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Real-Time Monitoring and Optimization of Drilling Operations with a Low-Code/No-Code Power Platform Dashboard

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Abstract

The main objective of oil companies is to maximize drilling efficiency and minimize drilling costs. As a result, oil companies face new challenges in reducing their overall costs, improving performance, and reducing the risk of encountering problems. Consequently, over the past decades, different methods and approaches have been introduced from other disciplines to the oil market to construct safe, environment-friendly, and cost-effective wells. Several approaches to drilling optimization include software technologies that can help measure drilling operations and equipment performance. This point of view focuses on one such solution undertaken for development by techno-domain experts at LTIMindtree. Keeping in mind all the problems encountered while real-time monitoring, a solution is designed using a low code/no code power platform, which will give immense power to the user to track the wells summary and its parameters from the solution dashboard.

This solution will allow users to monitor all operational and drill Key Performance Indicators (KPI). The solution dashboard comprises various parameters plotted against time and depth for real-time monitoring and making of timely decisions.

Introduction

Today's fast-paced world runs on energy, and emerging countries like India and China are driving this demand. Although alternate energy sources have gained prominence over the last few decades, fossil fuels, viz crude oil, remain the primary source.

Crude oil is generally found below the earth's surface and is extracted by drilling wells many kilometers underground. These drilling operations are cost-intensive and hazardous. Any accidents can result in massive safety, environmental and economic damages. Operations are monitored 24/7 using specialized applications in real-time operation centers. But the drilling monitoring applications are highly cost- and computation-intensive and may not be feasible for smaller operators and JV partners who are currently missing out on this critical real-time drilling information.

As the saying goes, tomorrow's fast-moving world belongs to those who respond fastest, change fastest, and modernize. A simple, intuitive, user-friendly drilling data dashboard with all significant parameters in Power BI platform can be designed to simplify drilling operation monitoring. Power platform solution's light weight is the main reason behind its popularity. Such a tool can be designed cost-effectively, focusing on small and medium oil and gas companies. Secondly, such a tool can be customizable as per user requirements. Its low/no code platform will enable any domain expert with no coding experience to change and tweak data and charts as required.

# Power platform-based drilling dashboard solution

A low-code/no-code Power platform dashboard for drilling can be an ideal solution to monitor and optimize drilling operations. Such a tool will consist of interactive visuals, charts, tables, and various KPI cards to visualize various drilling parameters like depth, weight on bit, rate of penetration, total gases, ambient gases, Measurement While Drilling (MWD) surveys, bit hydraulics, and so on. It will also enable the operations to calculate and derive operation summary and equipment usage based on the available data. Provisions should be built such that MWD surveys can be visualized in 3D grid format to check the position of the wellbore. The drilling dashboard will leverage the data streaming through the oil rig and present it in interactive visuals. The refresh rate should be customizable per one's Power BI platform dashboard requirement. It could be as low as 1 second. As the end user, the tool will use the Well-site Information Transfer Standard Markup Language (WITSML) data directly streamed from a third-party WITSML server. If the user wants to display legacy data,

it can be fetched from the server, which will be stored simultaneously in the WITSML store while streaming in the Power Platform dashboard. In case Azure-based data storage is provisioned, the configuration of the dashboard service becomes easy as it falls under the same Microsoft umbrella. Power BI is a cloud-based service for business analytics and data visualization that enables anyone to visualize and analyze data faster, deeper, and more efficiently. It connects users to a wide range of data through user-friendly dashboards, interactive reports, and compelling visualizations that bring data to life. The Power BI service website is built upon the Azure cloud platform and adheres to HTML 5 standards.

Let us take a deep dive and explore how the data is exchanged, what parameters should be monitored, and how the alerts can be designed and customized per requirements.

Interoperability of data (data exchange and standards)

Drilling contractors generally use special binary language for transmitting data from the site to the monitoring center. Typically, Well-Site Information Transfer Standard Mark Up Language (WITS-ML) is used as the standard format for data transmission. The transmitted data is then stored in third-party cloud storage and sent forward to real-time monitoring centers. The data dashboard and analytical solution can initially be designed by using static well data in CSV format. These static files will be ingested in a cloud-native data explorer and streamed using a simulator. The simulator can be designed to push data in the Power platform solution dashboard with negligible lag in data display. The simulator can use Python as its coding language. Integration with third-party stores will be required to work with actual well-site data. Available data in WITS-ML format can also be used for testing the solution and visualizing various parameters. A typical workflow of real-time monitoring can be displayed with the help of the following diagram.

