INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 08 Issue 11 November 2025

DOI: 10.47191/ijmra/v8-i11-68, Impact Factor: 8.266

Page No. 6499-6507

Pressure Test & Fluid Analysis While Drilling Deployment to Increase Well Economical Value in Field S

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ABSTRACT: Logging data acquisition in S Field PT East Kal play a crucial role in determining the remaining pressure, new reservoir tank, and the fluid type in this mature field with complex fault system. Since it can reduce the risk of water or cross flow during completion phase that can lead to reduce the well economic value & optimize operation time. Therefore since the wells in S field are consider of high angle consist of trajectory 55-60 degree with 3D turning, the data acquisition need to be carry on with pipe convey logging (PCL) or tough logging condition that time consuming in terms of operation, high risk of having stuck situation due to limitation of rotating and circulating, high risk of tool damage due to held up situation, mud invasion in wellbore when perform the test and the last is the potentially of the tool lost in hole is high and cost full.

The purpose of this research is to overcome those challenges by perform technique and more robust operation that can minimize the risk & improve operation time, that leads to increase well economical value. Pressure test & fluid analysis (PTFAWD) alongside with gamma ray-resistivity-porosity-density-measure while drilling in rotary steerable is installed in drilling bottom hole assembly. The operation can be performed shortly after the well reached the total depth during trip out of hole so that the risk of well stuck & mud invasion is minimize.

Pressure test & fluid analysis (PT-FAWD) while drilling is a method that suitable in face the challenge of high profile well that have wellbore risk & to improve operation time efficiently. By improving the operation time, the aim is to reduce Capex, and lead to increase the well NPV.

KEYWORDS: PT-FAWD, mature fields, logging while drilling, NPV

I. INTRODUCTION

PT East Kal's Field S, an offshore oil and gas producer in the Makassar Strait, has entered a mature, declining production phase since 1991. The challenge in revive this field lies in efficient and safe data acquisition within high-angle, 3D trajectory wells (Figure 1) that target depleted reservoirs. Conventional methods, primarily Pipe Conveyed Logging (PCL) or Tough Logging Condition (TLC), are hindered by operational constraints inherent to deviated wells, including the high risk of stuck pipe and the inability to rotate or circulate the logging string effectively. These risks translate directly into increased non-productive time (NPT) and elevated Capital Expenditure (CAPEX) due to tool contingency and longer rig schedules.

The current business issue is defined by three core questions: 1) The root cause of high-cost acquisition; 2) The financial consequences (NPV, IRR, Payback Period) of TLC versus PT-FAWD; and 3) The optimal financial strategy to mitigate data acquisition problems and enhance economic value. This research hypothesizes that the deployment of PT-FAWD, which combines Pressure Test and Fluid Analysis capabilities with the Measurement While Drilling (MWD) BHA (Figure 2), will overcome these operational challenges, leading to measurable improvements in financial metrics and well economic value.

Figure 1. Declining production in PT. East Kal in Field S.

