the foundation stage to the construction of the building is carried out at the same location. Meanwhile, offshore platforms are built or fabricated as a whole at a separate location (on land, then mobilized and installed by sea to the intended location. Offshore platform construction techniques are generally carried out using modules that are divided into two main parts, namely the lower structure (jacket) and the upper structure (topside) (Simanjuntak & Mahfud, 2020).

In PMBOK there is a main foundation for working on a project. In working on a project, good planning and mapping are needed to achieve project success and be able to manage various risks that may occur. If the project fails to implement the main foundation in managing the project, then the risk of project failure is very large because the three main factors in the project cannot be managed properly and have an impact on project losses. Project delays are triggered by a lack of project supervision and control, including shortages of construction materials, material changes, design errors and changes, shortages of labor, and rework on certain activities. Site management & supervision factors, unrealistic planning and scheduling, and material delays, are some of the causes of delays (Ruqaishi & Bashir, 2015).

Time delays in projects are a common risk factor in every project. The impact of this delay is a schedule delay, which can reduce the profits that have been targeted by the contractor managing the project. In addition, delays can also be caused by poor project management and errors made by the human resources involved. Therefore, as a project progresses, it is necessary to evaluate the planning and control process to improve the project's time performance. The objectives of this research are as follows: Identifying activity gaps in the planning and control process on Project X against PMBOK Editions 6 and 7, identifying dominant risk factors in the planning and control process of Project X that affect time performance, and developing a strategy for developing the management of dominant risk factors in the planning and control process of Project X using the PMBOK Edition 6 and 7 approach to improve time performance.

Literature Review

Offshore oil and gas platform project

Offshore platform is a building structure that contains drilling equipment built offshore to support the exploration or exploitation of mining materials or natural minerals. This study focuses on one type of offshore platform, namely the offshore fixed platform. There are two main components in the fixed platform type, namely topside and jacket. Topside is the upper structure that functions for well control, work equipment area, oil, gas, and raw product separation process, pump and compressor location, power plant, and accommodation for staff (manned platform). The jacket is the lower structure that functions to withstand the load of the facility (topside) and maintain stability against environmental factors such as sea waves (Firdaus et al., 2022).

The structure of an offshore oil and gas platform is a complex building designed to support the exploration and exploitation of oil and gas at sea. The main components of this structure generally consist of several parts, namely; the foundation, deck, production and drilling modules, transportation systems, and accommodation and support facilities (Angus, 1995; Tawekal, 2012). The substructure consists of 2 parts, namely piles and jackets. Next, the deck consists of 2 parts, namely; the main deck (the main area for operational activities) and the heli deck (for helicopter landing and takeoff). The production module section (production facilities) is part of the platform used to process oil and gas produced from wells. The transportation system consists of 2 parts, namely; pipelines (main channels for transporting oil and gas) and risers (vertical pipes to connect facilities on the surface with pipelines on the seabed). The accommodation and support facilities section consists of utilities that include all supporting facilities needed for daily operations on the offshore platform (Guide Jr, 2000; Fragapane et al., 2021).

The project planning and control process on Project X consists of several things, including; schedule management planning (setting criteria, procedures, and documentation), project activity determination (identifying specific activities that need to be carried out throughout the project to implement and complete the project according to the scope of work), project activity sequencing (identifying and documenting the relationship between all activities in the project), activity resource estimation (estimating the type and amount of materials, human resources, equipment and supplies needed, estimating the duration of project activities, preparing the project schedule, and controlling the project schedule (Morris et al., 2006; Cleland, 1995).

Time performance

Project time includes the duration required to complete the work in a project, calculated from the beginning of the process to the end of the project completion process. The theory of project time performance is an important concept in project management that focuses on the evaluation and management of the time required to complete a project. One of the main approaches in this theory is the use of the Earned Value Management (EVM) method which allows project performance to be measured based on a predetermined schedule. EVM itself uses three main indicators, namely; Planned Value (PV), Earned Value (EV), and Actual Cost (AC) (Sediyanto & Hidayat, 2017; Wahyuni & Hendrawan, 2018; Logique, 2021).

