



Digitally enabled

Bernard Looney, chief executive, Upstream



There are moments in life when you know things have changed fundamentally. For me, one came this year when an algorithm created by a BP employee with a PhD from Stanford helped us see through layers of salt to uncover a new "field in a field" - holding 200mn barrels of oil. It took just a fortnight to process the algorithm in our supercomputer in Houston - whereas with 20th century supercomputers, we estimate it would have taken well over 1,000 years.

Another moment came in August, when we started up our Juniper operation in Trinidad & Tobago. The start-up process was paperless, with information exchanged on computers and tablets. It was collaborative, with offshore personnel working in real-time with engineers in Port of Spain and Houston. It was thorough, with new software and dashboards monitoring well stock, well parameters, flowline velocities and "bean up" rates. And it was efficient, with a hand-over from the projects team to operations that took hours rather than weeks.

In short, it was a digitally enabled start-up - like others this year in Egypt. But of course, the start-up was only a start. The big impact will come over the years as digital tools such as our optimisation system, APEX, transform operations across the complex network in Trinidad & Tobago. Juniper is part of this transformation, with its 14 production platforms, and miles of pipelines, producing gas both for the twin islands and for export as LNG.

A connected company

BP's local system optimisation lead, Shaun Hosein, explains: "There is always some kind of activity in such a large system - wells starting up, valve testing, pipeline inspections and so on. Using our new tools, we can now quickly simulate what will happen, so we can optimise production. In one case, we had to shut in a pipeline for maintenance at our onshore facility, which would previously have meant lost production - but the system simulated the procedure and showed us exactly how to re-route



the flows and at what speeds. It protected a large volume of production for three days."

Trinidad & Tobago is a microcosm of BP - a complex web of operations being integrated into a single system. BP is building what we call the "Connected Upstream" in service of our vision of leadership in the digital upstream world - digitally connecting our people, plant and data to drive better business outcomes.

It is not only about digital technology. It is about people and assets too. What some have termed the "Fourth Industrial Revolution" - following those of steam, electricity and automation - is the fusion of the digital and physical worlds. In our industry this is about the capacity of big data, algorithms and analytics to orchestrate rigs, platforms, refineries, wind farms and other assets - as well as the people who operate them.

This revolution presents a great opportunity for our sector. Today, BP's upstream business is looking to technology such as APEX to create a much-needed competitive edge in what has become a margin business. We believe it can help improve safety, grow production and reduce costs. And as artificial intelligence, robotics and other technologies develop, I believe we will see a competitive gulf appear between those who fully exploit these tools and those who do not.

BP has taken time out to plan the Connected Upstream in detail - connecting people and data; connecting physical and digital assets; and connecting machine intelligence and decisions.

Connecting people and data

Digital monitoring for BP began more than 15 years ago when we started installing fibre optic cables - we now have around 2,000 km worldwide - to link people and data in offshore facilities to experts in operation centres. Our intention has always been to "democratise" data, sharing it widely across BP. We do this with SmartSearch, our proprietary search tool. This

year, the SmartSearch engine is expected to crawl over a billion subsurface and well documents, so that our technical staff spend less time finding data and more time analysing and making technical decisions.

Connecting people and data relies on solid digital foundations, like the BP Data Lake. Today it stores a petabyte (PB) of data, but with a billion new records added each day, roughly double the daily tweets on Twitter, we expect to be scaling it to more than 6 PB within a few years.

Then there is the in-house human capability to use the data. BP is putting its engineers, scientists and business analysts through data science boot camps, and making online learning available across the organisation on topics such as advanced statistics and machine learning.

Beyond the upstream sector, digitisation is also transforming our customer relationships. The BPMe app, now being piloted, enables motorists to pay for fuel using phones inside their cars. Castrol is piloting Carama, a platform which helps consumers find a workshop to service their car, view workshop ratings, book and pay for servicing the vehicle.

Meanwhile, Air BP is collaborating with RocketRoute to offer pilots and operators aviation fuel at the touch of a button at airports worldwide via the MarketPlace app.

