DIGITAL TWINS IN THE OIL AND GAS PRODUCTION

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ABSTRACT

Most oil and gas production facilities have been in operation for decades. To keep them running for decades more, modernization through digital transformation is an absolute necessity. Digital twins provide a virtual copy of your actual plant. They are the digital representation of the physical assets that keep your production facilities operating. They capture every piece of relevant information about an asset, such as operating instructions, schematics, troubleshooting procedures, maintenance records and more, and store them in the cloud for easy access and updating.

INTRODUCTION

Aside from the obvious benefit of creating a single, secure repository for all asset documentation – one that doesn't rely on the memory or expertise of an aging workforce – digital twins can positively impact the operational efficiency, reliability and agility of oil and gas manufacturers. The average age of oil and gas workers is 56, and more than half of them will be eligible for retirement in the next 5 to 10 years. [1] Without innovation like digital twins, the industry will face a critical skills shortage. 25% of organizations in Uzbekistan are expected to adopt digital twins by 2030 .[**3**]

- Detect early signs of equipment failure or degradation, enabling proactive corrective maintenance actions and avoiding costly plant downtime or asset replacement
- Model drilling and extractions to determine whether virtual equipment designs are feasible prior to implementation
- Gather real-time data feeds from sensors to evaluate an asset's state and condition, no matter where it's located
- Reduce the need for full-time personnel with specialized knowledge
- Minimize the costs associated with travel to and from field operations
- Eliminate the risk of missing, incorrect or inaccessible asset data

Digital twins and smart data systems could help oil and gas operators save up to 15% on total decommissioning project cost. [2]

MATERIALS

Extracting Value From Digital Twins

Oil and gas companies can leverage digital twin technology to see how a process or system is working, to create an analytical what-if model, or to build a predictive what-will model.

Digital twins can reduce the time needed to estimate project parameters. It can also help to improve concept selection decisions by holistic well-to-export visualizations.

Oil and gas companies can incorporate digital twins into subsea production systems and SURF (subsea umbilicals, risers and flowlines). Digital twins can conduct asset simulation dry runs to optimize asset value, such as improving tradeoffs between operating and capital expenditure. It can also speed up the process of testing alternative concepts by using parametric net-present value models and reduce the time required to interpret data and generate prospects using AI-assisted image recognition.

Such benefits have been attracting oil and gas operators across the globe to explore digital twin technology and some majors have shown significant interest in the past two years. [4]

The oil and gas sector has been slow in adopting digital twins. Only a handful of major companies have started to invest in this technology. However, with advancements in digital twin technology growing, its use is expected to become crucial for businesses considering volatile and uncertain market scenarios in the oil and gas sector.

The adoption of digital twins is being driven by its cost saving potential. In the North Sea, deploying digital twins in offshore oil and gas projects could save more than 2 million euros on project costs for assets with topsides of 10,000 tons, which increases to more than 8.5 million euros for assets with topsides up to 40,000 tons. Digital twins and smart data systems could help oil and gas operators save between 9% to 10% on total decommissioning project cost.
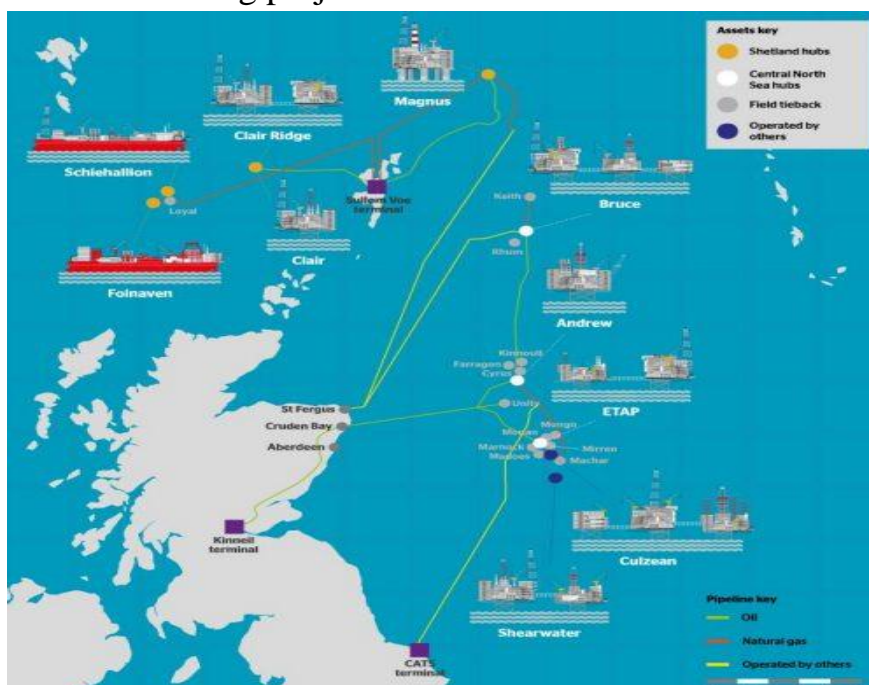
Experts predict that half of major industrial applications will be using digital twins by 2030, potentially increasing their operational effectiveness by 15%. It's only a matter of time before we see industrywide adoption of digital twins across the globe.

