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A Multi-Criteria Decision Analysis for Rigless Job Scope Prioritization: Framework for Strategic Rigless Well Candidate Selection

Harry Kurniawan*, Pri Hermawan
Institut Teknologi Bandung, Indonesia
Email: 29123394@mahasiswa.itb.ac.id*

Keyword
decision analysis, analytical hierarchy process, strategic decision making rigless, well candidate

ABSTRACT
Rigless well intervention is essential for restoring production and maintaining well integrity in upstream oil and gas operations. However, companies often face dynamic environments where multiple intervention candidates arise simultaneously, while execution capacity is limited by budget, resources, or financial constraints. Without a structured prioritization framework, Rigless execution decisions tend to be inconsistent and heavily reliant on judgment, especially under financial pressure or overly aggressive strategies. This research aims to develop a systematic decision-support framework for prioritizing Rigless well intervention programs by applying the Analytical Hierarchy Process (AHP). The framework integrates multiple technical, operational, economic, and risk-related criteria to determine the relative priority of Rigless program objectives. Expert judgments are collected and synthesized to establish a clear priority hierarchy among these alternatives including Lost Production Opportunity (LPO) Reduction, Integrity Restoration, Well Development and Stimulation. The results indicate that LPO Reduction emerges as the highest priority due to its direct and immediate impact on production recovery, followed by Integrity Restoration as a critical prerequisite for safe and sustainable operations. Based on these results, a Rigless Prioritization Guideline is also proposed as the primary business solution which translating analytical rankings into practical execution and deferral rules applicable under concurrent candidate conditions and financial or operational constraints. The main contribution of this study is translating analytical prioritization into a practical business decision framework that supports consistent, transparent, and defensible Rigless execution. This framework enables companies to adapt their execution strategy under aggressive targets or financial constraints without adding operational complexity.

INTRODUCTION

Rigless operations at PMN encompass a wide range of job types, such as Well Cooling Team (WCT), Well Unload Acid (WUA), surveillance logging, stimulation using Coil Tubing Units (CTU) and pump truck services, as well as Bump Down Jobs (BDJ) and Change Polish Rod (CPR) activities. These jobs are executed to achieve multiple objectives, including increasing oil production, addressing HSSE and social urgency concerns, mitigating Lost Oil Production (LPO), and supporting wellbore evaluation for future development. Given the diversity of objectives, Rigless job selection inherently involves trade-offs across technical complexity, execution time, cost, and technology requirements (El Atchy & Gauthier, n.d.; El Khatib et al., 2025; Khalili et al., 2025; Müller et al., 2025).

Rigless well candidates at PT Penopang Minyak Nasional (PMN) are generated continuously as part of routine field operations. These candidates are proposed by Petroleum Engineering (PE), submitted to Completion Engineering (CE) for technical review, and subsequently processed through approval and scheduling stages prior to execution. Under normal operating conditions, this workflow allows Rigless

As operational dynamics change, challenges begin to emerge when execution demand increases or when available resources become constrained (Bento, 2018). Under these circumstances, operational complexity increases when multiple Rigless candidates enter the process within the same time period or when execution capacity is constrained due to financial, manpower, or other operational limitations (Nwaochei et al., 2019; Al-Ghazal et al., 2020). In this situation, several Rigless candidates must be evaluated and processed simultaneously, resulting in direct competition for limited execution windows and operational resources (Nwaochei et al., 2019; Hauder et al., 2020; Okon & Appah, 2021).

Under this circumstance, the key business issue faced by PMN becomes apparent (Grisanto et al., 2025; Heriyati et al., 2024; York et al., 2022). The challenge is not primarily related to the volume of Rigless activities, but rather the absence of a structured basis to determine execution priority. Within the existing PE–CE–approval–scheduling process, there is no formal prioritization reference to clearly distinguish which candidates should be executed first and which candidates should be postponed or unselected under constrained conditions.

Without a formal prioritization framework, candidates with different levels of production recovery impact, HSSE exposure, economic value, and strategic relevance to field development may be treated with similar urgency. This condition reduces decision clarity during the review, approval, and scheduling stages and limits the ability to consistently manage concurrent Rigless candidates.

Decision-making in upstream oil and gas operations is inherently complex due to the presence of multiple, often competing, objectives related to production performance, operational risk, cost efficiency, safety, and long-term field development. Such complexity has driven extensive application of Multi-Criteria Decision Analysis (MCDA) within operations research as a systematic approach to support decisions that require simultaneous consideration of diverse qualitative and quantitative criteria under uncertainty. MCDA provides a structured framework that enables decision-makers to decompose complex problems, evaluate trade-offs among alternatives, and select solutions that best align with organizational objectives (Deng, 1999). The Analytical Hierarchy Process (AHP) represents decision problems in the form of a hierarchical structure consisting of three main levels which are : objective, evaluation criteria, and decision alternatives.

