## **DIGITAL TWIN**

# Digitising operations



igitalisation is seen as the key to integrate and optimise asset performance, maintenance and procurement oil and gas operations upstream and downstream and along the value chain. In today's world of web-based operations on the cloud and the Internet of Things (IoT) Kongsberg Digital and Norske Shell shared a common vision that assets of the future could be operated through a digital ecosystem as a dynamic digital twin.

In 2019, Norske Shell and Kongsberg Digital teamed up to digitalise the Nyhamna facility, a gas processing and export hub for Ormen Lange and other fields connected to the Polarled pipeline. Norske Shell entered the partnership as operator of Ormen Lange and as Technical Service Provider for Nyhamna, where Gassco is operator. The value of the contract scope to develop a digital twin of the offshore and onshore installations and subsea infrastructure was about NKr100mn (£8.64mn).

Kongsberg Digital utilised the Kognitwin Energy dynamic digital twin to establish a dynamic virtual representation of the gas plant which is continuously updated with integrated data and information from numerous sources, reflecting the status of the facility in real time. The digital twin enables frontline operators, engineers and remote vendors to become fully integrated, with integrated data and work processes, options for optimisation of transforming and optimising the operations and maintenance

A dynamic digital twin allows Shell to simulate different scenarios to determine new process plant Photo: Shell

philosophy of the asset. Rich data, including legacy and paper-based data, is used proactively and workflows are more automated through a contextualised 2D and 3D interface. The digital twin enables users to analyse and optimise performance using a digitised framework via the cloud.

Shell is now equipped to simulate different scenarios to determine new options for optimisation for the onshore process plant. Engineers, operators, partners and people along the full supply chain can access the digital twin via iPads, iPhones, pcs, laptops and other devices both in plant and remotely for improved collaboration and business transformation.

The dynamic digital twin is used to optimise and reduce the time and cost of commissioning, operating, planning and designing assets. Data-driven operations support smarter and more efficient ways of planning, design, engineering and operation of assets, with a real-time view of a facility, processes and production performance. Physical models and machine learning algorithms provide 'virtual sensors' and insight into both instrumented and non-instrumented parts of the facility, and can perform 'what-if' and scenario analysis to uncover the best options for plant optimisation.

These capabilities are used on existing assets to boost production, manage power consumption and reduce the

**Norske Shell and Kongsberg Digital** teamed up to create an advanced dynamic digital twin to optimise operations of a major gas processing and export hub. Brian Davis reports.

carbon footprint, as well as for planning, design and construction of new assets or modification of current facilities. Virtual collaboration between operators and oilfield service suppliers across different disciplines drives down maintenance and operating costs and facilitates remoteoperated assets and operation centres.

### **New and better solutions**

Shell's digital strategy is valuedriven, aimed at finding new and better solutions to drive improved business outcomes, offering new insights that can be leveraged to improve productivity, reliability and performance of the gas facility.

Hege Skryseth, President of Kongsberg Digital told Petroleum Review she is proud to work on Shell's digital front-runner at Nyhamna. 'The dynamic digital twin is an open ecosystem designed to utilise a variety of applications to increase efficiency and optimise production for assets. This is truly an exciting collaboration.'

What's more, 'We achieved a full line of sight to return on investment (ROI) within just nine months after go live,' says **Rolf Einar Saeter, Business** Improvement and Technology Manager in Norske Shell.

The results have been impressive, with a 10–15% increase in people productivity in some cases. The collaboration module yielded a 2–4% reduction in opex (operating expenses) by enabling enhanced levels of remote work, reduced travel to site for staff,

contractors and suppliers, and accelerated activities such as work permit creation. There have also been improved opportunities for modelling and experimentation through what-if production scenarios, eg simulating well lineups and plant modifications prior to implementation.

Saeter sees dynamic digital twins as 'the future of energy operations, during the energy transition'. And reveals that Shell plans to use the digital twin technology in scenario planning for offshore wind operations and potential hydrogen plants.

This is Shell's first digital twin implementation, serving an important gas supplier and huge infrastructure requiring high availability.

'From the outset in 2017, we wanted a digital system for energy optimisation and collaboration covering all types of work processes and access to different technologies. Our intention was to move into the digital landscape covering three specific pillars – energy optimisation, production system optimisation and collaboration,' Saeter explains.

