Managing the future

History-matching of reservoir simulation models, meaning adjusting and optimising the simulation model based on observed production data, has been a complex and time consuming task for the industry for years.

Halfdan Carstens

New software claims to revolutionise history-matching by reducing manpower requirements and assessing the uncertainty of reservoir simulation models in a quantitative manner. In this way the developers believe the software will better reflect how the real world behaves when producing oil and gas.

Photo: Halfdan Carstens

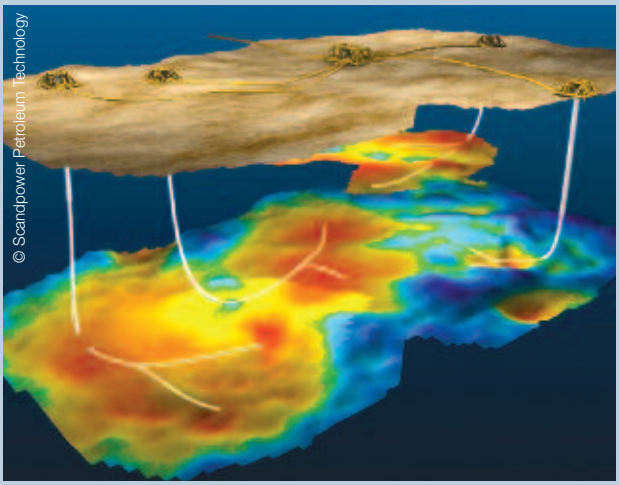
John Olaf Rømma (left) and Dag Terje Rian, Vice President and President of Scandpower Petroleum Technology, respectively.

Maximizing reserves

The company is growing, and it's growing fast.

Dag Terje Rian, President of Scandpower Petroleum Technology, is very pleased with the past and current year's achievements. He feels ready to conquer new markets with the company's innovative technology that promises to dramatically reduce the time required to history-match complex reservoir simulation models. Moreover, he promises to minimise the time it takes to estimate the likely range of uncertainties in predicted future production.

"With our new software MEPO®, which is designed to support the process of history-matching of reservoir simulation models, we are reducing manpower requirements as well as the uncertainties when doing reservoir simulation. The software helps to identify solutions which produce, not just the best possible match, but a number of acceptable matches for better predicting the range of future production" Rian says.



© Scandpower Petroleum Technology

Reservoir model with gas (red) above oil (green) and water (blue).

"Ultimately, the oil companies will produce more oil and gas and maximize their reserves, which is why they have been willing to invest hundreds of thousands of dollars in new software," he adds.

More time for analysis

Oil companies spend significant resources on creating models for reservoir simulations. However, as the turnaround time for creating and updating reservoir models has been significantly reduced, the reservoir engineer still has to validate the models through history matching and uncertainty assessment, before generating production forecasts, and this has always been an elaborate and time consuming task.

"The industry has been lacking efficient tools for assisted history-matching and analysis; furthermore, the resource requirement for reservoir optimization is of such a magnitude that industry has tended to rely on a limited number, or single, reservoir profile," Rian says.

"The new tool will enable the reservoir engineers to focus their energy on qualitative analysis rather than quantitative calculations," he adds.

There has been a need for this product for a long time, but it is only with the introduction of powerful computers that it has been possible to do the necessary calculations within an acceptable time frame.

How it works

The idea behind the new technology is to model past production, thereby being able to predict the future production of an oil or gas field.

"It is as simple as that, but it is no easy task to carry out. Powerful computers are needed, and during the process of doing countless calculations, experienced reservoir engineers are needed for supervision. To get a result for a given field may actually take a couple of weeks," explains Rian.

Despite this, it is still a major improvement from how it was achieved previously, and how it is still done by a lot of oil companies that have not yet invested in this modern and efficient technology.

Dag Terje Rian draws a cube on the white-board. "This is the static reservoir model with all the inherent uncertainties. The grid in itself may be erroneous, and within each cell parameters like porosity and permeability may also be incorrect," he explains.

