

DIGITAL TWINS IN OIL AND GAS

LARGE-SCALE INNOVATION AT SEA: THE DIGITAL OVERHAUL AT BP

An interview with Ken Nguyen
Digital Program Manager, BP

In the lead up to the Digital Twins in Oil & Gas Summit, we interviewed Ken to find out about BP's modernization and transformation projects.



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Ken Nguyen

Digital Program Manager at BP



Ken began his career working on automation systems for the oil and gas and the utility industry. Ken was Director of Program Management for Symantec, developing software for security.

For the last 15 years Ken, has been heavily involved with oil and gas, managing the deployment of IT systems, including both traditional IT telecom, and radio, subsea fibre, satellite, and radar.

Ken's current role at BP is Digital Program Manager. Within Upstream, he is part of the Global Project Organisation at BP, which handles all of the capital projects. Ken is the Program Manager for the Mad Dog Phase 2 Project.

Can you tell us about Mad Dog 2?

Mad Dog Phase 2 is a greenfield development in the Gulf of Mexico, building a brand new facility into the Mad Dog field. The field has about five billion barrels of oil in the reserve. Our goal is to build a new floating production unit, or the FPU as we call it within BP. It's a semi-submersible hull type.

The entire FPU facility is currently being built in Korea. It will be dry towed back into the Gulf of Mexico for final integration, and then deployed out into the field in 2021. It's a \$9 billion project, so it's a significant capital project for BP. BHP Billiton and Chevron are partnering with us on the project, but BP will be the operator of this new facility.

It comprises of 22 subsea wells, 12 producing wells and 10 injection wells – and it's capable of producing up to 140,000 barrels of oil a day. Mad Dog, or BP in general, and the the project team, have been proud of what we

were able to do. At the time that the project was sanctioned, oil had hit a major downturn around 2014 - 15. We were able to kind of transform the project from what it previously was, which was a different hull factor. It was to going to be the largest so far, but we've transformed it to a more common one that we've used in the past with BP. So, we were able to significantly cut down the cost of the facility.

We had to transform the project, introduce new technology in it. Some that are subsurface in the way that we detect a reservoir, all the way to subsea in the way that we bring the hydrocarbon up.

We've also undergone an initiative within BP Upstream called Modernisation and Transformation, which I will talk about at the IA in Oil and Gas Summit 2020. We've used a digital approach, using Agile method and changing our mindset, to really transform how we do business and how we continue to deliver, even in today's low-cost environment.

At this year's Digital Twins in Oil & Gas Summit you're going to discuss the Modernisation and Transformation of this project. Can you Tell us a little bit about Digital, Agility and Mindset?

Those are three areas that comprise what's in the Modernisation and Transformation initiative that we have ongoing within Upstream, and so it covers three areas.

The first part is that we wanted to be able change the way we think, which is our mindset. We wanted it to disrupt our ways of working by changing the way we think and approach things. We believe that real change can only be undertaken by us disrupting business as usual with different ways of doing things; sometimes it's for the better, sometimes there's not enough value, so we reset. Hopefully, all the things we're doing are for the better, but the key is that we believe our mindset has to change if we want to disrupt the status quo.

The second part is to use more agile techniques. A lot of the Agile is borrowed from the software and IT world, a lot of the same concepts, but there is applicability in oil and gas. We are doing that by setting up Scrums & Kanban activities and techniques.

We're able to have our team do, through iteration, more rapid delivery. That has increased the velocity with which we can deliver, as well as improve the quality, because we have much more feedback when we do iterations. This plays into mindset, we have got people to change the way they think. Agile gives them a way to change the way we do things.

The third element is Digital, which is all about embracing technology to facilitate disruption. We have been able to use various types of digital technology that revolutionise how major projects are not only delivered but, longer-term, how the FPU and the subsea equipment are also managed and operated.

What specific technologies are you using on Mad Dog 2 and how are they transforming the range of these operations?

We have a wide set of technologies that we pursued. The first thing that we did was we established a Modernisation and Transformation plan that identified key technology we would go after.

We've implemented the use of both virtual reality and augmented reality to help us through engineering, construction, inspection, commission and, longer-term, into operation.

We are using a next generation command and control centre that allows us to pull in technology, in way that's easy to use and quick to learn. We are also implementing high speed wireless technology on subsea 4,000-6,000 feet underneath the waterline. We're looking at a complete tether-less field based ROV, meaning it stays resident in field.

We then use the field based ROV for routine

maintenance and viewing of the field, which can service not only the Mad Dog 2, Argos FPU, and subsea equipment, but also other operating assets. We implemented the use of laser scanning, both on the topside and subsea, for scanning our existing equipment that's been out there for 10-15 years to make sure that everything is as it should be. We've implemented drones for flight surveillance, as well as crawlers which attach to our FPU, to go to places where we don't want to put people in harm's way.

We have over 2,000 suppliers, it's very important for us to track inventory. There are technologies we are using to allow us to better track and trace our material tools and packages as we ship them worldwide.

Lastly, we have implemented a new next generation LTE network across the water, out in deep sea. Whereas before we relied on satellite, we now use a fibre optic LTE network to provide high speed cellular network over sea. This provides a supplement for, and can eventually replace, satellite technology.

The technology we are using has really been a game changer in several areas. We used to completely rely on satellite for communication with our vessels, it provided adequate bandwidth, but it was very slow.

With the LTE network – right now, we have 4G (with 5G coming) broadly available– we now have the ability to provide high speed, low latency, at a fraction of the cost of traditional satellite. Satellite won't ever go away, but we can use it more as an on-demand.