METHOD;

Oil prices have swung sharply in recent months, fluctuating between $40/bbl to a high of almost $90/bbl. The unexpected price volatility is causing stress on the capex and opex of the oil and gas value chain. Compounding the challenges, the negative perception of fossil fuels, rising trade tensions and geopolitical upheaval are adversely affecting near-term demand and business costs.

As a result, more companies are looking toward a "digital transformation" to drive effective capacity, not only through capex, but also opex investments by optimizing operations and improving asset availability as these are more scalable and have a shorter lead time, enabling companies to swiftly respond to market changes.

A digital twin is a complete 360-degree replica of a physical asset such as pipelines, gathering systems, heat exchangers, turbines, pumps, compressors, or entire plants that enables modeling of process and control, and monitoring of equipment health. It is the foundation of a digital transformation that optimizes production, detects equipment problems before failures occur, uncovers new opportunities for process improvement, all while reducing unplanned downtime.

AVEVA NET gateways provide the interface to the source data. (All images courtesy AVEVA)
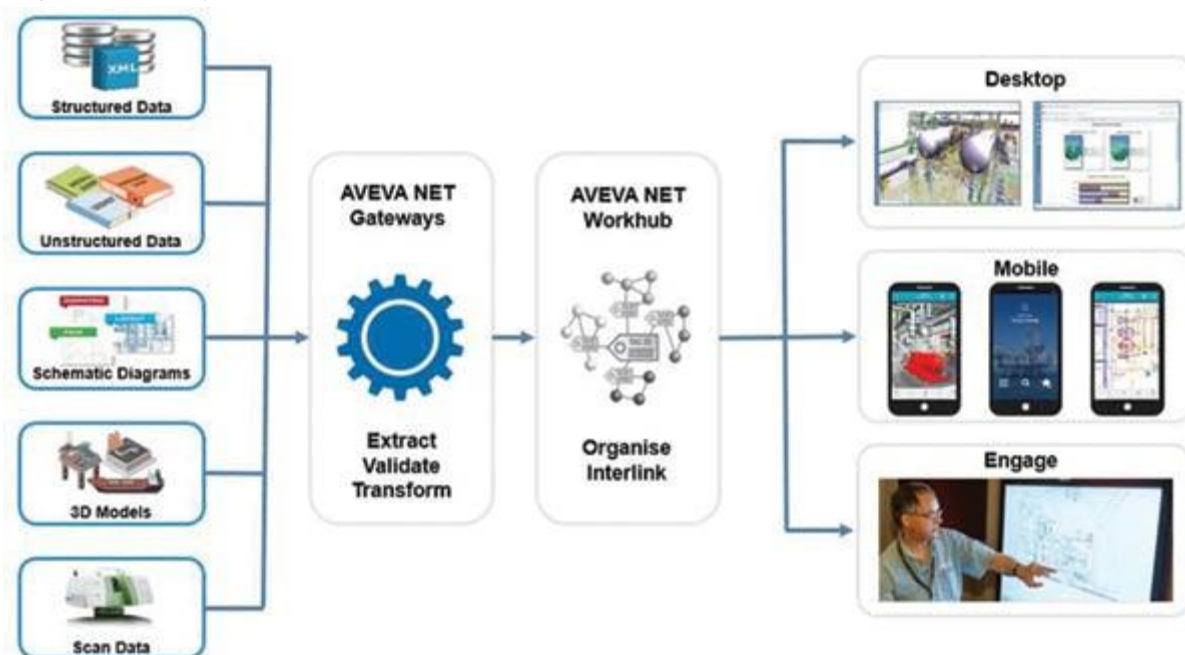
The concept of a digital twin has been around for more than a decade. However, it is the advancement in technology in recent years – cloud computing, analytics, and increased computing power – plus greater clarity on the use cases that has accelerated the adoption of digital twins in industry.

