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Point of view

Edge Analytics - **Making Oil Field Drilling More Efficient**

Introduction

The Exploration and Production of Oil and Gas involves drilling through various formations. It involves several complicated processes to locate potential sites, access the hydrocarbon reservoirs, and extract them safely and efficiently. As drilling operations sometimes depend on extreme environmental conditions, high-end machinery, and high-level skills, they are considered capital-intensive in terms of efficiency, investment, and productivity.

The advent of edge computing in the drilling space allows us to address complex challenges by combining IOT sensors, artificial intelligence with self-learning models, and edge computing. Real-time drilling analysis is made possible by edge computing and analytics, leveraging a large volume of data to develop analytical models.

The purpose of this study is to describe how Edge Analytics can be used as performance optimization and monitoring system for drilling rigs to function more effectively.

Primary Challenges in Drilling Operations

Companies that conduct drilling operations for the Oil and Gas industry face numerous challenges. Even in carefully planned wells, there is a certain amount of risk that challenges and problems occur during drilling. Listed herewith are some of the critical challenges faced:

- Downtime resulting from faulty equipment that affects the entire drilling operation, resulting in higher cost of extraction.
- Maintaining uptime of the base assets.
- Drilling data generation at a rapid rate necessitates handling and processing a large volume of data to derive results.
- Transferring Real-time data from rig site to end-user workstation.
- Drilling problems require time, materials, labor, and equipment for analysis, which drastically increases drilling costs.
- Environmental sustainability.
- Limited bandwidth at rig site for transferring large volume of data to offsite locations for further processing and monitoring.

How is the Drilling Data Handled Today?

The data collected from critical drilling machinery is not handled and analyzed at the drilling site. This massive volume of data generated from the rig must be transmitted to a data center from the remote site. The transmitting, analyzing, and generation of insights from the data thus becomes a painstakingly long process. Hence, only a portion of data currently gets transmitted for analysis.

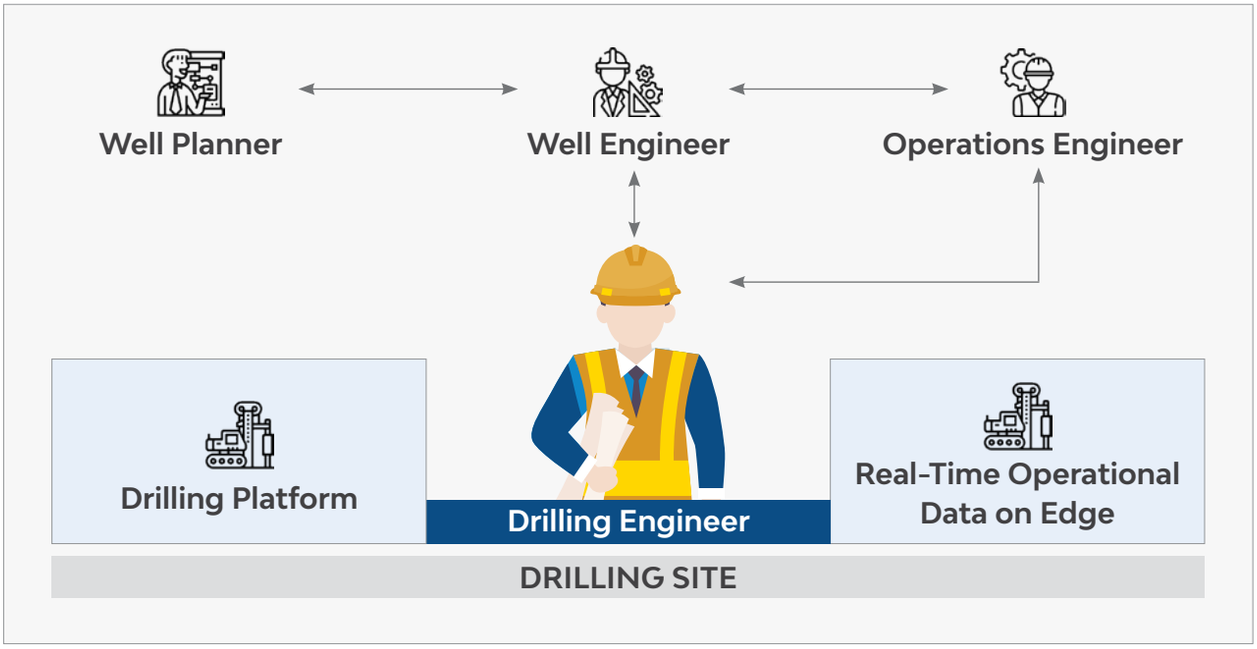
For a rig facility, a single-day deep-water offshore drilling cost may go up to $600k-800k, and the impact of downtime can be lead to a phenomenal increase. Also, this can occur multiple times in a year. Predicting the downtime will lead to massive cost savings through preventive maintenance. Analytics and insights from such data at rig-sites can potentially reduce unplanned downtime, cost, injuries, and environmental damage.

