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DATA ANALYTICS CASE STUDY IN OPTIMIZING WELL WORKOVER PROCESS

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Abstract

This study focuses on optimizing well workover processes in the oil and gas industry using advanced data analytics and digital tools. Data collected from the OIS Well Workover IT solution is analyzed with Python to enhance efficiency, reduce costs, and improve decision-making during workover operations. By examining planning, execution, and monitoring phases, the research identifies inefficiencies and proposes automation strategies to streamline processes. Actionable recommendations are provided to address operational challenges and enhance data quality, contributing to cost savings and optimized production. This work establishes a foundation for future research on leveraging digital solutions to promote innovation and efficiency in the oil and gas industry.

Key words: *Data analytics, Workover operations, Operational efficiency, Predictive Analytics, Oil & Gas industry*

1. Introduction

The oil and gas industry relies on artificial lift methods to maintain production across numerous onshore oil wells, which require regular maintenance by workover rigs (McKinney, 2022). Limited rig availability and high service demand challenge the minimization of production losses. Decisions on allocating workover rigs depend on factors such as well production, rig location, and the type of service needed.

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Efficient scheduling and management of workover operations are crucial for optimizing production and reducing downtime, but traditionally these decisions were made with incomplete information.

This study explores the optimization of workover processes through data analytics from the OIS Well Workover IT solution and Python, focusing on operational and financial data. By analyzing data from the planning, execution, and monitoring phases, the study identifies key areas for improvement and provides actionable recommendations for automation and data-driven decision-making.

The article is divided into four chapters: the introduction outlines the study's purpose; the theoretical background reviews relevant literature on workover wells, digital tools, data analytics, and data science; the third section presents the tested hypothesis and analysis results; and the conclusion summarizes findings and offers recommendations for further research.

2. Theoretical Background

2.1 Understanding Workover Operations

Workover is a term used in the oil and gas industry to describe the maintenance and repair of existing wells (Drilling manual, 2022). This process is used to restore production from a well that has decreased or stopped flowing, and it is an important part of the lifecycle of an oil or gas well. These tasks are performed using specialized equipment, such as workover rigs, and a team of skilled workers (Mendes et al., 2013). A series of activities should be followed to ensure that the company performs workover operations safely and efficiently during the planning, execution, and monitoring phases (Landgren et al., 2013).

The planning phase is crucial for the success of workover operations. It involves detailed assessment and preparation to ensure that the workover is necessary, feasible and can be conducted safely and efficiently. The realization phase involves the actual implementation of the workover plan, requiring careful coordination and management to adhere to the planned objectives, budget, and timeline. The control phase focuses on evaluating the workover operation's success, analysing outcomes, and implementing learnings for future operations (Mendes et al., 2013).

2.2 Digital tools, Data analytics and Data Science

The data in the oil and gas sector is one of the key components. Daily, vast amounts of data are collected every day (Tsay, 2013). Digital tools are software, applications, platforms, or systems that facilitate the execution of various tasks in a digital environment, including communication, collaboration, and problem solving (Alexander et al., 2017). Digital tools, in the way it is usually used, is a practice of analyzing large quantities of data where a comprehensive review of all transactions can be visualized including identification of anomalies (Ciric et al., 2022; Basulo-Ribeiro et al., 2023).

Data analytics can be defined as the process of analyzing raw data to identify trends and answers to questions. Advanced analytics deals with the 'What if?' question. This part of data science uses advanced tools for data extraction, making predictions and identifying trends. These tools include classical statistics, as well as machine learning (Mohammadpoor, 2021). Data Analytics competencies refer to the combination of skills, knowledge, abilities, and expertise required to effectively analyze data (Ciric et al., 2021; Bartlette, 2022; Crabtree, 2023).

Currently, the existing workflows to select workover candidates require a large amount of manual work. The workover potential is evaluated in terms of both additional production and economic profitability, for every well individually. This process is very time consuming so for determination and ranking of workover candidates, software solutions are used (Tavalli, 2018). In this case study, historical data from IT solution OIS Well Workover was used.

