Figure 1. Using collaborative operation centres, QGC is able to oversee 540 km pipelines and over 6000 wells spread over 3500 km² with fewer than four people. Courtesy of QGC.

DIGITALISATION IN ACTION

By consolidating disparate data into one system capable of real time monitoring and sophisticated analytics, digitalisation is set to play a major role in future pipeline installations. **Håvard Devold, ABB, Norway,** explains.

In today's sustained low price environment, industry players need to rewrite their operating playbooks with a greater focus on digital options. This is because the cost reductions required are so significant – often in the order of 40% – that traditional measures are proving insufficient.

Working more collaboratively, oil and gas companies must use big data and data analytics more effectively if they are to ride out the current downturn and emerge stronger in the years to come.

The availability of cheap sensors, better computer processing capabilities and widespread wireless networking opportunities mean that digitalisation offers companies a route through which to transform performance. Properly deployed, today's digital technologies can make it easier

for operators to keep production flowing more profitably, more safely and with fewer workers than ever before.

Successful companies will establish an integrated network of smart equipment overseen by appropriately informed human operators onsite and others overseeing matters remotely. Those continuing with the status quo of information silos and disparate pockets of digitalisation will eventually be surpassed by those who harness the power of digital across every part of their operation.

Digitalisation: the big picture

Industry players are currently drowning in data from multiple sources, so the answer is not just to collect more data. While data quality and type is important, a more pressing issue is visibility. Typically, much of the key information required to take effective action is hidden away in silos across different parts of an organisation. Key decision-makers typically receive only 1% of data collected. Engineers, for example, tend to devote 70% of their time searching for, and manoeuvring, data to suit their needs – time which could be spent more productively on other, more value-added tasks.[1]

For optimum performance, frontline operators through to headquarters executives need:

- Enough of the right information – neither too much, nor too little.
- Delivered to the right person at the right time.
- Shared in a real time format that ensures everyone is working from the same data set.
- With an appropriate level detail to suit their specific needs.

In terms of information customisation, data also needs to be tailored for at least four groups. At a base level, maintenance managers need device-specific data to understand real time equipment maintenance needs: how important are any alarms, is equipment predicted to fail imminently causing unplanned downtime etc.? At a second level, process managers need the data relevant to optimising their overall production parameters while, at a third level, plant managers need plant-wide performance overviews so they can optimise output across all of their areas of responsibility. And, let us not forget the enterprise level requirements of headquarters management. They need comparative performance statistics across sites so that they can pinpoint and address problem areas quickly, while transferring best practices from one area to another where feasible.

Recognising the benefits, companies are already investing in collaborative operation centres and control rooms, which consolidate disparate data into one system capable of real time monitoring and sophisticated analytics. They are ensuring all stakeholders work from the same information, thereby delivering optimised, joined-up decisions. The following details two examples of how this is being applied in two modern day pipelines.

Trans-Anatolian natural gas pipeline

TANAP Natural Gas Transmission Company is a company formed with Azerbaijan's SOCAR, Turkey's BOTAS and the UK's BP as shareholders to build the Trans-Anatolian natural gas pipeline (TANAP), which will bring Azerbaijan's natural gas directly to Europe. It will transport gas from the Shah Deniz 2 field in the Caspian Sea through Azerbaijan, Georgia, Turkey, Greece and Albania, to join the European network in Italy.

The project consists of a 56 in. and 48 in. dia. onshore pipeline system of 1814 km in length, with a 21 km offshore section beneath the Marmara Sea comprised of two parallel 36 in. dia. pipelines. The gas pipeline, which is buried a metre below ground for almost all its length, will include seven compressor stations, four measuring stations, 11 pigging stations, 49 block valve stations and two offtake stations. It is the largest diameter, longest pipeline ever constructed in Turkey and it will be the first time that a leak detection system will be deployed for a subsea water crossing.

Additionally, TANAP faces many challenges as there is a climate that moves between extremes of hot and cold, as well as a lack of infrastructure in some areas – not to mention issues of security unrest in the surrounding region.

It is being built with digital solutions embedded from the outset to ensure its productivity and integrity. More specifically, it will be controlled and fully automated via ABB's System 800xA, with main and backup control centres to meet the requirements of gas transmissions and associated environmental and safety considerations. The software solutions will integrate with the supervisory control and data acquisition (SCADA) systems and the telecoms that control the gas flows, detect leakages or intrusions and make CCTV coverage available for safety and security.

