Improving Operational Efficiency in Oil and Gas Production using IT Solutions

Abstract

To meet the production target cost effectively, the Oil & Gas producers continuously strive to optimize operational business processes, revamp roles of human resources and enable newer technologies. Such efforts are supported by well-planned operational efficiency improvement initiatives taking into consideration the characteristics and geographical location of the asset, government compliances, resource availability, and technological limitations. Innovative solutions for effective utilization of field sensors to capture information and intelligent surveillance of producing wells are examples of such critical initiatives. As many field workers independently operate in remote assets, technologies for oversight and procedural transformations for centralized monitoring are of paramount importance. This paper describes few such transformational initiatives that can help enable operational improvement for O&G production.

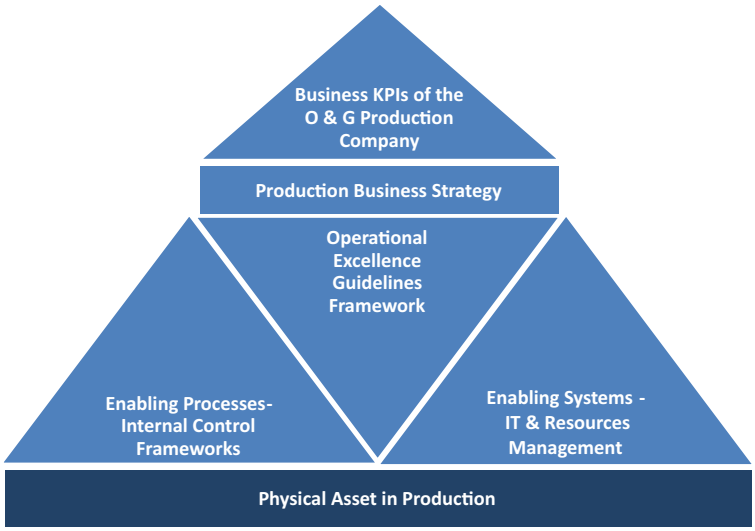
Introduction

Operational excellence in O&G production results from ongoing strategic and transformational initiatives that help implement the processes for exploiting the reservoir safely, reliably, sustainably, and cost effectively. In an era of lower O&G prices and tighter budgets, such initiatives are becoming increasingly critical. Examples of most innovative and technologically challenging initiatives in O&G production business are - strategic blueprinting of operations, alignment of IT/OT workflows and successful implementation of a production optimization platform. While establishing the right framework for production excellence is quite complex, a partnership with the right IT service provider can help achieve success in many dimensions.

Planning Operational Efficiency Improvements by Blueprinting Production

The production business is driven by certain Key Performance Indicators (KPIs) such as business targets for CAPEX and OPEX, Hydrocarbon Accounting and HSSE obligations. These KPIs are based on core industry needs, market demands, and investor expectations. An Operational Excellence framework based on industry-standard compliances, business rules, and technical guidelines is implemented to support the business strategy and achieve these KPIs. After analyzing the business requirements of the production unit, ongoing operational improvement initiatives should be executed to support the Operational Excellence framework. The vital pillars that hold the Framework in place are in the diagram below:

Blueprinting the current state of business operations is the most important part of planning the operational improvement initiatives.



Production Business Operations Support Framework — Enterprise Architecture Blueprinting is important for joining all the elements illustrated.

Enterprise Architecture Blueprinting is executed to capture information technology design and specific weaknesses of the organization to support the existing business processes. Once the blueprint is ready, the next step is to define the future architecture through information, process, and technology changes to meet the business KPIs. For the O & G production business, the team creating the blueprint need holistic knowledge about the production business, IT enablement, process compliance, and business strategies of the organization.

Improving Operational Efficiency in Real-Time Production Data Acquisition

Managing an oilfield effectively requires gathering and analyzing real-time operational data from various sources through installed electronic sensors and Supervisory Control and Data Acquisition (SCADA) systems. Operational control demands real-time sensor information to flow across various production business systems and processes. However, despite significant investments in operational technology, many O&G producers face challenges in effectively acquiring real-time production data.

Automation of real-time data collection at drilling and production platforms, LNG terminals and remote field locations often encounter critical challenges. The data acquisition at source, the mobile enablement of field engineers and transferring data reliably to central data repository have several infrastructure, compliance and cost issues to resolve. To meet these challenges, transformational strategies such as closer alignment and integration of Information Technology (IT) with Operational Technology (OT) are imperative.

Integration of production data from multiple sources helps business to model and effectively manage the reservoir. Integrating data to a centralized node is often challenging due to disparate technical environment and, changes in governance and regulatory needs. However, these challenges are addressed effectively today by data virtualization technology, which makes a heterogeneous set of data sources look like one logical database to applications and users. Effective virtualization enables location-agnostic instant data-access to interpreters, improved efficiency of resources and increased profitability for producers.

Maintaining production data quality requires surveillance, error detection, fixing and reporting of recorded critical parameters.

Key data quality metrics such as completeness, consistency, integrity, standardization, and accuracy should be accurately checked at defined intervals and causes of any noted deviations should be immediately addressed.

