

Leveraging up Profitability in the Oil and Gas Industry: Economic Evaluation of the Continuity of Monobore Drilling Well Architecture in PT Pertamina Hulu Indonesia Zone 9 in Structure-X

Alvine W. Tammala ^{1,*} and Oktofa Y. Sudrajat²

ABSTRACT

In the context of the high-risk, high-investment oil and gas industry, operational efficiency plays a pivotal role in profitability, making Key Performance Indicators (KPIs) a crucial focal point. In 2021, the oil production downturn in PEP TSS, particularly in the drilling sector, raised concerns about the financial outlook. The condition became tamed after merging with PHSS, which created an opportunity to transfer knowledge from one another. This actually prompts a critical examination of the potential for implementing monobore well architecture, notably in Structure-X. Monobore design, renowned for its cost-effective approach to wellbore design, production, and completion, emerges as a promising avenue for financial recovery for PEP TSS. The research stages encompass a thorough literature review, analysis of primary and secondary data, and quantitative assessments. Assumptions revolve around the cost-effectiveness and performance improvements achievable through monobore, supported by the hypothesis that it can outperform conventional well architecture with a high chance of success findings indicating a mere 14% probability of NPV < 0 and an estimated \$0.54 million USD increase in profitability compared to conventional well architecture, suggesting significant potential for financial gains in the industry.

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¹School of Business Administration, Bandung Institute of Technology, Indonesia.

²Bandung Institute of Technology, Bandung, Indonesia.

*Corresponding Author:
e-mail: alvine_winardi@sbm-itb.ac.id

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1. INTRODUCTION

PT PHI Zona 9, as one of the emerging oil companies in Indonesia, a subsidiary of PT Pertamina (Persero) that is under the same goal to be a world-class energy company (PT Pertamina, n.d.-a), faces a multitude of challenges impacting its Key Performance Indicators (KPIs). These challenges include fluctuating oil prices, technical and operational complexities, stringent regulatory compliances from stakeholders like SKK Migas and PT Pertamina, and geographical constraints, including land acquisitions. These factors collectively make it increasingly challenging for Zona 9 to achieve its KPIs effectively.

PT PHI Zona 9 developed four technical business strategies to address these issues following a merger and acquisition with PT PEP TSS and PT PHSS. These strategies emerged through a comparison and knowledge exchange between PT PEP TSS and PT PHSS, aimed

at increasing profitability and overcoming the challenges faced by Zona 9.

However, in 2021, Zona 9 encountered a significant setback in its Customer Focus Perspective, leading to a substantial production decrease of 6.83%. This decline prompted urgent attention from Zona 9's management, sparking a period of intense problem-solving and strategic reevaluation within the company.

A critical aspect of the challenge lies in drilling operations, a substantial investment for the industry. A notable increase in Costs per Barrel (CPB) in 2021 compared to previous years, reaching 39.13 USD/bbl. This elevated CPB and the industry's low oil prices due to post-Covid-19 global conditions created a precarious economic margin. If oil prices fell further, dipping below the cost per barrel, the company would face significant profit shortages.

Furthermore, drilling efficiency became a pressing concern. A majority (62%) of Zona 9's drilling wells in 2021



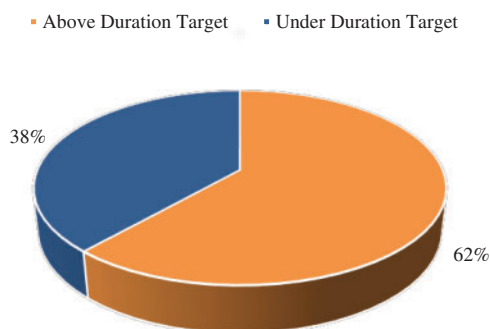


Fig. 1. Percentage above/under target drilling duration in days.

exceeded the targeted duration, indicating operational inefficiencies. This led to an additional 38 days of drilling operations, incurring an estimated cost of 456,000 US Dollars.

