RISK ANALYSES: SYSTEM AND MODELING IN OIL INDUSTRY

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Abstract

Large companies such as Albpetrol Sh.A often deal with major projects. For this, the selection of risk management and uncertainty scenarios for oil projects in the Albpetrol Company has been selected as the most powerful company in the oil industry, the only one in the Albanian market, a public one. The decision to invest is based on the project's profitability estimation. But how safe is calculated the profitability? What if the costs will exceed during the implementation of the project? Determining uncertainty and risk in oil projects is complex. These definitions will be based primarily on technical feasibility (reservoirs estimates, facility costs, oil cost construction review) and economic criteria (cost, net present value, cost-benefit analysis) using the manual method, and the simulation one using Monte Carlo, through the Crystal Ball Software. Since studies in the determination of uncertainty and risk in oil projects in Albania are rare or not, this paper will expand research literature and empirical flows. An important benefit of this scenarios approach is that it makes us realize that the future is uncertain, that it can evolve in a number of different ways and that decisions should be made within this content. The idea of scenario thinking is to seek flexibility in our decisions. When we have only one path without alternatives, any deviation between forecast and reality can mean a huge loss. If costs are higher in a year or production is lower than estimated, things do not happen the way we expect then the project may fail.

Keywords: Risk analyses, risk managing, modeling, simulation, project risk analyses

INTRODUCTION

The oil industry in Albania has a big potential in the economy. The lack of domestic capital and foreign investment is being limited; because of the risk it has itself this industry. Determining uncertainty and risk in oil projects is complex. Being the only company in Albania with 100% owner by the state, this company holds an important position in Albania but also in the market it operates and trades. Today, this field faces some risks.

Since 1998, various attempts have been made to go towards privatization; hence production research Albpetrol's activity is production and oil and gas activities in accordance with Albanian legislation and owns all oil and gas resources.

The definitions based mainly on this study are technical feasibility (reservoirs, wells to drill, facility cost, price cost) and economic criteria (Facility Cost, Net Present Value, Internal Rate of Return and Cost-Benefit Analysis) using simulation through Monte Carlo Technique by using Crystal ball software.

Studies in uncertainty and risk analyses, in oil projects in Albania are rare or not. This paper gives a view in forecasting the oil project, using simulation with the data of Albpetrol Company.

Albpetrol Shareholder has more than 65 years of experience in oil and gas extraction producing oil from 8 sandy and limestone sources, 4 gas fields and bituminous sand.

Estimates of proven oil reserves to date are:

In sand deposits   338,696,109 tons

In limestone deposits 98,949,034 tons

Total   437,645,143 tones

Outstanding initial reserves 81,025,885 tons

Oil issued until 01.01.2018:

From sand deposits   32,697,101 tons

From limestone deposits 28,665,963.2 tons

Total   61 363 064.2 tons

Remaining outstanding reserves until 01.01.2018:

From sand deposits   11,205,380.7 tons

From limestone deposits 9,270,209.8 tons

Total   20,475,590.5 tons

Oil produced from deposits in Albania is generally heavy. The total number of wells in inventory is around 3130, of which around 1880 are active for oil, gas, etc., and about 1275 wells are in production for oil. The depth of the wells varies from 400 to 3500 m. Daily debts vary from 0.13 to 5.0 tons / well.

Research Objective

The objective of the study is to provide management analysis in terms of risk and uncertainty in oil projects using the Monte Carlo Method. By defining theoretical terms, assessing and

determining the extent of risk and uncertainty in the oil project, show how a company can be profitable by using the Monte Carlo Simulation.

Study hypothesis

The null hypothesis for the study was: There is significant relation by using Monte Carlo method technology, with its sensitivity analysis, which leads to better project conception performance compared to current methods.

LITERATURE REVIEW

The most common applications of the Monte Carlo method require that a function be evaluated in a large number of points; consequently, the use of a computer is a necessity (Christian, Baecher 2003). The popularity of the Monte Carlo methods is matched by the possibility of using the computers. Nowadays, the analyst can use a large number of computer programs created for stochastic simulations. The possibilities of the Monte Carlo methods relate to the use of computer programs, mostly containing the functions algorithms needed to carry out the Monte Carlo analysis. So, nowadays, programmers have solved many problems they have had to face analysts in the past. However, the analyst must have knowledge on matters relating to the Monte Carlo methods, also be careful to use the program correctly, in the conditions for which it was created. Any simulation that relies on random numbers requires a determined to generate these odd numbers. There are many examples in the literature that deal with this problem (Kahaner et al., 1989; Press et al., 1992; Knuth 1997) which provide details for generating odd numbers.