The Analytical Hierarchy Process (AHP), introduced by Saaty, has been widely adopted due to its intuitive hierarchical structure and its ability to incorporate expert judgment through pairwise comparisons, allowing subjective managerial preferences to be translated into objective numerical priorities (Saaty, 1993; Shi, 2002). The strength of AHP lies in its suitability for decision contexts where data may be partially quantitative and partially experiential, and where transparency and consistency of judgment are essential. This makes AHP particularly relevant for operational prioritization problems in engineering-based industries where multiple evaluation dimensions must be considered simultaneously.

Beyond methodological considerations, corporate investment literature emphasizes that the decision context in which prioritization is performed is itself dynamic and unstable. Firms do not operate under static resource availability; rather, investment decisions are shaped by shifts in financial conditions, market volatility, organizational strategies, and managerial behavior. Empirical evidence shows that firms may experience sudden financial constraints caused by liquidity tightening, budget realignment, or external shocks, which lead to sharp reductions in investment even when planned activities were previously considered feasible. Perez-Orive et al. (2026) demonstrate that investment responses to tightening conditions are asymmetric, noting that the decline in investment following contractionary shocks is significantly larger than the increase observed during expansionary periods, indicating that financial constraints may emerge abruptly rather than gradually.

Conversely, the literature also documents that firms may enter periods of overly aggressive investment execution during favorable economic outlooks or when managerial expectations are optimistic. Greenwood and Hanson (2015) show that firms tend to overinvest during expansionary phases based on extrapolated beliefs that current performance and earnings will persist. When conditions deteriorate, this behavior is followed by a rapid contraction in investment, forming a characteristic boom–bust pattern in corporate investment behavior. These dynamics suggest that aggressive execution strategies may lead to the simultaneous emergence of multiple competing investment candidates that strain available execution resources. In addition to external financial conditions, behavioral finance studies highlight that managerial cognition plays a significant role in shaping investment decisions. Malmendier and Tate (2005) find that overconfident managers systematically overestimate expected returns and perceive external financing as excessively costly, causing firms to behave as if they are financially constrained even when access to external capital remains available.

This behavior introduces perceived constraints that further complicate prioritization decisions, particularly in environments where multiple projects or candidates must be evaluated concurrently. In the context of Rigless well intervention programs, which are characterized by high execution volumes, short cycle times, and diverse operational objectives, these conditions significantly increase decision complexity. Rigless candidates may arise simultaneously due to aggressive production recovery targets or operational campaigns, while execution capacity remains limited by budget availability, manpower, and operational windows. Under such circumstances, reliance on sequential planning or ad-hoc judgment increases the risk of inconsistent execution decisions and suboptimal resource allocation.

Consequently, the application of a structured MCDA-based framework such as AHP provides a defensible methodological foundation to support Rigless prioritization. By systematically integrating technical, operational, economic, and risk-related criteria, such a framework ensures that execution decisions remain transparent, consistent, and aligned with organizational objectives under both aggressive execution scenarios and sudden or perceived financial constraint condition.

This research aims to develop a systematic framework using the Analytical Hierarchy Process (AHP) method in prioritizing Rigless well intervention programs, determining the priority hierarchy between Lost Production Opportunity Reduction, Integrity Restoration, Well Development, and Stimulation, and compiling a Rigless Prioritization Guideline as a business solution that translates the results of analytical priorities into applicable execution and delay rules. Theoretically, this study enriches the literature on multi-criteria decision-making in the upstream oil and gas industry and integrates the concept of financial constraint and aggressive execution behavior into the framework of operational priorities. Practically, this research produces priority guidelines that can be implemented by PT Penopang Minyak Nasional (PMN) as a reference for consistent, transparent, and accountable decision-making for the Petroleum Engineering and Completion Engineering teams, supporting management in efficient resource allocation, and providing examples of the application of structured AHP that can be adapted to similar operational prioritization problems in the upstream oil and gas industry in general

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METHOD

Research Design

This study adopted a structured decision support methodology to address the problem of prioritizing Rigless well intervention candidates under dynamic operational and financial conditions. The research is designed as an applied quantitative study using a Multi Criteria Decision Making (MCDM) approach with the Analytical Hierarchy Process (AHP) selected as the primary analytical method.