From unprecedented real-time insights of their operations, to elevating their operational excellence to the next level, it is no wonder oil and gas companies are starting to realize the benefits that digital twins enable. For example, a 0.1% increase in production due to improved process and operating efficiency can easily yield several millions of dollars in additional revenue. [5]

RESULTS;

Due to its asset-intensive nature and reliance on large pieces of highly instrumented equipment, often operating in remote, unsafe, and uncompromising locations, the oil & gas industry has had digital twins on its agenda for several years.

Shell, together with Swiss engineering modeling and simulation technology company, Akselos and engineering research and development experts at LICengineering, a Danish consultancy firm specializing in the marine and offshore energy sectors, have recently signed up as participants in a two-year digital twin initiative. The partnership focuses on advancing the structural integrity management of offshore assets by combining fully detailed cyber-twin simulation models. Things are well under way with Shell North Sea assets, with the intention to improve management of their offshore assets, improve worker safety, and explore predictive maintenance. There are two phases to this initial project:

- First, to develop a condition-based model of its selected assets, enabling the company to analyze structural integrity with more accuracy and detail
- Second, to combine this model with sensor data, to allow Shell to monitor the health of its asset in real time, which would enable the company's operators to predict the future condition

The world's first "digital rig" is targeted to achieve a 20 percent reduction in operational expenditures across the targeted equipment and improve drilling efficiency. The solution connects to all targeted control systems, including the drilling control network, the power management system and the dynamic positioning system. Data is collected through individual IoT sensors and control systems, modeled and then centralized on the vessel before transmitting in near real time to GE's Industrial Performance & Reliability Center for predictive analytics. The system has already started to capture multiple anomalies and produce alerts of potential failures up to two months before they would occur. The data models come from a digital twin of various physical assets, along with advanced analytics to detect behavioral deviation. Thanks to vessel-wide intelligence, personnel both on the vessel or onshore can gain a holistic view of an entire vessel's health state and the real-time performance of each piece of equipment onboard.[6].

CONCLUSION

The backbone of digital twins are various modeling technologies, which continue to undergo improvements as the industry has always done. Advances in computing power, big data, and machine learning and sensors, combined with lower technology costs, are driving increased adoption of digital twins. Domain knowledge and industry experience are the key ingredients to success and maximization of benefits from this technology.

The oil and gas industry will continue to see increased adoption of remote asset and enterprise performance management solutions enabled by digital twin technology. Newer fields with the required instrumentation and control hardware for remote operations will provide opportunities for closed-loop control. As technology advances and engineers become more comfortable with these technologies, we expect to see increased adoption rates in upstream operations[7]

LITERATURE

1. "Oil and gas industry suffers brain drain." Energy Digital. May 2020. https://energydigital.com/utilities/oil-and-gas-industry-suffers-brain-drain
2. HOW DIGITAL TWINS IN THE OIL AND GAS INDUSTRY CAN MODERNIZE YOUR BUSINESS https://www.ericsson.com/en/blog/2021/11/how-digital-twins-in-the-oil-and-gas-industry-can-modernize-your-business
3. "THE INCREASING POPULARITY OF DIGITAL TWINS IN OIL AND GAS." GEP. November 2020. https://www.gep.com/blog/mind/the-increasing-popularity-of-digital-twins-in-oil-and-gas
4. The increasing popularity of digital twins in oil and gas https://www.gep.com/blog/mind/the-increasing-popularity-of-digital-twins-in-oil-and-gas
5. Offshore oil and gas production https://www.offshore-mag.com/production/article/16763951/digital-twin-strategy-improves-offshore-oil-and-gas-production
6. digital twin define oil and gas https://www.arcweb.com/blog/digital-twins-define-oil-gas-40
7. Essential digital twins for upstream oil and gas production operations Vineet Lasrado https://www.automation.com/en-us/articles/september-2020/digital-twins-upstream-oil-gas-production-op