Applications of Industrial Internet of Things in the Oil and Gas Industry

This paper examines the growing applicability of IIoT in the Oil and Gas industry, and also lays out the cost-benefits of moving from a conventional method to a more enabled data driven platform.

Digital Transformation and the O&G Industry

The O&G industry is ushering in a new era of Digital Transformation and, in order to stay ahead in the game, companies would have to invest in the right technology at the right time and establish policies that help increase and improve productivity. The principal enabling technology for Digital Transformation currently is IIoT.

Industrial Internet of Things (IIoT), otherwise known as Industry 4.0 or Industrial Internet, is a smart network of machines, advanced analytics and people that enables them to monitor, collect, exchange, analyze, and deliver valuable data to help drive smarter and faster business decisions. The growth of IIoT has been tremendous in the past decade and according to a research by McKinsey Global Institute, it could have about 6.2 trillion USD impact on the global economy by 2025.

IIoT in O&G: Benefits

Adoption of IIoT has several benefits for the O&G industry, a few of which have been mentioned in this article:

- The sensors attached to various equipment, be it the upstream or downstream equipment, provides real-time data to the operator that enables them to make proactive decisions related to maintenance and downtimes. For e.g., Shell collaborated with WellDog for the use of a laser-based sensor technique to enable them identify shale gas and oil reserves. The device is dropped into a wellbore where it shoots lasers and measures the frequency at which the light is reflected which helps to identify what type of hydrocarbons are located underground. The technology was successfully tested in a Shell well in the Marcellus Shale; in future it will work with Shell to test the device in shale across the US

- The real-time equipment data analyzed and provided by the sensors also enables operators to switch maintenance operations from a "just-in-case" to a "just-in-time" model. This enables them adjust their operations quickly and accurately, which in turn helps them avoid unplanned downtime and develop faster pathways to complete scheduled maintenance

- It helps operators use their maintenance crews optimally by reducing all unwanted trips to the field and informing them beforehand which tools and/or replacement parts they need to carry with them

- It provides connectivity and helps streamline and simplify all present fragmented and globally distributed O&G supply chain which establishes synergy across the supply chain and helps reduce the hassles involved in costs and supply

- IIoT also enables remote monitoring of production facilities/assets which effectively increases all round production and helps maintain higher safety scores for the operator

- It also helps in automating remote operations. Automation increases safety and improves quality, while decreasing the time spent on time for workers, equipment downtime, failures and overall cost. For e.g., Shell and Honeywell closely worked on the construction of a four well pads at the Sri-Lanka and Cruz de Lorena sites that will transfer oil and natural gas to the Early Production Facility. Here Honeywell used its low-cost Control Edge RTU solution for automating the wellheads

- Further, in the downstream sector, IIoT can help provide personalized service at retail points, increase share of the customer's wallet and amplify their loyalty to the brand by proactively predicting what the customer needs

- Finally, the enormous amount of data being collected by sensors will enable the industry to move from descriptive analytics to predictive analytics to ultimately prescriptive analytics

Remote Monitoring: Prime Application Of IIoT in O&G

The O&G is the world's most asset-intensive industry, having spent over 3 trillion USD all in the global upstream sector between 2011 and 2016. It however lags far behind its peers with respect to the average ROA. According to result from an independent study conducted by a leading consulting firm, O&G industry maintained an average ROA of 7.5% between 2007 and 2014 while industries like industrial machinery and semi-conductors had an average ROAs between 30% and 60%.

According to another research, remote (asset) monitoring is the top non-product use case of IIoT in the O&G domain being used by over 50% of the companies that have deployed IIoT-enabled technology. Remote monitoring is also currently the number one investment area for firms that plan to invest in IIoT in the immediate future.

Asset monitoring is extremely critical for an asset-heavy industry like O&G due to the simple fact that a downtime would lead to loss of millions of dollars per day during operations. Integrating IIoT-enabled technology can enable firms to monitor assets and their performance remotely and take proactive measures to minimize unscheduled downtime.

Operators can use real-time data from sensors to make timely repairs to equipment that require attention and to avoid catastrophic failures and unplanned downtime. Sensors fitted on machines enable operators to analyze critical information in a way that allows O&G firms to reduce capital expenditures by 20%. An example of the benefits derived from the integration of sensors is Equinor's Valemon platform in NCS. Equinor was able to unman Valemon for four out of six weeks by using Honeywell's Experian C300 IIoT system which when installed in an onshore facility, helps to control the offshore platform.