In practice, to improve project time performance, project managers need to implement strategies that include careful planning, continuous monitoring, and timely corrective actions. With a comprehensive and integrative approach, the theory of time performance on projects helps project managers achieve desired time goals while maintaining quality and budget (Barrie & Paulson Jr, 1976; Soeharto, 1995).

From the implementation in the field, the time performance assessment can be done. Project time performance can be measured by determining the Schedule Performance Index (SPI). SPI is determined by comparing EV (Earned Value) and PV (Planned Value). Where EV is the value of the work that has been completed and PV is the value of the budget cost in each project activity contained in the WBS. The calculation of time performance is by comparing the difference between the planned time and the actual time to the planned time. The equation for calculating time performance is as follows:

$$SV = BCWP - BCWS$$

From the calculation above, the magnitude of the SV value can be known. The following are indications shown from the SV value:

- If the SV has a positive value, then the actual progress is greater than the planned progress, it can be said that there is project acceleration against the plan (schedule underrun).
- If the SV has a negative value, then the actual progress is smaller than the planned progress, it can be said that there is a project delay compared to the plan (schedule overrun).

Project time performance can be calculated in another way, namely by comparing the BCWP value to the BCWS. This calculation is known as the SPI (Schedule Performance Index). Here is the equation for calculating SPI:

$$SPI = BCWP/BCWS$$

From the calculation above, the value of SPI can be known. The following are indications shown from the SPI value:

- If the SV has a positive value, then the actual progress is greater than the planned progress, it can be said that there is project acceleration against the plan (schedule underrun).
- If the SV has a negative value, then the actual progress is smaller than the planned progress, it can be said that there is a project delay compared to the plan (schedule overrun).

Project Planning Based on PMBOK 6th and 7th Edition

PMBOK (Project Management Body of Knowledge) is a guide published by the Project Management Institute (PMI) that provides a framework, principles, and best practices in project management. PMBOK is designed to help professionals and organizations manage projects effectively and efficiently by considering the principles and best practices in project management (Tan et al., 2021).

A'zizah (2022), explains that the planning process based on the sixth edition of PMBOK consists of 10 knowledge areas, namely; integration management, scope management, schedule management, cost management, quality management, resource management, communication management, risk management, procurement management, stakeholder management.

PMBOK 7th edition introduces a new approach that is more flexible and principles-based compared to the 6th edition. This approach focuses more on outcomes and value generated rather than rigid processes. The core principles in PMBOK 7th edition are; effective leadership, the importance of stakeholders, focus on value, adaptability and flexibility, and strong team building. The practical elements in planning consist of; strategic alignment, business case development, stakeholder analysis and engagement, scope and requirement definition, schedule and budget planning, risk management planning, quality management planning, resource management planning, communication planning, and procurement planning (Nguyen et al., 2016; Leporini et al., 2019).

Project Control Based on PMBOK 6th and 7th Edition

Project control based on PBMOK's sixth edition involves a series of processes aimed at monitoring and controlling project performance. Details of the project control process in PMBOK's sixth edition are integration management, scope management, schedule management, cost management, quality management, resource management, communication management, risk management, procurement management, and stakeholder management. The focus of PMBOK's sixth edition is to ensure that the project stays on track by managing change, monitoring performance, and controlling variations from the established plan (Liu et al., 2007; Verhagen et al., 2012).

The seventh edition of PMBOK introduces a significant change by introducing the concept of project performance domains that focus more on principles and outcomes rather than rigid processes. The following are eight project performance domains outlined in the seventh edition of PMBOK; project stakeholder performance domain, team performance domain, life cycle development approach performance domain, planning performance domain, project work performance domain, delivery performance domain, measurement performance domain, and uncertainty performance domain. There are several differences between the sixth and seventh editions of PMBOK, which can be seen in the following table.