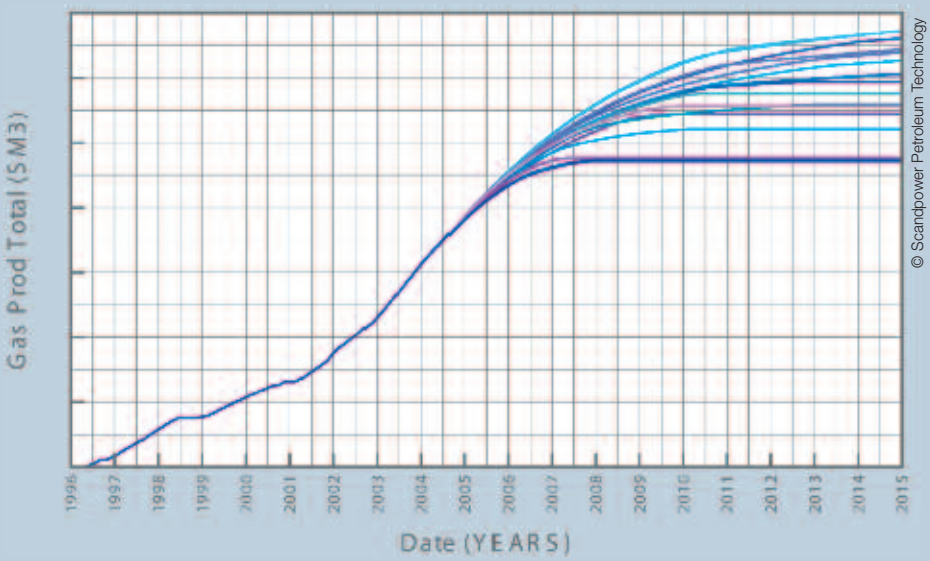
"The numbers within each cell are exported to the dynamic simulation model. If the input values are incorrect the simulation will naturally also be wrong. Without any production history to compare with before production start-up, the reservoir engineers are at this stage left with their own predictions for future production."

"After having produced the field for some time, however, the reservoir engineer will have a historic production to compare with the model he started out with. If there is a good fit, he may continue to simulate the production of the field in the same way as he has done so far. However, if there is a mismatch, the reason may be found in the static or the dynamic modelling parameters, meaning that it is necessary to change them. With a large number of unknowns that may include porosity, permeability and fault barriers, this is a very difficult stage," Rian explains.

Using MEPO, the static model may be changed. Specific data in a given cell, permeability, for example, may be altered.

"Only by trial and error is it possible to match a number of production profiles based on varying the input parameters. The user may, however, influence the process. His knowledge of the reservoir parameters, static as well as dynamic, is essential to define a range of parameter values that need to be optimized. There is no way to do this in an automatic manner."

"This is an interactive process," Rian emphasizes.



History matching defines a process to find a set of model parameters that minimise the difference between simulated and observed reservoir data. This example from the Statoil operated Gungne North Sea gas condensate reservoir demonstrates the uncertainty in cumulative gas production when forecasting using a set of alternative history matched models on.

Gaining ground

Having established production profiles, decisions must be made based on questions like: Where to drill the next well? Which wells need to be closed? Which wells should be recompleted? Where will the water come? The ultimate goal is, of course, to maximize production and optimize the reserves.

The task of the reservoir engineer is to look into the future. Using MEPO, it may be possible to manage the future by selecting a particular scenario for future production that is more likely than others.

A number of the major oil companies have already adopted the new software. One of the first significant achievements was realized when successfully applying MEPO® to Chevron's Captain Field located in the UK sector of the North Sea, where eight acceptable matches were found using fundamentally different parameter combinations, quantifying uncertainties for new infill wells.

"MEPO® provided us with a time and cost-efficient tool to better understand the impact of the dynamic uncertainties on the reservoir model and history matches. It successfully assisted us in improving the quality of our production forecasting," says Gert de Jonge, of Chevron UK.

"Based on the response we have got so far we believe this solution could save the oil companies significant time and costs compared to conventional methods and other applications." It appears the oil companies are of the same opinion. "There are clear indications that the product is succeeding and winning recognition by the month," says Dag Terje Rian.

SPT

Scandpower Petroleum Technology (SPT) develops and sells software and related consulting services to the oil and gas industry. The main business area is software for dynamic modelling of multiphase flow (OLGA®), where the company has a leading position worldwide. The technology has been developed through many years by Norwegian research institutions and the oil industry. MEPO® is a new software tool developed over five years and introduced to the market in 2004. SPT has 140 employees, with head office in Oslo and regional offices in Dubai, Hamburg, Houston, London, Mexico City, Milan, Moscow and Perth. The company has had considerable growth during the last few years, from a turnover of USD 5 million in 1999 to more than USD 25 million in 2005.