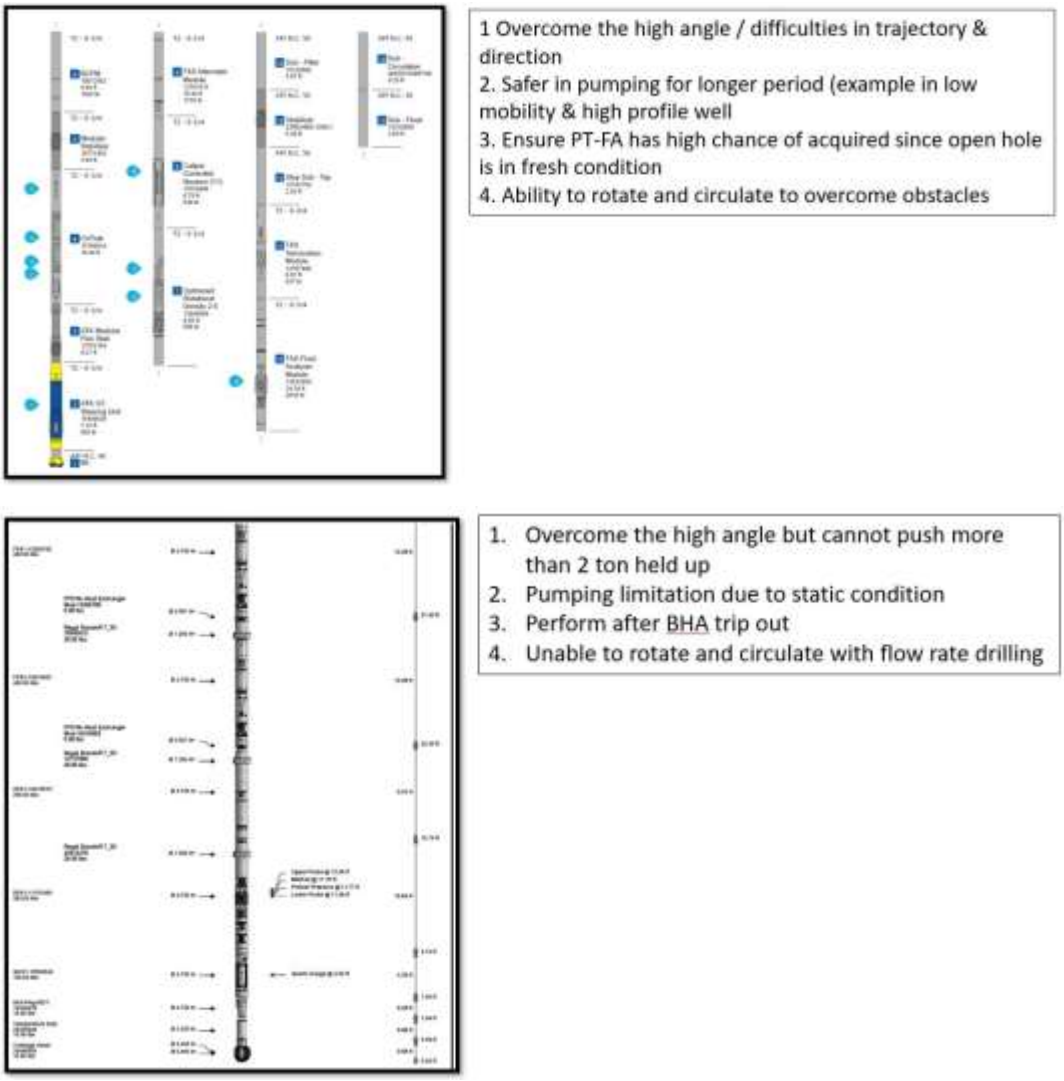


Figure 2. PT-FA while Drilling vs Pipe Convey Logging.

II. RESEARCH METHOLODY

The study employs a quantitative research design utilizing the Capital Budgeting framework, specifically the Discounted Cash Flow (DCF) method, to evaluate two scenarios: PT-FAWD and TLC.

A. Data Collection

Primary data for Capital Expenditure (CAPEX), Operating Expenditure (OPEX), and production profiles were sourced internally from PT East Kal. Economic inputs, including the Indonesian Crude Price (ICP) forecast and the company's 10% hurdle rate, were also used. The Weighted Average Cost of Capital (WACC) was calculated to be 9.6% (Table I) but the company's official 10% hurdle rate was used for the final DCF analysis.

Table I. WACC Calculation

<table>
<tr><th>Component</th><th>Value</th><th>Description</th></tr>
<tr><td colspan="3">Cost of Equity (Re)</td></tr>
<tr><td>Risk-Free Rate (Rf)</td><td>6.3%</td><td>based on yield of of long-term Indonesia government bond
Source: https://www.investing.com/rates-bonds/indonesia10-year-bond-yield. *Data was Taken from August 20th 2025</td></tr>
<tr><td>Beta (β)</td><td>0.72</td><td>A measure of the stock's volatility in relation to the market.
A slightly higher beta is assumed to reflect the specific risks of operating in mature and complex fields. The value is
benchmarking with BP.
<table><tr><th>Date</th><th>BP Yearly return</th><th>S&P Yearly return</th></tr><tr><td>2025</td><td>+0.63%</td><td>+15.47%</td></tr><tr><td>2024</td><td>-1.19%</td><td>+23.31%</td></tr><tr><td>2023</td><td>+4.39%</td><td>+24.23%</td></tr><tr><td>2022</td><td>+23.42%</td><td>-19.44%</td></tr><tr><td>2021</td><td>+27.91%</td><td>+26.89%</td></tr><tr><td>2020</td><td>-42.74%</td><td>+16.26%</td></tr></table>
From the Beta data (slope) S&P vs BP, the value is 0.72 which is for every 1% move in the market (like the S&P 500), this stock is expected to move only about 0.72% in the same direction.</td></tr>
<tr><td>Equity Market Risk Premium (Rm - Rf)</td><td>5.7%</td><td>EMRP = Expected market return – Risk free rate
(12% - 6.3%) = 5.7% Source from Kiwoom Sekuritas Indonesia * https://www.kiwoom.co.id/main</td></tr>
</table>

