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Real Time Operations in Asset Performance Workflows

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Abstract

It has been successfully demonstrated over the past few years that the use of a collaborative environment adds considerable value to the operation of oil and gas assets. The value achieved is maximized when asset personnel can access the right information in an easy, fast and comprehensive manner. In this respect, assets that invest significantly in measurement and automation demand technologies that allow the users to capture, validate and make use of data in business workflows on a real-time basis.

Integrated production operations require coordination of every sector involved to impact the performance of the asset in the most efficient way. Field personnel often have to perform complex tasks ranging from acquiring field measurements under the best known conditions of the reservoir and plant, analyzing and validating the data collected, updating well and field models, and taking timely decisions in accordance with asset studies and annual plans.

In this paper, we present the implementation of real time operations (RTO) technologies for Barracuda-Caratinga fields in Brazil's Campos basin, which enable asset teams to effectively execute workflows related to well production testing, production test validation, production estimation, production loss control, plant efficiency and key performance indicators (KPIs) management. The adopted workflows are enabled through change management processes in addition to innovative technologies. Reliable and time-effective workflows for production surveillance and testing, continuous performance modeling, and sharing consistent and validated data across multi-disciplinary teams provides better control of operations for the asset management. This paper discusses the methodology for selection of relevant technologies and the phased approach applied to implement the different workflows. Benefits include better understanding of asset performance based on the most recent and accurate information.

Introduction

The Barracuda-Caratinga asset is being developed by two FPSO platforms of similar characteristics and serves as a pilot for the Petrobras corporative program for Digital Integrated Field Management (*GeDIg*[1]). The selection of the asset as a pilot was mainly due to its distinctiveness among other assets, a Greenfield with technology in place rich of data along most of the processes, which with a proper knowledge capture methodology implemented with selected key workflows becomes an excellent case for analysis.

The paper focuses on one of the projects of the pilot, namely the implementation of a Real Time Production Operations Monitoring system (MOP-TR). This system supports decisions made during the production processes for technical areas of the asset.

The intention of this paper is to address the technical and non-technical aspects of the implementation of the MOP-TR project, which is based on key asset performance workflows during real time operations.

Business Case.

An assessment was conducted to identify value opportunities for the asset operations. Among the findings of the assessment, there were three clear areas of improvement that touched across most of the asset performance work processes, namely:

- Visualization: A coherent strategy to monitor the operations of the asset by providing access to the right data and by standardizing rules to convert the data into information by involving key people to interpret it and transform it into knowledge.
- Modeling: Make use of Real Time data to continuously optimize operations by validating the models of wells, reservoirs and operations.

- Automation: Direct control over the operational variables and platform actuators in an automated and closed loop with the previous two efforts. Automation is to be implemented in order to effectively make decisions that have been already conditioned and validated by the asset managers in different scenarios.

The areas of opportunity mentioned above are aligned to Petrobras' corporate vision characterized by operational excellence regarding people, processes and technology. The implementation of this project pursues uniform excellence by:

- Joining distant teams to work together on the same platform and same workflows and effectively working in a multidisciplinary manner where expertise at all levels is made available.
- Providing visibility of workflow tasks being executed to all sectors and putting together the results of the connected production workflows to provide the big picture of the performance of the asset.
- Connecting decisions made on integrated production workflows where impacts on other sectors are measurable and where preventive/corrective actions can be taken at the right time, supported by integrated models that look for solutions that continuously optimize.
- Doing a detailed design of every component to be implemented in order to make sure that final results are as expected, with no surprises, and such that users can take ownership of the system.
- Defining and standardizing rules and algorithms for calculations based on the reality of available data and on the best models that apply for a workflow; when available, trying to incorporate international standards.
- Offering a technology platform flexible enough to link the available infrastructure, hardware and software, and fill the gaps to implement the real time operations workflows demanded by the asset. Key technologies are to be driven by the asset and not the asset to be driven by technology.
- Establishing clear communication channels between sectors involved in use of the system and its components. Such communication channels are referred to as "Total Asset Awareness."
- Delivering a phased approach to guarantee the knowledge transfer and to facilitate training and change management.

