Real Options Analysis as a Decision Tool in Oil and Gas Field Development

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Abstract
This paper shows applicability of real options and how it is used along with decision analysis to maximize the returns on a given project and minimize losses. This shows that a field that can be produced and abandoned at will has large value flexibility. The net present value of such an asset will underestimate the true economic value. The real option produces a strategy map showing actions within the project.

Introduction
An important aspect of decision-making is timing or deciding “when to decide”. Conditions and input information can change over time, altering the outcome if decisions are made at different points.

From the work done by William Bailey and others1, many companies- three quarters of the Aberdeen sample – use decision trees as an aid to illustrate the choices available, the uncertainties faced by the decision maker and the estimated outcome of each possible decision. These trees clarify the choices, risks objectives monetary gains and information needs involved in investment decisions. Putting in an estimated value for each possible outcome and a judgment of the probability of each of those outcomes occurring allows the calculation of an overall risked value of the outcome of the decision.

Decision trees enable the decision maker to choose based on the financial outcome of the options. Options theory, more properly known as the theory of real options, enables a value to be assigned to the option itself. Option theory builds on the idea that most projects consist not of “all or noting” decisions but of a sequence of choices, many of which involve choosing among options – for instance between investing money now in a development or postponing the decision on whether to invest in the development until further information becomes available.

The traditional way of evaluating investment projects in the oil industry is the discounted cash flow (DCF) analysis. It is based on the unrealistic assumption that once an investment is made, it runs its course without intervention. It also evaluates only the successful outcome. The possibility of abandoning it in the face of adverse circumstances or expanding it in response to unanticipated demand is not considered. Options theory is more sophisticated than DCF because it captures the flexibility inherent in most projects. Option theory is both a tool, like DCF, and a mind-set. As a tool, it helps people make decision, As a mind-set, it pushes people into thinking, about projects in a much more dynamic way, constantly looking for alternative and better ways to run projects.

Methodology
Real option is the right but not the obligation, to undertake some business decision. This kind of option is an actual tangible option (in the sense of choice) that a business may gain by undertaking certain endeavours. Decision – tree analysis, net present value NPV are used as valuation tools for real options.

analysis. In this paper, decision – tree analysis will be used to display various choices, while the NPV will show which choice path provides the greatest value.

The following example considers a hypothetical fields and figures, OPT 114 with reserves 0.8, 1.5 2.0 billion barrels and probabilities 0.2, 0.5 and 0.3 from geological data. The project team recommended developing the well using Tension Leg Platform (TLP) with direct vertical access wells (DVA) because of its drilling capabilities and flexibility.

TLP- 8DVA wells was recommended and can be increased to TLP- 10DVA or TLP- 12 DVA. The NPV for TLP- 8DVA for the following reserves 0.8, 1.5 and 2.0 billion barrels are $2633160600, $5063549400 and $6769992600. The project team recommended developing the well using Tension Leg Platform (TLP) with direct vertical access wells (DVA) because of its drilling capabilities and flexibility.

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The oil price is $15 per barrel and the production rate per well for TLP -10DVA is 9120000 barrel per day and it will take 12 years to drill while the production rate for TLP -12DVA is 7800 000 barrel per day and it will take 10 years to drill.

A simple deterministic net present value for TLP -10DVA and TLP-12DVA Calculations give a nominal net present value discounting the cash flow at 10% per year. (Npv 10).

For TLP –10DVA for 1.5 billion barrel
9,120,000 x $15 x 10 wells x 12 years = $16416000000
$16416000000 - $619000000 = $15797000000
$15797000000 x 0.3186 = $5032924200

For TLP – 12DVA for 1.5 billion barrel
7800000 x $15 x 12 wells x10 year - $14040000000
$140400000000 - $846000000 = $13194000000
$13194000000 x 0.3855 = $5086287000

Following the same procedure, 0.8 2.0 billion barrels for TLP – 10DVA will give $2574759528 and $6758869608 and TLP 12DVA for 0.8 and 2.0 billion barrels are $2542449600 and $6876301244.
This is illustrated using decision-tree

Figure 1: Expected value for the field development with real option built in
Table 1. Comparison of Economic Values for the OPT 114 fields

<table>
<thead>
<tr>
<th></th>
<th>Design with options</th>
<th>Rigid design / No option</th>
</tr>
</thead>
<tbody>
<tr>
<td>E (NPV) (Million)</td>
<td>5131.2</td>
<td>5089.6</td>
</tr>
<tr>
<td>Initial CAPEX</td>
<td>846</td>
<td>619</td>
</tr>
<tr>
<td>Cost of option</td>
<td>227</td>
<td></td>
</tr>
<tr>
<td>Benefit of option</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Cost benefit Ratio</td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

From the figure and the table above, it shows that investing additional $227 million in capital expenditure to build in option leads to $42 million gain which is a return of $0.19 for every dollar spent.

**Some important calculations used**

\[
5089.6 = (0.5 \times 5064) + (0.2 \times 2633) + (0.3 \times 6770)
\]
\[
5131.2 = (0.5 \times 5064) + (0.2 \times 2633) + (0.3 \times 6872)
\]

Cost of option = initial CAPEX of design with option - Initial CAPEX of rigid design

Benefit of option = NPV of design with option – NPV of rigid design

Cost benefit Ratio = \( \frac{\text{Benefit of option}}{\text{Cost of option}} \)

**Summary**

The combination of decision variables such as oil price, working interest, production rate, and type of facility of projects can be further optimized to achieve a maximum worth of the company. Real option uses NPV and decision–tree to make strategic decisions in project development.