Challenges

Despite the many advantages of implementing IIoT, its on-ground acceptance has been low in the O&G industry. Few of the reasons for it are mentioned below:

- **Cyber security:** Since tremendous quantity of data is being collected, the threat of data breach becomes much more eminent and scary. Companies implementing IIoT need to also invest heavily in managing and protecting the data being collated

- **Technology maturity:** Many of the technologies being used by the industry are quite old and need to be updated to fully realize the potential of IIoT

- **Lack of data integration technologies:** The IIoT devices are typically procured from different vendors. These vendors usually have programmed devices which gathers and sends data in a particular format which is usually different from other vendors. This lack of standardization creates a problem in collection, cleansing and the analysis of data

- **Readiness of IIoT devices for O&G environment:** O&G E&P is conducted in different types of environment ranging from subtle to very harsh. But today's IIoT devices are not built to sustain such variations and there are very limited suppliers of such devices to the O&G industry. Hence, finding the best suited sensor for the operating environment is highly essential for the proper functioning of the device and retrieving reliable data

- **Lack of data management platforms:** There is a dearth of matured integrated data and information management platforms that can deal with the kind of data and information generated by the industry. The adoption of the Big Data technologies to store and analyze collected data is very slow

- **Organizational constraints:** Restrictions on handling personalized data; general lack of trust in predictive models; missing capabilities in the areas of analytics, modelling and statistics; low interest of leadership with regards to the adoption and deployment of IIoTs

Way Forward?

Global IIoT sensor market in the O&G industry is expected to grow at more than 5% CAGR over 2018-2022. However, an organization needs to understand that implementing Digital Transformation is more of a change management activity. The O&G industry has been using integrated reservoir management for about a decade now but a closer look reveals that their focus has been extremely narrow and they have done it in silos with tight controls. Digital Transformation, on the other hand, is about breaking down silos, both cultural and technical, and transforming the way business is done in day to day life.
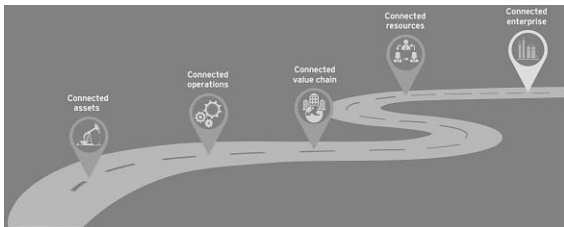
For this, companies will have to lay down a robust plan to build their capabilities along a maturity curve (starting from connecting operations, to connecting the value chain and finally, building a fully connected enterprise). The transformation begins with connecting the field assets and equipment to the Industrial Internet through the use of sensors for automated monitoring and diagnostics followed by creating a cloud and an IT environment for data storage and analysis. This way, the company begins to gather real-time and predictive insights about the operations of individual assets and processes. This helps in predictive maintenance, higher utilization rates and lower operating costs. However, for this to work, companies will have to ensure that the entire processes are automated and monitored instead of individual assets.

The next step in this journey is extending this interconnectivity to the extended value chain, including transportation, terminals and warehouses. By this we mean that the system should have automated ordering and logistics functions enabled by real-time tracking and predictive analytics of asset performance in the field. This enables the system to forecast and place orders for new parts or equipment based on asset's current run life or expected time to failure.

Finally, the last leg of the transformation journey is the complete integration of all of the company's assets and processes with an integrated value chain. This will allow the companies to connect on a global scale rather than on a local level. This level of enterprise-wide connectivity will help optimize asset utilization and maintenance planning for all assets across all fields, processing facilities, refineries, etc. and help improve decision making throughout the supply chain. The end result is a higher ROA.

Concluding Remarks

There are numerous advantages found in deploying the IIoT-enabled technology in the production environment for an operator but remote asset monitoring leads the pack. The major reason for that is the ability to avoid unprecedented loss due to unplanned downtime.

However, adding only sensors to equipment will not be beneficial as the organization must have a robust technology strategy to make full use of the power of digital technology.

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