CASE STUDY ON POWER BI FOR DRILLING DATA

By

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INDEX

1. Introduction to Open-Source Drilling Data

Drilling data is essential for understanding the intricacies of well construction and operational efficiency in the oil and gas industry. This analysis focuses on a dataset containing daily drilling report data, including key metrics such as drilling depth, rate of penetration (ROP), mud type, and incidents.

1.1 Dataset Information

- **Well ID**: A unique identifier for each well.
- **Mud Volume (L)**: The volume of mud used during the drilling operation.
- **Rig ID**: A unique identifier for the rig used in the operation.
- **Drilling Depth (m)**: The depth drilled in meters.
- **Bit Type**: The type of drill bit used.
- **Mud Type**: The type of drilling mud used, such as water-based, synthetic-based, or oil-based.
- **Formation**: The geological formation being drilled, e.g., limestone or granite.
- **ROP (Rate of Penetration)**: A measure of drilling speed in meters per hour.
- **Downtime (hours)**: The time lost due to issues during drilling.
- **Incidents**: Any complications encountered during the drilling process.
- **Cost (USD)**: The cost of drilling operations daily.
- **Contractor**: The contractor responsible for the drilling operation.

2. Purpose and Goals

The purpose of this analysis is to utilize the drilling data to enhance operational efficiency and inform decision-making.

2.1 Purpose:

- Track the daily operational performance of the drilling process.
- Identify any inefficiencies or issues that may affect the drilling operation.
- Enable decision-makers to act based on real-time data insights.

2.2 Goal:

- **Optimize Drilling Efficiency**: Use key metrics like ROP (Rate of Penetration), Mud type, Mud formation, and bit type to ensure optimal performance.
- **To track the cost of drilling operations:** Monitor costs over time and compare them across different wells. rigs, or formations.

3. Key Questions on the Data

To guide the analysis, the following key questions have been formulated:

1. Which well has the highest ROP, and what are the contributing factors?
2. What are the trends in downtime for each rig and well?
3. How much drilling depth was achieved daily across different rigs?

These questions are designed to uncover insights that will help optimize drilling operations and reduce costs.

4. Strategy for Presenting Data Effectively

- Highlighting Key Metrics
- Using Visuals Effectively
- Color-Coded Alerts
- Filter and Drill-Down Options

5. Key Performance Indicators (KPIs)

To measure the performance and track progress toward achieving operational and strategic objectives, the following Key Performance Indicators (KPIs) have been defined:

1. **Average Rate of Penetration (ROP)**: Indicates the efficiency of drilling operations.
2. **Total Downtime**: Measures the non-productive time during drilling, aiming to identify and reduce delays.
3. **Total Incidents**: Tracks the number and type of incidents that occur, aiming to reduce their frequency.
4. **Total Cost by Quarter**: Monitors the expenses associated with drilling operations over time.

6. Results

1. Which well has the highest ROP, and what are the contributing factors?

- **Average ROP (Rate of Penetration) by Bit Type:**
  - Diamond bit has the highest ROP with a value of **17.90** m/hour.
  - Contributing factors likely include the formation type and bit type:
    - Diamond bits are typically more efficient in harder formations.
    - The formations where incidents occurred the most (Dolomite, Limestone, Sandstone) could indicate which wells were drilled with these bits.

2. What are the trends in downtime for each rig and well?

- The dashboard reports a **total downtime of 2.56K hours**. However, detailed downtime trends per rig or well are not specifically broken down on the dashboard.

- To assess trends, you would need detailed rig-specific data, but we know that different formations may influence downtime due to operational complexity. The high number of incidents in Dolomite, Limestone, and Sandstone formations may correlate with longer downtime.

3. How much drilling depth was achieved daily across different rigs?

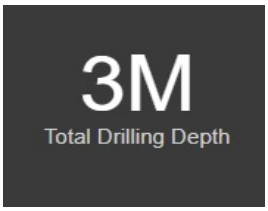
- **Total Drilling Depth:**
  - The total drilling depth achieved is **3M meters**.
  - Drilling depth by mud type is broken down into:
    - **Oil-Based:** 952K meters (34.96%)
    - **Water-Based:** 924K meters (33.96%)
    - **Synthetic-Based:** 846K meters (31.08%)

Analysis of the Dashboard:

1. **Total Incidents (202)**

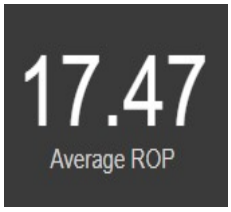
Without a daily breakdown visible, an average daily drilling depth calculation would require more data about the total duration or daily operations. You can estimate this if more details are available, such as the number of days or rigs involved**.** This number represents the total incidents that occurred during the drilling operations. An incident could include equipment failure, accidents, or any other interruptions that may cause downtime or affect operational efficiency.