Challenges.

Challenges are a crucial part to consider during the project in order to achieve the main objective of a continuous production optimization from the asset. Technical challenges can be presented separately, but the different solutions need to be integrated. The project and its participants (the asset sectors, Management, business unit and coroporate IT department) need to jointly overcome the challenges in order to avoid disintegration across performance workflows without breaking the silos, and as consequence keep the asset in a suboptimal setting and never closing the gap between the Actual production and the Asset Potential[2].

Among the challenges to be considered, both technical and non-technical, are:

- Emphasize to the participants the importance of efforts during the Detailed Engineering phase. The detailed engineering phase is the basis for a successful component of the solution. All participants need to understand the scope of the project during this stage so that they are in alignment during implementation. Prototyping of separated component is not a valid option because there is a risk that they cannot be integrated. Demos are allowed with the purpose of showing progress of the implementation or to show detailed and approved engineering functionalities.
- Smart reengineering of components that are to be integrated, after detailed engineering phases are completed, making sure the overall objectives of the system are not jeopardized.
- Alignment of IT departments supporting Data, Infrastructure and Acquisition.
- Assure that the design of the integrated applications platform is a product of a process that considers *people, workflows, and technology*. The right balance of these three design components needs to be obtained to maximize the lifecycle benefits of the system.
- Assure that applications defined include those already existent that were already adding value to the asset. Exclusions, if any, need to be justified to the final users. Otherwise other challenges such as change management will be more difficult than expected, and costs of project will be over budgeted.
- Continuous bi-directional communication between the asset team and the implementation team in order to update project progress and asset evolvement.
- During the design and implementation phases, take into consideration industry standards when fulfilling asset requirements. Consideration of industry standards will minimize reengineering efforts where new technologies are implemented.
- Keep all stakeholders in the asset and other departments in the Company on board regarding their responsibility and role of the success of the project. A minor reluctance from a user could result in a bad decision at the same or different level. Also, not forgetting that participants also have day to day duties to cover.

Selection of Technology.

Though RTO technologies are relatively new to oil and gas industry, the selection of appropriate technology is critical to the success of digital oilfield projects. As production operations become increasingly complex, real time monitoring, optimization and control methodologies are required to maintain high productivity and operational excellence. Smarter strategies for flexible and adoptive operations are required. The most successful operations are those that are closely monitored and adjusted according to changing production conditions. Although these principles are intuitive, achieving them is very difficult in practice due to uncertainties and the complex nature of operations. Success requires continuous and dynamic optimization of operations based on changing production conditions.

Being multi-disciplinary in nature, RTO requires infusion of technologies related to workflow automation, optimization, visualization, system integration and data management among other things, beyond the traditional realm of conventional simulation tools. It is required that there is information availability and visibility across the enterprise. Closer integration and better information flows are required, where asset personnel can collaborate effectively. Further, it is necessary to ensure the existing skill set of the asset personnel are adequately augmented by a chosen technology, thus closing the gap between asset potential and current practice. The technology should be suitable for direct use in engineering analysis, while reducing the investment on redevelopment. Scalability and flexibility are two vital aspects of RTO technologies, as new work processes are added and existing work processes are modified. It should be noted the chosen technologies should not impose restrictions on their future use.

As information and valuable knowledge are shared within the organization through application of RTO technologies, it enables systematic data transformation tasks and provides a common data repository and interface for that data. It is essential that strict principles be enforced around unnecessary data duplication to ensure a single, common set of data used for all decision-making processes. A judicial choice of data management methods should be used as dictated by the asset needs.

A flexible, standardized architecture is required to support the connection of various applications and the sharing of data. In order to achieve this, it is imperative that open standards (e.g. OPC, Web services etc.) are used as much as possible in accordance with the best practices in the industry. This applies to both data interfaces (OPC, OLEDB, ODBC, etc.) and application interfaces (web services, PRODML etc.). A service-oriented architecture (SOA) is suitable here to integrate existing and prospective systems and work processes. Federation of resources is expected to help both rapid deployment and maintenance of the deployed systems.