METHODOLOGY

The use of quantitative approaches in data collection, taken from the Albpetrol Company, years from 2008-2017, for recovery size, production, oil cost, expenses and revenues, for analyzing the risk management. Till know, the Albpetrol Company used manual data, taking into account the previous year.

Through Monte Carlo Simulation, we made iterations for the variables that have impact and risk. An alternative to an improvement upon deterministic models (like time value of money) is stochastic models (such as Monte Carlo simulations) that incorporate randomness into the modeling process.

The data taken into consideration (input variables) are given at Figure 1, the Albpetrol Oil Production.

Table 1 Albpetrol Oil production

Input Variables		
Recovery Size	1500	mmbbls
Recovery	42	%
Time to plateau	2	years
Well rate	10	mbd
Wells to drill	25	
Minimum rate	10	mbd
Discount factor	10	%
Well cost	10	$mm
Facility size	250	mbd
Oil margin	2	$/bbl
Plateau ends at	65	% of reserves
Plateau rate is	10	% of reserves annually

Source: www.albpetrol.al

ANALYSES

One direction, an important voice that directly affects the effectiveness of Albpetrol Shareholder society is the reserve size and the wells to drill. The wells have been banned for various reasons such as damage, inability to process, low profitability, stock price fluctuations, etc. This does not include wells for lack of material-technical base, mechanical, electrical defects, or need for underground works.

The main activity Albpetrol has with the Bankers Petroleum Company, where it is developed under the Patagonian Maritime Agreement, is the largest source of oil. Taken in its complexity, it carries on its activity in some of its activities, as well as its activity in cooperation with other private operators, based on the hydrocarbon agreements. All distribution or sales processes are defined in the Hydrocarbon Deal. Albpetrol Shareholder technology, given that the Albanian government set clear objectives on how the oil industry will develop and since it is impossible to finance this sector it has abandoned and deemed it reasonable to introduce the operation with the cooperating companies as they seek substantial funding to finance this industry and the state is unable to make such large investments. Everything that has been done with the investments is done with other operators. In the deposits that she owns this year she has tried to invest in the pump system. The labor force in 2018 is 2153 employees.

In its development program in 2017, this was the development of Albpetrol for the administration and operation of Albpetrol. The reforms in Albpetrol have begun and they will be

addressed, we emphasize that by doing a restructuring retrospective, in 1999, where Armo was realized in 2008, it was privatized. Today Albpetrol has a much reduced activity

Today we have Kucove's betrayal, which is administered entirely by Albpetrol and there are about 1000 wells. Combined industry with the community is a source that comes from 1998 and is in collaboration with the community. In Patoz Marinze is administered 95% by Bankers Petroleum, and very little by Albpetrol. So Albpetrol holds all the promises.

The reform being carried out in Albpetrol is objective, it will be an organizational structure, to link the hydrocarbon agreement to anyone who will operate in the hydrocarbon market, and Albpetrol will monitor these petroleum agreements. The restructuring involves the merger of two or more centers of the colonies, centers that are close to each other from the site of the deposits, to reduce the costs of spending, and thus to reduce the costs of personnel expenses since the number of employees will therefore be shortened.