AHP is chosen due to its capability to structure complex decision problems, integrate expert judgment, and synthesize qualitative and quantitative evaluation criteria into a consistent prioritization framework. The overall research process is structured into four main stages:

(1) Problem structuring and research design
(2) data collection through stakeholder engagement and expert judgment,
(3) Application of AHP to derive criteria weights and priority scores, and
(4) Synthesis of results to support Rigless execution decision making.

This design ensures that the research objectives are addressed systematically and that the methodological flow remains transparent and traceable.

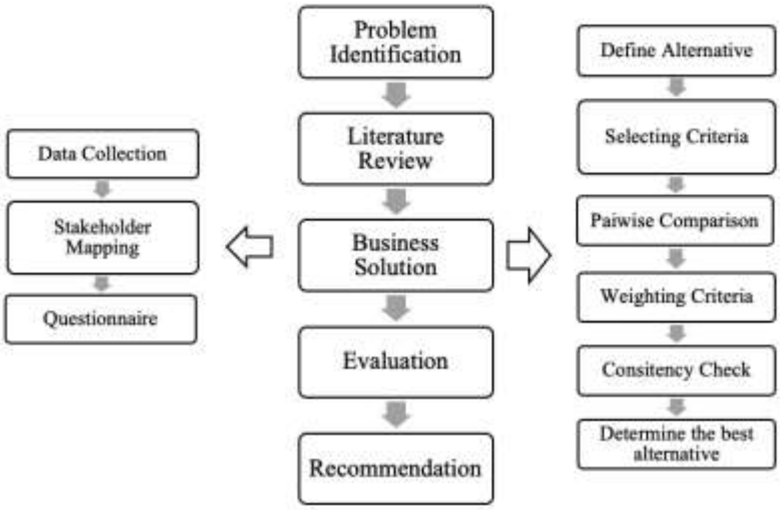

Figure 1. Research Design and Methodological Flow
Source: Author, (2025)

Data Collection and Stakeholder Identification

Primary data for this study are obtained through expert judgment, as Rigless prioritization decisions rely heavily on operational experience, engineering knowledge, and contextual understanding of execution constraints. Stakeholder identification is conducted to select Subject Matter Experts (SMEs) who are directly involved in Rigless planning, review, and execution processes.

Stakeholder mapping is performed to classify stakeholders based on their level of influence and involvement in Rigless decision making. Individuals with high authority and direct responsibility in engineering review and operational planning are categorized as key decision contributors.

No	Job Role	Stakeholder Analysis	Reason
1	Manager DWI Rigless Engineering	Manage Closely	As Leader to manage of program deployed to engineering team
2	Manager Petroleum SSD	Keep Satisfied	As Leader of program owner
3	Manager DWI Rigless Operation	Keep satisfied	As Leader to monitor well program execution related with operation and safety
4	Analyst / Engineer Petroleum	Manage Closely	As well candidate developer and program generator
5	Sr. Engineer Completion	Manage Closely	Working on reviewing well program Rigless candidate
6	Engineer Completion	Manage Closely	Working on reviewing well program Rigless candidate
7	Jr. Engineer Completion	Manage Closely	Working on reviewing well program Rigless candidate
8	Company Man	Keep Informed	As company representative to witness the well program execution and to ensure the execution are aligned within the program objective and meet the safety compliance
9	Operation Support for Rigless Operation	Monitor	Act as operation support responsible for managing supporting documentation throughout the execution of rigless operation

Figure 2. Research Stakeholder Mapping
Source: Author's analysis based on stakeholder identification and mapping conducted at PT Penopang Minyak Nasional (PMN), 2025

Criteria Identification and Validation

The prioritization criteria used in this study are identified through structured questionnaires and preliminary discussions with selected SMEs. These criteria reflect key operational dimensions influencing Rigless execution, including execution time, cost considerations, technological requirements, and socio environmental impacts. Criteria validation is conducted to ensure relevance, clarity, and applicability under real operational conditions. Expert consensus is used to confirm that the selected criteria appropriately represent the factors considered during Rigless candidate evaluation.