Component	Value	Description
Calculated Cost of Equity	10.4%	Re = Rf + (β X Rm-Rf) 6.3+(0.72 x 5.7%)
Cost of Debt (Rd)		
Pre-Tax Cost of Debt	8.3%	interest rate on the company's debt, from S&P Global rating is BBB (Risk free rate + Credit spread) = 6.3 + 2 = 8.3%. Where: BBB rating is given by S&P and demand 2% on top of the risk-free rate due to the business market is consider volatile, massive capex but have government support in case of financial distress
Corporate Tax Rate (T)	22.0%	The standard corporate tax rate in Indonesia for 2025.
After-Tax Cost of Debt	5.69%	Rd * (1 - T) 7.3% * (1 - 22.0%)
Capital Structure		
Weight of Equity (E/V)	79.4%	E/V = Weight of equity benchmarking with BP (Annual report and form 20-F2024 Total Equity (E)= $78,318 M. Financial Debt (D) = $59,547M. Cash and cash equivalent (C) = $39,204M V= Total Equity + Finance Debt – Cash = $78,318M + $59,547M - $39,204M = $98,661M E/V ratio = Total Equity / Enterprise Value = $78,318M / $98,661M = 79.4% Net Debt: Financial Debt - Cash $59,547 - $39,204 = $20,343 M Weight of Net Debt: Net Debt / V
Component	Value	Description
		$20,343 / $98,661 = 0.2061 = 20.6% Weight of Equity (79.4%) + Weight of Net Debt (20.6%) = 100%
Weight of Debt (D/V)	30%	Assumed proportion of debt in the company's capital structure

Weighted Average Cost of Capital (WACC)	9.5%	(Weight of Equity × Cost of Equity) + (Weight of Debt × After-Tax Cost of Debt) (79.4% X 10.4%) + (20.6% x 5.69)

B. **Analytical Metrics**

The financial attractiveness of each scenario was evaluated using standard capital budgeting metrics:

1. Net Present Value (NPV): The sum of discounted Net Cash Flow (NCF) over the project life, minus the initial investment. A positive NPV (Equation 1) indicates a value-creating project.
2. Internal Rate of Return (IRR): The discount rate at which the NPV equals zero (Equation 2). The project is accepted if IRR Hurdle Rate (10%).
3. Profitability Index (PI): The ratio of the present value of future cash flows to the initial investment (Equation 3). A PI > 1.0 indicates an attractive investment.
4. Payback Period (POT): The time required for the cumulative NCF to recover the initial investment.

$$\text{NPV} = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0$$

Equation 1. NPV Formula

$$\$0 = \sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t} - CF_0$$

$$\sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t} = CF_0$$

Equation 2. IRR Formula

$$\text{PI} = \frac{\sum_{t=1}^{n} \frac{CF_t}{(1+r)^t}}{CF_0}$$

Equation 3. PI Formula

III. RESULT AND DISCUSSION

The analysis compared the economic life of the well from 2025 (Drilling) to 2034 (Abandonment).

A. Capital and Operational Expenditure (CAPEX)

The deployment of PT-FAWD resulted in a reduction in CAPEX due to minimized rig time and operational risk compared to the TLC method, which requires dedicated trip time and faces higher contingency costs.

