Calculating relative permeability from a digital rock sample
the broader oil and gas domain. And you will need subject matter experts who have in-depth skills for their domain, but also understand the broader analytics approaches.

The second rule is to work on the right platform (software system). The E&P industry typically works with linear workflows, where data is worked on with one application in one department, then sent on to another application in another department, and these methods have evolved over time.

But this means that some data types have never been put together, because the traditional apps don’t have a way to do it. Trying out new ways to put data together is usually a big part of analytics work.

Analytics also often involves looking deeply within data to see if there is something worth looking at further, which is not something which can be done easily if the data can only be accessed via an application.

The third rule is to work around “good enough” data management – doing the minimum amount of work to be able to answer the business question you want to answer. This might mean storing data so you can just pull out the piece you want, such as individual seismic traces, or well log data just for a specific depth level.

It helps if data is “profiled” so people can get an idea of what it is, without having to load it into the right software system to understand it.

The fourth rule is to be “agile”, or focus narrowly on what the goal requires. The industry can so easily get stuck into “waterfall” rigid step by step processes which take years, rather than going as fast as possible to answer the specific question.

“If you have a business request for a piece of work, do that piece of work, make sure the value is delivered, don’t turn it into a 10 year project,” she said. Small projects can be better – people working quickly to see if they can achieve some specific outcome which is useful for the business.

The fifth role is to get business buy-in. If you want to make changes across silos of the business, you need business support at level which the various departments will both listen to, which might mean “C” level. Otherwise you can’t escape out of any silo. One idea is to have a C level “chief data officer” who guides the company on things to stop doing or start doing.

The chief data officer might also try to stop people using software tools which are very difficult for someone else to work with, such as Excel and PowerPoint. They can also ensure continued governance on the data and continued data quality improvement. Dashboards can be a good way to drive data quality.

Companies are increasingly forming “asset teams” where people with different disciplines work together on business problems – rather than in the old days where one department works on data and throws it over a wall to the next one – geophysicists do their seismic interpretation, reservoir engineers do their simulation.

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**Paradigm k – a new cloud-based system for production engineers**

Oil and gas E&P software company Paradigm has developed a cloud-based system for production engineers that provides well surveillance data, reservoir simulations, and online collaboration capabilities.

Oil and gas E&P software company Paradigm has developed a cloud-based software solution for production engineers called Paradigm k, to help them perform reservoir simulations and production surveillance analysis.

“The task of production engineers is to maintain production targets. Historically this has meant mainly surveillance, seeing what production currently looks like. Access to reservoir simulations will give them a better understanding of why changes in production rates are happening,” says Indy Chakrabarti, senior vice president of Product Management at Paradigm. “It is a merger of subsurface and surface workflows coming together.”

The system can be used by production engineers to test different plans for in-fill wells, and predict how much oil they might produce. They can investigate reasons why a well is not achieving its target production, or predict what might happen if you change the choke size or do an artificial lift.

The software can ‘ingest’ surveillance data from well flowmeters and sensors. This data can be used to update the reservoir model.

The software also supports collaboration, making it possible to share what you are doing at each well with your colleagues, as well as the results of those activities.

Paradigm sees this evolving into a knowledge base around wells. For example, someone might...
post that they are planning a workover for a certain well, and someone else notes that the same well was worked over a few years ago and sends details of the outcome.

There are no software requirements to get started – you can run it from an existing reservoir model, or take whatever inputs you have. It is hosted on Amazon Web Services.

Paradigm is initially offering the product to customers involved in shale oil and gas, where the modelling complexity can be most acute, particularly when modelling fractures.

“Paradigm can offer data management as part of the service, or oil companies can manage the data themselves. Oil companies are increasingly paying attention to their sensor data, and historian software systems for storing it, Mr Chakrabarti says.” “We can tap into those systems.”

Until now, production engineers have basically had two options if they wanted to understand their reservoirs: Either over-simplified, seeing the reservoir as a tank of hydrocarbons with no complex geology, or performing full-scale reservoir simulation, which production engineers often find challenging, Mr. Chakrabarti says. “That process is onerous, and as a result, limits who can do it”.

And the majority of reservoirs in the world still do not have numerical simulations, Mr Chakrabarti adds.

A different kind of simulator

Paradigm has developed a different kind of reservoir simulator for Paradigm k, which uses the full resolution of the available geological information, while running much faster.

Standard reservoir simulators divide the reservoir into tiny 3D boxes, and model the parameters for each box individually. This is a computationally intense process which also requires simplifying the geological model into boxes.

The Paradigm k simulator, on the other hand, looks at the entire geology without simplification, and then uses equations to calculate the flows. This means that it does not require any reduction in resolution to run, and can provide a simulation within minutes, Paradigm says.

Tests show that the outcomes of the simulator are very similar to those from a more sophisticated simulator, in much less computing time.

This semi-analytical simulator has been used on unconventional reservoirs, which have fractures which are very difficult and time-consuming to numerically simulate.

“You don’t have to build a simulation deck for a production engineer,” he says. With this software, “We can represent the fractures and the full complexity.”

Exa and BP – get relative permeability from a digital rock sample

Exa Corporation has developed software together with BP to model flows of multiple fluids through a digital image of a physical rock sample, and so find the relative permeability, a critical factor in understanding the reservoir

Exa Corporation, a company based in Massachusetts, USA, has developed a way to simulate fluid flow through a digital image of a physical rock sample without losing any resolution, working together with BP. The technology is provided as an online software product called DigitalROCK.

The simulation solution was co-developed with BP, during a 3 year technology collaboration agreement.

It can be used to understand relative permeability – how multiple fluids flow through a reservoir, and the forces they will make on each other.

Exa claims that this is the first predictive computational solver for relative permeability for oil and gas.

Relative permeability is the resistance to flow for a mixture of fluids – for example a certain reservoir might allow water to flow through much more easily than oil. It is different to absolute permeability, which is the reservoir’s overall resistance to flow.

The relative permeability can be used to understand what ultimate recovery can be achieved from the reservoir (a function of how much oil will be left behind in the pore spaces and never flow to a well). It can enable an understanding of how this can be changed with an enhanced oil recovery technique or water flood.

The basis of the study is a 3D CT (computerised tomography) scan of a small piece of core or drill cutting. Clients can take a scan image themselves, and upload it to Exa’s online software, to run a simulation.