Albpetrol Shareholder is a regular payer to the state, this for environmental pollution, as this also poses a risk to itself. This year, Albpetrol paid the state 74 million ALL for the environmental tariff. Another risk is oil production and high sulfur content.
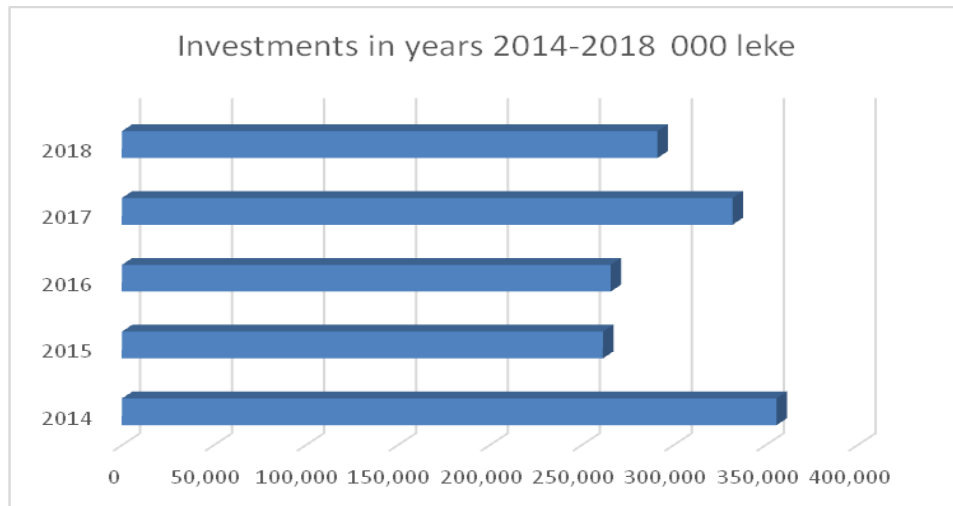
Figure 1 Production Oil for Albpetrol and by the Hydrocarbon Deal from 2008-2018
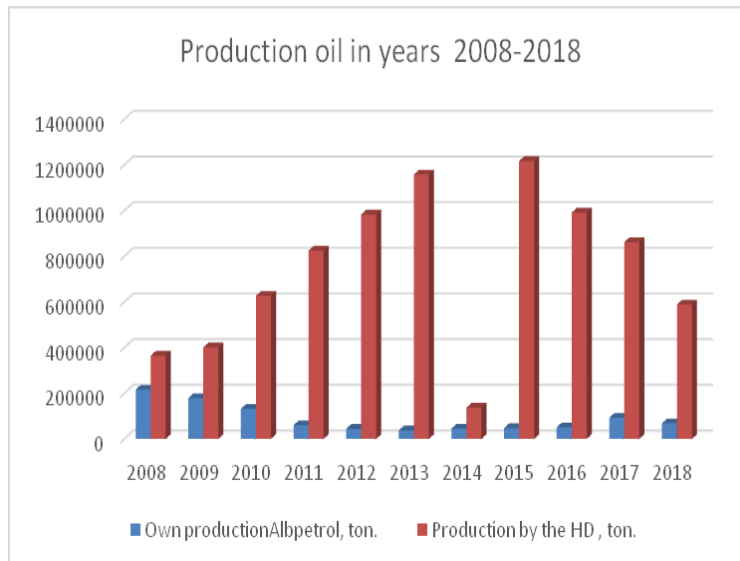
Source: www.albpetrol.al

We can see by the figure 1, that the production oil by Albpetrol company, the highest volume was on 2008, and by the Deal Agrement was on 2015 .
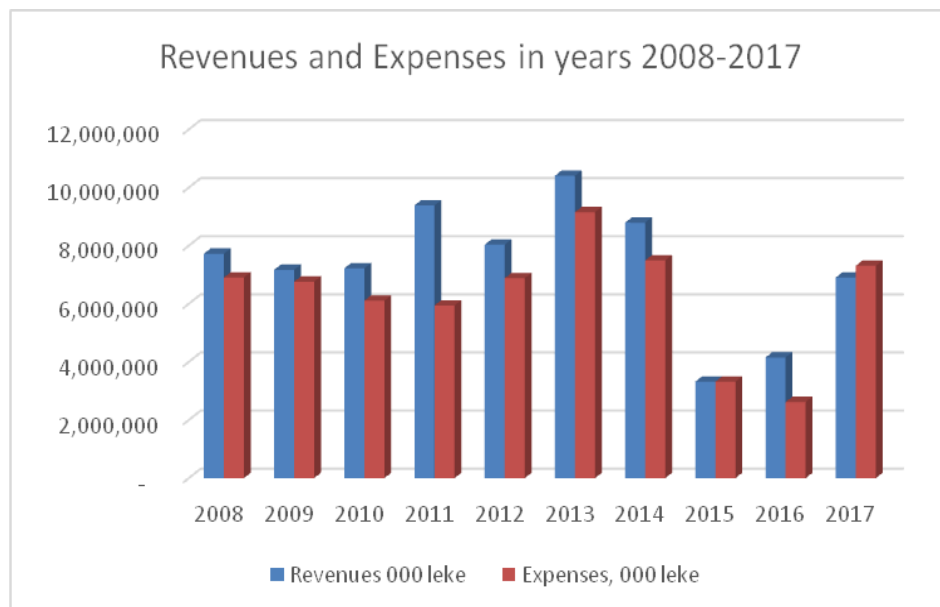
Figure 2 Investments in Albpetrol from 2014-2018