After the merger, a stark contrast emerged between PT PHSS and PEP TSS. PHSS demonstrated remarkable cost-effectiveness, spending only 12.89 USD to produce one Barrel Oil Equivalent (BOE), while PEP TSS had a much higher CPB. This disparity raised urgent questions from top-level management, emphasizing the need for efficient drilling operations to improve Zona 9's overall performance.

In summary, PT PHI Zona 9 faces a multifaceted challenge in achieving its KPIs and high-risk event due to its probability and severity of occurrence (PT Pertamina, 2020), driven by factors like oil price fluctuations, technical complexities, regulatory compliance, and operational issues. Fig. 1 underscores the urgency of addressing these challenges and optimizing drilling operations to enhance the company's performance.

2. PROBLEM ANALYSIS

2.1. Pivotal Role of PT Pertamina (Persero)

PT Pertamina (Persero) and its subsidiary in the upstream industry have competitive advantages compared to other companies in Indonesia. It has already integrated its business vertically from upstream to downstream (PT Pertamina, n.d.-b), reducing the value chain process and becoming one big player in Indonesia.

The current condition in the industry enforces a good sign to react quickly to seek more profit by enhancing production recovery. Current oil prices help all oil and service companies improve their financial performance (PT Pertamina, 2022). PT PHI Zona 9 seizes the momentum very well by implementing the monobore project.

However, the downstream business recently has another game changer – electrical energy, which should be a concern by PT PHI Zona 9. The revenue can significantly fall if the market becomes more aware of the environment. PT PHI Zona 9 must be attentive to sustain in the industry.

2.2. Production Sharing Contract

In Indonesia, the Production Sharing Contract (PSC) scheme has played a vital role in governing the oil and gas industry's exploration and production of hydrocarbons.

This contractual arrangement is a cornerstone for cooperation between the Indonesian government or state-owned entity, often the host country, and international oil and gas exploration or exploitation companies, known as contractors (SKK Migas, 2015). The PSC framework outlines the respective rights, responsibilities, and the sharing of profits between these parties, ensuring a clear and structured approach to managing the nation's valuable hydrocarbon resources.

Indonesia is a nation rich in oil and gas resources, and PSCs have been instrumental in facilitating collaboration between the government and international oil companies. These contracts enable the host country to harness oil and gas companies' expertise and financial capital while retaining control over their natural resources. Notably, they provide mechanisms for the fair distribution of profits generated from the exploration and production of hydrocarbons, ensuring that Indonesia benefits from its valuable resources while attracting foreign investments and technology.

The origins of the PSC scheme in Indonesia can be traced back to a series of legislative acts and regulations, including *Perpu no. 4 tahun 1960 pasal 6*, *Undang-Undang no. 8 tahun 1971*, and *Undang-Undang no. 22 tahun 2001*, along with *Peraturan Pemerintah no. 35 tahun 2004* and its subsequent modification in 2005. These legal foundations amalgamated to create the Production Sharing Contract (PSC) framework, integral to the nation's oil and gas industry.

In addition to the PSC scheme, Indonesia has also introduced the Gross Split scheme, providing an alternative approach to revenue distribution within the industry. Together, these frameworks have been pivotal in managing the nation's oil and gas resources, ensuring both economic benefits for the government and the participation of international oil companies in the exploration and exploitation of Indonesia's valuable hydrocarbons. These schemes reflect Indonesia's commitment to balancing the interests of its natural resource wealth and the need for foreign investments and technological expertise.

2.3. Conflicting Drilling Operations

In 2021, the problem was pretty vivid to the management where complex well architecture in PEP TSS made drilling operations not profoundly effective at that time. At the same time, merger and acquisition combining PEP TSS and PHSS created a platform to gain novelties from one another, including in well architecture implemented. Monobore is widely used and known in PHSS for its efficiency and cost-effectiveness in drilling operations.

Fig. 2 shows what differs between the conventional well type (panel a) and monobore well type (panel b). The following subsections discuss the fundamental physical dissimilarities between those two types.