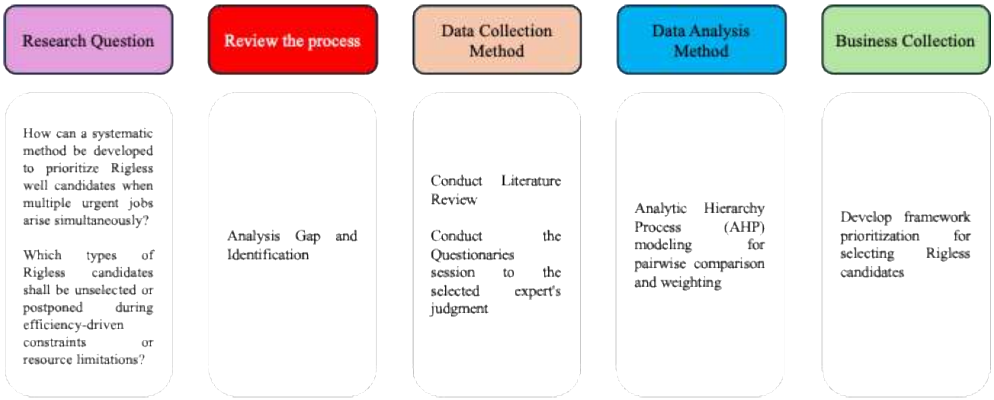

Figure 3. Data Collection Method for Criteria Identification

Source: Author's design based on expert judgment and structured questionnaires, 2025

Analytical Hierarchy Process (AHP) Application

The Analytical Hierarchy Process (AHP) is applied by structuring the Rigless prioritization problem into a hierarchical model consisting of decision objectives, evaluation criteria, and decision alternatives. Experts perform pairwise comparisons among criteria using the Saaty fundamental scale to express relative importance.

To improve consistency and reduce judgment bias, the Saaty scale in this study is limited to values between 1 and 7, excluding extreme dominance values. This adjustment reflects the practical nature of Rigless decision making, where absolute dominance among criteria is rarely justified.

Consistency Assessment and Priority Scoring

Consistency testing is conducted using the Consistency Index (CI) and Consistency Ratio (CR) to ensure reliability of expert judgments. A CR threshold of 0.10 is applied as the acceptance criterion. Judgment matrices exceeding this threshold are reviewed and revised to maintain analytical robustness. After consistency is confirmed, global priority scores are calculated for each Rigless candidate by aggregating weighted criterion scores.

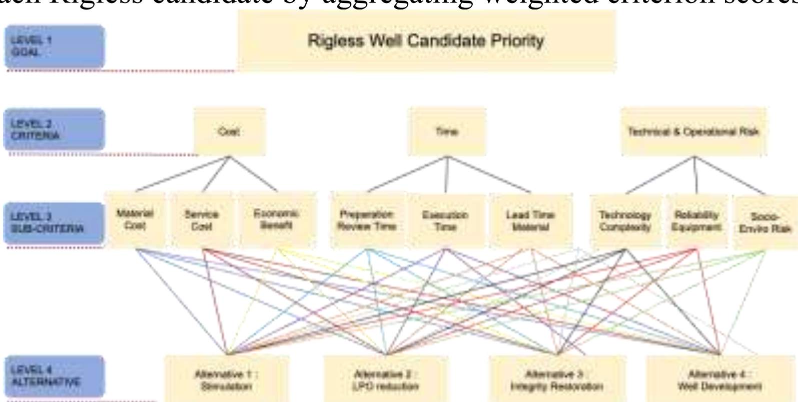

Figure 4. Alternative Selection and Priority Scoring Process

Source: Author's design based on AHP methodology, 2025

Output and Decision Support Implementation

The final output of the methodology is a structured Rigless prioritization model that supports operational decision making under concurrent execution and constrained resource conditions. The model functions as a decision support reference rather than a replacement for engineering or managerial authority, enhancing transparency, consistency, and defensibility of Rigless execution decisions.

RESULT AND DISCUSSION

The final stage of the Analytical Hierarchy Process (AHP) integrates results from all levels of the decision hierarchy to determine the optimal prioritization of Rigless well intervention candidates. This synthesis process aggregates judgments starting from the main evaluation criteria, followed by their respective sub criteria, and ultimately the strategic alternatives representing Rigless program objectives. The global priority weight of each alternative is calculated by multiplying the weight of each criterion and sub criterion by the corresponding alternative's priority score and then summing across all evaluation dimensions.

Based on this integrated assessment, Lost Production Opportunity (LPO) Reduction emerges as the highest ranking Rigless prioritization objective. This alternative demonstrates dominance across multiple criteria, particularly in dimensions associated with production recovery urgency, execution effectiveness, and operational feasibility. The second ranked alternative is Well Integrity Restoration, reflecting strong consideration of HSSE and socio environmental risk mitigation. Well Development ranks third, while Stimulation is positioned as the lowest priority under constrained execution scenarios, due to its relatively lower urgency and deferred production impact.