Norske Shell ran some pilots to test and educate itself about the potential of digital solutions. In 2018 it decided to focus on the Nyhamna gas processing plant and build a dynamic digital twin covering all three pillars, and the underlying business cases end-to-end from the reservoir, via the pipeline or vessels, to the gas processing plant and bringing the product to market.

Saeter continues: 'We piloted the digital twin concept internally then searched for a vendor who could be a true partner to help us fill our technology gap, with the insight and knowledge to help us transform our current business into the future definition of where we want to be '

After discussion with several potential vendors, Kongsberg Digital was selected as partner in 2019. 'There were a lot of good companies covering different niche capabilities. But we wanted a more holistic approach and independent partner to help us create a digital landscape.'

'We required an open, innovative ecosystem that covered all domains. Using data from numerous sources for scenario planning, analysis and demonstration of different business cases. The road is not linear. A problem today is not necessarily one that can be solved five years from now. We required a dynamic mechanism to solve problems and identify opportunities over time.'

#### **COVID-19 impact**

The COVID-19 pandemic proved to be a perfect example. 'The digital twin has helped us through this pandemic period, with remote support from vendors across Europe handling a wide range of challenges. It accelerated our understanding and observation of demand for the digital twin. And in practice, COVID-19 has had little impact on our Norwegian operations,' Saeter reflects.

From signing the contract in October 2019, the first version of the digital twin was in operation in less than 90 days, providing an open, innovative and standardised digital landscape based on Microsoft Azure.

Kongsberg's Skryseth puts the picture in context. 'Typically, an oil and gas company has multiple systems, with numerous sensors gathering data within the digital bus, ie often using customised solutions for energy management, operational excellence and production optimisation. We took a different approach.'

Norske Shell insisted from the outset it wanted standard, not customised, software. Because if an organisation really wants to benefit from digital solutions it needs to ensure that as many applications as possible work on the same solution to give richness in functionality and continuously increasing features over time – whether developed by Shell, other energy partners or third-party developers. 'This is the backbone of an open ecosystem,' Skryseth maintains.

Norske Shell also required a compelling business case. 'We required a forward-looking business case, with a lot of education [on digitalisation] to build trust around our analytics. While also bringing back value fast to convince the decision makers that we were on the right path,' says Saeter.

So, what was the main challenge? 'The big challenge was to dig out data from legacy IT systems, so internal data was readily available for innovation and planning. The data was contained in different applications, shapes and forms. The time required to access all that data was maybe the biggest lag to project progress,' Saeter admits.

There was also the thorny issue of change management. However, he notes: 'In practice, after just a few weeks the team was driven by "expectation management". People were eager to configure a system which could support their needs, with precision and upskilling on all sides, to ensure it serves its purpose while also creating value. This was a win-win for the partnership – creating an integrated organisation, removing boundaries between functions and sharing data collaboratively."

Artificial intelligence (AI) and machine leaning algorithms now play an important role in optimising performance and maintenance management, rather than the conventional firefight in many process plants. 'Even a 1–2% improvement gives substantial payback,' says Saeter. 'The key word is trust. You must have trusted data from the machine learning/AI landscape.'

#### **Significant benefits**

Today, Norske Shell and Kongsberg believe the dynamic process flow simulator is giving a huge advantage in understanding how the Nyhamna plant is operated and how to improve it further.

The dynamic digital twin has reduced the cost of buying energy by 30%. Saeter suggests: 'The digital twin can be seen as a "new operating system", able to check that everything has the right connectivity within one easily accessible system, for process management, efficiency and materials management, for example. We are seeing efficiency gains throughout the organisation. We also have a leaner IT infrastructure and have managed to virtualise risk – which is a major focus of oil and gas operations.'

Looking forward, Norske Shell aims to take the digital twin from the reservoir to the market across the whole value chain, including subsea infrastructure, pipeline inspection and well testing. Giving the organisation the opportunity to optimise energy use and production while also reducing waste in the transactional landscape. Most important, the digital twin accelerates the timeto-market for new projects.

The skills landscape has also changed. Saeter says: 'Three years ago, there were no data scientists outside the IT department. Now, AI and machine learning is at the front-end of oil and gas operations, transforming the business. Transparency helps us make decisions faster, builds awareness and indicates areas of business and performance optimisation. I believe digitalisation is creating a flatter organisation which is transforming the business.'