2.3.1. Borehole Design

2.3.1.1. Monobore

In a monobore design, a single-diameter borehole is used throughout the entire well. This means that the wellbore maintains a consistent diameter from the surface

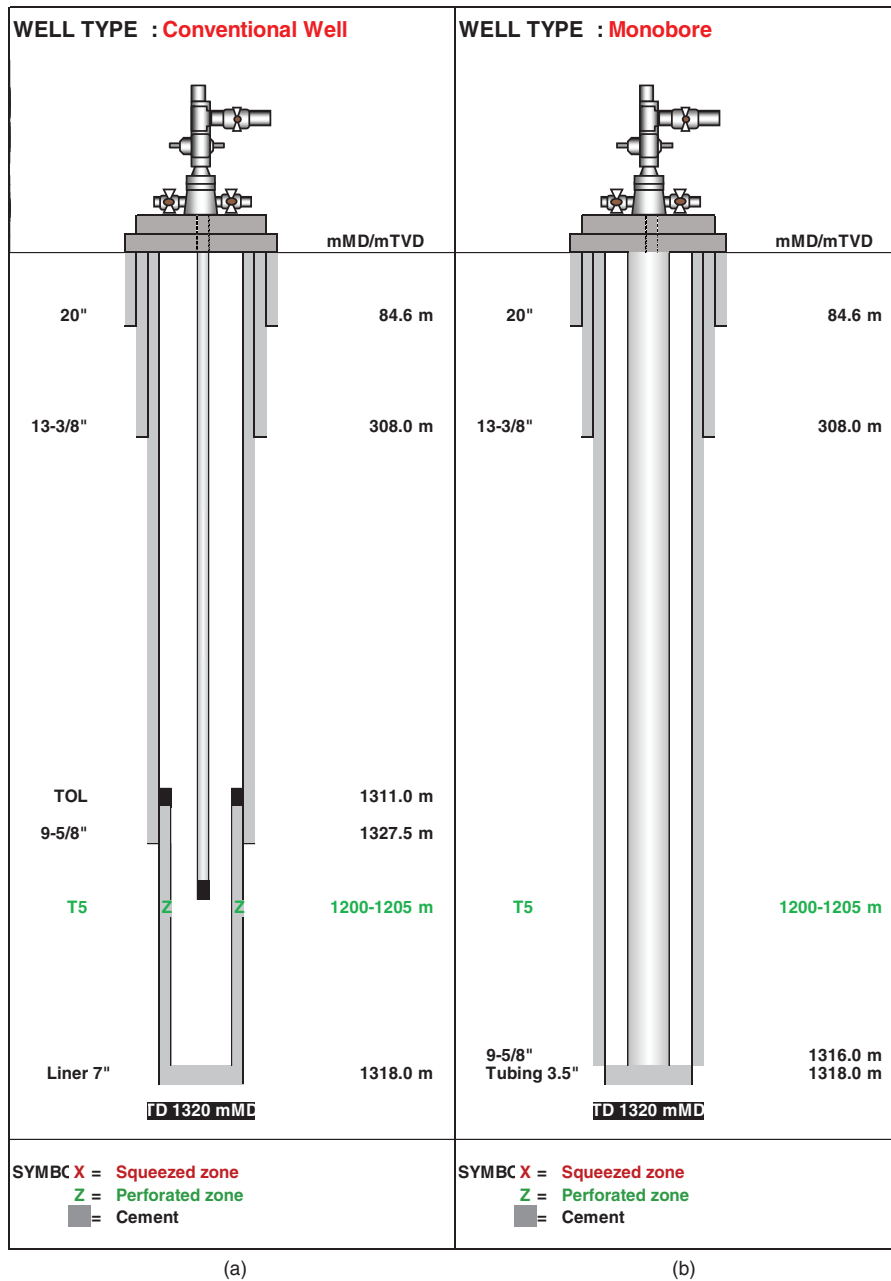


Fig. 2. Common drilling well profile (a) in PEP TSS, (b) PHSS.

down to the target reservoir. There are no distinct sections or casing changes within the well, simplifying the design.

