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Research Article

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Application of Economic Decision Tools in Petroleum Investment

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Abstract

Oil reserve developments require making some inevitable decisions. Due to the huge cost of investment in petroleum, these decisions may lead to huge losses or profits. The desire of every petroleum industry investor is to make profit. In a situation where there are many oil reserve alternatives for development, maximizing profit is another key factor in decision making as every investor desires to develop the most productive oil reserves. Economic decision tools provide guidelines for managers and investors in the petroleum industry in ranking oil reserve alternatives. This paper provides guidelines in ranking and selecting profitable oil reserves based on total profits, unit cost of oil reserve development, net present value and pay-back period.

Keywords: Payback period; Net present value (NPV); Oil reserve; Unit cost of well development; Total profit

Introduction

Research into investment decision-making has become increasingly popular over the last thirty years, and many published studies now exist [1-5]. Evaluation of potential oil and gas exploration investment is a complex and it is one of the important steps that influence the success of investment [6]. The amount of investment losses and profits has a long-term consequence on investors due to huge cost of investment in oil and gas. Investment decisions on oil and gas exploration demand thorough analysis of the economic and non-economic feasibility of embarking on such projects [7]. Many economic concepts have been applied in the oil and gas investment decision making. These include pay-back period on investment, net present value, future worth, internal rate of return to mention a few. It is the responsibility of decision makers in the oil and gas industry to choose appropriate and reliable combination of decision tools.

The importance of decision-making in oil and gas exploration places a greater demand on decision-makers and the tools employed in their decision-making [8]. Payback is useful to some decision makers in combination with other decision tools [9]. The more common traditional investment methods used in decision making in projects are NPV, IRR, ROI and payback [10]. The development of projected cash flows requires accurate price of crude oil barrel, possible daily production rate, reservoir oil and water saturation and reservoir volume.

Materials and Methods

Decision Tools

Net present value: The net present value (NPV) is defined as the difference between the sum of the discounted cash flows expected from the investment and the amount initially invested [10]. The higher the net present value of all cash flows during the life-cycle of a well, the more profitable the well is:

$$NPV = \sum_{t=0}^{N} \frac{CF}{(1+i)^t}$$

Where NPV is the net present value, i is the discount rate, N is the life span of the project, t is the time of the cash flow.

Payback period: Payback or payback period is defined as the length of time required for the return on an investment to "repay" the sum of the original investment [10]. All other things being equal, the better oil development is the one with the shorter payback period.

Total profit: This is the total profit made at the end of the project. The total profit is computed by the algebraic sum of cash flows throughout the life-cycle of the project [9]. The best oil well development among other oil well alternatives is the one with the highest total profit during its lifecycle.

Unit cost of development: This is the unit cost of project development. In the context of oil well development, this is simply the ratio of the cost incurred in finding and developing oil reserve and the producible barrels of crude oil [9]. The lower the unit cost of finding and developing oil well, the higher the profit during the life-cycle of the well.

$$UNIT\_COST = \frac{Total\ Investment\ (\$\ million)}{Total\ Producible\ Crude\ oil\ (bbl)}$$

Result and Discussion

Decision making in reservoir gas-lift installation for oil wells

Oil wells are shut in after they can no longer flow naturally. The Tables 1-4 and analysis presented below demonstrate the ranking and selection of suitable oil reserve among three reserve alternatives. The three oil reservoirs are not flowing naturally and therefore require design and installation of mechanical lifts called artificial gas lifting systems to produce the hydrocarbons from the reservoirs to the surface. Each oil reserve already has a well connecting the reservoir to the surface. The tables and chart below show the expected cash flows during the production of the three reservoirs based on the information obtained from geologists, production engineers and reservoir engineers. Oil wells A, B and C produce hydrocarbons from oil reservoirs A, B and C respectively.

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Year	Production (STB/yr)	Revenue Cash Flow (million USD)	Expenses (million USD)	Taxes (million USD)	Investment (million USD)	Net Cash Flow (million USD)	Cumm. Net Cash Flow (million USD)	Net Present Value (million USD)
0	--	--	--	--	750	-750	-750	-750.0000
1	48800	976	233	297	--	446	-304	405.454545
2	48700	974	233	296	--	445	141	367.768595
3	39000	780	206	230	--	344	485	258.452292
4	29300	586	170	166	--	250	735	170.753364
5	19500	390	143	99	--	148	883	91.896356
6	9800	196	107	36	--	53	936	29.917118
7	4900	98	38	24	--	36	972	18.473692
Total	200000	--	--	--	--	--	--	592.715962

Table 1: Projected cash flow for restoring oil-well reserve “A” back to operation [9].

