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Proactive Job Optimization in Heavy Oil Asset Optimization Team

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Abstract - **The oil and gas circumstance were changing rapidly in early 2020 where the oil price declined significantly more than 50% due to demand contraction as coronavirus pandemic spreading around the world and supply surge due to Russia/Saudi supply agreement breakdown. This condition causing unprecedented upheaval in business activities including the oil and gas industry including in C Corporation Indonesia, the leading oil producer in Indonesia. The project's purpose is to develop an optimization plan for the proactive job in a low-oil price environment by using simple linear programming that incorporated the recent technical lookback, production sharing contract economic calculation, and decision analysis process to develop alternative solutions. The optimization result would impact the operation management of proactive job activities related to resources adjustment, production, and operation expense (OPEX) outlook. This effort has successfully improved proactive job economic viability in the low oil price environment.**

Keywords - **Alternative solution, decision analysis, economic evaluations, forecasting, operation management, optimization.**

I. INTRODUCTION

C Corporation Indonesia (CCI) is one of the leading oil and gas operators that has been operating Rokan Block in Riau Province, Indonesia for decades. This company operating Heavy Oil Field, the biggest oil field producer that applied steamflood technology in the country. The average production of Heavy Oil Field was 63,000-barrel oil per day (BOPD) in 2020.

A. Heavy Oil Asset Optimization Team (HO AOT)

Heavy Oil Asset Optimization Team (HO AOT) is a team that is responsible for managing base business activities related to wells maintenance and its optimization in the existing wells in Heavy Oil Field including managing the oil reservoir performance.

The team composition is dominated by Petroleum Engineer and Earth Scientist (Geologist and Geophysicist) that in charge of hydrocarbon reservoir management. The team manage the day-to-day production and injection operation, mapping subsurface opportunities, calculate oil reserve, develop production forecast and outlook, develop a business plan, and generate work program and budget to fund base and proactive job group handled by HO AOT consist of the well services, chemical stimulation, workover, surveillance, and rig-less jobs.

B. Business Issues

Oil and Gas Industries were once again stirred up in early 2020 by oil prices crashed due to demand contraction associated with the COVID-19 pandemic and supply surge due to the price war between Russia and Saudi Arabia [1].

The decline in oil prices in early 2020 was quite fast and was not predicted in advance by any oil company in the world. The high-risk nature of the oil and gas industry is highly dependent on oil price stability and its forecast. When oil prices are predicted to stabilize at a certain level for a certain period, oil companies will spur to execute various projects on their portfolios that are still commercial to do on that condition. With the high oil prices level and its forecast, the company could act to aggressively explore the oil reserve in difficult locations or complex hydrocarbon reservoir characteristics. They would use sophisticated technology and spend high capital investment from the available company resource.

This research was conducted in HO AOT to evaluate the economic impact of the oil price drop on the proactive job group in the Heavy Oil Field and develop an optimization effort to improve the economic viability of proactive jobs amid low oil price conditions.

TABLE I
THE ECONOMIC IMPACT OF OIL PRICE DROP TO HEAVY OIL PROACTIVE JOB

	Proactive Job		
Parameters	Chemical Bullhead	Chemical Coil Tubing	Proactive Workover
Job Count	676	360	112
Cost/Job, $M	10.0	27.4	53.5
Estimate oil gain /job, BOPD	6.2	6.5	9.4
OPEX, $M	6,760	9,878	6,000
Economic Result at Oil Price $60			
NPV, $M	5,345	2,260	1,182
Profitability Index (PI)	1.87	1.25	1.22
Economic Result at Oil Price $30			
NPV, $M	3,785	609	401
Profitability Index (PI)	1.59	1.07	1.07

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The unexpected significant drop in oil prices has made some proactive jobs in Heavy Oil Field was struggling to meet the economic threshold set by the company. Some jobs might not be easy to stop since the resources (such as rig and materials) that have prepared to do that job were tied to a contract in a certain period, then the team must identify the opportunities to develop alternative solutions to optimize the proactive job activities in the shortest possible time.

The oil price drop made the profitability index of chemical coil tubing and proactive workover below 1.20 as the company economic threshold. In the business plan 2020, the company still assumed that oil price would be steady at $60 per barrel until 2021 (see Table 1).