2.3.1.2. Conventional

Conventional drilling well architecture typically involves using multiple casing strings of varying diameters within the wellbore. This includes surface casing, intermediate casing, and production casing, each with different diameters. These casing strings are installed to provide structural integrity and prevent well instability.

2.3.2. Casing Installation

2.3.2.1. Monobore

A monobore well design may have reduced or no intermediate casings. This can lead to cost savings in terms of casing materials and installation time.

2.3.2.2. Conventional

Conventional well architecture involves the installation of multiple casing strings, which can be more expensive and time-consuming.

2.3.3. Production and Completion

2.3.3.1. Monobore

Monobore designs often streamline the completion process. The production tubing is typically the same diameter as the wellbore, making it easier to install and retrieve production equipment.

2.3.3.2. Conventional

Conventional wells have multiple casing sizes, which may require more complex completion procedures to

accommodate different equipment sizes and ensure well integrity.

2.3.4. Well Integrity and Stability

2.3.4.1. Monobore

While monobore designs can be cost-effective, they may be less flexible in handling drilling challenges or unstable formations because of the single-diameter borehole.

2.3.4.2. Conventional

Conventional well architectures with multiple casing strings offer greater wellbore stability and control, which can be important in challenging geological conditions.

Therefore, in 2022, project monobore was approved and carefully executed in one well as a pilot and became a success at that time with fewer operation days and budget spent. However, there is still a bigger question on this project as it may not seem as effective as only one result. It immensely goes if the project is wholly manifested in another level, in this case, for Structure-X.

Whether the project is economically seen as beneficial if PEP TSS scales up the monobore implementation in Structure-X remains unevaluated. Therefore, this study will deeply dig out the final answer.

3. ASSUMPTIONS

3.1. Hurdle Rate

The hurdle rate, often called the “required rate of return” or “minimum acceptable rate of return,” is a financial term used in various investment and financial decision-making scenarios. In this study, the calculation will use WACC with the CAPM (Capital Asset Pricing Model) method.

The key concepts of the CAPM include:

1. Risk-Free Rate: For this term, the calculation will use Indonesia’s 20Y bond yield with a value of 7.248%, as shown in Fig. 3 (Bank Indonesia, n.d.).



Fig. 3. Indonesia’s 20-year bond yield history.

