Palisade - quantifying risk

Knut Hollund from the Norwegian Computing Centre used Palisade's @Risk tool in order to assess the relative benefits of different drilling strategies for Lundin, a small exploration company, for developing the Alvheim Field

The Alvheim field is located in the Norwegian North Sea and operated by Marathon; Marathon has a 65% stake while ConocoPhillips has 20% and Lundin 15%.

Original seismic surveys in the seventies showed several promising structures, although it was considered no more than a marginal oil prospect, the focus being on gas. It was considered finished in the eighties, but new seismic interpretation studies revitalised the area, identifying several new prospects, although some of the structures were still not understood in detail.

A structure called Kneler was seen to have the highest upside potential, as the fluid contacts between oil and gas, and oil and water had a large range of uncertainty. There was also an anomalous contact in the seismic data which, depending on the interpretation, could increase the size of the oil column from 17m to 60m.

During the early phases of development the first decision to be made was whether to drill more appraisal wells and in what order to drill them. Three structures were considered: Kneler, Boa and Kameleon East. At that time the amount of oil and gas in the area was highly uncertain, said Mr Hollund.

A concept selection decision also had to be made on what kind of facilities to build to develop the field: whether to build a fixed rig, a floating vessel or something similar.

"For a small company like Lundin, quantification of risk is highly important," said Mr Hollund. "If you take too much you can easily break your neck, but they are optimists, this is a risky business and the possibility of the upside potential is equally important."

@Risk

Palisade's @Risk software uses Monte Carlo simulations to run a model multiple times with different input parameters for any value which has an inherent uncertainty. Random values from a statistical distribution are used instead of a fixed value.

This makes it possible to assess which are the most likely outcomes, and by linking it to a cost model, what the cost and benefit of a particular decision will be.

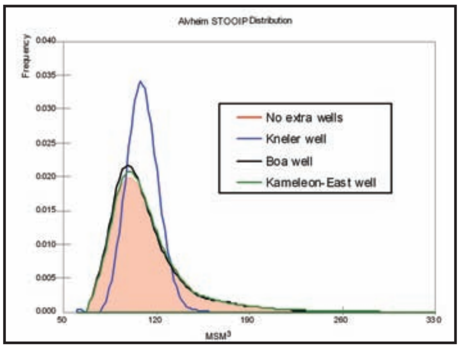

Figure 1 - uncertainty in oil in place for different drilling scenarios

The software runs from within Excel giving it a familiar user interface; a simple toolbar gives access to the range if functionality from building standard statistical distributions to plotting outcome curves.

The model

"The problem we are facing here, like most problems in the oil and gas industry, is unique," said Mr Hollund. "You can't just grab a standard statistical methodology and makes inferences from that."

"You have to some computation from models in order to aid the decision support. In my opinion you get the best decision support if you combine the engineering models with the statistical models; and the statistical models don't have to be complicated."

The first step in building a model for Lundin was to complete a simple @Risk model for volume of oil in place. This was then extended to include a cash flow model to assess the potential for earnings.

The cash flow model started from the oil in place and included standard calculations for the percentage of recoverable oil and the speed of production; a fixed oil price was assumed.

"A model is always a simplification, so we had to pinpoint the most important issues," said Mr Hollund. "We wanted to model only the most important parameters to build a fast model, so we chose fluid contacts and seismic data."

The parametric model has the benefit of being much faster than a detailed numerical model and it is therefore possible to run multiple simulations to assess the likely outcome given different input parameters.

He used seismic data to create depth maps showing the potential heights of the oil and gas columns. The maps had a high degree of uncertainty because of noise in the data and the interpretation variances. To make it really simple only two parameters were modelled: depth uncertainty and lateral uncertainty.

Each uncertain value was modelled using a probability distribution which could be put into the @Risk model.

"The really interesting part of the study was when we tried to translate geological knowledge into probability distributions," he said. "We had a general distribution for the height of the oil column for the Kneler structure to reflect the optimistic scenario of a 60m oil column some of our guys believed in."