Year	Production (STB/yr)	Revenue Cash Flow (million USD)	Expenses (million USD)	Taxes (million USD)	Investment (million USD)	Net Cash Flow (million USD)	Cumm. Net Cash Flow (million USD)	Net Present Value (million USD)
0	--	--	--	--	1200	-1200	-1200	-1200
1	49000	980	250	297	--	433	-767	393.6364
2	49000	980	250	296	--	434	-333	358.6777
3	42000	840	246	230	--	364	31	273.4786
4	30000	600	210	166	--	224	255	152.995
5	30000	600	210	99	--	291	546	180.6881
6	15000	300	107	36	--	157	703	88.62241
7	6000	120	45	24	--	51	754	26.17106
Total	221000	--	--	--	--	--	--	274.2692

Table 2: Projected cash flow for restoring oil-well reserve “B” back to operation [9].

Year	Production (STB/yr)	Revenue Cash Flow (million USD)	Expenses (million USD)	Taxes (million USD)	Investment (million USD)	Net Cash Flow (million USD)	Cumm. Net Cash Flow (million USD)	Net Present Value (million USD)
0	--	--	--	--	650	-650	-650	-650.000
1	40,000	800	190	297	--	313	337	284.545455
2	37,000	740	180	296	--	264	-73	218.181818
3	30,000	600	170	230	--	200	127	150.26296
4	28,000	560	165	166	--	229	356	156.410081
5	22,000	440	135	99	--	206	562	127.909793
6	15,000	300	107	36	--	157	719	88.622407
7	6,000	120	45	24	--	51	770	26.171064
Total	178,000	--	--	--	--	--	--	402.103578

Table 3: Projected cash flow for restoring oil-well reserve “C” back to operation [9].

Oil Well Reserve	Net Present ValueNPV (USD)	Total Profit, TP (million - USD)	Unit Cost of Oil Reserve Development (USD/bbl)
A	592715962	972	3750
B	274269227	754	5430
C	402103578	770	3652

Table 4: Results of the economic analysis of the three oils well reserves.

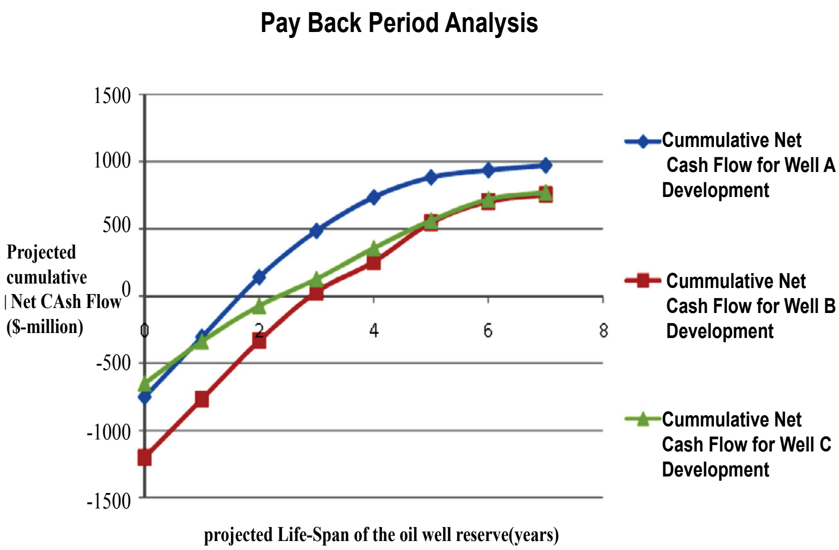

Figure 1: Projected cash flow for restoring oil-well reserves back to operation [9].

Conclusion

The three major vital details every management in the oil and gas industry would like to know before investment are: expected total profit, payout time and cost to find and develop oil reserve. From Figure 1, restoration of oil reserve A to operation using artificial mechanical lift system would "repay" the sum of the original investment in shortest time. Also, the oil reserve A has the highest expected total profit as indicated in Table 4.

Oil reserve A also has the highest net present value among the three oil well reserves. Even though the oil well reserve C has the smallest unit cost of oil reserve development, oil reserve A is more profitable than other two oil well reserves based on the highest expected total profit, highest net present value and shortest payback period. Oil reserve B is the least profitable reserve based on highest payback period, lowest net present value, lowest expected total profit and highest unit cost of oil reserve development.

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