Table II. PT-FAWD VS TLC Capex

Scenario	Drilling CAPEX (MUSD)	Total CAPEX (MUSD)
PT-FAWD	13,835	14,103
TLC	14,843	15,111
Difference	1,008	1,008

The PT-FAWD scenario yields a direct CAPEX saving of approximately 1,008 MUSD.

B. Financial Feasibility Comparison

The project’s cash flow analysis confirmed that both scenarios are economically viable (NPV > 0), but PT-FAWD delivered substantially better financial performance across all key metrics (Table III).

Table III. Summary Project

Metric	PT-FAWD Case	TLC Case	Conclusion
NPV (MMUSD)	2.62	1.64	59.8% higher
IRR	18%	15%	3.0 percentage points higher
PI	1.19	1.11	Better return in investment
Payback Period (POT)	4.5 years	5.2 years	Recovers investment 0.7 years sooner

The accelerated Payback Period for PT-FAWD (4.5 years) occurs one year earlier than TLC (5.2 years), highlighting the impact of upfront cost savings and faster realization of revenue.

C. Risk and Sensitivity Analysis

A sensitivity analysis (Tables IV and Table V) identified oil production and oil price as the highest-impact variables on the project's NPV, followed closely by CAPEX. In unfavourable conditions (e.g., 65 USD/bbl oil price), the TLC scenario yielded a negative NPV, making it vulnerable to market volatility. In contrast, the PT-FAWD scenario maintained a positive NPV under the same stressed conditions, demonstrating its robust financial profile and ability to sustain profitability despite market fluctuations (Figure 3 and Figure 4).

Table IV. Sensitivity Analysis on PT-FAWD Case

Percentage	-30%	-20%	-10%	0%	10%	20%	30%
NPV	1.85	2.10	2.36	2.63	2.89	3.15	3.41
Capex	6.64	5.30	3.97	2.63	1.29	-0.05	-1.39
Opex	2.75	2.71	2.67	2.63	2.59	2.54	2.50
Production Oil	-2.01	-0.47	1.08	2.63	4.17	5.72	7.27
Production Gas	2.21	2.35	2.49	2.63	2.77	2.90	3.04
Oil Price	-1.26	0.11	1.41	2.63	3.78	4.86	5.86
Gas Price	2.63	2.63	2.63	2.63	2.63	2.63	2.63

Table V. Sensitivity Analysis on TLC Case

Percentage	-30%	-20%	-10%	0%	10%	20%	30%
NPV	1.14	1.31	1.47	1.64	1.80	1.96	2.13
Capex	5.94	4.51	3.07	1.64	0.20	-1.23	-2.67
Opex	1.77	1.73	1.68	1.64	1.59	1.55	1.50
Production Oil	-3.00	-1.46	0.09	1.64	3.18	4.73	6.28
Production Gas	1.22	1.36	1.50	1.64	1.78	1.91	2.05
Percentage	-30%	-20%	-10%	0%	10%	20%	30%
NPV	1.14	1.31	1.47	1.64	1.80	1.96	2.13
Oil Price	-2.25	-0.88	0.42	1.64	2.79	3.87	4.87
Gas Price	1.64	1.64	1.64	1.64	1.64	1.64	1.64

