

Management And Financial Accounting In Oil and Gas Upstream Industry.

How to determine the value of Oil and Gas Properties and optimizing their values.

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Abstract

A lot of us may wonder why the oil and gas companies buy or sell the interests of other oil and gas companies in specific properties at that price? Why it should not be more or less? How the value of oil and gas properties are determined? Many Explorationists, geologists, Finance Manager, management accountants or students have the same questions. Therefore, We discussed in this paper the factors that impact the sale price of properties and how they are contributed to assess the value of those properties. We classified the properties into three categories; exploration properties, development properties and production properties and the Internal auditor's role in reviewing the valuation of such properties.

Keywords: value of proved and probable reserves, oil and gas reserves disclosures, petroleum reserves disclosure, special financial and non-financial ratios for oil and gas industry, net present value of reserves

According to Financial Accounting Standard No. 157 (FAS157) and International Financial Reporting Standard No. 13 (IFRS 13), indicate to three approaches of valuation techniques, Income approach uses the discounted cash flow which is one of the important techniques that is used as value measurement in oil and gas properties for development and production properties and may be reasonably and sufficiently reliable that can be categorized within Level 1 of fair value hierarchy due to availability of market that provide quoted commodity of oil and gas. Market and cost approaches that can be used for exploration properties.

Valuation of Production and development properties

If Company intends to buy a oil or gas properties, it needs to estimate cash that will flow in during the life or properties. First the needs to know the proved reserves that is recoverable from the ground, and needs to know if there is any further initial investment needed after buying the properties, the estimate lifting costs, type of the agreements that is held with landowners or host governments, tax rate, recoverable and non-recoverable costs. All those factors help the Company to estimate the cash flow. But estimating the cash flow is not the final stage, Company needs to consider the time value for the money received over

time which the monetary value of cash is decreased due to decreasing the power of purchase. Therefore, the estimated cash flow should be discounted at specific rate that seller or buyer like to use it as appropriate rate. Some companies may use weighted average capital costs (WACC), some companies use required rate of return, other may use inflation rate or free-risk rate. But the most appropriate rates are the first two rates. After discounting the cash flow, Companies will have a negotiation for the price that can be effected by other factors such as political and security risks, ability of production, fund needs and other factors that determine the power of buyer and seller in the negotiation. The more positive factors toward the seller, the more power the seller has to negotiate the price to their interest and vice versa.

To understand the magnitude estimate of cash flow, we will assume the following:

There is development or productive properties which engineer estimate its proved reserves by 200 mmbbls of crude oil, and they estimate that proved reserves can be produced for ten years at annual production volume of 20 mmbbls if the Company drill and develop three other wells. The properties was explored and one well was drilled before by total costs of USD 120,000,000 that include non-recoverable costs of \$10,000,000 and a productive well cost of \$30,000,000 , and the costs of drilling and developing new wells will costs the Company of \$30,000,000 per well to be ready for production. The operating and selling costs will costs the company about \$30 per well and the current oil price is \$110. Financial department of the Company calculate the weighted average capital costs by percentage of 11% and the median required rate of return in the industry is 18% and income tax rate is 35%

The Company signed Production Sharing Agreement with host government that impose 4% of production as royalties, 70% of production after deducting the royalties and cost recovery and paying annual bonus of \$1,000,000 which is not recoverable costs by cost oil.

How much the value of the property?

a) Royalties	4%
b) Government Share	70%
c) Current Petroleum Price	\$110.00
d) WACC	11%
e) Median Rate of Return in Industry	18%
f) Historical (Sunk) Finding Costs, \$	\$120,000,000
g) Non Recoverable Sunk Cost, \$	\$10,000,000
h) Future Development/Finding Costs, $(i+j)*k$	\$90,000,000
i) Number of productive wells	1
j) Number of Wells to be drilled in Future	3
k) Average development & Facility Cost per well,	\$30,000,000
l) Chance of Success for remaining area	20%
m) Income Tax Rate	30%
n) Maximum initial Production per well,bbl	5,000,000
o) Operating Cost per bbl	\$30.00
p) Company's share	35%
q) Recoverable Proved Reserves, bbl	200,000,000
r) Total annual Non-recoverable Costs, \$	\$1,000,000