2. **Total Drilling Depth (3M)**



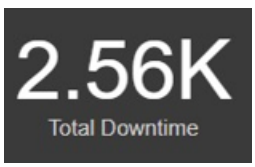
This metric shows the cumulative drilling depth achieved across all operations. It sums up the total distance drilled (in meters) for the entire project, indicating the scope of the drilling activity.

3. **Average Rate of Penetration (ROP) (17.47 m/h)**



The ROP refers to how quickly the drill bit penetrates the geological formations, measured in meters per hour (m/h). An average of 17.47 m/h suggests relatively efficient drilling, but this value can vary depending on the type of bit, formation, and other factors.

4. **Total Downtime (2.56K hours)**



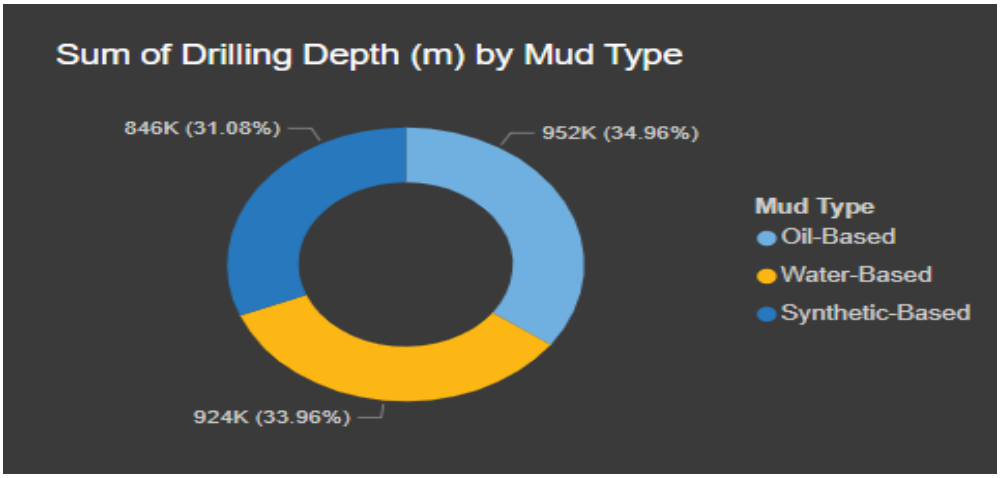
Downtime represents the cumulative hours when the operation was halted due to incidents, maintenance, equipment failure, or other delays. A total of 2.56K hours (or 2560 hours) indicates a significant

amount of non-productive time (NPT) that could be further analyzed for improvement.

5. Total Cost (54.81M USD)

The total cost reflects the overall expenditure on drilling operations, including equipment, labor, mud, and other operational costs. This can help in budgeting and tracking cost efficiency across various periods.

Sum of Drilling Depth by Mud Type

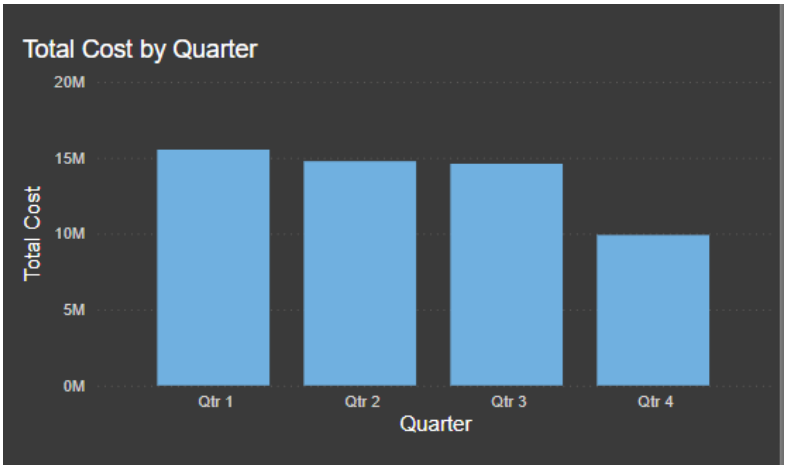


This pie chart shows how drilling depth is distributed based on the type of drilling mud used:

- Oil-Based Mud (34.96%): Responsible for 952K meters of drilling.
- Water-Based Mud (33.96%): Contributed to 924K meters of drilling.
- Synthetic-Based Mud (31.08%): Involved in 846K meters of drilling.

This breakdown allows an analysis of how mud types affect the depth achieved and can indicate which mud is more efficient in different formations.