Table 1. Final AHP Result and Priority Ranking of Rigless Program Objectives

Criteria	Weight	Sub-criteria	Weight	Alternatives			
				Stimulation	LPO Reduction	Integrity Restoration	Well Development
Time	0.289	Review Program	0.478	0.085	0.421	0.450	0.129
		Lead Time Material	0.207	0.110	0.490	0.393	0.117
		Execution	0.315	0.085	0.491	0.414	0.096
Cost	0.210	Material	0.138	0.092	0.469	0.429	0.102
		Service	0.168	0.138	0.528	0.353	0.119
		Economic Benefit	0.694	0.145	0.506	0.362	0.132
Technology	0.502	Complexity Advancement	0.119	0.147	0.436	0.375	0.190
		Reliability	0.193	0.124	0.478	0.376	0.376
		Social Environmental Impact	0.688	0.158	0.439	0.455	0.105
Total Weight				**0.130**	**0.462**	**0.417**	**0.144**
Alternatives Ranking				**4**	**1**	**2**	**3**

Source: Author's calculation using Analytical Hierarchy Process (AHP) based on expert judgment survey, 2025

The priority order indicates that decision makers place greater emphasis on immediate production recovery and operational continuity when resources are limited. LPO Reduction is consistently favored because it directly accelerates Put on Production (POP) following well down events, thereby protecting revenue and minimizing deferred oil. Integrity Restoration follows closely, as it addresses critical safety and environmental risks that. if it is neglected, it could result in forced shut ins or regulatory noncompliance. Well Development and Stimulation are not insignificant, are more suitable for execution under conditions where operational capacity and financial flexibility are sufficient. Their lower ranking reflects their medium to long term value contribution rather than immediate impact. These results confirm that the AHP model effectively differentiates Rigless objectives based on urgency, risk exposure, and business value rather than execution volume alone.

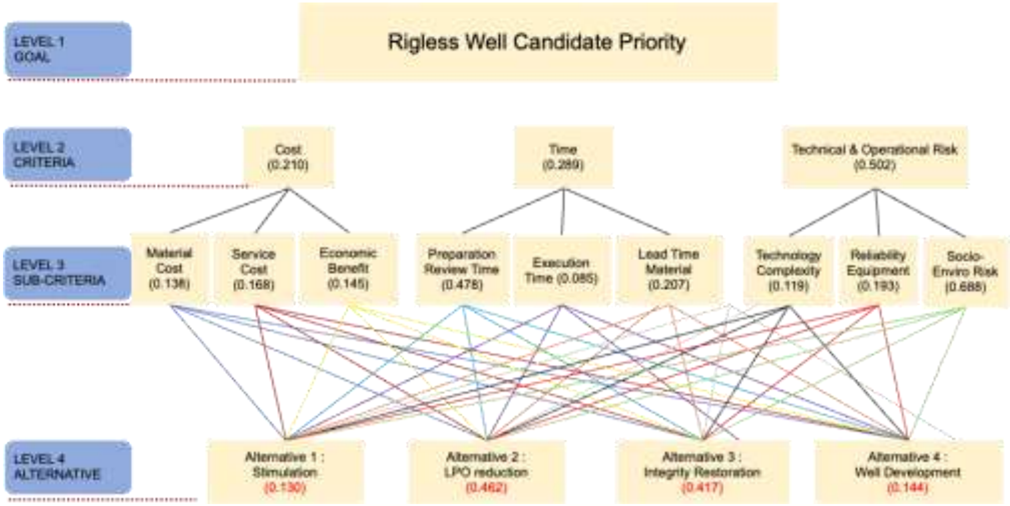

Figure 5. Final AHP Priority Score Distribution for Rigless Program Objectives

Source: Author's calculation using Analytical Hierarchy Process (AHP) based on expert judgment survey, 2025

Business Interpretation and Strategic Implications

The dominance of LPO Reduction in the AHP results is not merely a numerical outcome but reflects a set of operational mechanisms fundamental to mature upstream assets. Under constrained conditions, prioritizing well down recovery maximizes short term production gains while stabilizing field performance. Execution speed and operational reliability therefore become first order strategic considerations, outweighing longer term optimization activities. From a risk governance perspective, the high ranking of Integrity Restoration highlights the importance of maintaining HSSE and socio environmental standards as non-negotiable decision gates. Rigless programs addressing integrity issues reduce exposure to major incident risks and ensure sustainability of production activities, particularly in sensitive operating environments. These findings demonstrate that Rigless prioritization in PMN is best guided by a balance between production urgency, safety, and execution feasibility. Rather than eliminating lower ranked objectives, the framework supports selective execution and structured deferral, enabling PMN to adapt effectively to aggressive campaign periods as well as financial or operational constraints.