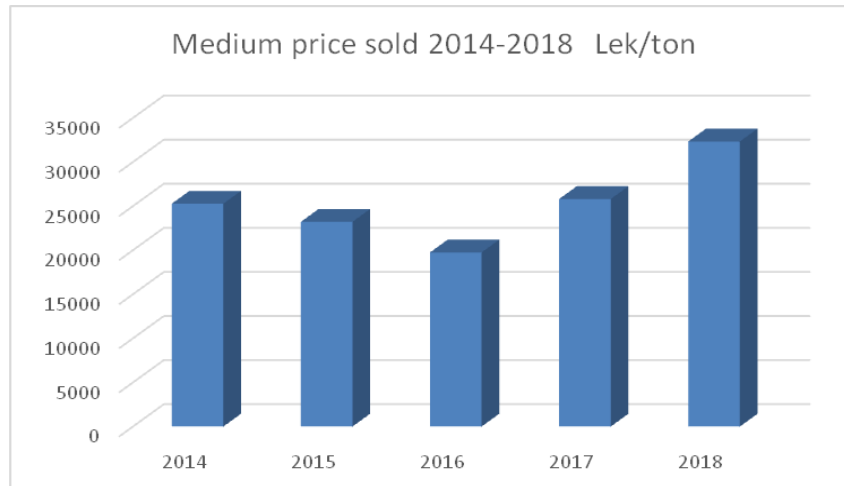By the figure 2, we can see the capital expenditures, made to investment(facility cost, wells to drill,exploration), on 2014 and also on 2017 were bigger This also is related with the figure 3, where the revenues where bigger on 2014 and 2017.

Figure 3 Revenues and Expenses for Albpetrol from 2008-2017

Figure 4 Medium price oil sold from 2014-2018

Source: www.albpetrol.al

In the figure 4, we see the price of oil is getting higher from 2014 till know, the price is higher on 2017 and in the figure 3, we see the expenses are higher than the revenues.

There are also risks of health injuries to workers at work, which is the consequence of oil leakage, as the assets available to Albpetrol are out of date in 1992 and for this reason a deep reform and taking all measures. This is an inherent situation since 60-70 and requires a detailed financial plan to manage in compliance with applicable rules and legislation. Inclusion of holes and spreading in yards, homes, and crops is a risk factor and emergency intervention is required. For these, Aplbetrol has taken measures to transport those oil leaks. In every country where high oil is extracted, there are also risks of human or material damage.

Oil companies need to assess new fields or prospects where very little hard data exists. Based on seismic data, explorationists can estimate the probability distribution of the reserve size. With little actual data available, we want to quantify and optimize the Net Present Value (NPV) of this asset.

We can simplify this analysis by representing the production profile by three phases. With only estimates for the total (STOIIP = reserve size) and percent recovery amounts, the objective is to select a production rate, a facility size, and well numbers to maximize some financial measure. In this example the measure used is the P10 of the NPV distribution. In other words the oil company wants to optimize an NPV value which they are 90% confident of achieving or exceeding. As described, the problem is neither trivial nor overly complex. A high plateau rate doesn't lose any reserves, but it does increase costs with extra wells and larger facilities. However, facility costs per unit decrease with a larger throughput, so choosing the

largest allowed rate and selecting a facility size and number of wells to match might be appropriate.

Phase Description

❖ **Build up** The period when you drill wells to gain enough production to fill the facilities.

❖ **Plateau** After reaching the desired production rate (plateau), the period when you continue production at that rate as long as the reservoir pressure is constant and until you produce a certain fraction of the reserves. In the early stages of development, you can only estimate this fraction, and production above certain rate influences plateau duration.

❖ **Decline**. The period when production rates, P, decline by the same proportion in each time step, leading to an exponential function: $P(t) = P(0) \exp(-c*t)$ where t is the time since the plateau phase ended and c is some constant.