s) Number of years to be produced		10	
Recoverable Proved Reserves (<i>q</i>)			200,000,000
Oil Price (<i>c</i>)	110.00		
Operating Cost per bbl (<i>o</i>)	(30.00)		
aa) Contribution Margin [(c-o) * q]	80.00		16,000,000,000
Recoverable Historical finding Cost (<i>f-g</i>)	0.60	110,000,000	
Recoverable Future Development/Finding Costs (<i>h</i>)	0.45	90,000,000	
ab) Total Recoverable Finding Costs (f-g+h)	1.05		200,000,000
ac) Gross Profit (aa-ab)			15,800,000,000
ad) Royalties (q*c*a)			(880,000,000)
af) Government Share [(ac - ad)*b]			(10,444,000,000)
bb) Contractor's Net Oil Profit (ac-ad-af)			4,476,000,000
bc) Total Contractor's cash flow in (bb+ab)			4,676,000,000
bd) Non-Recoverable Costs during the life of property (s*r)			(10,000,000)
bf) Less: DD&A [(i+j)*k]		0.60	(120,000,000)
bg) Operating Income Before Tax (bc-bd-bf)			4,546,000,000
ca) Income Tax (bg * m)			(1,363,800,000)
Operating Income after tax (bg-ca)			3,182,200,000
Add: DD&A			120,000,000
cc) Total Operating Cash Flow-In			3,302,200,000
cd) Company's Share of Cash flow In (cc * p)	35%		1,155,770,000
Annual Operating Cash Flow in (cd/s)			115,577,000
Net Present Value of Operating Cash Flow-In			680,659,768
Company's portion of Initial Investments (<i>k*p</i>)			(31,500,000)
Net Present Value of Cash Flow (Fair Value of Reserves)			649,159,768

The above discounted cash flow model shows that the net present value of property is US\$649,160,000. This value is determined based on the seller's factors and let's assume they are the same factors of buyer's too. This amount could be reduced because the buyer should have economic feasible purchase of properties, the value of properties that will be bought needs to be more than the cost of acquiring the properties, and the expected rate of return of buyer might be the median rate of return in the industry,

Therefore, buyer may need to make the profit index 1.18. Therefore, the cost of purchasing the properties will be as follow

$$\text{Profitability Index} = \frac{\text{Present Value of cash flow (Fair Value of properties)}}{\text{Initial Investment (Cost of purchasing properties)}}$$

$$1.18 = 649,160,000 \div \text{Cost of purchasing properties}$$

$$\text{Cost of purchasing properties} = 649,160,000 \div 1.18 = 550,136,000$$

Therefore, the buyer company might pay price of \$550,136,000 or less for the property. If the buyer knows that there is high political and security risks or the seller face short-term solvency problem, or seller could not be operator for producing large oil volume, or the seller has gas production sharing agreement that not include producing oil, the buyer will have power to negotiate with the seller to acquire the property by price less than 550,136,000. Let's quantify the political risks or the above factors that give the power to the buyer. If the all the above factors is probable to be occurred and the certainty of obtaining the present value of cash flow of \$649,160,000 is 70%. Therefore the expected value of property will be calculated as follow:

$$\text{Expected Value (EV)} = \text{Present Value of net cash flow} * \text{Probability of cash flow.}$$

$$\text{Expected value} = \$649,160,000 * 70\% = \$454,412,000$$

And the cost of purchasing properties will be \$385,095,000

Therefore, the price of property can be negotiated between \$38 5,095,000 and \$45 4,412,000.

The above valuation is not optimized study estimate. The above estimate method is magnitude estimate or pre-feasibility study which can be prepared for short time period, to take quick decisions or to have overall view of the value of properties, in this method, the required accuracy of input data is ranged between 25%-40%. And the accuracy of output data is ranged between 50%-60%. If the Company intends to have feasibility study and to optimize its study method to increase its accuracy of output between 80%-95%. It needs to have more accurate calculation in spreadsheets or in a system that calculate the taxes based on their tax laws, calculate DD&A based on GAAP, calculate the royalties, cost oil, contractor's oil profit and overhead recovery based on agreements, obtaining more accurate relevant costs and needs to use more accurate input data. Company should know that the more information and its accuracy is, the more ability to sell the properties in high price or buy the properties in low price.