Table 1
Differences between PMBOK 6th Edition and PMBOK 7th Edition

Aspect	PMBOK 6th Edition	PMBOK 7th Edition
Approach	Process-based (49 processes, 5 process groups, 10 knowledge areas).	Principle-based (12 principles of project management).
Focus	Focus on project deliverables and outputs.	Focus on outcomes and achieving expected results.
Framework	Using processes and ITTO as the core of the framework.	Using a more flexible and holistic value delivery system.
Performance Domain	Lack of clear concept of performance domain.	Introducing 8 performance domains.
Project Management Principles	Lack of explicit project management principles.	Introducing the 12 principles of project management.
Characteristics of the Approach	A more linear and process-oriented approach.	A more flexible and adaptive approach.
Presentation and Structure	Detailed structure with many tables and process diagrams.	Principle-based narrative presentation, fewer process diagrams.

Flexibility	More rigid and difficult to apply in dynamic project environments.	Emphasize flexibility and adaptation (tailoring) according to project needs.

Risk management

Risk can be said as an event or incident that may occur and can have good or bad impacts. According to PMI (2017) there are several stages of risk management, including; risk identification (to produce clear documentation regarding individual project risks and overall risk sources), perform quality risk analysis (to determine the priority of each individual risk in the project), perform quantitative risk analysis (the process of numerically analyzing the combined effects of identified individual project risks and sources of project uncertainty), plan risk response (the process of determining options, choosing strategies), implement risk response (the process of implementing the agreed risk response plan).

Risk Factors of Offshore Oil and Gas Platform Project Planning and Control Process on Time Performance

Project management plays an important role in achieving the success of every project activity. Project schedule review is needed to determine what steps need to be taken in dealing with changes in project activities. This is done to improve the accuracy of the project completion period (Scars, 1991). The following are the variables and sub-variables used in this study:

Table 2
Research Variables in Project Planning

X.1 Project Planning Process		
Sub variables	*Knowledge Area*	PMBOK Edition
X.1.1	Scope Management	PMBOK 6 and 7
X.1.2	Schedule Management	PMBOK 6 and 7
X.1.3	Resource Management	PMBOK 6 and 7
X.1.4	Communication Management	PMBOK 6 and 7
X.1.5	Procurement Management	PMBOK 6 and 7
X.1.6	Integration Management	PMBOK 6
X.1.7	Cost Management	PMBOK 6
X.1.8	Quality Management	PMBOK 6
X.1.9	Risk Management	PMBOK 6
X.1.10	Stakeholder Management	PMBOK 6
X.1.11	Project Team Conditions	PMBOK 7
X.1.12	Changes in the project	PMBOK 7
X.1.13	Metrics	PMBOK 7
X.1.14	Harmony	PMBOK 7
X.1.15	Interaction with Other Domains	PMBOK 7

(source: author's processing)

Table 3
Research Variables in Project Control

X.2 Project Control Process		
Sub variables	*Knowledge Area*	PMBOK Edition
X.2.1	Scope Management	PMBOK 6 and 7
X.2.2	Schedule Management	PMBOK 6 and 7
X.2.3	Resource Management	PMBOK 6 and 7
X.2.4	Communication Management	PMBOK 6 and 7
X.2.5	Procurement Management	PMBOK 6 and 7

X.2 Project Control Process		
Sub variables	*Knowledge Area*	PMBOK Edition
X.2.6	Integration Management	PMBOK 6
X.2.7	Cost Management	PMBOK 6
X.2.8	Quality Management	PMBOK 6
X.2.9	Risk Management	PMBOK 6
X.2.10	Stakeholder Management	PMBOK 6
X.2.11	Project Team Focus	PMBOK 7
X.2.12	Changes in the project	PMBOK 7
X.2.13	Learning in projects	PMBOK 7
X.2.14	Interaction with Other Domains	PMBOK 7

(source: author's processing)

Relationship of Risk in Project Planning and Control Process to Time Performance

According to Serrador & Turner (2015), there is a significant relationship between project planning and the quality of its planning to the success of the project. Without good planning, effective project implementation may be impossible and without considering the variation of the planning factors, the failure of the project may occur in the near future. According to King (2021), maintaining the scope of the project during the implementation process is a challenge that must be faced by project managers. Implementation of the planning process that is less effective, especially in the control process, will cause delays, cost overruns, and owner dissatisfaction. Therefore, proper planning and effective control strategies can improve the performance of project time and cost (Memon et al., 2012).