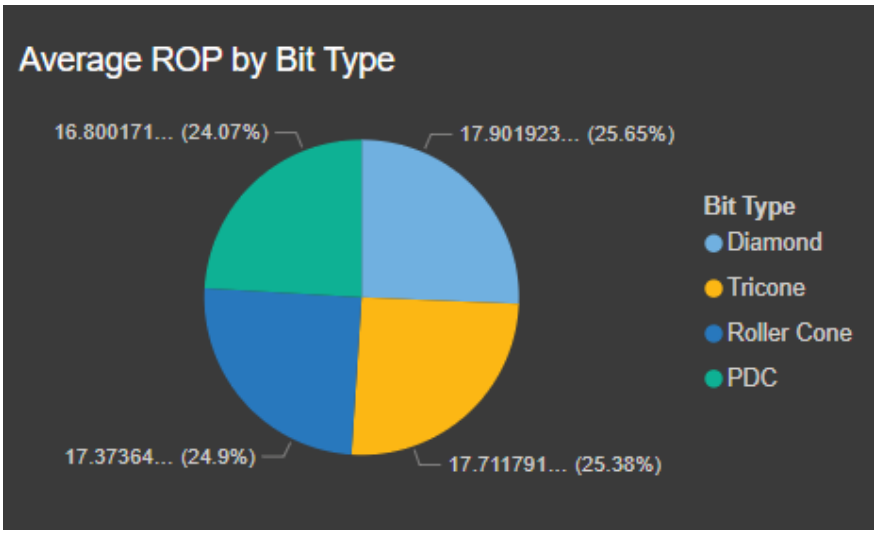
Total Cost by Quarter



The line chart displays the costs incurred over four quarters:

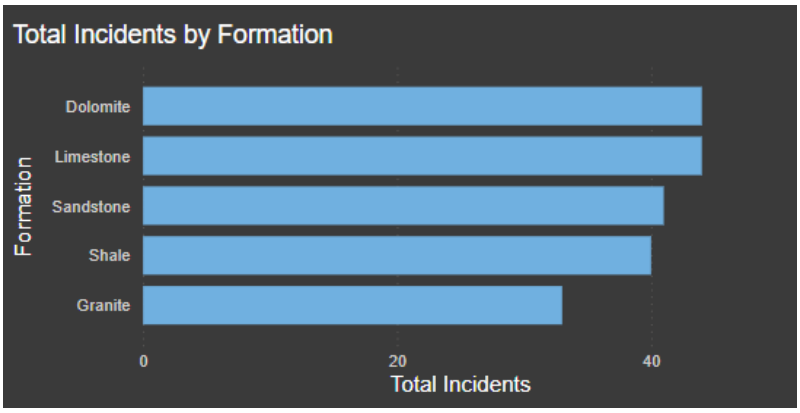
- The cost appears to decrease steadily, starting at around 16M USD in the first quarter and dropping to approximately 12M USD by the fourth quarter.
- This trend may suggest increasing efficiency, cost-saving measures, or a reduction in drilling activity over time.

Average ROP by Bit Type



- This bar chart compares the average ROP for different drill bit types:
  - Diamond Bits (17.90 m/h): The most efficient in terms of penetration speed.
  - Tricone Bits (17.71 m/h): Slightly lower than diamond but still effective.
  - Roller Cone Bits (17.37 m/h): Showing a slightly lower performance.
  - PDC (16.80 m/h): While commonly used, PDC bits show the lowest ROP on average.
- This comparison is crucial for selecting the most effective bit depending on the formation being drilled.

Total Incidents by Formation



- This bar chart breaks down the incidents based on geological formation types:
  - Dolomite, Limestone, Sandstone: All have a relatively higher number of incidents.
  - Shale, Granite: Lower incident rates compared to the other formations.
- This helps in identifying which formations are more prone to issues and can lead to preventive measures when drilling in such formations.

Key Insights:

- **High Incident Rate (202 incidents):** The total number of incidents highlights the need to focus on operational efficiency and safety improvements.
- **Efficiency of Mud Types:** The depth drilled using different mud types is quite evenly distributed, but further analysis can reveal which mud performs better in terms of cost and safety.
- **Bit Performance:** Diamond and Tricone bits seem to offer the highest ROP, suggesting their preference for achieving faster drilling times.
- **Formation-Specific Challenges:** Some formations (Dolomite, Limestone) have higher incidents, indicating possible challenges when drilling through these types of rock.

  This dashboard offers a clear snapshot of drilling performance, operational costs, and incident trends, enabling decision-makers to identify inefficiencies and optimize future operations.

7. Conclusions

The data reveals critical insights into the operational dynamics of drilling processes. Key findings include the importance of optimizing ROP to reduce costs and downtime and the impact of mud type on incident rates. Wells with lower ROP incur higher costs and face more downtime, indicating areas where efficiency improvements are needed.

Moving forward, optimizing drilling strategies and selecting the appropriate mud types can significantly reduce incident rates and enhance overall performance.

8. APPENDIX

Dashboard of Drilling Data