Rigless Prioritization Guideline as Practical Outcome

This decision matrix represents the tangible business solution of the research. By formalizing analytical prioritization results into a practical decision table, the matrix enables PMN to make transparent, consistent, and defensible Rigless execution decisions across varying operational scenarios.

Guideline Solution under Concurrent Rigless Candidate Conditions

When multiple Rigless well candidates arise simultaneously within the same execution horizon, and all candidates cannot be executed concurrently due to limited execution windows or operational capacity, the following prioritization rule shall be applied: Execution priority rule for concurrent conditions:

- Rigless candidates categorized as LPO Reduction shall be prioritized for execution due to their immediate impact on oil production recovery.
- Rigless candidates under Integrity Restoration shall be executed subsequently to ensure operational safety and asset integrity.

- Well Development and Stimulation candidates shall be scheduled after higher-priority objectives, subject to available execution capacity.

This rule ensures that high-impact Rigless activities are not delayed by lower-priority programs when candidate submission is aggressive.

Guideline Solution under Financial or Operational Constraints

During periods of financial constraint, cost-efficiency enforcement, or operational limitations, where not all Rigless candidates can be executed as initially planned, the following selection and deferral rules shall be applied. Execution selection rule for constrained conditions:

- LPO Reduction and Integrity Restoration programs shall be retained for execution to protect production continuity and operational safety.
- Well Development and Stimulation programs may be selectively postponed or unselected, depending on the severity of the constraint and budget availability.

This approach allows PMN to implement cost control measures without compromising core production and integrity objectives.

Table 2. Rigless Prioritization Guideline for Concurrent and Constrained Conditions

Rigless Program Objective	AHP Priority Rank	Concurrent Candidates Scenario	Financial / Operational Constraint Scenario	Decision Description
LPO Reduction	1 (Highest)	Execute immediately	Must be executed	Highest priority due to direct and immediate impact on production recovery and revenue protection
Integrity Restoration	2	Execute after LPO Reduction	Must be executed	Critical for operational safety, well integrity, and prevention of unplanned losses
Well Development	3	Execute if execution capacity allows	Can be postponed	Provides medium- to long-term value but limited short-term production impact
Stimulation	4 (Lowest)	Execute last	Can be postponed or unselected	Incremental production benefit with lower urgency under constrained conditions

Source: Author's synthesis based on AHP prioritization results, 2025

This guideline enables PMN to apply analytical prioritization results in a consistent, transparent, and defensible manner without introducing additional operational complexity. By institutionalizing priority-based decision logic, Rigless execution decisions can be aligned more closely with production objectives, safety requirements, and resource availability.

Managerial Implications

The implementation of the Rigless Prioritization Guideline provides several managerial benefits, including consistent decision-making across planning periods, clearer justification for execution choices, and improved alignment between Rigless execution objectives.

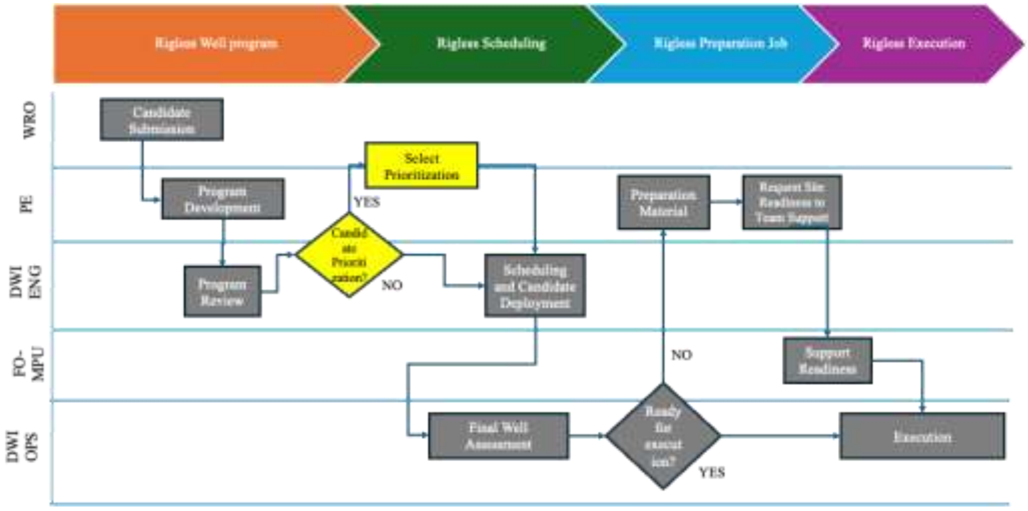

Figure 6. Rigless Execution Decision Flow Based on AHP Prioritization
Source: Author's design based on AHP prioritization framework, 2025

Above figure illustrates the improved decision flow by adding a structured prioritization step after the technical review stage. Compared to the current process in Figure I.2 which follows a sequential workflow without clear priority, this improved flow enables PMN to rank concurrent Rigless candidates and apply consistent execution and deferral decisions.