Particularly important is the feature called point of control (PoC): a function that was added to ABB's System 800xA and deployed on the BTC and SCP pipelines. PoC allows the transfer of authority to operate parts of the pipeline to be passed between central and local human machine interfaces (HMIs), while automatically maintaining the integrity of the system. Using PoC, engineers can quickly and safely transfer control from the central control room (CCR) to local operational staff on request. The CCR retains view-only access until control is transferred back. This feature of System 800xA sets it apart from many of its contemporaries and reflects ABB's commitment to making collaboration as easy as possible between various stakeholders.

Running alongside the SCADA system will be the telecom systems, which are separate from System 800xA but integrated where required. Both control and telecom systems data will be carried along a fibre optic backbone that will run the length of the pipeline. It will take the form of one 48 core and two 96 core fibre optic cables installed in high density polyethylene ducts. As well as these standard functions, there will be a number of backup communications available, such as TETRA radio, which

is used by emergency services and satellite phones for unmanned stations that are off the mobile phone grid. There will also be meteorological networks at the compressor stations.

The most important and sophisticated part of the telecom systems is leak detection and pipeline monitoring, which will be done using a distributed acoustic sensing (DAS) solution. DAS relies on the fact that, when sound waves hit a cable, they cause minute changes in the optical properties of the fibre contained within it. Changes in temperature have a similar effect. Laser pulses sent down a cable will report any changes using a technique called coherent optical time domain reflectometry (COTDR), and server algorithms will analyse the data, pinpoint the leak's location, verifying it with other data, e.g. the pressure wave that usually accompanies such a break in the line.

Figure 2. Workers next to the large pipes at the Sangachal terminal in Baku, as part of the gas pipeline infrastructure where the Southern Gas Corridor begins at SCPx before joining TANAP. Courtesy of BP.

Trespassers will be identified in the same way as leaks: with laser pulses. Fences will surround all the pipeline's stations, manned and unmanned. And, each fence line and surrounding areas will be fitted with a fibre optic cable to enable monitoring on a 24 hr/d basis. The system will automatically try to verify any dubious activity using CCTV, escalating the issue to the human operator if something untoward is observed. In addition to presenting the evidence related to the suspect activity, the system will also share relevant standard operating procedures to guide the employee on next steps.

Queensland Gas Company

In Australia, there are 250 trillion ft of gas reserves estimated to lie underneath Queensland and New South Wales. This can power a city of one million people for 5000 years.

Queensland Gas Company (QGC) was the world's first company to convert coal seam gas into LNG. The project, which started construction in 2010, began producing LNG in 2013. Development remains ongoing.

It has a 540 km underground pipeline network linking the company's gas fields to its two train liquefaction plants in Gladstone. These plants are capable of producing up to 8.5 million tpy of LNG.

When the gas is transported to the liquefaction facility it is chilled to -162°C until it becomes a liquid, and condenses to about 1/600th of its original gaseous volume. This makes it easier to store and ship, with more than 70 cargos being distributed globally in the first year alone (2015).

Telecom solutions used by QGC include CCTV, perimeter intruder detection and hotline services that support the safety and security of people and sites.

A common dashboard provided by ABB's System 800xA enables operators to monitor and regulate the pipeline, numerous processing facilities and over 6000 wells spread over 3500 km^2 from a single control room in Chinchilla.

At the same time, Chinchilla's information is shared via a common user interface with managers in QGC's Brisbane headquarters. In this way, headquarter employees can keep an eye on the performance of the company's wells, processing facilities and pipeline, while simultaneously managing the operations in Gladstone.

Communication and co-ordination between Chinchilla and the headquarters is particularly quick and effective, with everyone receiving the right level of information at the right time to suit their needs and optimise overall performance.

It is also worth noting that the 24 hr Chinchilla control room is manned by a maximum of only four operators. This is because the System 800xA systems automates production and pulls together the many different pieces of information so seamlessly that human operators only need to get involved in particular sets of circumstances.

Conclusion

While this article has delved into two case studies of digital empowerment in this sector, many similar initiatives are underway. A momentum is growing of likeminded companies that recognise the key to success in this Fourth Industrial Revolution is to avoid focusing on individual technologies and, instead, devise an integrated Industrial Internet of Things strategy capable of transforming operations.

References

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