Building the Digital Spine of Oil & Gas Enterprises

Abstract

The advent of Fourth Industrial Revolution is transforming the existing cyber-physical systems, impacting the way companies compete, operate, and grow. Increasingly organizations, across industries and geographies, are treading on the digital path by embracing the latest technology trends - from Internet of Things (IoT) to cloud and cognitive computing.

The oil and gas (O&G) industry is no exception. Companies are deploying digital technologies to meet industry challenges, resulting in cost savings, increased efficiencies, and improved safety and sustainability. However, there is scope for the O&G industry to better utilize its asset base and become more efficient.

This paper discusses how developing a digital spine or making the core strategy digital is key to survival and growth. It highlights the key components of the digital spine and proposes a framework for operationalizing it. Finally, the paper illustrates the relevance of the framework by showcasing various use cases through real word examples.
The Components of a Digital Spine for Oil & Gas

The O&G industry is relatively less matured as compared to other industries when it comes to the adoption of emerging technologies. Let’s take a deep dive into the O&G value chain to understand the ideal components of the digital spine.

A. **Real-time visualization**: The ability to visualize results on-the-go is one of the most important requirements of O&G companies. Tracking the live performance of wells or oil rigs that are typically situated in remote locations can provide meaningful insights to both onsite operators as well as senior management for superior decision making.

B. **All-inclusive production models that are aligned with the assets**: Many O&G companies have implemented various digital interventions, but they have not been successful in aligning them with their assets. Effectively interpreting vast volumes of data collected across assets requires massive data processing capabilities. While three of the top five privately held supercomputers belong to oil and gas companies, the collected data points are hardly being used by the O&G companies to generate meaningful insights.

C. **Comprehensive maintenance systems with in-built alarm monitoring**: Real time monitoring not only helps address risks on a proactive basis but also incorporates agile methodologies. For instance, ExxonMobil is leveraging Fast Drill™ technology for real-time monitoring of drilling performance to create greater efficiencies, and build a connected oil infrastructure to improve the accuracy and the likelihood of oil and gas discovery.

D. **Data analytics using sensors**: Leading oil companies have deployed sensor technologies across their asset base. The challenge, however, is to store and process the vast amount of data generated by the connected infrastructure to produce actionable intelligence that supports business decisions across the value chain. As per the BP Technology Outlook Report of 2018, only 35% of the oil is being recovered from a typical oilfield, and only 3% of the data generated is being captured.

E. **Cybersecurity management and secured communication between devices and personnel**: IT-OT integration and IoT have resulted in increased cyber-vulnerabilities for O&G IT systems. Cyber-attacks are growing in number as well as sophistication. According to a recent HP
report, energy and utilities firms incurred the highest average annualized losses amounting to $13.2 million due to cyber-crimes. A strong and resilient IT system is therefore an essential element of the digital spine.

F. **Futuristic evaluation of digital needs, including corporate culture:** While O&G companies have been digitizing their services, operations, and processes; many are unable to utilize the implemented solutions due to the lack of a futuristic vision and guidelines. Challenges related to upskilling, digital literacy, intention to invest and awareness, along with inefficient adoption of automation, stand in the way. Clearly, cultural changes are imperative for an organization to become digital-ready.

Figure 1 illustrates the different levels of maturity of the digital spine components and the adoption rate of the elements across the five elements.

![Figure 1: Incumbent maturity of digital spine elements across the O&G value chain](image)

From Figure 1, it’s clear that different elements have varying levels of maturity across upstream, midstream, and downstream companies in the O&G value chain. However, it’s important to note that each has a varying degree of importance when it comes to operations and processes. In the production models element, downstream has a very low maturity, which
reflects the lower importance of the element in the downstream area. But, the futuristic evaluation of digital needs that depends on the culture of the company appears to be a major weak point along with data analytics capability.

**Operationalizing the Digital Spine Using the I-B-A-V-C Framework**

In the O&G sector, four core components constitute the digital spine: methodology, skills, technology, and infrastructure. The I-B-A-V-C framework (see Figure 2) is designed to help O&G companies develop a digital spine to maximize the benefits of digitization. The framework is based on Business 4.0 technologies – intelligent, agile, automated, and on the cloud - and highlights the relevance of the core components across O&G value chain. However, their relevance can vary according to the client’s positioning in the O&G industry.

**Figure 2: I-B-A-V-C framework**

- **I** - Infrastructure development that explains the important needs when defining the pathway of adoption with respect to IT and cloud solutions or platforms.
- **B** – Building the base in the form of an adaptive core and comprehensive enterprise wide API framework that is integrated with mobility platforms.
- **A** - Adopting Analytics solutions and integrating them with real time monitoring systems to mitigate risks.

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However, cyber-security is a overarching layer and could also be defined as a horizontal cutting across IBAV

**Innovation (Through Culture & Change Management)**
- **V** - Visualization helps in envisioning the analysis and taking proactive steps for maintaining the same.

- **C** - Cybersecurity assessment sits on top of the others to ensure data security, transparency, and credibility of collected information. At the same time, culture also has an essential role to play by enabling change management through innovative and agile measures. The right culture can help organizations embrace futuristic solutions along with social media and gamified learning options.