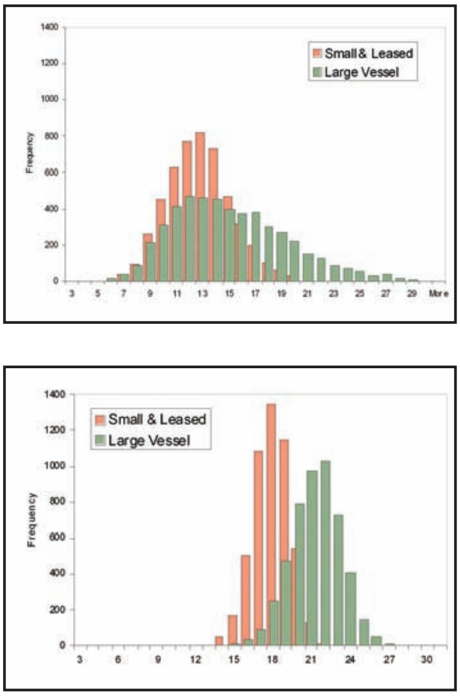

Figure 2 - NPV (Net Present Value) for different FPSO vessel choices (top before drilling extra wells, bottom after)

Outcomes

The studies showed that drilling a well in the Kneler structure would have the highest impact in reducing the uncertainty in the total oil in place for the Alvheim field, while wells drilled in Boa or Kameleon would make relatively little change in the uncertainty overall (Figure 1).

A well drilled in Kneler would also give the best information about the upside potential of the field, and it was therefore decided to drill Kneler, although subsequent wells were also drilled in Boa and another prospect, Gecko.

The drilling showed that there was a 50m column in Kneler, and more oil than expected in Boa. The Gecko reservoir was poor and there was no big gas column at all.

"From that point suddenly this area had a much bigger value and everything was turned upside down. Everybody wanted to know the value of the field."

After the wells had been drilled, the cash flow models were used to determine what kind of FPSO (floating production storage and offloading) vessel concept would give the best value. The decision was whether to make a big initial investment in a large owned vessel, or to lease a smaller vessel.

Before the extra wells were drilled, there was little separation between the two outcomes in terms of net present value (NPV). After the drilling, the larger vessel was the clear choice (Figure 2).

Quantify your flow more accurately

The rising price of a barrel of oil has led to a marked increase in the demand for tools that accurately quantify transfers of crude oil and finished products. We interviewed Darren Heath, global product and marketing manager, custody transfer solutions, Honeywell Enraf, to find out more.

(Left and right): checking you bought what you thought you had - the Syncrotrak Flow prover

Sales of Honeywell Enraf's Syncrotrak flow provers, which meets the most stringent accuracy requirements for custody transfer meter proving, are rising significantly year on year, as the rising oil price makes it much more important to accurately measure fluid transfers, Honeywell says.

The Syncrotrak is a device utilised to verify the readout of in-line flowmeter. It is not intended for continuous use (like a flowmeter), but used to carry out 'spot' calibration checks.

Darren Heath, global product and marketing manager, custody transfer solutions, Honeywell Enraf, estimates that companies typically recoup their investment within 12 months, due to increased flowmeter accuracy and as the lifespan of a Syncrotrak is greater than 25 years will provide excellent value for years to come.

Being compact in size the Syncrotrak prover is ideal for both stationary and postable applications.

The prime features of the Syncrotrak flow prover are its precision, smooth bore cylinder and unique measurement piston, which contains an integral bypass value which minimizes flowstream disturbance.

"It's the most accurate flow prover that is available today" says Mr Heath.

You can find Syncrotrak flow provers used on offshore oil platforms, FPSO's, refineries, transfer pipelines and terminals and can measure liquid, gas and condensate.

Densitrak

A related product is Densitrak, which is used to measure the density of pipeline products.

The Densitrak takes a continuous small feed of product for a pipe, giving the end user real time information. It is used on a wide range of liquids and gases.

The Densitrak device measures liquid by monitoring resonant frequency of a u-tube containing the process liquid. As the density changes, the resonant frequency will change. This means there are no moving parts and no maintenance.

The Densitrak was originally developed as an accessory for the Syncrotrak flow provers, but was subsequently released as a product in its own right.

Syncrotrak and Densitrak were first developed by Calibron, a company which was acquired by Enraf which itself was sold to Honeywell in June 2007.

Metersuite

Metersuite is a DCS (distributed control system) embedded fiscal metering solution for both oil and gas. It is used to accurate quantity, control movements of process liquids and gasses and upon completion produce report to the required fiscal standards.

Metersuites accepts input from a varying range of field devices including flow, temp, then utilises metering specific calculations to produce both volume and mass totals.

Metersuite was developed by Swinton technology based in the UK together with Honeywell and is a combination of Experion hardware and software combined with application engineering to provide the overall solution.

Metersuite can be integrated into existing field DCS, thus eradicating the need for a separate flow computer device.

"As we all know, flow computers tend to need upgrading or replaced every few years, but a system which integrates directly with an automation system can be expected to last much longer without the need for replacement" said Mr Heath, who went on the say "that Metersuite is also less expensive than rival products, and can make having an accurate metering solution for lower flowrates and throughputs economically viable"

The system was first implemented in September 2005, with Shell using it to measure and document imported gas from the western leg pipeline to its North Cormorant platform.