C. Proactive Job in Heavy Oil Field

A Proactive job is a type of work performed proactively on a well that intended to improve the performance of underperforming wells due to problems in subsurface or wellbore that are not related to pump problems. Proactive job in HO AOT divided into three groups that classified based on economic viability. First, chemical bullhead to clean out scale in the wellbore in single zone completion. Second, a chemical with coil tubing unit (CTU) to clean out wellbore in multiple zone completions. Third, proactive workover that has the objective to change hydrocarbon producing zone or revise the wellbore configuration.

II. METHODOLOGY

This research used the internal company data and information from HO AOT in CCI, especially related to business planning that consists of production and operation expense budget (OEB) forecast including the assumptions as to the primary data.

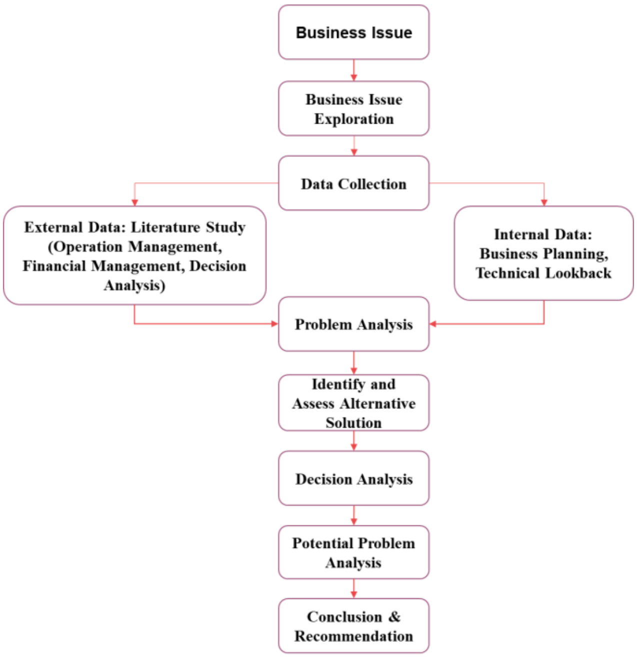

Fig. 1. Research Methodology

The secondary data obtained to support this research came from business and administration textbooks, petroleum engineering textbooks, thesis reports, published papers, websites, and public reports. These data are important to support the primary data to generate a comprehensive evaluation of business issues and develop the solution.

The research methodology was created to answer the research objective which is to develop the optimization plan for a proactive job in Heavy Oil Field. The optimization incorporated the lesson learn from the recent performance, technical and financial look back, lean sigma projects, and the latest decision made by management related to economic hurdles. Linear programming method will be used to develop the most optimum and profitable operations in each scenario that developed.

The economic evaluation of this research will refer to production sharing contract (PSC) economic calculation that resulting from some financial indicators such as net present value (NPV) and profitability index (PI). The main input of PSC economic calculation are oil production, oil price, and decline rate.

A. Production Sharing Contract (PSC)

C Corporation Indonesia (CCI) is a contractor of the Government of Indonesia (GoI) under a production sharing contract (PSC). PSC is a contractual agreement between a company and a host government whereby the company bears all exploration, development, and production cost in return for an agreed-upon share of production [2].

The characteristics of PSC are the company appointed by the government as a contractor to exploit oil or gas concessions in a certain area. The contractor is responsible to endure all risks related to exploration cost, development, and production. If the exploration successfully discovered hydrocarbon and commercial to be developed, then the contractor could get cost recovery from the government. Cost recovery is a reimbursement of the cost spent by the contractor. The contractor also acquires the production share after cost recovery called profit share or profit split or profit oil. The contractor must pay the income tax and other taxes. All equipment and installation on the field are belonged to the government [3].

B. Profitability Threshold

In general, profitability is the main determinant of a company's performance. Profitability is closely related but different from profit. While profit is an absolute amount, profitability is a relative one. Profitability is used to measure the company's efficiency and eventually its success or failure. Profitability can be also further defined as the ability of a given investment to earn a return from its use [4]. The level of the profitability of a company can be measured by using several profitability ratios including gross profit margin, net profit margin, return on equity, and return on investment [5].