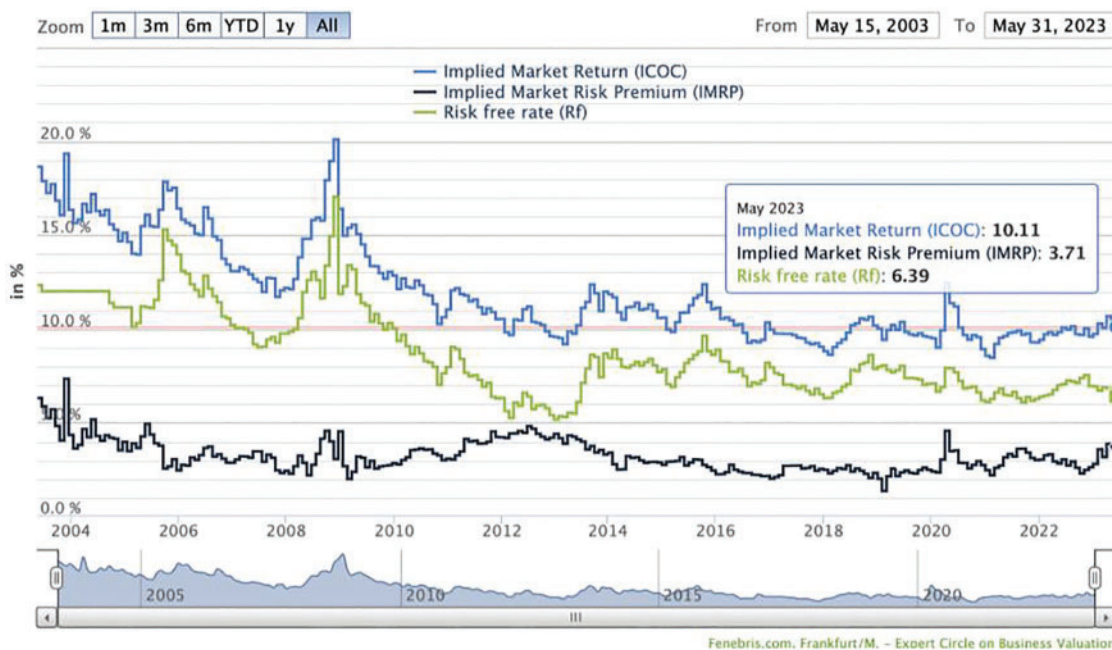


Fig. 4. Indonesia’s risk premium value.

TABLE I: BETA COEFFICIENTS OF TYPICAL COMPANIES SIMILAR TO PEP TSS

Company	Code	Beta value	Source
PT Medco Energi Internasional Tbk	MEDC	1.56	Yahoo Finance

TABLE II: INFLATION RATES IN INDONESIA IN THE PAST 5 YEARS

Year	Inflation rate (%)
2017	3.81
2018	3.20
2019	3.03
2020	2.17
Average	3.05

2. Market Risk Premium: For this term, the calculation will use Indonesia’s risk premium magnitude with a value of 3.71%, as shown in Fig. 4.
3. Beta Coefficient: For this term, the calculation will use the average beta coefficient from three companies’ publicly offered stock, which is similar to PT PEP TSS. The average is 1.11.

3.1.1. CoE Calculation

$$\begin{aligned} \text{CoE} &= \text{Risk - Free Rate} + (\text{Beta Coefficient} \times \text{Risk Premium}) \\ &= 7.248 + (1.56 \times 3.71) \\ &= 15.04\% \end{aligned}$$

The Beta coefficient value used is shown in Table I.

3.1.2. WACC Calculation

$$\text{WACC} = \text{CoE} \times \left[\frac{\text{Equity}}{\text{Equity} + \text{Debt}} \right] + \text{CoD} \times$$

$$\begin{aligned} &\left[\frac{\text{Debt}}{\text{Equity} + \text{Debt}} \right] \\ &= 15.04\% \times \left[\frac{100\%}{100\% + 0\%} \right] + 0\% \times \left[\frac{0\%}{100\% + 0\%} \right] \\ &= 15.04\% \end{aligned}$$

Therefore, WACC = Hurdle Rate = 15.04%

3.2. Inflation Rate

Price escalation is fundamentally based on the inflation rate. The calculation will use the average inflation rate from 5 previous years (2017–2022) as shown in Table II, when the COVID-19 pandemic did not start in 2017 until the endemic at the end of 2022 (Bank Indonesia, n.d.). Therefore, the assumption will cover many different conditions.

The stakeholder officially regulating oil price forecast is the Exploitation Planning Division.

4. RESULTS AND DISCUSSION

4.1. Oil Forecast

Drilling is an uncertainty that one cannot predict exactly. There are always unprognosed layers found. Therefore, based on the newest drilling data in Structure-X, the probabilistic of the hydrocarbon layers found is shown in Fig. 5. The picture approximates that at least 6 hydrocarbon layers are found when drilling one well in Structure-X.

In accordance with Fig. 5, the oil forecast is then derived until the end of the contract of PEP TSS, as shown in Fig. 6. The total production at the end of the contract is expected to reach 4.1 million barrels of oil (MMBO).

4.2. Total Cost

Investing in one oil or gas well covers the drilling process where the well is being made and the workover where the well is completed by perforating into the targeted potential hydrocarbon layer. At least 18 drilling wells in Structure-X using conventional well architecture from 2020 until 2023.