3. Case Study Insights on Workover Efficiency

This case study can be considered descriptive and explanatory. It follows quantitative approach, being implemented through observational methods. For any upstream operation, it is of vital importance to be able to run oil production at maximum safety while achieving the best financial and economic results possible. In 2018, IT solution OIS Well Workover was implemented focusing on automation of well workover process (OIS Well Workover, 2005).

For the research purposes, workover services performed in NIS j.s.c. during 2022 were selected as a sample period that included 230 workover rig activities, 221 documents with technical limits, 5.510 daily drilling report, 5.135 routing and allocation plans. The observation period covers the use of IT solution OIS Well Workover from which the data were uploaded to Python for the purpose of identifying potentials for increasing the efficiency of business processes and reducing inherent risks during workover services of oil and gas wells.

As part of case study, the following approach was applied: (1) Data were collected from of daily reports, workover rig routing and allocation plans, and workover rigs technical limits, (2) data were sorted in Python, following unique format, including data validation and verification of completeness, (3) standardized business process flow is defined as per internal procedures, key steps uploaded in Python, (4) Actual data of business process was imported into Python, forming actual business model adding further text mining and clustering of historic data and further structured, (5) Analysis was performed in Python identified potentials for optimization such as identification of gaps between standardized and actual process flow, identification of patterns and rout-cause analysis, defining potentials for process improvements (Ciric et al., 2021).

Key areas of analysis were formulated to guide case study. Key areas that were analysed based on which each potential for improvement was concluded was: (1) *Data quality* was tested through identification of mandatory field entries and real-time data validation in daily workover reports, (2) *Planning phase* of workover operations was tested from the perspective of introduced automatic controls and restrictions comparing to technical limits of each workover rig, (3) *Routing and scheduling decisions* were tested from the perspective of logistical planning and nearest-well prioritization, (4) *Monitoring of routing and scheduling* was analysed using real-time tracking and identification of inefficient logistical movements of workover rigs comparing to wells locations, (5) *Execution* of workover operations were compared to technical limits where deviations were identified increasing risk of excessive usage or failure, (6) *Process transparency* of workover operation was analysed assessing gap between workover operations against planned objectives.

3.1 Case Study Key Results and Opportunities

One year of data collected and structured from IT solution OIS Well Workover were used to identify alternative and more effective scenarios of business process workflow and further areas for automation. Results are structured in 6 segments where the potential for optimization is identified including development of dashboard for the purpose of easy configuration, alerting functionality with the capability of defining meaningful and complex real-time alarms, and automated processes combined with easy-to-analyze visualizations proved valuable and resulted in enhanced decision-making (Meinlschmidt, 2018).

3.2 Data Quality Improvement

Data quality deficiencies in daily reports were identified such as blank daily reports, incorrect data formatting, recorded time without a date of execution, daily reports without a workover plan (0.3% of all daily reports), no objectives or type of workover operations defined.

Potentials for future improvement are focused on implementing automatic controls for key data entries, or by incorporating double- check procedures in order to enhance the accuracy, completeness, timeliness, and consistency of data ensuring its suitability for further use.

3.3 Optimizing Planning Phase Efficiency Relative to Technical Constraints

In the framework of the developed analysis, a total of 5.135 scheduling plans were analyzed, 65.036 operations were recorded in the works plans, out of which 21.407 were unique operation types. During the analysis, it was identified 2 .456 operations (3.8%), which exceed the maximum of technical limits for planned workovers, 24.661 operations (37.9%) that cannot accurately be compared to technical limits and 37.919 operations (58.3%) that correspond to technical limits for planned workover operations.

Potentials for improvement are identified in enabling software functionalities to enable automated controls and prevent the planning of workover operations that exceed technical limits, ensuring activities are kept within acceptable levels.