A variation of the net present value (NPV) rule is called the profitability index (PI). For a project that has an initial cash outflow followed by cash inflows, the profitability index (PI) is simply equal to the present value of cash inflows divided by the initial cash outflow. When companies evaluate investment opportunities using the PI, the decision rule they follow is to invest in the project when the index is greater than 1.0. A PI greater than 1.0 implies that the present value of cash inflows is greater than the (absolute value of the) initial cash outflow, so a profitability index greater than 1.0 corresponds to a net present value greater than 0. In other words, the NPV and PI methods will always come to the same conclusion regarding whether a particular investment is worth doing or not [6].

CCI uses the profitability index (PI) as the main economic parameter to rank the job opportunities or projects that will be funded during the business planning cycle. The certain PI threshold will be set by the company depend on the oil and gas business environment situation. The threshold will assist management to decide on budget allocation during the business plan. Each project will have competed with the overall projects listed in the company portfolio.

C. Decline Rate Analysis

Decline rate analysis is a reservoir engineering empirical technique that extrapolates trends in the production data from oil wells. The purpose of a decline analysis is to generate an oil forecast for future production rates and to determine the expected ultimate recoverable (EUR) oil reserve [7].

There are several declines curve types or methodologies in the textbook, but the exponential decline is the most popular method used in the industry for generating oil forecasts in the mature field or mature well. Historical trends are used as a basis for predicting future production. However, the prediction generated from decline analysis will only be valid if the characteristics of the producing well remain constant, or if the assumptions in a prediction are accurately revised over the life of the well [8].

Since Heavy Oil Field's current production performance is already in the mature phase, then the exponential decline method is the appropriated and proven method to develop the oil forecast. This method is not only used for field or well forecast but also used to predict the performance of well after proactive job execution.

D. Job Lookback and Resource Evaluation

To develop the alternative solution in this optimization effort, the researcher collected the recent information related to technical job lookback, study, or lean sigma project of the proactive job in HO AOT. The information collected was historical job count, actual oil gain, decline rate after job, actual cost, success rate by area, and subsurface opportunity catalog.

HO AOT performs the job lookback for the proactive job at least once a year. The lookback process consists of technical and financial evaluation. The purpose of this lookback is to know the performance of a job group to extract the lesson learned from the success and failure jobs based on certain parameters. The job that delivers good performance that supporting the overall field production will be retained and maintained in the next years. The jobs that have marginal economics will get special attention and further evaluation to decide to stop or continue with the improvement. The results will be presented to all team members including higher-level management.

The researcher also collected the information about resource capacity that is used to execute the proactive job to seek any opportunity to adjust the resource outlook that would incorporate to generate the alternative solution. The opportunity of resource adjustment outlook then communicated to decision review board to get the management endorsement. During the resource capacity review, the team identified the chance to reduce job capacity in chemical CTU and proactive workover, also found an opportunity to increase job capacity in chemical bullhead.

E. Linear Programming

Linear programming (or simply LP) refers to several related mathematical techniques used to allocate limited resources among competing demands in an optimal way. LP is the most widely used of the approaches falling under the general heading of mathematical optimization techniques and has been applied to many operation management problems.

The linear programming problem entails an optimizing process in which non-negative values for a set of decision variables X_1, X_2, …., X_n are selected to maximize (or minimize) an objective function in the form.

$$\begin{gathered} \text{Maximize(minimze) } Z = C_1 X_1 + C_2 X_2 + \ldots + C_n X_n \\ \text{Subject to resource constraints in the form} \\ A_{11} X_1 + A_{12} X_2 + \ldots + A_{1n} X_n \leq B_1 \\ A_{21} X_1 + A_{22} X_2 + \ldots + A_{2n} X_n \leq B_2 \\ . \\ A_{m1} X_1 + A_{m2} X_2 + \ldots + A_{mn} X_n \leq B_m \end{gathered} \tag{1}$$

Where C_n, A_{mn}, and B_m are given constraints. Depending on the problem, the constrains also may be stated with equal signs (=) or greater-than-or-equal-to signs (≥) [9].

On this research, we will use linier programming method to generate the optimum forecast of resource or activity level to maximize the aggregate net present values (NPV) considering budget and resources available.