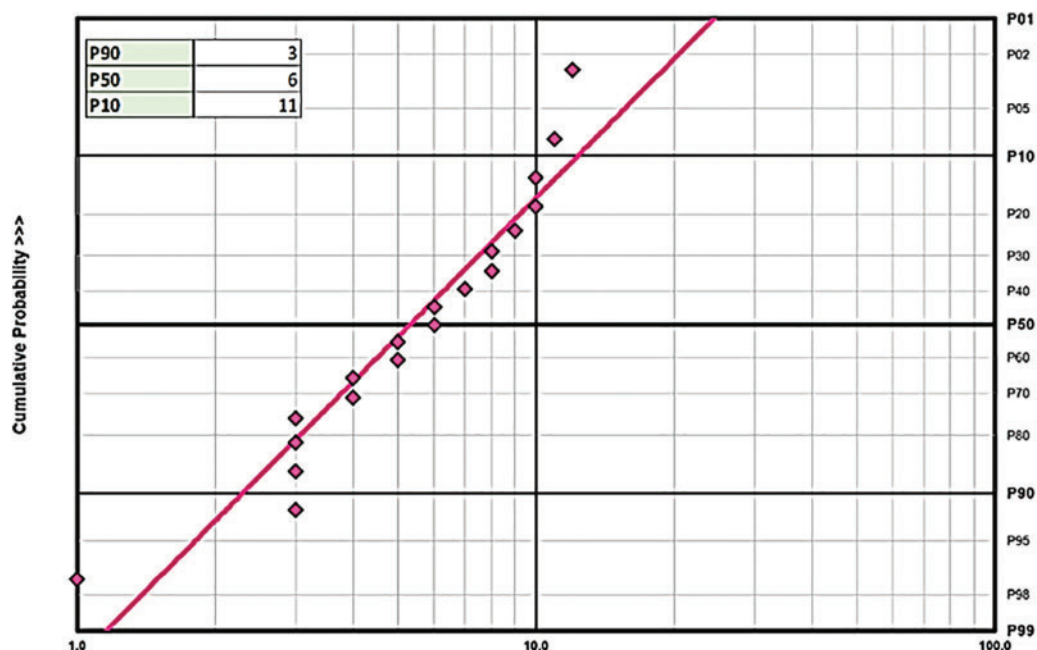


Fig. 5. Probability of hydrocarbon layers found in a drilling well.

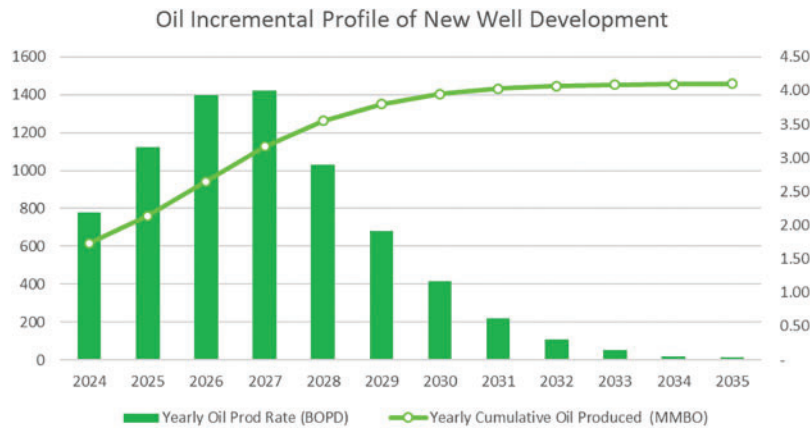


Fig. 6. Production forecast for remaining drilling wells in Structure-X.

The average drilling cost from those wells is \$3,180,490. Meanwhile, from one pilot project monobore, the price can be representative of the next well in the monobore project. One monobore drilling well only costs \$2,998,992.

Moreover, based on the workover case in PEP TSS that represents conventional well architecture, it is \$49,542. At the same time, the monobore type can be analyzed through PHSS data, whereby monobore is the type implemented in all wells. The historical data convey that the average workover cost from 2020 to 2020 is \$40,810.