In this project, two major technologies are employed that achieve the following functions:

1. Data integration, information services and visualization
2. Application integration and workflow orchestration
3. User integration through a common web based environment

Project Methodology.

Initially there were sixteen identified components based on Asset Performance workflows, as shown in fig. 1, and each one of them covers a piece of the main efforts mentioned above. The current scope is based on the strategy to get the value from the implementation of Visualization and Modeling technologies and nine components are considered:

1. Daily Production Reporting. Gives a standardized way to report daily data from the platforms and where validation is reinforced.
2. Asset Performance Metrics. Presents a platform processes monitoring approach of the operations parameters per sector and area, creating a commitment of the people for the success of the performance seeking the goals.
3. Production Loss Control. Identifies where and when the production losses occur and who is responsible for them. The idea is to generate automatic identification and analysis leading to a more realistic picture of the bottlenecks and of necessary actions to correct or minimize them.
4. Plan Efficiency Metrics. Automatically calculates operational time and availability of platform equipments.
5. Enhanced Production Test. Supports the conduct of and the optimization of well testing procedures by collecting, validating and consolidating data from the point of view of focusing on improving well productivity.
6. Virtual Multiphase Meters. Automatic calculation of multiphasic flows based on sensors data.
7. Production Test Validation. Automatically adjusts well performance model parameters and validates well potentials.
8. Integrated Production Optimization. Automatically calculates the optimized operational points of the asset, controlling variables from the reservoir to the sales point.
9. Real Time Reservoir Simulation. Long and short term simulations using the most recent information from the asset.

All components are interconnected in a way that reflects the flow of information according to the operations and workflows of the asset. As an igniting strategy, two components of each area (Visualization and Modeling) are implemented in parallel in order to adjust and pursue an effective integration.

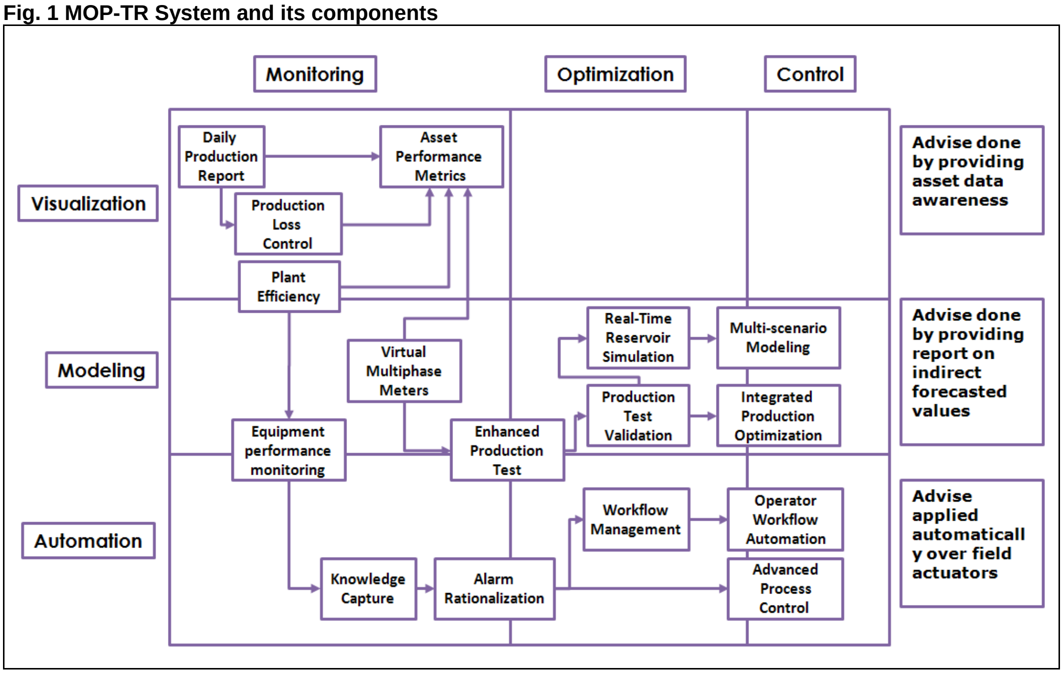
The components presented in this section are designed to consider predictive tools that make use of the real time data and allow operators and managers to work on a “by exception” mode.