Figure 5 Selecting the NPV Objective

Select	Name	Forecast Statistic
▶ Maximize Objective ▼	NPV	Percentile (10) ▼
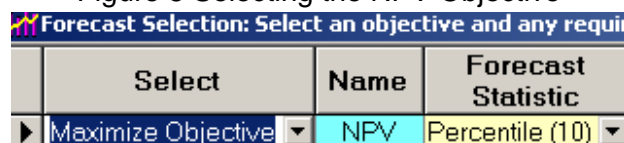
Source: Author's calculations

RESULTS AND DISCUSSIONS OF ALBPETROL COMPANY

The objective of the company it to maximize the profit of the Net Present Value, a 10 % of the NPV, and if we have the data put into our program Crystal Ball, from the calculation, we generate from the program the simulation to maximize the 10 percentile of the net present value (NPV is the sum over the years of the project of its discounted cash flow. This represents the value of the project to the investor).
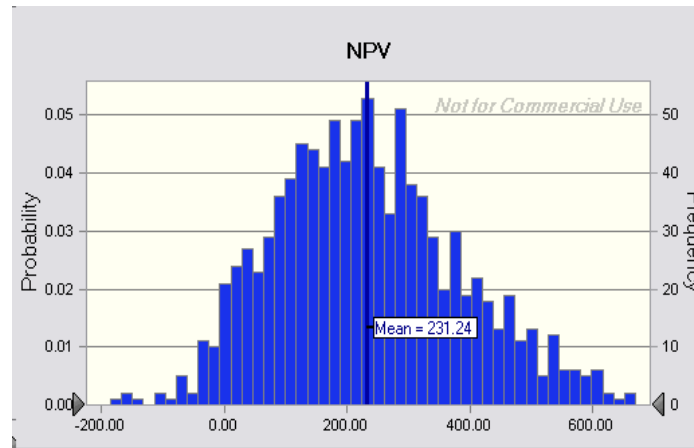
Figure 6 Forecasting NPV of Albpetrol Oil Solution by using Monte Carlo method by Crystal Ball software

Percentile	Forecast values
0%	-144.37
10%	195.72
20%	235.94
30%	257.97
40%	276.22
50%	293.82
60%	310.46
70%	326.70
80%	349.72
90%	379.75
100%	508.34

Source: Author's calculations

The best simulation for maximizing the 10p of the NPV is 195, 72.

Figure 7 Forecasting Net Present Value

Source: Author's calculations

Each histogram presentation in the figure 7, shows the likelihood, or probability, of earning income. The data shows that the most likely revenue level is $ 200 million and $ 400 million, with a mean 231.24.

Company's objectives are also maximization and optimization in human health care as well as environmental protection; this also requires the intervention of government or donor funds to help eliminate these risks. Environmental costs are highly risky, highly delicate important and require funding to operate.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Generally, defining the uncertainties as stochastic variables and running simulations gives a better insight in the project results. The information provided tells more about the likelihood to earn profit or to face loss. The correlations between the oil prices and the correlation between the productions in individual years create a degree of dependence between the values in individual years. This reflects the typical periodic life-cycle for oil projects and oil prices where a scarcity of oil and high prices lead to increases in investment in projects executed over several years and thus a slow return to lower oil prices, and vice versa.

The dependence in production from year to year reflects that the reason for higher or lower production in any particular year probably still exists (but to a lesser extent) in the next year.

Without the correlation factor, "high" and "low" years would follow each other randomly and thus cancelling each other's impact and thus under-representing the true risk or upside.

Based on the presented results and conclusions about the impact of the parameters, as the number of the iterations increases, the value of the Net Present decreases, so we can say that there is a convergence of values. We advise the research and development departments, the company to use simulation models for their reservoir formation and to see the iterations of drilling tools.

We find it really important and very useful the use of the simulation process this for a better decision for Albpetrol Shareholder.

Therefore the awareness of the uncertainties should lead to ensure the estimation on variable such as production profiles, and reserves size , that are not given as a single number but with carefully considered min/max ranges representing the degree of confidence in these estimates.

Ensuring in particular that economic models of petroleum production contracts with "asymmetrical" risks and profits, we have take into account the expected range of oil prices, costs and production.

Analyzing the actual profitability of projects against that originally predicted, give us a better understanding of the risks and uncertainties.

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