If the analysis is divided into two scenarios, it would be:

Scenario 1: New wells to be drilled will use the existing well architecture (conventional well type), which was widely used in Structure-X before.

Scenario 2: New wells to be drilled will use monobore well architecture that is adopted from PHSS.

The total cost can be estimated using the forecast oil in Fig. 6, where the data is derived from the total drilling wells per year. The cost realization shows the total aggregated cost needed for drilling and WO in scenarios 1 and 2.5. The calculations are regarding the inflation rate of 3.05% calculated in the previous chapter. The total cost for scenario 1 is USD 116,806,639. Meanwhile, scenario 2 is USD 108,993,053. From there, it could be seen that there is quite a huge difference of USD 8 million among those invested budgets from both scenarios.

4.3. Economic Evaluation

Kepner found that each technique is covered in a variety of case studies which give a good insight in how to go about practising the techniques (Kepner & Tregoe, 1981). The economic calculations utilize the scheme that is applied in PEP TSS, which is PSC (cost recovery). Therefore, the analysis made throughout two scenarios which summarized in Table III below.

TABLE III: SUMMARY OF ECONOMIC CALCULATIONS FOR BOTH SCENARIOS

Scenario	NPV (million USD)	IRR (%)	Payback period (years)
Scenario 1	29.24	159	1.66
Scenario 2	29.78	180	1.58

For the same amount of forecasted oil reserves in the remaining contract year, scenario 2 results in USD 29.78 million of NPV; meanwhile, scenario 1 only results in USD 29.24 million of NPV. There will be a great amount of USD 0.54 million profit from converting drilling well architecture to monobore type. The IRR also says a similar trend where scenario 2 generates 188% while scenario 1 only generates 159%, which is 29% lower than a monobore project could offer.

This denotes a good move for a solution by shifting well architecture from conventional to monobore type prevails. The company could benefit more than half a million USD, which is a big profit, and could meet an even faster payback period with scenario 2. Therefore, the solution for the case should lean on to scenario 2, where PEP TSS should amend the well architecture into monobore type and could scale the project up for the next whole drilling wells in Structure-X.

4.4. Business Solution

From the previous section where already aforementioned, that scenario could eventually benefit more. Therefore, the project could be holistically executed in Structure-X. Nevertheless, a sensitivity analysis and chance of success analysis must be conducted to assess whether or not the project will prevail. By knowing the level of the project risk, top-level management will be able to provide the best decisions considering the current condition of Zona 9. Sensitivity analysis will first be conducted to measure how volatile the NPV is regarding parameter changes, as shown in Fig. 7. The simulation will use random scenarios to generate thousands of scenarios. Then, the Monte Carlo simulation will be held to attain the final success probability of all cases run.

Through this sensitivity analysis, 6 parameters will be NPV-based tested. Those parameters include oil price, oil reserves, CPB per well, drilling well cost, inflation rate, and WO cost. All parameters are run in the changes by adding or subtracting 50% of each parameter to assess how volatile the NPV is regarding the parameter changes. The base case NPV of USD 29.78 million will be the base scenario result that will anchor the sensitivity result. The following is the result of sensitivity analysis for 6 parameters. The result shows that at least 5 parameters highly affected the NPV. In the next analysis, the scenario

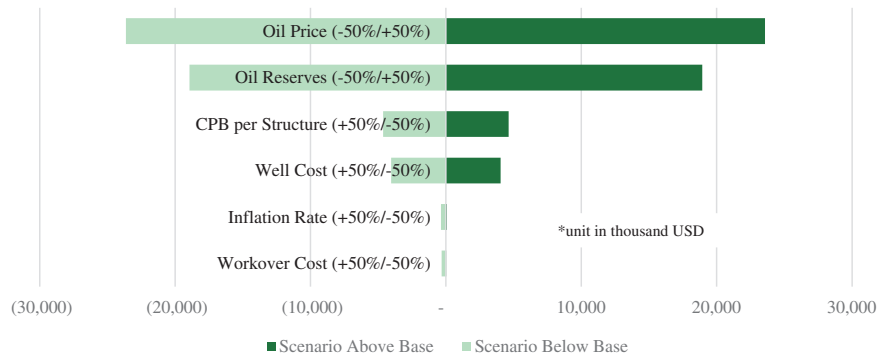


Fig. 7. Tornado chart for sensitivity results.