Edge Computing Platform - The Savior

With edge computing and the different automated solutions currently available, data can be aggregated and analyzed at the rig site in real-time with low latency. Data streaming from internet of things (IoT) sensors can be collected for immediate processing and used for real-time analytics. Automation solutions using self-learning AI/ML models can handle data streaming, carry out analytics and provide insights to improve the performance and efficiency of the rig in real-time.

One of the key objectives of deploying ML-powered applications is to analyze data, make predictions, and provide recommendations. It is also important to monitor the ML models constantly for their ongoing accuracy. Insight is provided once the prediction analysis receives all the required prediction points. Also, edge-based AI systems require a data transfer mechanism using event-driven architecture to continuously send and receive the required information using event-based messaging systems like Kafka or RabbitMQ. Predictive maintenance based on insights gleaned from monitoring and analytics, minimizes the duration of planned downtime, and reduces the occurrence of machine failure.

Technology Consortiums such as the Open Subsurface Data Universe (OSDU™) Forum are currently working on seamlessly integrating rig-site data and transporting the same to offsite environments using the "Rig-Site Connectivity framework." The data will be further fed into 'OSDU Edge' reference architecture for deploying a Drilling Rig solution used during the Well Construction phase.



Use Cases for Edge Analytics

The Oil and Gas industry is currently developing various Edge-based automation solutions such as alert services, sending automated set points to rig control systems, and orchestrating rig operational state-based automation. These are a few of the use cases:

Building a **Universal Well-Pad Monitoring and Control** (UWC) solution for well and surface facilities on Edge can transform the well-pad control to be more open and interoperable. The supervision of various facility controls like monitoring Tank Level, Chemical Injection, Flow Control, etc., can thus be carried out.

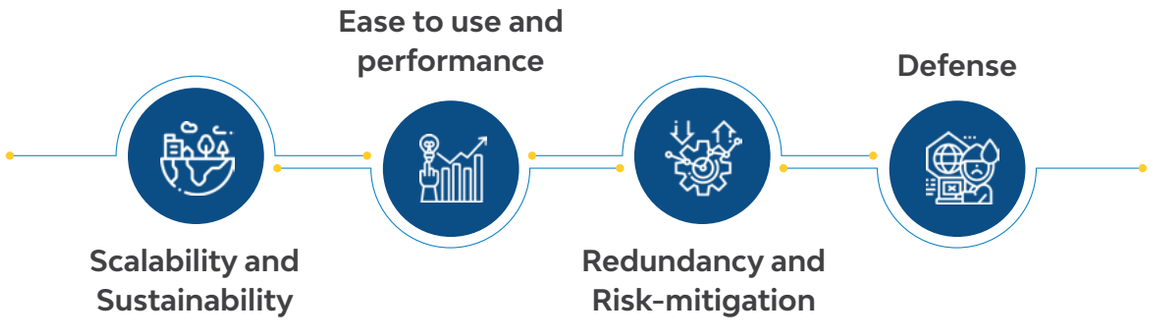
Solution for **Artificial lift Optimization**, which lowers the production bottom-hole pressure on the formation, can obtain a higher production rate from the well. Devices like Electric Submersible Pumps (ESP), Progressing Cavity Pumps (PCP), Rod Lift, Gas Lift, Plunger Lift, etc., can also be managed similarly.

