



## Excalibur: optimizing the resources of the subsoil

*Mathematics and the latest advances in computing for better oil field development plans. This is what Excalibur was designed for; a technology that characterises the uncertainty of the subsoil and helps minimise the risks. Repsol focuses on a know-how which also includes tools from the video game industry and the financial world to be able to evaluate Exploration and Production projects up to 1,000 faster.*

With oil field geology becoming ever more complex, the oil industry has to tread very carefully. In a sector where drilling a dry well can mean an expense running into tens of millions, investment decisions are always adopted “in a context of uncertainty because the absolute knowledge of what is occurring in the subsoil is impossible. This is why we need new technologies like Excalibur. The problems are of such complexity that without them they could not be addressed”, explains Santiago Quesada, Director of Exploration and Production Technology for Repsol.

Geomathematics, a scientific discipline that applies mathematical advances and supercomputing to the study of subsoil “has largely become the driving force of new technological trends in the oil and gas industry”.

### Technology to reduce the uncertainty

The Excalibur project, developed in the Repsol Technology Centre in Móstoles (Madrid), uses the latest mathematical and data-processing techniques to fully evaluate the oil fields. The tool simultaneously combines all the interest variables, from geosciences to finances, “to characterise the uncertainty more accurately and in less time” says project leader Sonia Embid. This information helps to support the experts in “defining the optimum oil field development plan”.

This faster and more accurate evaluation of the assets also helps to detect new opportunities in the portfolio of projects in a priority area for the energy company, which directs three-quarters of its investment to the Exploration and Production (E&P) business. For this Excalibur includes some of the risk calculation techniques used in the finance sector.

The tool is already being used successfully in Repsol oil fields. In one of its projects in Brazil’s offshore, Excalibur has managed to improve the Net Present Value (NPV) by 36% on the estimate given by commercial tools.

### Up to 1,000 times faster

Using the data available about an oil field, Excalibur constructs 3D geological models which help specialists to study its characteristics. Finally the program applies some numerical optimisation algorithms created specifically by Repsol researchers to all the information produced. As a result “the probability of success increases” in aspects as important as where to find accumulated crude oil or where to drill wells to reduce their number, “which is a very significant competitive advantage for the company”, continues Embid.



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As well as accuracy, the methodology developed offers speed thanks to innovative techniques such as Smart Sampling, which reduces the time needed to characterise the uncertainty by intelligently selecting the evaluations. Also to make information processing more efficient, Excalibur uses a virtual cloud cluster where the services work online and in parallel.

In its technological centre Repsol has constructed an Advanced Simulation Laboratory which has the necessary computing power for this type of program and can also be linked up to Mare Nostrum, the supercomputer at the Barcelona Supercomputing Centre (BSC) when large amounts of data have to be processed. With this set of improvements the tool manages to accelerate (in orders of magnitude) the evaluation of an oil field, which can be up to 1,000 times faster than methods used to date.

Untapped oil fields, the greatest challenge

This technological development is particularly useful in more uncertain oil fields, green fields or untapped oil fields, which represent the greatest challenge for the industry because data hardly exists on them. Excalibur compensates for this lack of data with an analogous search prototype which compares the new oil field with others that have already been discovered. Using this as a reference it calculates the petrophysical properties of the untapped oil field and its probable distribution which serve as a skeleton to construct the 3D model.

The result “is like a layer cake” where the different properties of the oil field are virtually represented: rock type, geological structure, permeability or porosity; determining variables when it comes to deciding how to produce the crude oil and which have a decisive influence on the economic costs. With this use of Big Data, the system also includes “the accumulated knowledge by the company and the industry in different areas, aiding experts in reaching more accurate solutions”, continues Embid.

Towards cognitive computing

Yet aside from the capacity of supercomputing, technology now advances towards greater interaction between man and machine. During the development of Excalibur, the need arose for a graphical interface that was “more creative, intuitive and friendly”. This is where collaboration was sought with the video game industry, which is the most advanced in the visual field. In this case Excalibur uses the natural Kinect interface of the Xbox videoconsole, which allows researchers to control and interact with the machine without the need for external devices.

The outcome is a laboratory reminiscent of the future imagined in the film “Minority Report” where researchers move and expand the different 3D models with their hands. The company specialists can connect with the Advanced Simulation Laboratory from anywhere in the world, “which makes team work easier, speeds up the process and above all, improves the quality of forecasts”.

The main technological partner is IBM, which already collaborates with Repsol on other supercomputing projects such as Kaleidoscope, the seismic imaging program of the subsoil. Both partners are already working on a new development called Pegasus, an evolution of the Excalibur project through the application of cognitive computing, “new systems which are going to be a qualitative leap in the oil industry because they are capable of reasoning and learning”, concludes Quesada.