2 Materials and Methods

The following are the research methods used in this study.

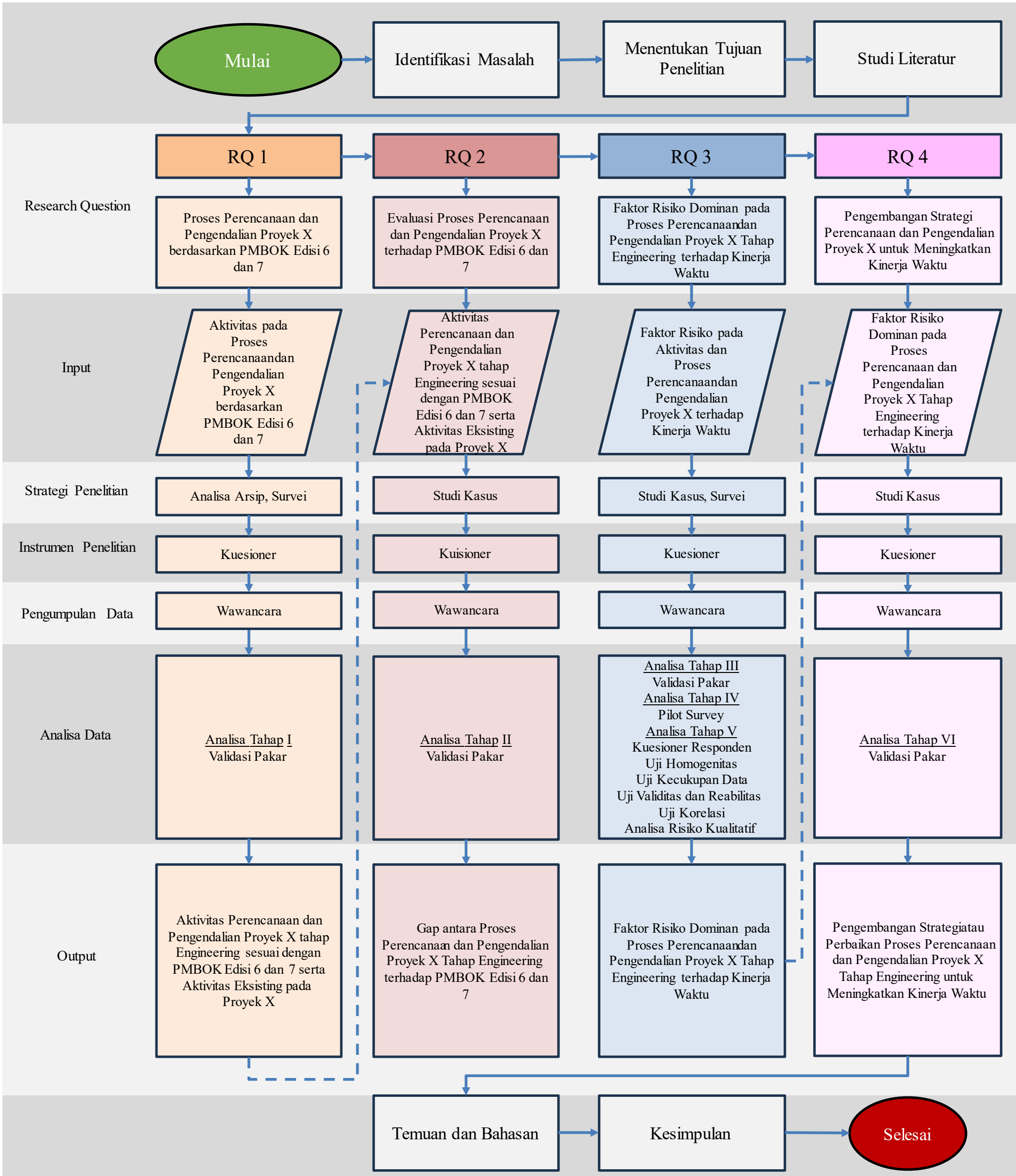

Figure 1. Operational model of research and research methodology

3 Results and Discussions

Based on the results of the questionnaire validation on related experts, the activities in the planning and control process of the offshore oil and gas platform project at the engineering stage were as follows:

- There are 31 activities included in the planning process for Offshore Oil and Gas Platform (AMPL) projects based on the PMBOK 6th and 7th Edition approach.
- There are 16 activities included in the control process in Offshore Oil and Gas Platform (AMPL) projects based on the PMBOK 6th and 7th Edition approach.

Based on the results of the validation of the questionnaire on the next expert, the results of the identification of gaps between the planning and control activities of the offshore oil and gas platform project at the engineering stage on

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Project X based on the indicators of the project planning and control process and activities in PMBOK Editions 6 and 7, it is known that:

- All activity indicators, totaling 31 activities, included in the engineering stage of the offshore oil and gas platform project planning process have been carried out in Project X.
- All activity indicators, totaling 16 activities, included in the engineering stage of the offshore oil and gas platform project control process have been carried out in Project X.