Torque and drag between the drill string and the wellbore wall are key factors for drilling a well to a certain measured depth. Having a **Torque and Drag** solution at the rig site will help to automatically detect the drilling irregularities and help make effective operational decisions. It can view and analyze the hook load trends and generate friction factor calculations using machine learning models. By comparing the planned vs. actual drill path results, engineers can perform real-time analysis and make informed decisions.

Collision with Offset wells while drilling can have catastrophic consequences on humans and the environment. **Anti-collision** technology is an effective approach to reduce such risks while drilling. This solution helps users visualize and monitor the position of the drilling well to the nearby offset wells and avoid going into no-go zones. Plotting the outcomes in charts to show the distances to the nearest threats will also help engineers make decisions quickly.

Key Factors for Successful Edge Adoption

By considering the nature of the drilling site, location factors like temperature, vibration, weather elements, ecosystem, and types of machinery, developing an edge solution and obtaining approval from various regulatory authorities will be the key for efficient drilling.



Scalability and Sustainability: Besides simulated environments, the proposed and designed solution must be evaluated on real-life devices to measure its reliability and flexibility. The solution must be designed to work across various platforms. It needs to be agnostic to different equipment models, different versions of software applications, and operating systems running on the equipment.

Ease to Use and Performance: The Edge solutions designed must be easy to set up considering most rigs are in remote locations, or worse, offshore. This includes easy to install and troubleshoot software and plug-and-play models, for simplified implementation. Needless to say, the performance must be in an acceptable range to allow real-time data to be processed.

Redundancy and Risk-Mitigation: The solution must consider that constant monitoring is necessary to identify any issues that may arise during the life of the system. The solution must handle any fail-over scenarios in the event of any network failure during data transmission and should re-transmit the data in case of failure. One of the key requirements of the design was the ability to troubleshoot and update remotely.

Defense: The Edge solution allows two-way communication between source and destination machine, creating a unique challenge in securing devices. Ensuring the network is secure from all threats is a major concern for any operation. Security design involves management of devices, authorization, and, most importantly, prevention of misuse.

Below are the key objectives of the Edge:

- Get the required machinery operating data, analyze it, and send it to a centralized server.
- Using remote content management, provide updates for common software programming controllers and configuration files to update the patches across all devices in time.
- Conduct Edge processing on the equipment, including remote and on-site monitoring of the equipment.
- By carefully examining each technique's advantages and applicability on Edge, along with the amount and type of information, we can determine which method is most suitable for a given operation.

Conclusion

An Edge Platform is a collection of various solutions, algorithms, and devices. Advanced analytics and various prediction algorithms require various self-learning models. The future of edge computing development looks promising in the Oil and Gas industry, and the key to it is by Increasing the scope of edge computing and its adoption. Its technology landscape and components must be simple, cheap, energy-efficient, and easy to adapt to the existing architecture.

However, the edge-based solution implementation in the Oil and Gas industry does come with few challenges. Given the current skill gaps and the aging workforce, reskilling is necessary to keep up with technology advancements. To handle future edge-based solutions, Oil and Gas companies, their service providers, and vendors require advanced training. Considering the technology stack and upskill requirements, a company should revisit processes, investments, value chains, and operating models to adapt to a new event-based Edge analytical solution.

About the Authors

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Shankar has more than 20 years of experience in the IT Industry in Data Analysis and Application development. He has worked with major Oil and Gas companies in implementing solutions for Subsurface Data Management and Drilling applications. He has proven expertise in implementing solutions in areas of data audit, migration, quality analysis, business rules creation and dash-boarding. He has rich working experience in various G&G applications, data models and frameworks.

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Jeyakumar has over 15 years of experience in the Oil and Gas Upstream area in developing /implementing and managing data in applications/ frameworks for major Oil and Gas clients in the areas of data audit, loading, digitizing seismic data, migration, QC, building assessment dashboards and integration of subsurface applications. He is currently working with an O&G service provider for OSDU implementation and data exchange, and standardization between internal applications. He has rich experience in various G&G applications/ frameworks and data models.