For every component, the following project execution approach is followed:

1. Basic Engineering: Where all technical specifications are collected including minimal interaction of the component with other workflows of the system.
2. Detailed Engineering: Where component functionalities are designed in detail, generating a list of requirements such as database accesses, user interface specifications, software licenses, performance speed, communication channels, model procedures updates, expected outcomes.
3. Implementation: Realities envisioned during the detailed design are validated for expected outcomes by:
    a. Component testing
    b. Training & Documentation

4. Review of Component Performance: Period of time is taken to guarantee the optimal functioning of a component.

Fig. 1 MOP-TR System and its components



There is a dedicated Petrobras Project Management working with his Halliburton counterpart. Additionally, Technical Leaders coordinate the engineering and IT efforts of the design and implementation phases.

A board of directors performs project reviews in periods no longer than eight weeks. The main objectives of these reviews are to identify the hurdles on the implementation path and propose solutions to them.

Results.

The project has already rolled out the first Modeling component of the system, Production Test Validation. Daily Production reporting, one of the Visualization components is in final stages of implementation. In addition, another Visualization component is also on its detailed engineering phase, Asset Performance Metrics.

Early results of the Production Test Validation are matching the expected outcomes from the detailed engineering phases.

- 50 – 80 % reduction in workflow time execution.
- Most recent valid well models available for the use of asset performance events simulations (considered in other components of the system).
- Automatic data collection for well test validation.
- New Standardized Calculations, eliminating subjective criteria that could be used by different engineers involved in the data validation tasks.
- Consolidation of simulation results into a database; eliminating the use of Excel spreadsheets that are more difficult to analyze and to maintain.
- Easy and immediate ways to establish communication about well test results once the test has been validated. In the cases of new well potentials identified, to guarantee a fast tracking of the most recent asset performances and contribute to production losses control.

Expected results from the Daily Production Reporting component, in its current phase of implementation are listed below:

- The effort required from operators for data entry has been minimized, leaving them more time for other activities
- Priority efforts over the data being reported, less but more quality data for the asset
- Standardized Calculations
- Data validation rules to minimize errors and misleading information
- Approval process workflow established

Expected results for the Asset Performance Metrics component, in phase detailed engineering:

- Alignment of all sectors in the metrics detailing and validation rules
- Operational and Performance alarms identified
- Data Validation rules before the metric is analyzed by the user. Rules have been applied according to the purpose of the metrics and not according to the nature of the variables

- Integration of multiple sectors and real-time databases oriented to monitoring of individual metric goals and contribution to the visualization of the asset performance
- Strategy seen as a fulcrum by other assets that require similar requirements

Petrobras is still evaluating the first component results in the 9 components considered.

Conclusions & Lessons Learned

1. Early results of the project have already demonstrated value for the asset performance visualization, modeling and automation. The results are aligned with the vision of the Company.
2. Real-Time Operations in the Asset Performance Workflows is feasible and supports the paradigm of people, workflows, technology.
3. A phased execution approach including a Basic Engineering and a Detailed engineering phase is crucial for the success of the project
4. Periodic project reviews are necessary in order to identify potential impacts in execution after implementation of the early components.
5. A flexible technology platform needs be available to manage different data sources, diverse kinds of applications, including existing ones, and for the use of diverse groups of people. This platform should allow the integration to occur at the data, application, and user level.
6. In order to capture the benefits and value of the system, it is necessary to engage all stakeholders early in the project making sure they understand their roles on the success of the implementation.

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