Well A

Well B

WITS-ML Files

Third party WITS-ML Storage

Drilling data Dashboard
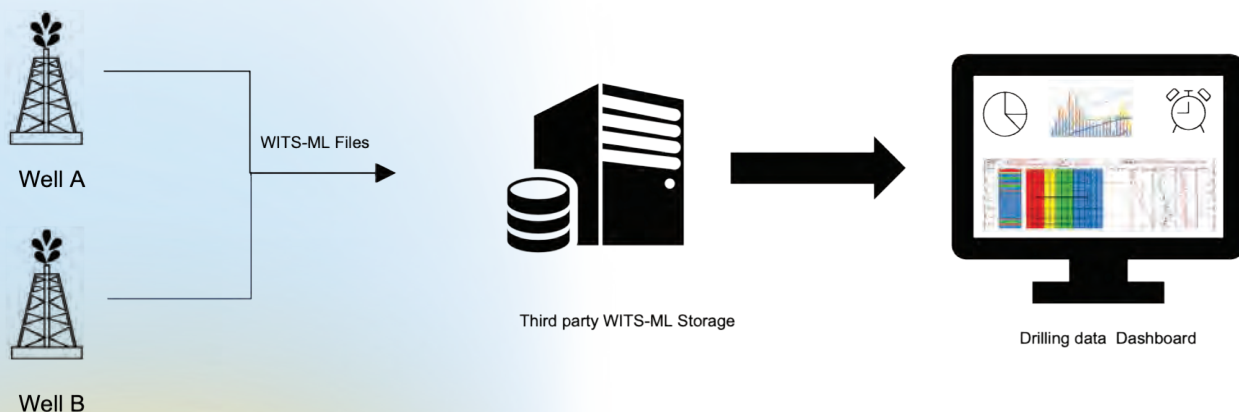
1: Well site data is transferred from various rigs to third-party store and later displayed on the dashboard

Data workflow

Data received from the rig site is in WITS-ML format. This data will get stored in the database of vendors, which is later processed and sent to various Real-Time Operations Centers (RTOCs) for real-time monitoring. The Power platform-based solution will use the same data store to get data and integrate it with Power BI. Enrichment and enhancement will be followed by visualizing the data in interactive dashboards.

Parameters monitored from the dashboard

In the data dashboard solution, nearly all the essential drilling and cost parameters should be taken into consideration. The first report will ideally be dedicated to well records as soon as the user opens the solution. It will consist of all required details and the rig history of a certain area. A detailed report of well summary consisting of the total number of wells, including completed, abandoned, suspended, appraised, etc., will also be provided as per user requirement. It will also display the depth drilled by any rig with further drilled-down features for deeper investigation of any wellbore or rig.

The next page will be dedicated to real-time monitoring of the home page on the dashboard, which has various tabs for navigating to various reports. It will also have data summarizing actual vs. planned depth and cost. The location of the active well can also be plotted on the dashboards. These features will be helpful in monitoring if the progress of the well is on track or delayed for any reason.

2: Simulated dashboard with well summary and real-time data (active/non-active wells data)

Real-time monitoring should have various tabs showcasing various parameters and log curves. Drilling parameters will allow the user to monitor the values of various sensors installed at the well site. Critical parameters like hole depth, bit depth, and active pit value can be monitored in the drilling parameters tab. All gas data ranging from C1 to C5 and CO2 are also considered in this tab. Users can hover and check the parameters of respective wells from the interactive slicer, which responds on click.

Time, depth, and gas logs comprise of curves with real-time values that can be easily dragged up or down, or zoomed in and out as per user requirement. Values like rate of penetration, weight on bit, hook load, strokes per minute, standpipe pressure, torque, rotation per minute, density in and out, etc., will be plotted against time in the time log tab and against depth in the depth log tab. The gas log will comprise of curves displaying total gas values, C1-iC5, and CO2 plotted against depth. Users will be able to glance at various wells parameters in time fashion and depth records. Timely decisions can be taken for various wells from a single application just by monitoring the logs plotted in the solution dashboard.

M/LWD log will include recorded values from tools used in measurement and logging while drilling. Drilling parameters, along with gamma, neutron, and density, will be plotted in this tab. Users can correlate parameter values transmitted via the MWD and Mud logging units. Data like gamma ray and formation type can be co-related for making timely decisions and deciding on formation tops and casing tops. Users can monitor current measured depth, true vertical depth, azimuth, and inclination versus target parameters. Detail survey table helps the user to track all parameters in real-time.

The operation summary report section will display operations for the last 12, 24 hrs. format. Users can monitor and correlate the data for operation in the last 12 to 24 hrs. A detailed correlation can give the user an idea about the time taken by various activities at different locations and help reduce Non-Perfoming Time (NPT). Ultimately it offers users a wise decision, saving a lot of costs.

The next tab will enable the user to get details about the equipment used in the well bore. Users will have the provision to add or edit the details about the added equipment. This function in the solution dashboard can monitor equipment health. Any equipment downholed for drilling can wear and tear if over-used and would lead to many hole problems like slow penetration rate, high torque, or even washouts. To reduce or avoid getting stuck or tripping, users should keep an eye on equipment health, which can be done from this solution.

Values of various logs and well trajectories can be plotted in Power BI using python queries and libraries. LTIMindtree's techno-domain expert team will be available for support whenever required. Below is the representative image of the drilling parameters and the M/LWD log dashboard. The parameters, its units, or arrangement can be changed or altered anytime as per the user's requirement.