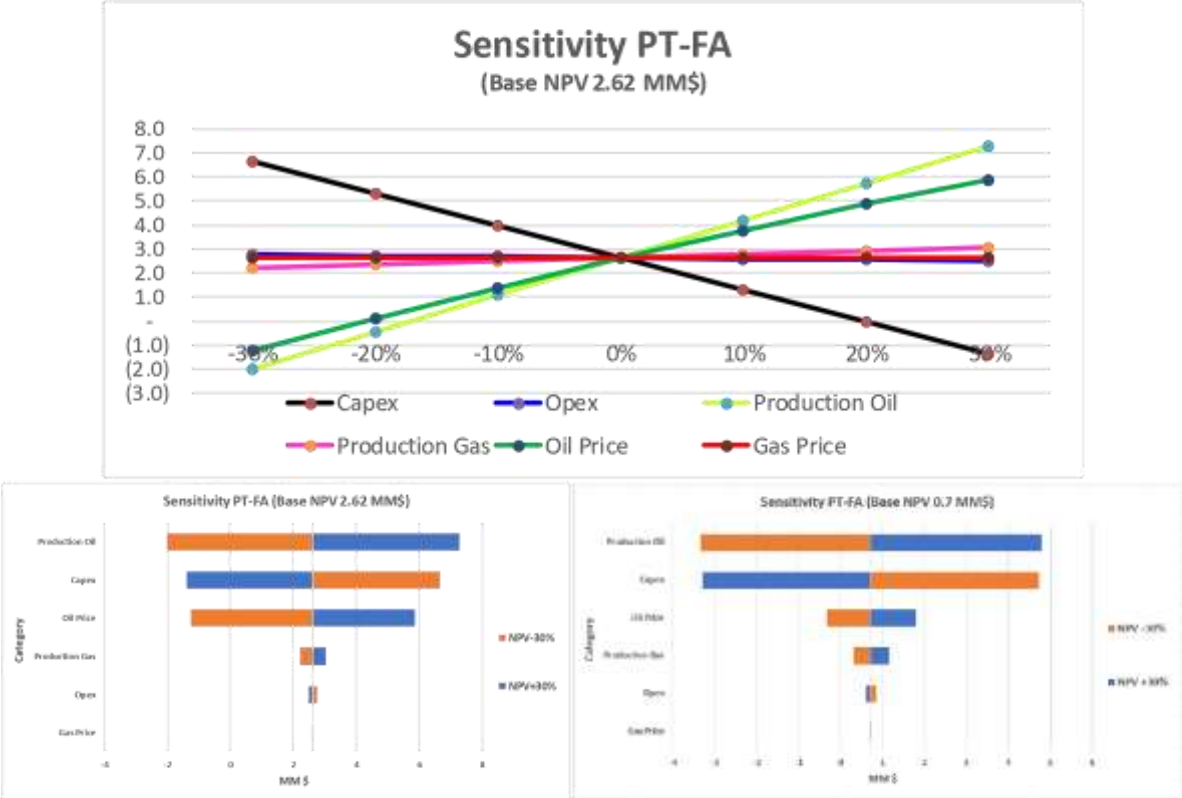


Figure 3. Sensitivity analysis on PT-FAWD 2.62MM using oil price 74$/bbls and 0.7MM using oil price 65$/bbls.