Implementation Plan and Justification

Based on the proposed business solution, an indicative implementation plan is developed to illustrate how the Rigless Prioritization Guideline can be introduced, tested, and adopted within the organization. The proposed Gantt chart presents the sequential implementation steps required to operationalize the business solution over time, while the accompanying explanation provides clarification on the objective, scope, and expected outcome of each step. Together, the Gantt chart and its explanation serve as a practical representation of how the proposed business solution may be implemented in PT Penopang Minyak Nasional in a structured and manageable manner.

Table 3. Proposed Gantt Chart Schedule for Implementation Plan
The color only representing about step of the Gantt chart

Task	Duration Estimation	W1-W2 April 2026	W3-W4 April 2026	W1-W2 May 2026	W3-W4 May 2026	W1-W2 June 2026	W3-W4 June 2026	W1-W2 July 2026	W3-W4 July 2026	W1-W2 Aug 2026	W3-W4 Aug 2026	W1-W2 Sep 2026
Finalize Guideline	13											
Management Endorsement	14											
Socialization (PE–CE)	13											
Process Integration	20											
Pilot Implementation	30											
Evaluation & Refinement	14											
Formal Adoption	15											

Source: Author's proposed implementation plan based on AHP prioritization results, 2025

The implementation schedule presented in the Gantt chart represents a conceptual roadmap intended to illustrate sequencing and logical dependency among activities. The actual starting date, duration, and overlap of each step may be adjusted in accordance with PT Penopang Minyak Nasional's (PMN) operational readiness, organizational priorities, workload distribution, and resource availability. As such, the proposed timeline should be interpreted as flexible and adaptive rather than prescriptive.

To support interpretation of the proposed Gantt chart, an explanatory table is included to describe the objective and role of each implementation step. This combination ensures that the business solution is presented not only in terms of timeline, but also in terms of decision rationale and practical relevance

Table 4. Sequence Step for Implementation Plan

Step	Objective	Description	Expected Output	Remarks
Finalize Guideline	To establish a clear decision reference	The prioritization results are compiled into a formal Rigless Prioritization Guideline, including execution and deferral rules.	Draft prioritization guideline	The guideline serves as a decision reference, not as a formal procedure
Management Endorsement	To provide governance and authority	Management reviews and endorses the guideline to ensure alignment with corporate objectives and decision authority.	Endorsed guideline	Endorsement strengthens accountability without adding bureaucracy
Socialization (PE–CE)	To ensure shared understanding	The guideline is communicated to PE and CE teams, focusing on how it is applied in decision-making.	Common understanding among stakeholders	Methodological details are not emphasized
Process Integration	To align with existing workflow	The guideline is used as a reference during approval and scheduling within the PE–CE–approval–scheduling process.	Guideline applied in execution decisions	No changes to existing workflow structure
Pilot Implementation	To test practical applicability	The guideline is applied to selected Rigless cases under concurrent or constrained conditions.	Initial implementation experience	Pilot application reduces implementation risk
Evaluation & Refinement	To improve clarity and usability	Feedback from the pilot phase is reviewed, and minor refinements are made where necessary.	Refined guideline	Refinement is based on operational feedback
Formal Adoption	To institutionalize the guideline	The refined guideline is formally adopted as a standard decision reference for Rigless execution.	Consistent decision reference	Adoption remains adaptable to future changes

Source: Author's proposed implementation plan based on AHP prioritization framework, 2025

This study was conducted to address the decision-making challenge faced by PT Penopang Minyak Nasional (PMN) in prioritizing Rigless well candidates under dynamic operational conditions. The challenge becomes particularly significant when multiple Rigless candidates arise concurrently or when financial and operational constraints require selective execution. In the absence of a structured prioritization reference, such conditions may lead to inconsistent decision making and suboptimal allocation of execution resources. Using the Analytical Hierarchy Process (AHP), this study established a structured prioritization of Rigless program objectives based on expert judgment and multiple decision criteria. The results indicate that LPO Reduction is the highest priority, followed by Integrity Restoration, Well Development and Stimulation. This priority order reflects expert judgment regarding the relative importance of production recovery, operational integrity, strategic value, and execution impact within Rigless operations. Based on the analysis conducted in this study, the research questions have been addressed as follows:

RQ1: How can a systematic method be developed to prioritize Rigless well candidates when multiple urgent jobs arise simultaneously?