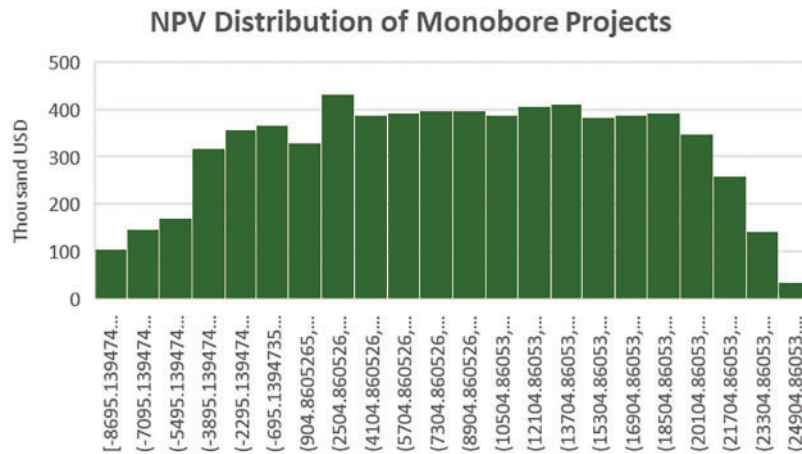


Fig. 8. NPV distribution of the monobore project simulation.

of those parameters will be simulated using the Monte Carlo method.

From Fig. 8, the chance of success of this project can be calculated. It can be seen that the monobore project in Structure-X has a strong percentage of chance of success. The probability of NPV < 0 is only 14%. The distribution is also categorized as normally spread, indicating a good result generated with the historical input data. Therefore, this project is deemed to be a very prolific one.

5. CONCLUSIONS AND RECOMMENDATIONS

In accordance with the economic analysis, the monobore project will result in a high profit, which is USD 29.78 million. The IRR attained is also at a high level of 180%, far above the hurdle rate of 15.04%. Moreover, the payback period is also faster, where the project only needs 1.66 years to achieve NPV = 0.

After doing sensitivity analysis and simulation, the project is intriguing to apply in Structure-X, particularly when this project produces a good chance of success. The probability of NPV < 0 is only 14%, which may seem darling since it can be an easy win for PEP TSS. Even more so when the project could be implemented in many other structures. Based on these results, it can be concluded that the monobore project is viably prolific and profitable to continue in Structure-X.

For this project to be continued, there are several recommendations to get the project well-executed soon, which are:

5.1. Continuation of the Monobore Project

Given the substantial advantages of the monobore drilling project, we recommend that PT PEP TSS proceed with the continuation of this project in Structure-X.

5.2. Expand Project Scope

Considering the project's efficiency and profitability, we suggest exploring the possibility of implementing the monobore drilling approach in other structures within the organization. This expansion can maximize the overall benefits and provide long-term sustainability.

5.3. Rigorous Monitoring and Evaluation

To ensure the project's continued success, establish a comprehensive monitoring and evaluation system. Regularly track key performance indicators, drilling efficiency, cost savings, and safety records.

5.4. Risk Mitigation Plan

Develop a contingency plan for unexpected challenges that may arise during the monobore project. This plan should include strategies for addressing technical, environmental, and safety issues.

5.5. Skills Development

Invest in training and development programs for the workforce to enhance their skills and knowledge related to the monobore drilling technique. Ensure that the team is well-prepared to handle this innovative approach.

5.6. Environmental Impact Assessment

Conduct a thorough environmental impact assessment to address any potential ecological concerns associated with the project. Ensure compliance with all relevant environmental regulations.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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