Next, related to the risk analysis carried out in each process, there are 29 indicators in the planning process and there are 13 indicators in the control process. In the risk analysis, the average impact and probability of risk are calculated and weighted based on the risk matrix. At this stage, the dominant risk factors in the planning and control process and activities of the offshore oil and gas platform project at the engineering stage in Project X are as follows:

Table 4
Dominant risk factors in project planning and control

Variables	Risk Code	Risk Factors	Risk Value	Risk Rating	Process
Project Integration Management	A.1.1	Inaccuracies in Project Execution Plan Preparation	0.26	6	Planning
Project Scope Management	A.2.1	Inaccuracies in Developing Engineering Scope Management Based on Contract Documents and FEED Documents	0.27	5	Planning
Project Schedule Management	A.3.1	Inaccuracies in Engineering Schedule Management Planning	0.31	3	Planning
	A.3.4	Inaccuracies in Estimating Engineering Activity Duration (Too Optimistic)	0.34	2	Planning
	A.3.5	Inaccuracies in Developing Engineering Activity Schedules	0.26	7	Planning
Project Scope Management	B.2.2	High Number of Changes During Engineering Activities	0.42	1	Control
Project Procurement Management	B.9.1	There are Changes in Materials and Delays in Material Delivery	0.28	4	Control

Source: Primary Data Processing (2024)

Then, an in-depth interview with the final stage experts was conducted. The formulation of the causes and impacts of dominant risks was also carried out, as well as risk mitigation steps for preventive and corrective actions for dominant risks in the validated project. The results of the discussion with experts were poured into the form of a risk matrix which is shown in the following table:

Table 5
Risk Matrix in the planning process

<table>
<tr><th>Knowledge Area</th><th>Risk Code</th><th>Risk Factors</th><th>Causes of Risk to Time Performance</th><th>Preventive Actions on Time Performance</th><th>Impact of Risk on Time Performance</th><th>Corrective Action on Time Performance</th></tr>
<tr><td>Project Integration Management</td><td>A.1.1</td><td>Inaccuracies in Project Execution Plan Preparation</td><td rowspan="2">The Project Management Team prepared a project execution plan (Project Execution Plan) with the 1DBM-One Design Build Many strategy. However, in project realization, this strategy cannot be applied to platforms that were previously identified as identical platforms.</td><td rowspan="2">During tendering, it is necessary to carry out more detailed identification of the platform characteristics to determine the level of identical design, whether it is identical (exactly the same) or just typical (representing general characteristics, but there are still minor variations).</td><td rowspan="2">Unplanned activities arose as a result of the 1DBM strategy not being able to be implemented because the Engineering Deliverable which was initially planned with one design for several identical platforms had to be made different into individual designs for each platform.</td><td rowspan="2">Develop a proper recovery plan to adjust the details of engineering activities and adjust the design, resources, and document approval procedures which initially consisted of 3 cycles to 2 cycles (IFR then directly to AFC)</td></tr>
<tr><td>Project Scope Management</td><td>A.2.1</td><td>Inaccuracies In Developing Engineering Scope Management Based On Contract Documents And Feed Documents</td></tr>
<tr><td rowspan="3">Project Schedule Management</td><td>A.3.1</td><td>Inaccuracies In Engineering Schedule Management Planning</td><td rowspan="3">Many new activities arose outside the activity plan and project schedule plan because D1BM could not be implemented and the design developed differently for each platform.</td><td rowspan="3">During tendering, it is necessary to carry out more detailed identification of the platform characteristics to determine the level of identical design, whether it is identical (exactly the same) or just typical (representing general characteristics, but there are still minor variations).</td><td rowspan="3">The planned project schedule was not achieved.</td><td rowspan="3">Prepare a recovery plan to catch up on engineering progress and minimize negative deviations from the project schedule baseline and prepare justification for inaccuracies in the preparation of the project schedule plan and submit an EoT (Extension of Time) request for the engineering scope.</td></tr>
<tr><td>A.3.4</td><td>Inaccuracy in Estimating Engineering Activity Duration (Too Optimistic)</td></tr>
<tr><td>A.3.5</td><td>Inaccuracies in Developing Engineering Activity Schedules</td></tr>
</table>

Source: Primary Data Processing (2024)

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Table 6
Risk Matrix in the Control Process

Knowledge Area	Risk Code	Risk Factors	Causes of Risk to Time Performance	Preventive Actions on Time Performance	Impact of Risk on Time Performance	Corrective Action on Time Performance
Project Scope Management	B.2.2	High Number of Changes During Engineering Activities	The initial project plan with the D1BM concept could not be realized, coupled with the client's request for a too high level of detail.	During tendering, it is necessary to carry out more detailed identification of the platform characteristics to determine the level of identical design, whether it is identical (exactly the same) or just typical (representing general characteristics, but there are still minor variations).	The need for engineering resources and engineering duration increases but there are limitations due to the established budget. With high requirements and limited resources, it has an impact on delays and document quality.	Develop a recovery plan to pursue engineering progress and minimize negative variations to the project schedule and project cost baseline.
Project Procurement Management	B.9.1	There are changes in materials and delays in material delivery	Many deliveries of steel structure materials are late from the scheduled time.	Ensure that MTO (Material Take Off), MR (Material Requisition), and PR (Purchase Requisition) are issued on time. And coordinate in monitoring and controlling the status of material delivery.	There was a request for replacement material from the fabrication team due to material delays.	The engineering team was asked to redesign using the material properties available and recommended by the fabrication team.

Source: Primary Data Processing (2024)

4 Conclusion

Based on the findings and discussion above, the hypothesis of the need for evaluation in the planning and control process of offshore oil and gas platform projects at the engineering stage can provide a proposal for a development strategy in the project planning and control process to improve time performance. This research has been conducted using the Project Management Body of Knowledge (PMBOK) Edition 6 and 7 risk-based approach involving experts in their fields. Based on the research results, it was found that there were 7 dominant risks in the planning and control process of offshore oil and gas platform projects at the engineering stage in Project X. In the final stage of the research, the development of project planning and control processes and activities that can be carried out to minimize risks so as to improve project time performance was carried out. Thus, the hypothesis proposed in this study has been proven.

Conflict of interest statement
The authors declared that they have no competing interest.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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This research was conducted by evaluating the process and activities of planning and controlling the offshore oil and gas platform project engineering stage from the contractor's perspective. In further research, it can be done for the procurement or construction stage.

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