3: Power platform-based dashboard with drilling parameters and survey data with 3-D well trajectory.

Customized alert system

Benjamin Franklin rightly said, " a small leak will sink a great ship"; this saying teaches us always to be vigilant. Alerts play a vital role in real-time monitoring. The drilling monitoring and dashboard solution should be designed to send alerts via push notification to the users, so that they will be able to monitor well on the go. Optimum drilling needs optimum drilling parameters. So, alarms can be set on threshold values of drilling parameters to keep everything working smoothly. Once the threshold value is crossed, push notifications in the form of mail or SMS will be sent to the user as an alert. This alert can be customized as per users' requirements. Various alarms can help operators in the oil and gas industry make the right decisions for different scenarios by analyzing alerts. This will also help in reducing cost as well as enable to perform safe operations with minimal incidents.
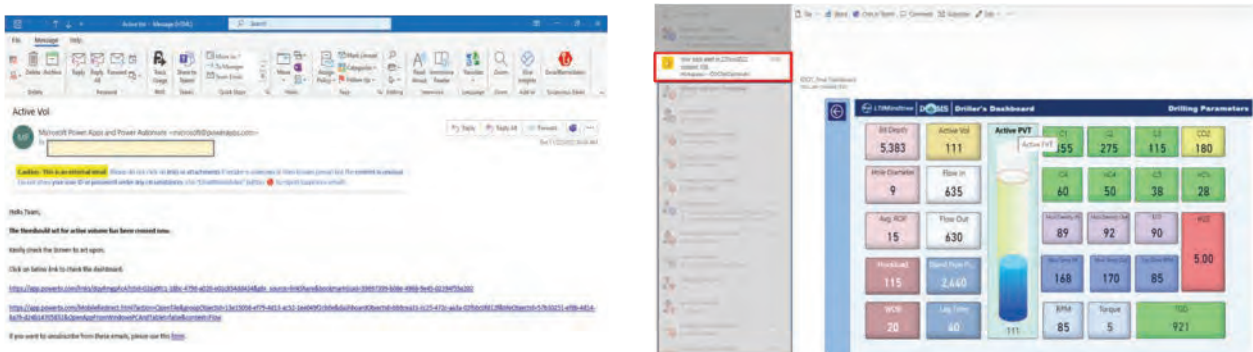
4: Alert mail and message in teams received by user when the threshold value is crossed.

Data governance

Data security plays a crucial role in real-time data monitoring. Considering this, the dashboarding solution will have an added security patch by using the inbuilt functions of Power BI. To elaborate, a user can only view data related to specific fields based on access given by the admin. However, if users want to access other fields, a request should be raised to access a required database. This functionality can also be termed data governance, the core concept in real-time data security. It restricts a user from viewing and having access to databases. Admin will create roles and define rules using the Power BI desktop's Data Analysis Expressions (DAX) function. After publishing the report to Power BI service, the admin will assign roles to a specific user. This would enable a user to view and access the data based on the roles assigned. Additionally, the same roles can be assigned to multiple users so that the entire team can access the same dataset.

Advantages and differentiating factors

The Drilling Dashboard and Monitoring Tool will be an intuitive one-stop, highly customizable application built on low/no-code platforms like Power platform. Robust drilling algorithms will back it for alerts and monitoring. The target customers will be small and medium oil and gas companies unwilling to invest in RTOC infrastructure. It should be a lightweight tool unlike all other heavy applications present in market for online data monitoring. Additionally, real-time data users can customize it as per requirements. If not, LTIMindtrees experts will be available to support the application and align its features and visuals for monitoring. Different reports in a single dashboard give the user the immense advantage of viewing all parameters in one go. Dashboards can be viewed in Power BI desktop and mobile application versions. When presenting to the stakeholders in PowerPoint, users can view the same dashboard in PPT format. All visuals and reports will behave the same way as it functions in the Power BI dashboard. Advanced security features and data governance make this solution perfect for the Petroleum industry, where a data breach can lead to high costs. A customized alert system for all parameters will differentiate it from other dashboard applications available.

LTIMindtree's techno-domain team built a Power platform-based drilling data dashboard. It can ingest various types of drilling data, and the user interface is interactive and manipulative, which can be customized at any given time. It leverages the integration of two technologies, i.e., real-time data and Power Platform.

For more information on this tool, please contact Manesh.Parmar@Lntinfotech.com and AnvarAli.Sayed@Lntinfotech.com.

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About the Author

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Anvar is a Petroleum geologist with 8+ years of experience in the Upstream Oil & Gas industry. In his career across multiple O&G companies, he has worked extensively in exploration and development projects. His core competencies include real-time data monitoring, and subsurface data analysis and management. He has also worked as a part of the managed services team and successfully delivered multiple projects in data migration and management. He is highly inclined towards techno-domain functionality and practices Low Code/No Code platform in developing applications. He is a certified Mendix rapid and Power BI developer as well as a Scrum Master.