This study answers the first research question by employing the Analytical Hierarchy Process (AHP) to establish a structured and systematic prioritization framework. The method integrates expert judgment with multiple decision criteria, including economic impact, operational urgency, HSSE considerations, and technical feasibility. The results demonstrate that LPO Reduction ranks as the highest priority, followed by Integrity Restoration, Well Development, and Stimulation. This prioritization reflects the relative importance of immediate production recovery, operational integrity, and long-term value creation. Furthermore, the transformation of these analytical results into a Rigless Prioritization Guideline ensures that the proposed method is not only theoretically robust but also practically applicable in supporting consistent, transparent, and business-aligned decision-making under concurrent operational conditions.

RQ2: Which types of Rigless candidates shall be unselected or postponed during efficiency-driven constraints or resource limitations?

The second research question is addressed through the prioritization outcomes which indicate that lower-ranked candidates are more likely to be deferred under constrained conditions. Well Development and Stimulation activities are recommended to be postponed compared to LPO Reduction and Integrity Restoration. LPO Reduction delivers the highest immediate economic benefit through rapid production recovery, while Integrity Restoration is essential to ensure well safety, mechanical reliability, and regulatory compliance. Conversely, Well Development and Stimulation generally provide longer-term benefits and may involve higher uncertainty or dependency on well conditions, making them less critical in situations with limited resources. Therefore, under efficiency-driven constraints, candidates with lower immediate impact, higher execution complexity, and non-critical urgency are systematically deprioritized.

The results show that under current operational conditions, restoring oil production after well-down incidents delivers the greatest immediate value. LPO Reduction stands out as the dominant priority because it consistently performs well across almost all sub-criteria, particularly in generating quick economic returns and shortening the time required to bring wells back on production through the Put-On-Production (POP) process. Following LPO Reduction, The Integrity Restoration emerged as the second highest priority within the Rigless prioritization framework. This ranking is justified by the critical role of well integrity as a prerequisite for all subsequent interventions. While LPO Reduction focuses on short term production recovery, Integrity Restoration functions as an operational gatekeeper by ensuring the mechanical soundness, safety, and regulatory compliance of the wellbore. Without adequate integrity restoration, further interventions such as stimulation or production enhancement would be associated with elevated technical risks and HSSE exposure, potentially leading to severe environmental consequences or permanent well loss.

The prioritization results reflect a strategic orientation toward value creation rather than cost minimization as indicated by the strong emphasis on economic benefit criteria. this study highlights that analytical prioritization results only become truly valuable when they are translated into practical decision guidance. For this reason, the prioritization outcomes are formalized into a Rigless Prioritization Guideline, which serves as a clear and structured reference for execution, deferral, and scheduling decisions. Through this guideline, PMN is better equipped to manage situations involving concurrent Rigless candidates and constrained execution capacity in a systematic, transparent, and business-aligned manner. In summary, the main contribution of this research lies in bridging analysis and practice by transforming prioritization results into an implementable business solution that strengthens Rigless decision-making.

CONCLUSION

This research has succeeded in developing a systematic framework using the Analytical Hierarchy Process (AHP) to prioritize the Rigless well intervention program at PT Penopang Minyak Nasional (PMN). The results of the analysis show that Lost Production Opportunity (LPO) Reduction is the highest priority due to its direct impact on production recovery, followed by Integrity Restoration, Well Development, and Stimulation. These priorities reflect a balance between production urgency, operational safety, and long-term business value. Based on these results, the Rigless Prioritization Guideline was developed as a practical business solution that translates the results of analytical priorities into execution rules and delays that are applicable to the candidate's concurrent conditions or financial or operational limitations. Based on the results of the research, it is recommended that PT Penopang Minyak Nasional (PMN) immediately ratify and implement the Rigless Prioritization Guideline as an official reference in making decisions on the execution of Rigless. The Petroleum Engineering and Completion Engineering teams need to conduct internal socialization and training to ensure a uniform understanding of these priority guidelines. Management should conduct periodic evaluations of the implementation of the guidelines, at least every six months, to make adjustments based on field feedback and changes in business conditions. Further research is suggested to integrate uncertainty factors such as oil price fluctuations or dynamic budget availability into priority models, as well as expand the scope of analysis on the aspects of real-time scheduling and resource allocation.

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