Improving Operational Efficiency through

Operations Data Sources	Data Types
Real-Time Operation Data	• Analog pressure data, viz., pump/compressor intake pressure, pump/compressor discharge pressure
	• Analog temperature data, viz., pump/compressor intake temperature, pump/compressor discharge temperature
	• Analogue and digital volume data, viz., flow networks, production intakes, production discharges
	• Digital status data, viz., power on/off and the pump state for electric submersible pump and beam pumped wells
	• Analog set-point data, viz., gas lift rate set-point for gas lift wells, injection rate set-point for injection wells, choke settings
	• Other production engineering data, viz., motor vibration data, motor speeds, electrical currents, voltages, frequency and phases, compressor characteristics
Production Test Data	• Well test data, viz., well test starting time, well test end time, gross liquid volumes, gas total and lift volumes, net oil flow, water volumes
Equipment Specification Data	• Subsurface / surface installed equipment models / numbers, viz., pump types, volumetric capacity, tubular, drive head, separator configuration
Maintenance Histories	• Corrective and preventative maintenance planned and executed activities, including RCA reports

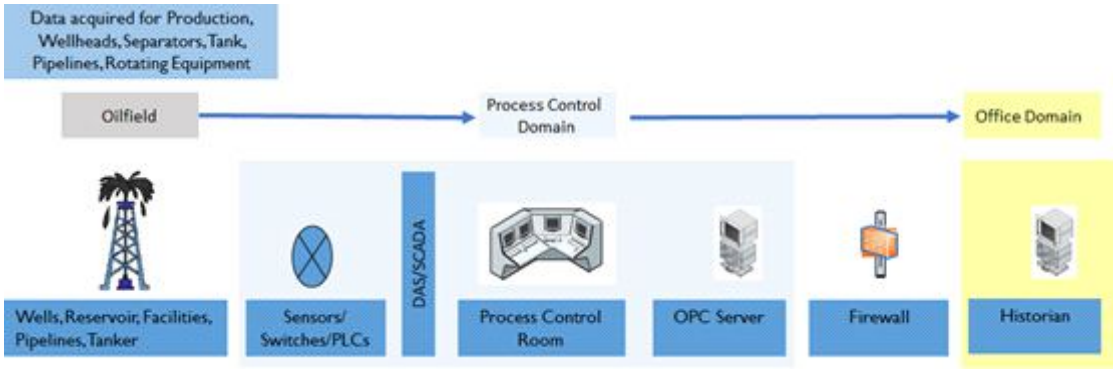
Production engineering data types used for operational analysis

Production Data Surveillance

In a producing asset, unmonitored operational performance makes it difficult to manage, track, report, and analyze well productivity. While unplanned maintenance incur huge cost, production downtime results in substantial revenue loss. Customized operational control tools can help Asset Managers to prioritize the highest impact wells that need immediate attention. Other important solutions such as production data-flow surveillance, automation and data analytics help execute daily reviews and empower management decision support substantially.

Remote surveillance of wells entails:

- Monitoring real-time data flow from field instrumentation
- Monitoring data aggregation and calculations in the systems
- Tracking well production and root cause analysis for any deviations against targets



Flow of real-time data during production

Consistent surveillance of production data-flow from field instrumentation enable detection, fixing and reporting of data loss and data error in time.

Improving Operational Efficiency by Deploying Production Optimization Workflows

Hydrocarbon production is often constrained by reservoir conditions, deliverability of the pipeline network, fluid handling capacity of the facilities, resource safety and economic considerations. Successful producers often implement Integrated Production Modeling and Optimization Platform to monitor and manage asset performances that help increase production rates and reduce cost of operation.

Most common performance parameters are:

- Compressor performance
- Tubing and Choke restrictions
- Daily production Loss Management
- Down-hole sand control failure, and,
- Back-out by high pressure production etc.

The conceptual design of such platforms is based on integrated production models delivered by industry-standard software applications with a workflow engine and visualization layer added for managing integrated field operations. Such platforms are useful for equipment performance trend curve analysis, automated well testing, production data mining and alarm management.

Production Optimization Business	High-level Functional Details
Real-time Data Management	• Interface to historians and other historical data sources • Rule-based techniques to detect data anomalies & quality issues • Notification system to inform business stakeholders
Alarm Management	• Manual and system-generated alarms • Exception-based notifications
Data Visualization	• Role based view of data • Color coded tree maps • GIS-based data view • Video streaming ability • Real-time and historical trends • Pattern recognition and analysis • Interactive Business Intelligence
Production Reporting	Asset-based navigation tree-view and drill-down functionality • Online automated KPI scorecards • Customized dynamic reporting • Historical reports
Knowledge Management	• Centralized searchable database for operation manuals, diagrams, logs, HSSE documents • Extraction and querying of unstructured information

High-level functional details of production optimization workflows

Conclusion

In an era of lower hydrocarbon prices, efficiency is the key to achieve global competitiveness and profitability for the O&G producing companies. The paper focused on some of the critical IT-based operational efficiency improvement initiatives that can empower O&G organizations to achieve much desired operational excellence in their production operations.

Footnotes

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