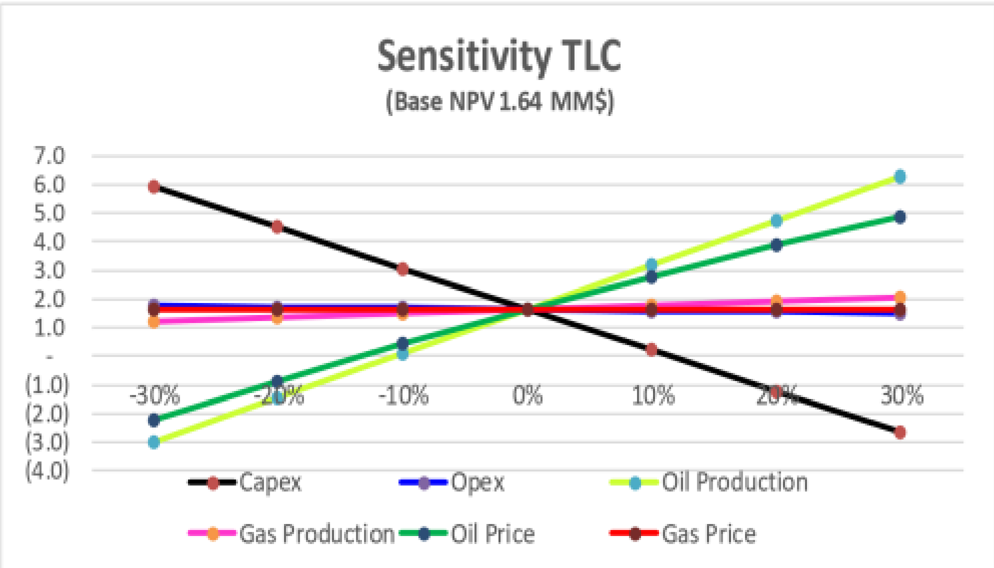
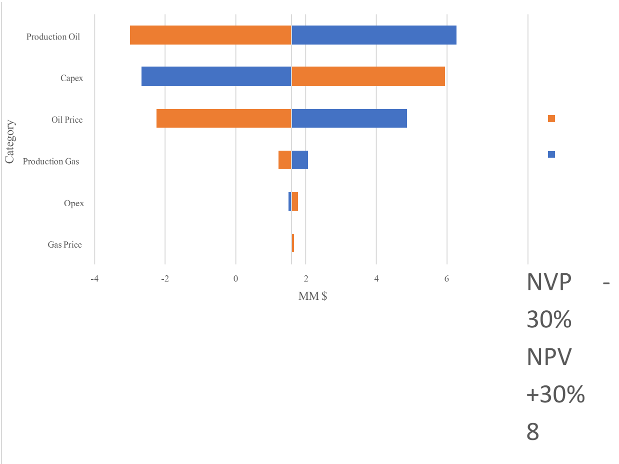
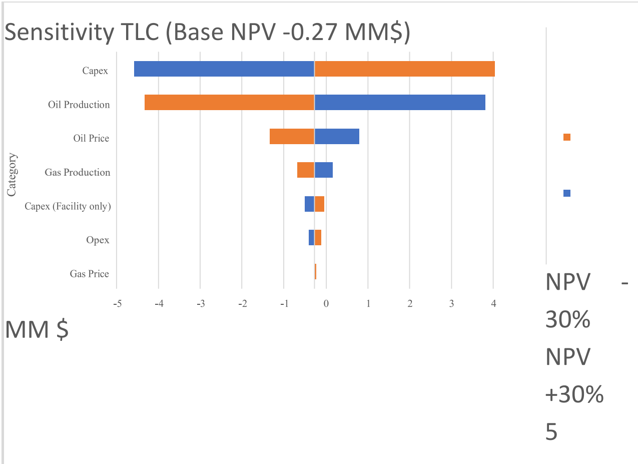


Figure 4. Sensitivity analysis on TLC 1.64MM using oil price 74$/bbls and -0.27MM using oil price 65$/bbls

Sensitivity TLC (Base NPV 1.64 MM$)





IV. CONCLUSION AND RECOMMENDATION

The deployment of Pressure Test & Fluid Analysis While Drilling (PT-FAWD) in Field S is conclusively the optimal strategy. It successfully addresses the root cause of high-cost acquisition—operational complexity in high-angle wells—by providing a safer, more efficient, and more reliable data logging solution. The resulting operational efficiency and CAPEX reduction translate directly into a superior financial outcome, including a 59.8% higher NPV and a shorter payback period, aligning with PT East Kal's objectives for lean operations and enhanced project economics.

Recommendation: PT East Kal should prioritize securing a long-term contract for PT-FAWD services for all future high-angle and challenging wells in Field S to further reduce unit contract costs and ensure consistent data quality and operational efficiency. The company must also establish a robust system for post-mortem analysis and continuous monitoring of operational metrics and expenses to ensure sustained economic benefits.

ACKNOWLEDGMENT

This final project is dedicated to my beloved wife Raini Adinda Siwikirana, My Sons Kayano Wicaksono & Kenji Wicaksono, you are my world and my reason for being. Pak Oktofa Yudha Sudrajad, S.T., M.S.M., Ph.D for the thesis guidance. Papa Mimbar, Mama Erni, Mbak Lia, Mas Seno, and for my 3-fur unconditional love Citam, Kontey & Cantik. My best support system in my master journey Sindikat Balikpapan: Bobby Yusuf, Cindy Savitri, Rian Ikhsan, Hafizhan Ihsandani, Muhammad Harifan. Blemba IAITB 70 Balikpapan Riau. My finance mentor Mr Betrus Borselano & Mr Teguh Diyanto, Rian Rachmanto, Admin Adiyanto, Lord Maharditio, Lord Trinanda, DNP Team: Mbak Yuniartania Savitri, Chandra Fadilah, Lord Gema Rivaldi. Pak Ahmad Yuda. Pak Sulis as my manager, Mas Amank as my leader. Mbak Riska Chester for early MBA Discussion.

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