Connecting physical and digital assets

The upstream sector is an inherently physical business, made up of hugely complex, highly engineered facilities and infrastructure. BP is building applications which integrate and interrogate data across these physical assets. For example, we are working with Baker Hughes, a GE company (BHGE), on a promising new system called Plant Operations Advisor (POA), at the Atlantis platform in the Gulf of Mexico. While it is early days for POA, it provides a good illustration of the digital opportunities we are looking to harness across our upstream business.



Every day, POA performs 40mn calculations on 400 pieces of equipment on Atlantis' trees, manifolds, separators, compressors and other components, helping the engineering team to spot excursions from normal operating limits. Previously those same engineers would spend hours collating and studying the data for such excursions. This data is now available immediately on a user-friendly, colour-coded, web interface. The time saved can be used to run analytics and attend to equipment or processes that might need attention.

The next step for the POA pilot will be to identify not only excursions but anomalies that could lead to excursions - enabling engineers to identify operational performance issues and intervene before they become significant.

Chris Cooley, who leads BP's Atlantis engineering support team, says: "Engineering should be about actions – redesigning, reprogramming, fixing and improving things. One of our goals with systems like POA is to enable our engineers to spend less time manipulating spreadsheets and more time engineering."

Having increased our operated plant reliability from 86% to 95% since 2011, BP hopes such systems will help push plant reliability into the high 90s.

The use of digital monitoring is not confined to the upstream sector. For example, our refining team uses sensors and drones to inspect infrastructure and digital systems for asset maintenance.

BP's wind business has a 24/7 remote operations centre in Houston that tracks much of what is happening in our portfolio of US wind farms, from a snowstorm to a snake getting into a substation and tripping a breaker. The Castrol lubricants business created a new joint venture this year with Romax InSight to provide predictive maintenance services for wind farm operators.

Predictive analytics are also used at the global level in BP's upstream business. We have a cloud-hosted data platform called ARGUS that holds data on our 2,500 wells around the world, available to any relevant engineer, anytime. Well reviews that used to take days of preparation can now be done live using ARGUS.

Another BP expert developed an algorithm that distinguishes different types of sound, like a music app that can pick out jazz from rap. This algorithm recognises the sound of sand entering a well, potentially constraining oil production. This algorithm is being used in Azerbaijan to pinpoint precisely where sand enters, so we can patch it and restore production.

In terms of optimisation, the APEX system has taken us into a new era of precision, constantly comparing models with actual data to detect irregularities, simulating the impact of procedures and showing engineers how they can tweak flow rates, pressures and other parameters to safely optimise production. And the system works 24/7. Hosein says: "If I am out walking with my kids in the evening, it's good to get an alert telling me everything is working well."

Connecting machine intelligence and decisions

We are seeing an increasing number of uses for machine learning and automation to enable and embed data driven decisions. Massive potential exists in any large corporation to automate manually intensive process work, particularly in areas such as finance, human resources and procurement. BP is currently piloting novel uses of machine learning across the business. This is an area where we are learning from other industries such as financial services and aviation.

One frontier that is literally at our doorstep is the convergence of optimisation and automation. BP is already deploying automated, proprietary process control on wells and moving into drilling. For example, in Oman, we have drilled more than 4,000 metres of hard rock using

closed-loop systems with drillers supervising the process rather than physically conducting it.

As we train machine algorithms to "understand, process and speak" oil and gas, the potential for machines to enhance complex human decision-making and to make routine operational decisions looks almost unlimited.

Connected technology, connected future

It is impossible to know where the journey will end. Perhaps one indication is our investment in Beyond Limits, the company that created cognitive systems for the Mars Rover and other space missions - going beyond conventional artificial intelligence to autonomous reasoning and decision-making.

You could see this as bringing their technology down to earth. But I prefer to see it as a message to our industry - the sky's the limit.

Source : Energy Institute (www.energyinst.org), Petroleum Review, Dec 2017/Jan 2018.