

Digitalisation: A Paradigm Shift in Oil & Gas Industry



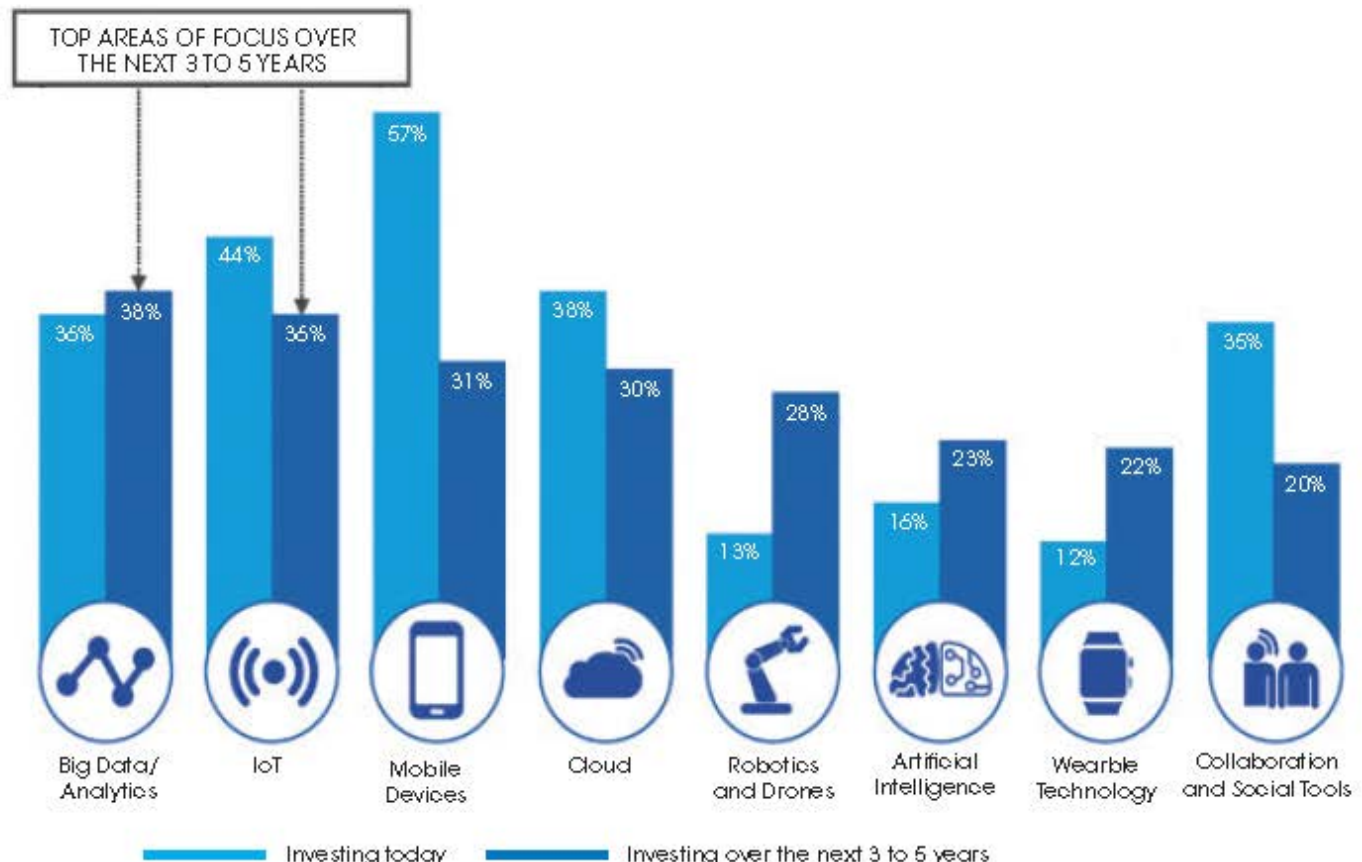
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The Oil & Gas industry was one of the pioneers which adopted digital technologies as early as in the 1980s. The industry had long depended on high volume of data to understand reservoir resource, production potential, improving safety and health and boosting operational efficiencies at oil fields.

However, the true potential of the data generated is yet to be realised by generating actionable insight. Based on a recent study, digital transformation can unlock approximately US\$1 trillion in value for the Oil & Gas industry. Environmental benefits include reducing CO₂-equivalent (CO₂e) emissions by approximately 1,300 million tonnes, saving about 800 million gallons of water, and avoiding oil spills equivalent to about 230,000 barrels of oil. Ever since oil prices began declining, digitalisation had been rising as a strategic business priority for Oil & Gas companies. This “new oil field” paradigm will differentiate between the players that succeed and those that disappear over the next decade.