Valuation of Exploration Properties

The above valuation method is quite widely used among oil and gas companies for determining the value of development and productive properties. However, exploration properties might have different method. Exploration method can use the above method but the present value of cash flow must be converted to expected value by multiplying the present value of cash flow by the probability of success. The probability of success of many properties as an overall are ranged between 10%-50%, it depends on probabilities of geological success that represents the probability of availability of source, trap, porous rocks, fractures, the probability of time, immigration and permeability, and the probability of commerciality. If we assumed replace the proved reserves with the possible or probable and have the

same input data except for the probabilities of success that it is assumed 25% by technical engineer for the exploration property. The expected value of exploration property will be 162,290,000 (649,160,000 * 25%) but such method might be not generally used by oil and gas companies.

- Oil and gas Companies may use market approach for joint venture properties which consider the initial payments, committed future exploration expenditure and payment of cash, uncommitted hypothetical expenditure proposed in production sharing agreement, discount rate and probability of success and period of time that each exploration stage may take (*Michael J. Lawrence, Chapter 25/Mineral Properties, 2010, Guide to Fair Value under IFRS, Edited by James P. Catty. Page 374-375.*). All those factors are combined in the below calculation.

Value of 100% Joint Venture property =

$$\frac{100}{\text{Equity of Farmor}} * [\text{Initial Payment} + (\text{Committed future exploration expenditures} * \frac{1}{(1+\text{discount rate})^t}) + (\text{Uncommitted hypothetical expenditures proposed in PSA} * \frac{1}{(1+\text{discount rate})^t} * P)]$$

Based on the above calculation. We will assume the following information obtained from exploration properties. Three companies are jointly entered to invest in Exploration property, the equity of farmor is 75% of the property, the initial payments is \$120,000,000, Operator of the exploration entered into committed future exploration in the first exploration period by total amount of \$4,000,000 and the PSA stated the second exploration period that has not been entered yet is \$10,000,000, the WACC of the company is 11%. The remaining of first exploration period is 2 years and the second exploration period is 3 years. The technical engineer advises that the probability of success is about 25%. How much the 100% value of the exploration property is? And how much the value of Company's interest of the exploration property?

Based on the above data, we can simply replace the formula with the quantified input in the above example.

$$100\% \text{ Value of Joint Venture exploration property} = 100/75 * [(120,000,000 + (4,000,000 * 1/(1.11)^{1/2} + 10,000,000 * 1/(1.11)^{1/3} * 25\%)]$$

$$100\% \text{ Value of Joint Venture exploration property} = 165,622,000$$

$$\text{Company's share of the exploration property} = 165,622,000 * 32\% = 52,999,000$$

Optimizing the value of oil and gas property

Oil and Gas Companies are always seeking to optimize the value of properties that are held by them. If the Company discovered proved reserves and produce for such reserves and there are chance for developing proved reserves, the company will seek to optimize the value of property by run 3D seismic for the wells, drilling more development wells and building pipeline to produce more proved reserves in the the property until the marginal cost of developing the property equal the marginal revenue. In this case, the optimization method will be changed as long as there is no chance to develop the reserves, the company will intend to reduce the operating costs to increase the expected cash flow in and increase the value of the property.

If the Company needs to optimize the exploration property, Oil and gas company needs to run more seismic acquisition and processing (2D or 3D), to find new prospects that have high chance of success, and high size of potential reserves. Company may then seek to drill few wells at lower costs and high efficiency to discover proved reserves. If the Company discover proved reserves, the value of proved reserves will be subject to cash flow analysis and the probability of success will be between 90% - 100% that will increase the expected value of the property. Also, If Company drilled a well but it is not sure about the initial production rate or the original oil reserves, the Company needs to enter into long-term production testing that will give more accurate data of production and reserves that lead to increasing the value of the property.

Reserves estimate

Due to the reasons of optimizing value of property and as we know that any accounting estimate can be considered as high inherent risk because it will be susceptible for misrepresented or misstated in the financial statements and with Stock Exchange Market, which mislead analyst and stocks or bonds investors to maintain or buy Company's stocks/bonds or even buy reserves or properties from other companies. Also, technical estimate for reserves may mislead Joint Venture investors to keep investing on nonpotential area.