O&G companies looking to leverage disruptive solutions and register exponential growth need to understand the gaps, map them to IT requirements, and engage the right partners for their implementation. The I-B-A-V-C framework can help O&G firms embrace, manage, and tackle different obstacles in the process.

**Relevance of I-B-A-V-C Framework across the O&G Value Chain**

Table 1 highlights the various use cases of the framework based on real world applications.

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<th>O&amp;G Value Chain</th>
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<td><strong>Upstream</strong></td>
<td>IT Vendors are working on cloud-enabled solutions for supporting hydrocarbon supply chain, forecasting return on investments, and improving upstream production. For example, a US O&amp;G explorer plans to optimize 40% of costs through workload transfer to a PAAS solution.</td>
<td>API framework aims to provide transparency, security, and safety. Such a framework can help generate insights for exploration, production, supply chain Automation, and mobility &amp; analytics integration. One of the largest O&amp;G companies in Russia is planning to invest in their digital transformation process by developing a directorate and platform for augmenting solutions like IoT, AI etc.</td>
<td>Use of robotics on rigs for optimizing drilling operations using analytics is on the rise. An O&amp;G operator in the North Sea has started using advanced analytics on production platforms with the goal of increasing efficiency and improving the production output.</td>
<td>Rig monitoring, use of sensors, and real time data analytics representation are some of the emerging solutions. An upstream US O&amp;G company has been vocal in its intention of using sensors, IoT, and digital solutions.</td>
<td>Following an unfortunate hacking incident of their corporate website, a large O&amp;G company from Saudi Arabia has been assessing its cybersecurity strategy and developing new infrastructure in addition to expanding its team to identify further gaps, with the goal of preventing future attacks.</td>
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<td><strong>Upstream</strong></td>
<td>This will allow them to align with cloud environment and automate operations, thereby increasing efficiency.</td>
<td>OFS companies are using analytics to optimize well planning, drilling operations, and seismic spaces. A UK-based O&amp;G operator is using analytics to predict rig failures.</td>
<td>One of the largest UK-based O&amp;G companies is focused on testing critical engineering work by creating digital twins that uses VR concepts.</td>
<td>Following an unfortunate hacking incident of their corporate website, a large O&amp;G company from Saudi Arabia has been assessing its cybersecurity strategy and developing new infrastructure in addition to expanding its team to identify further gaps, with the goal of preventing future attacks.</td>
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<td><strong>Midstream</strong></td>
<td>ERP solutions on cloud by IT vendors on pipeline operations &amp; finance</td>
<td>Analytics is being used for supply forecasting, pressure monitoring, data discovery, and transportation cost management.</td>
<td>Cargo monitoring, wellhead monitoring, and pipeline monitoring are some of the widely used solutions.</td>
<td>An Australian O&amp;G operator has taken initiatives to incorporate cybersecurity solutions. An O&amp;G exploration &amp; production company has started an expedited process of adopting the cybersecurity solutions to prevent losses in the range of millions of dollars.</td>
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<td><strong>Downstream</strong></td>
<td>Solutions by IT vendors around petroleum drilling &amp; refinery</td>
<td>Predictive analytics used for trade optimization, market analysis, demand &amp; price optimization. A European downstream company has been using analytics to improve equipment reliability, retail/sales margins, and digital platforms.</td>
<td>An integrated O&amp;G company with headquarters in US is using a VR app to simulate its challenging work environment.</td>
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<td><strong>Market Opportunity</strong></td>
<td>Cloud applications $ 3.33 BN (2017) to $5.68 BN (2022). CAGR – 11.3%</td>
<td>Digital transformation could unlock $ 1.6 TRLN for the O&amp;G industry</td>
<td>O&amp;G analytics $ 19.65 BN (2019 Prediction) $ 30.57 BN (2026 Prediction) CAGR - 19% (Till 2024) 24.65%</td>
<td>O&amp;G security $ 23.14 BN (2016) to $ 36.01 BN (2023) CAGR – 6.7%</td>
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Table 1: Relevance of I-B-A-V-C framework across the O&G value Chain
The Strategic Impact of the Digital Spine

Once an organization builds its digital spine, it can deploy and leverage the following elements for superior outcomes:

- A resilient IT backbone with a flexible hybrid cloud infrastructure.
- An amalgamation of core digital technologies such as analytics or IoT to successfully navigate the Business 4.0™ era.
- An agile methodology to meet customer expectations and drive innovation at scale.
- IT-OT integration to provide better connectivity to the operational structures by interlinking components, systems, and people. Cybersecurity needs to be an integral part of the IT-OT convergence as it brings in risks and costs of its own.

At the core of the digital spine lies innovation - the ability, and more importantly the willingness, of the O&G organizations to innovate and create a smarter, faster, and lighter enterprise. Organizations should carefully plan and deploy a phased implementation process to reap varied benefits across the value chain. The digital spine presents a significant opportunity to process the data collected, both manually and through automation, to improve the operating efficiency and safety across the asset base, enabling competitive advantage in a Business 4.0™ world.

-All the predictions or values in the Market Opportunity section are from different sources. Please refer to the references section for detailed links.
References

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