DIGITALISATION

Digitalisation is the use of digital technologies to change a business model and to provide new revenue and value-producing opportunities. Digital technologies include Big Data Analytics, IIoT, Mobile Devices, Cloud, Robotics and Drones, Artificial Intelligence, Wearable Technology and Social Tools. According to a recent survey by Accenture, Big Data Analytics and IIoT are emerging as top digital topics for Oil & Gas companies, based on the percentage of current investment and the expected investment over the next 5 years.



* The percentages in the bars are the proportion of Oil and Gas companies surveyed. Source: Accenture, The 2016 Upstream Oil and Gas Digital Trends Survey

Figure 1: Investment in Digital Technologies

INTERNET OF THINGS (IoT)

Internet of Things is a system of connected computing devices, machines, objects or people with unique identifiers and the ability to transfer data over a network without human-to-human or human-to-computer interaction. IoT is a revolutionary advancement between operation technology (OT) and information technology (IT). IoT also enables machine-to-machine interactions.

Plants and refineries are mostly automated and under constant surveillance and control loops. Advanced measurement devices such as electronic flow metering technology, data-intensive pipeline inspection gauges (PIGs), SCADA, and digital sensors are embedded in vessels, tanks, compressors, turbines and pipelines to capture real time data. Recent offshore drilling platforms have about 80,000 sensors. All real time data captured via these sensors are usually sent to the control rooms for diagnosis and monitoring activity by experts.

Machinery used in O&G, especially drilling equipment, has to operate in harsh conditions and, over prolonged periods, is susceptible to wear and damage. With the advancement of IoT, machinery is now fitted with smart sensors to collect data about its performance, enabling maintenance and parts replacement to be done efficiently.

IoT has enabled unstructured, machine-generated data to be analysed for insights that drive improvements in design and operation, leading to smarter, faster decision-making with minimised downtime.

BIG DATA ANALYTICS

Big Data Analytics is the theory and practice of applying advanced computer analysis to the ever-growing amount of digital information collected from smart elements. A single drilling rig can generate one terabyte (1024 gigabytes) of data per day. The total amount of data collected from an oilfield during its lifetime can reach up to 15 petabyte (15 thousand terabytes).

Big Data Analytics will help companies navigate this enormous amount of data. An analyst builds a simulation interconnecting these data and the elements of business. The simulation is used to explore how tweaks in certain operations may have an impact on the productivity or efficiency of another.

The huge amount of data collected from all segments of the business activity results in a higher degree of accuracy in simulations, as close as possible to the way things will play out in the real world. This helps decision-makers make better decisions which can affect the company's fortune. Recent findings show that only 13% of O&G companies are using the insight from the Big Data Analytics to drive their approach towards the market and their competitors. Based on a recent study, analytics can help exploration companies extract 3-5% more oil.

Shell uses Big Data Analytics for preventative maintenance and to reduce breakdowns and downtime. In 2015, it saw a US\$1 million return on an US\$87,000 investment in sensors and analytics to monitor oilfields in some of Nigeria's toughest terrain.

DIGITALISATION ENABLERS

Cisco estimates that companies will see 11% earnings growth across the value chain, with most of the cost savings upstream. One integrated oil company managed to save about 10% on unit costs by digitising a remote offshore operations centre. Another reduced operating costs per barrel by about 10% and improved recoverability of reserves by applying selective applications in intelligent oilfields through collective computing and sharing real-time information at all company levels. The cost saving potential is evident. Disruptions in supply, demand and commodity prices will maintain the pressure on oil price and push O&G companies to focus on reforming their portfolio and establishing a bigger footprint in the digital transition to bring down the cost of production.

There is also a growing number of push and pull from the industry itself for swift digitalisation effort. The first drive is from the search for new hydrocarbon deposits, which carries a high cost of over US\$100 million. With the huge amount of effort, material and manpower needed in new field explorations, there is no room for error or looking in the wrong place.

The emerging digital assets, such as drilling algorithm and intelligent pipelines innovation, are also driving the digitalisation effort positively. With advancement of the technology, communication between field workers and smart devices is becoming more collaborative and two-way. On-site work autonomously performed and remotely managed, for example, use drones for inspections, material transfers and maintenance.

The industry is also venturing into innovations and research efforts on application of robotics to handle complex and repetitive task such as connecting pipes and replacing broken machinery. At the moment, robotics is being used in autonomous drilling where workers are completely removed from the drill floor. Other advancements include robotic moving platforms for shale wells and remote-controlled trucks to transport oil or gas. According to a study, 47% of jobs in the industry will be automated with robotics over the next 20 years.