F. Decision Analysis Process

Decision analysis is a process for solving the problem. While most decisions are unique, the general process can be the same. There is a ten-step sequence decision making: proactively identify decision opportunities, define the problem, identify alternatives, develop the decision model, quantify judgment about uncertainty, develop the valuation model, calculate the expected value for each alternative, rethink the problem, implement the best alternatives, post-analyze the decision [10].

G. Conceptual Framework

The researcher developed a conceptual framework to show the relationship between the variable that involves in the research. The objective of this research is to develop an optimization effort of proactive jobs in the Heavy Oil Field to improve the economic viability (NPV and PI) in a low oil price environment. Three main parameters affected economic viability on executing proactive jobs consist of total operation expense (OPEX) and oil production as controllable parameters and oil price as uncontrollable parameters.

The OPEX spending planning will depend on the job capacity and estimate cost per job. The job capacity affected by resource availability consists of the service company, materials, and other contracts. The resource will be prepared by the company based on business planning that is approved one year before execution. Cost per job will refer to existing contracts and material price.

The oil production forecast or outlook for economic calculation will depend on existing knowledge of each proactive job referred to the recent technical job lookback. The optimization effort will focus on how to optimize OPEX and oil production for the proactive job.

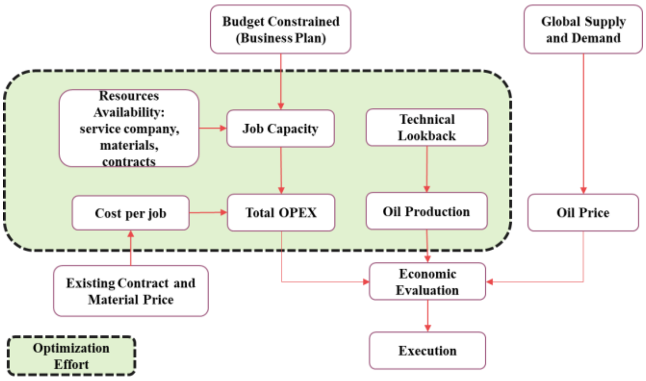

Fig. 2. Conceptual Framework

The optimization effort of this research was following the steps of the decision analysis process explained in the previous section. The researcher created linear programming methods that incorporated all parameters that affected the economic viability of proactive jobs such as estimating oil gain per job, decline after job, cost per job, maximum resources capacity, and job opportunity capacity. The economic calculation in linear programming used the PSC term. The program resulted in the maximum NPV with the optimum number of resources and the optimum scheduling for each alternative solution.

III. RESULTS

The result of optimization effort for proactive job in Heavy Oil divided into three recommendations. First, increase chemical bullhead job with the optimum capacity of resource available. Second, decrease chemical coil tubing unit (CTU) to minimum level and reallocate the budget saving to chemical bullhead. Third, optimize the execution of proactive workover by focusing on low-cost job, improving the candidacy, and utilize deadstock material for several type of proactive workover to improve economic viability.

TABLE 2
2020 PROACTIVE JOB PLAN VS OUTLOOK

Job Type	2020 Plan		2020 Outlook		Delta	
	Job	OPEX	Job	OPEX	Job	OPEX
Chemical Bullhead	676	6,760	986	9,714	310	2,954
Chemical CTU	360	9,878	329	7,350	-31	-2,528
Proactive WO	112	6,000	172	6,470	60	470
Total	1,148	22,638	1,487	23,534	339	896

From table 2, it shows that the total job count outlook was 339 jobs higher than the plan contributed from increasing chemical bullhead job as the impact of increasing bullhead job capacity. Proactive workover job also increased due to executing faster cycle time job and lower cost per job. The increasing job count impacted to higher OEB outlook than plan $896,000 (4% increase from the base case).

Table 3 shows the economic impact of optimization effort compared to the base case scenario on all proactive job activities in the Heavy Oil Field in a low oil price environment. The optimization effort has driven the company to increase the proactive job volume without sacrificing the economic parameters such as net present value and profitability index that showed improvement.