Another example is, by using the technology, our hope is that it will allow us to build more remote operations. We can send less people offshore, only key critical people, and reduce over time. We aren't reducing the workforce, but removing the need to travel off to the site when they can do it onshore.

This has really been game changing in the way that we do things. It is increasing the operational efficiency, reducing our health and safety risk offshore, and minimising the costs

associated with operating these facilities and building these facilities.

Can you tell us about the Dynamic Digital Twin, and how is that improving your operations?

Dynamic Digital Twin is a first of its kind. Digital twin is a concept that's been around for 15-20 years, in some ways, the term is over-used. Everything can be considered a digital twin, sometimes we have vendors calling a cell spreadsheet with some data from a piece of equipment a digital twin.

Our definition of a digital twin is much more comprehensive than that, it is an exact digital replica of the entire field. This covers the subsurface, the entire reservoir, the oil path, all the way through to the subsea equipment and the FPU on the topside. Our aspiration is an exact replica, so we model the subsurface as if it were the one that our Reservoir Development team use subsurface. We get the model of things that have already been built, as well as the FPU.

In some cases, we use laser scans to get the final as-built things to have dimensional accuracy, tie-in points, and things like that, to ensure that we do have a complete as-built version of the field. Our attempt, in order for us to get our aspiration of remote operation, is to make sure that when somebody looks at the digital twin it's as if they were looking at a live view of the asset.

The dynamic in how this all comes together, primarily, is where the uniqueness comes. In fact, we have a patent that we have submitted in the US Patent Office. We expect to get that sometime next year because we do believe what we're doing is very unique.

We will be able to pull in data from our reservoir on the flow information, all the way through to the heat of a piece of equipment, pressure, and flow rates. We'll be able to pull in things like live CCTV camera on the topside and live feed from our

ROV operating at the bottom of the sea. We'll be able to track vessels on-board through radars and through AISs, and track helicopters coming in and out. We can complement that with the use of immersive technology such as the HoloLens, to actually allow people to put on the HoloLens and walk around as if they're on the asset. This is all part of the aspiration to minimise the amount of travel.

That is going to be a game changer for our Operation team. It's changing the way we design right now, but our Operation team can do things like competency assessment, and won't have to go offshore to do it.

We can now send less people offshore to do the work because the majority of our control system is automated. This allows us to introduce things like machine learning and, later on, artificial intelligence to automate that. The hope is that we really decrease our risk for health and safety, and increase the operational efficiency of our facility.

What challenges have you encountered in employing all of these technologies and how have you overcome those?

A challenge we have is adapting to these new concepts, Mad Dog 2 is leading the way for BP across all of its major projects, and it's also leading our suppliers. Oil and gas has traditionally been fairly slow in terms of adopting new digital technology, or not as fast as one would like.

Our challenge has been getting our 2,000 suppliers to move along with us on the journey. For example, on the Dynamic Digital Twin, we need support from our suppliers to provide us the data in a digital format, to get things like models of their equipment in a way that we can consume it, to normalise that data. We believe that we're setting up an ecosystem that is not only beneficial to BP but to our suppliers, our partners, and I believe eventually into the whole industry.

How are you creating a next gen collaborative environment?

Some of this technology has been around for a while, and some of it is in bits and pieces. We are attempting to pull this together in a way that is easily consumed, that's key. Digital is great, technology is great, but sometimes we're so inundated with the amount of technologies there are. It becomes less useable, because there are so many things available to you that it becomes confusing.

One of the things that we wanted to do, when we set up our next generation collaboration environment, was for it to be almost presented in a way that you don't have to know anything about it and get going. I'm sure a lot of companies have this challenge, is that they have these environments but in order to use them they need training or it takes an IT person to help them, which takes 10-15 minutes to make the technology all work.

A key aspiration or design criteria was we wanted a way in where somebody could look at this gigantic touchscreen wall that lists out 80% of the type of activity they would do, and either they use voice detection to say I want to start a review meeting, or they tap on the wall and everything is set-up.

Whether it's the video camera for video conferencing, the touchscreen, its set-up; where it displays all the information that's relevant to that meeting. We wanted to minimise the amount of learning that people would need. We wanted to replicate the experience that a person would have using their cell phone. Everybody has a smart phone, they don't have to go through intensive training. It's very intuitive.

We wanted to replicate that experience. A child could go in there and be able to do what they need to do. They're able to get going instantly, and we don't have to spend time making the technology work for us, whereas the technology is now working for us, not against us.

What are the next steps when it comes to intelligent automation on Mad Dog 2?

The next step is using deep machine learning and artificial intelligence. I believe there is a clear separation between kind of deep machine learning and artificial intelligence.

Deep machine learning is a set of algorithms that you teach a machine on what it needs to do based on a set of criteria. Artificial Intelligence, in my view, is where the machine can learn how to learn, not just that you tell it what to do. We aren't there yet, but we've made some large steps.

We've implemented a foundation by putting automated controls on our wireless system, that allows us to be able to use deep machine learning to take corrective action, adjust things like flow rate and pressure, to maximise our operating efficiency.

As the technology matures we want to get to the point where it is artificial intelligence that is actually operating the entire field. We tell it what business parameters we want, production rate, operating efficiency, and it knows what it needs to do to achieve those parameters.

That won't ever replace people, but it allows humans to be able to concentrate in key areas within the asset, to make it even better and safer. I believe that's our next step, to get to the point where these things are basically able to operate with oversight from a human being, but are able to take and recommend actions based on artificial intelligence.

I believe that if companies aren't disrupting the way they do things by changing and adapting to the fast pace of technology, at some point the company will be disrupted by these technologies and processes.

I feel that we are taking these changes into our own hands, controlling our own destiny. You can either let it affect you can take steps to manage that change yourself.