The rapid advancement of technology is expected to save the field service industry US\$1 billion annually. This is possible with the use of smart glasses to diagnose and fix problems faster. For example, maintenance workers can expect to get instant access to information regarding a specific pump and its maintenance history or a wearable smart device such as Google Glass, which identifies the equipment automatically.

INDUSTRY DRIVERS

Royal Dutch Shell is one of the world's largest O&G companies and the fourth largest by revenue. It has been developing the idea of a "data driven oilfield" in attempts to bring down the cost of drilling for oil which is the industry's highest expense.

Shell has partnered with Hewlett-Packard to develop special fibre optic sensor probes which are put into the earth at the survey spot; these will register the pattern of the waves distorted as they pass through oil or gas. Data is then transferred to its private servers maintained by AmazonWeb Services. Shell expects to get a far more accurate image of what lies beneath. This will then be compared alongside others around the world to enable geologist to make more accurate recommendations on where to drill.

Schlumberger is the world leading provider of technology for reservoir characterization, drilling, production, and processing to the oil and gas industry. Schlumberger is now monitoring subsea conditions using "wave gliders" or unmanned marine surface vehicles. These use solar and wave energy and can travel across the oceans to collect data for up to one year without fuel or crew.

In 2016, GE announced a series of partnership agreements with small and large oil companies to implement digital devices, databases and sensors which includes Meridium (a leader in the industrial asset performance management), Bit Stew Systems (experts in data integration and analysis for Industrial Internet systems) and ServiceMax (a provider which enables technologies for field service technician and engineers). GE is also investing in the deployment of more than 550,000 digital twins and exploring various scenarios for interaction between users and digital twins, with the aid of voice recognition and Microsoft HoloLens visualisation.

DIGITALISATION IN THE NEAR FUTURE

Digitalisation will drive the industry to rely less on personal experience and preference and to rely more on science which can be understood and shared by all. Some jobs such as equipment inspector may possibly be replaced but jobs requiring digital literacy skills, analytic skills and skills of developing new software and intelligent hardware, will emerge as the new requirement in the industry.

In future, wells may also be equipped with smart technologies that enable them to initiate and participate in conversations to increase performance using social tools such as Chatter. A well may, for example, initiate a discussion thread when there is a possible problem such as high temperature reading or abnormal vibration. The idea is for the well to initiate the dialogue, similar to how a patient calls for a doctor. Smart analytics can then pull specific people with the right expertise into the discussion forum to solve the problem collaboratively.

The vision is to have an unmanned control centre powered by the platform with artificial intelligence coordinates operation in real time, bringing together supply and demand. This operating model can significantly increase the life-cycle of O&G assets while driving efficient operations and HSE performance.

EXPECTATIONS FROM ENGINEERS

Digitalisation of the O&G industry is only possible with the active involvement of engineers. However, the expectations from engineers may differ in the digitalisation era.

- 11,900 new data analysts are needed in the energy industry to make sense of big data. 90% of these new jobs require excellent digital skills, which are different from engineering skills of the past. The expectation is to have digital literacy and scientific skills with the ability to interpret and turn information into key decisions. Future engineers need to be comfortable working with new digital tools, analytics and to understand behavioural economics.
- Engineers need to develop just-in-time skills and to use technology to support new skills. In future, they will not only be relying on years of experience but they will also need to acquire just in-time skills and to apply these directly at work.

- With digitalisation, the industry will rely on an open innovation model to solve problems in innovative manner. Digital innovation will be a highly sorted out skills needed in an engineer.
- In order to be successful, engineers will have to remain agile to adapt to the changes and be flexible enough to respond quickly to dynamic technology changes.
- Certainly, there will be an increasing need for engineers to work on providing only the right data to the right people at the right time, in an easily digested format.
- To be successful, engineers must remain agile to adapt to current changes and be able to respond quickly to dynamic technology changes.

CONCLUSION

In order to gain a competitive advantage, O&G companies will need to develop a strategic plan for the use of digital technology, over the next three to five years. With the current market situation of volatility and uncertainty, these companies will need to focus on transformational efforts required to create a winning strategy. They must remain agile to adapt to current changes and be flexible enough to respond to the dynamic technology changes and grasp the full potential of digitalisation. The expectations from engineers to enable this new paradigm shift are enormous; they will be expected to remain agile and lead the change process.

"It is not the strongest or the most intelligent who will survive but those who can best manage change," – Charles Darwin. ■

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