TABLE 3
THE ECONOMICS IMPACT OF PROACTIVE JOB OPTIMIZATION

Parameters	Base Case	Preferred Alternatives	% Increase
Job count	1,148	1,487	30%
OPEX, $M	22,637	23,533	4%
NPV, $M	4,796	6,308	32%
PI	1.23	1.29	5%
OIL, Mbbls	2,383	2,930	23%

IV. DISCUSSION

The sudden fall in oil prices due to the covid-19 pandemic has shocked the oil and gas industry players. Upstream is severely impacted negatively; steep decline in revenues, which in some cases may not cover relatively higher-cost producers' operating expenditures. In the meantime, stopping oil production could technically be difficult and very risky as it could jeopardize the extraction of the reserve in the future. All service companies related to the oil sector will certainly pain and ultimately need to make drastic adjustments [11].

The management of CCI also takes fast actions on this unprecedented upheaval. Optimization continues to be carried out in all existing business units so that the company can survive amid a low oil prices environment which will continue the weeks and months ahead.

The research question for this final project:

From this research, we learned that the capability to adjust the resource for running the activities is an important factor to mitigate the rapid change of business situation such as oil price sudden drop. The company is supposed to have a continuous improvement effort routinely that has the objective to reduce cost, increase revenue, and maintain the safety of their activities by doing job lookback, study, or any improvement project that is captured in the company knowledge management. In the end, strong leadership of management would become the catalyst for the company to make fast adjustments and improvements.

V. CONCLUSION

The combination between internal proactive job lookback, resource capability evaluation, cross-functional team collaboration, economic analysis, and linear programming tool successfully developed the alternative solutions and gave the best alternative option to management on optimizing proactive job activities in Heavy Oil Field in a low oil price environment. This effort has impacted the company to adjust their business planning on managing proactive job activities in Heavy Oil Field. The company still can execute the economic jobs in low oil environment by doing resource and funding reallocation by prioritizing the prolific job that has a lower cost per job and better oil production.

The research helped the company to develop the alternative solution and choose the best alternative to pursue. All recommendations for a proactive job successfully increase the economic viability of the job amid a low oil price environment. The preferred alternative solution successfully brought HO AOT on enhancing the performance of the proactive job in the Heavy Oil Field. The oil production increased 23% from 2.4 to 2.9 million barrels. The NPV increased 32% from $4.8 to $6.3 million and the profitability index increased from 1.23 to 1.29.

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REFERENCES

[1] Baker & Mckenzie International, "The impact of COVID-19 on the Oil and Gas Industry," 2020.
[2] PT CPI. "Doing Business in CPI," Internal Publication, 2019.
[3] Lubiantara, Benny, "Ekonomi Migas", Jakarta: PT Gramedia Widiasarana Indonesia, 2012.
[4] Tulsian, M, "Profitability Analysis (A comparative study of SAIL & TATA Steel)," IOSR Journal of Economics and Finance, 3(2), 19-12. 2014.
[5] Hery. "Analisis Laporan Keuangan," Jakarta: Bumi Aksara. 2012.
[6] Gitman, Lawrence J., & Zutter, Chad J. "Principle of Managerial Finance (14th Edition)," New York: Pearson, 2015, pp. 451.
[7] Fekete. "Traditional Decline Analysis Theory", Available at http://www.fekete.com/san/webhelp/feketeharmony/harmony_webhelp/content/html_files/reference_material/Analysis_Method_Theory/Traditional_Decline_Theory.htm, accessed: February,16 2021.
[8] Allen, Thomas O., & Roberts, Alan P, "Production Operations Volume 1 Well Completions, Workover, and Stimulation (Fifth Edition)", Tulsa Oklahoma: Petroskills. 2012, pp. 2-42.
[9] Jacobs, F. Robert., & Chase, Richard B, "Operation and Supply Chain Management Fifteenth Edition", New York: Mc Graw Hill Education, 2018, pp.691.
[10] Schuyler, John, "Risk and Decision Analysis and Projects Second Edition", Newtown Square Pennsylvania: Project Management Institute. 2001.

***ISBN**:978-623-92201-2-9*

[11] Prawiraatmadja, Widhyawan, "Covid-19 Pandemic: Impact on the Oil and Gas Industry", Available at http://iesr.or.id/wp-content/uploads/2020/05/Covid19-Pandemic-Impact-on-the-Oil-and-Gas-Industry-IESR.pdf, accessed: May, 16, 2021