3.4 Streamlining Routing and Scheduling of Workover Rig Units

Analyzing the planning of routing of workover rig units for the period 2022 following statistics have been identified: 2 cases when the same workover rig crew should move to 2 different wells on the same day, 9 duplicated activities in planning the daily workover report and 9 cases of incorrect date entries, where relocation start date was later then workover completion date.

Potentials for improvement are identified in implementation and enabling automated controls in planning schedule to prevent assigning a single rig to two different locations within the same time period, enable system functionality for determining the nearest well where maintenance is needed, including defining moving dates and enable system functionality to guide and plan logistics when moving equipment and crew members.

3.5 Dashboard Reporting for Workover Rig Routing and Scheduling

As part of a case study where low efficiency was tested related to routing and scheduling of workover equipment, few standard dashboards are created in Python in order to identify and control the occurrence of such situations. In total, as part of the logistical planning of the workover rig allocations, the most common overlapping has been identified in 2 oil fields, where intersections/overlap movements were identified for following rigs – B-5, T-4, T-2, T-1.

Potentials for improvement are identified in implementation of dashboards that can be used to identify inefficient routing and scheduling of workover rigs.

3.6 Efficiency Gains During the Execution Phase of Workover Operations

As part of the execution phase, a total of 5.150 daily reports were analyzed, 65,391 operations were recorded in the daily reports, out of which 36.984 were unique executed operations. Applying detailed analysis in Python, it was identified: 827 operations (1.3%), exceeding the maximum of technical limits for workover execution, 25.378 operations (38.8%), could not be correlated to technical limits and 39.186 operations (59.9%), corresponding to the technical limits for workover execution.

Potentials for improvement are identified in enabling software functionalities by enabling additional fields for comparison with the plan, enabling automatic control of operations length.

3.7 Enhancing the Reporting Process

The analysis of daily reports and workover schedules identified 21,407 unique planned and 36,984 execution types of workover operations. High variability of used terms is creating difficulties in assessing deviations from the plan both in terms of schedule and efficiency and makes it nontransparent.

Future improvement can be achieved by implementing standardized types of workover operation categories, including introducing additional fields for different intervention types to increase the quality of monitoring over the planning and execution of operations. Taking into consideration all potentials for increase in process efficiency, overall internal assessment was performed considering usage percentage of each OIS well workover module, were the following percentage of use of available functionalities were identified: Candidate well selection module (17%), Maintenance candidate distribution module (67%), Workover candidate distribution modeling (67%), Work document module (43%), Workover control module (38%), Workover reporting module (13%), Monitoring of activities module (not implemented), Routing and scheduling module (57%), Report on interventions module (50%), Evaluation module (not implemented).

Future improvement can be achieved by implementing all the functionalities of the IT solution OIS Well Workover for all phases of the workover process focusing on further automation including standardization of operation categories, monitoring deviations of key indicators including development of appropriate dashboards, and standardization through electronic documentation workflow.

4. Conclusion

The integration of advanced analytics and digital technologies in workover operations marks a transformative shift in the oil and gas industry, significantly enhancing operational efficiency and optimizing production. By analyzing well candidates across the portfolio and proposing economically viable interventions, companies can optimize oil production with maximum safety and financial returns. Automating manual tasks allows engineers to focus on higher-value activities, fostering innovation during planning and execution stages (Dakovic et al., 2020).

The comprehensive functionalities of the OIS Well Workover solution promise substantial improvements in operational efficiency and a reduction in human errors, leading to smarter intervention strategies through automation and advanced data analytics. Enabling software functionalities and standardizing reporting will support economic production gains while considering operational constraints. Through standardized, automated software that captures best practices from past interventions, companies can maximize asset potential (Popara et al., 2023).

This research focuses on the OIS Well Workover digital solution in the oil and gas industry. The findings can inform future research by addressing limitations in planning and execution, such as minimizing rig movement costs, accounting for technical constraints, and fostering innovative business practices to achieve strategic goals.

Future research opportunities include consolidating data from field development and well operations to account for uncertainty, integrating rig scheduling with operational decisions, and extending analysis to include detailed performance indicators and benchmarks.

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