Proven reserves owned by Venture partners are supposed to be recognized in the same reporting period by all venture partners, but this cannot be happened, a venture partner may recognized part of reserves as proved reserves however, other partners has not made final decision to do so, this can give an indication that a company may overstate its proved reserves that can lead to false financial statements and false cash flow analysis or may refer to different technical standards and experience but we cannot take different technical standards and experience an excuse for overestimating the reserves, There are always reasonable average values of parameters in estimating the reserves.

For example exaggerate the proved reserves by 25% more than it should be lead to understating DD&A and overstating net profit and overstating the cash flow in, and increasing financial ratios, pushing stock price up. Such overestimating of reserves more than it should be, is supposed not to refer to judgment or different technical standards and experience.

Oil and gas reserves evaluation is considered as high risk which any misestimated reserves can lead to misstated costs and profit and deceive the investors to call out Company's stock and increase the stock price. Therefore, estimated reserve is high risk area that needs to be subject to internal audit by using independent Petroleum Reserves Evaluator to mitigate the risk of overstating the reserves, and practice advisory 1210.A1-1 strongly recommends Chief Audit Executive (CAE) to obtain competent external service to determine the quantities of reserves to perform an engagement properly. Buyer may have engagement with internal auditor to review and valuate the properties that buyer intend to purchase or depend on its technical staff experience to review the reserves data and estimate along with its management accountants to estimate the value of property.

Possible reserves can be misclassified under probable and probable reserves can be misclassified under proved reserve by exaggerate the variables of computing the Petroleum Initially in Place that lead to overstating the proved and probable reserves, the main variables that can misstated reserves are

- a) the average values of porosity which may not be within reasonable limit of the rock properties available in specific basin which increase the estimated reserves. For example, Company may use high porosity of rock or reservoir in basin A in country X and apply it in basin B in country Y, however, the porosity of basin B is most likely less than Basin A. Therefore, the evaluator should have adequate knowledge about the geological history and properties of rock available in the each basin because degree of porosity varies from location to another due to lithology of rock that describes mineral content and grain size. The variance in porous rocks is caused by changes in pressure, temperature, chemical compaction that rocks have in different location and time. [Norman J. Hyne. *Nontechnical Guide to Petroleum Geology, Exploration, Drilling, and Production*. 2nd Edition. PennWell Corporation. Tulsa. Oklahoma. USA. Page 434-436]

However, porosity and permeability are important factors for evaluating reserves, but this importance has been decreased since nineties when the unconventional reserves become economical viable and produce petroleum from shales that are less permeable or basement that is very less porous. Therefore, the classification of proved and contingent for unconventional reserves has different criteria.

- b) reservoir area can be overstated too, specially if the discontinuity of horizon of reservoir is not defined by remapping after development drilling and it is estimated by seismic interpretation or exploration prospect mapping. [*Oil and Gas Resources of West Siberian Basin, Russia*. November 2007. Energy Information Administration, Office of Oil and Gas, U. S. Department of Energy, Washington, DC 20585. Page 123]

Lack of reliability and transparency of reserves, revenue, exploration, development and production cost can be a problem since overstating reserves become more susceptible.

Transparency International Organization recommends to disclose reserves, production, revenue, exploration, development and operating cost country-by-country in the annual report. Many Oil Companies perform cost and benefit analysis for reporting by country-level in their financial statements but it should be made internally for management purpose to enable management to measure its performance in each country and enhance its technical knowledge and experience in this country or to learn from its failure and to find out ways to improve its exploration and development in such basin.

The overstated reservoir cannot be detected or reviewed by financial auditors, therefore, Company must subject reserves evaluation to internal audit engagement and assign external consultant for evaluating its reserves for reliable reserves disclosure. If the Company does not assign independent technical auditor to evaluate the proved reserves, Company shall disclose unaudited reserves in its annual report.

We really recommend all stock exchange regulations to include a requirement for disclosing the net present value of expected cash flow in future for proved and probable reserves at current average price of oil/gas or other commodity, current operating cost either Company's has long-term sell and purchase contract for buying Company's commodity or not that will be subject to internal audit and external audit review. Such disclosure really helps investors for not trapping themselves unknowingly to buy high stock price for weak Company's performance. Also, author recommends management of oil and gas Companies to consider those ratios and net present value of expected cash flow in future for proved and probable

reserves as key performance indicators for specially small and medium Companies in comparison to other Oil and Gas Companies' to pass over its weakness and enhance its strength.

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