Performance monitoring in petroleum production: metrics, reporting criteria, utilisation of data and improvement processes

NTNU – Trondheim
Norwegian University of
Science and Technology

Lars Kristian Holgersen
Department of Marine Technology
Faculty of Engineering Science and Technology
Norwegian University of Science and Technology

Abstract

The petroleum industry is capital intensive, meaning the oil company is dependent on stable and reliable production. Capital costs in early phases must be balanced by revenue in production. A company must constantly improve its performance to ensure positive cash flow and stay competitive in the market. An understanding of past performance is important when the task at hand is improving future performance. This study aims to increase knowledge of performance monitoring systems in offshore oil and gas production, identifying improvements that may give better understanding of such systems and provide opportunities for increased production and therefore revenue, through a reduction of production losses and a higher overall facility output.

An explorative literature review in operations management, systems engineering, petroleum-production, information management and industry experiences is carried out to create an integrated theoretical framework. Criteria for performance monitoring systems in offshore oil and gas production are established. A case studying the performance monitoring of a multi-national oil and gas-company is structured and data for two production units is recovered directly from the company and used to develop an understanding of the practical application. The case is evaluated by subjective assessment of the criteria. Results show that an overall strategy of performance monitoring is lacking. Data management proves as a problematic area, where a robust structure and streamlined flow is weak.

Method

Performance improvement has two main objectives: increasing efficiency and effectiveness - effectiveness is focused on equipment and efficiency is focused on resource and techniques. [1]. Important in this is collecting data, processing it to tangible information and presenting the information and trends. Performance is measured through metrics that quantify efficiency and effectiveness. A combination of performance oriented metrics is a Performance Management System (PMS) [2]. PMS is important when an organization is to formulate expectations and discuss past experiences. The system may act as a tool for communication as well as for measuring and evaluation [3]. Metrics should be firmly rooted in objectives, i.e. aspirational statements or Critical Success Factors (CFS). Such metrics are commonly called Key Performance Indicators (KPI) [4]. Metrics, or indicators should be based on the objectives of the system itself, as set by internal and external stakeholders [5].

Industry experiences suggest that PMS and included indicators are to support strategic company objectives, have balance, be success-critical, guard against sub-optimization, be limited in number, readily accessible and intuitively understood [6]. A direct relationship between the indicators and what is covered is important, indicators should be quantifiable, unambiguous, be able to set goals for and be validated. The system should facilitate for taking corrective actions, be available and not susceptible for manipulation [7-9].

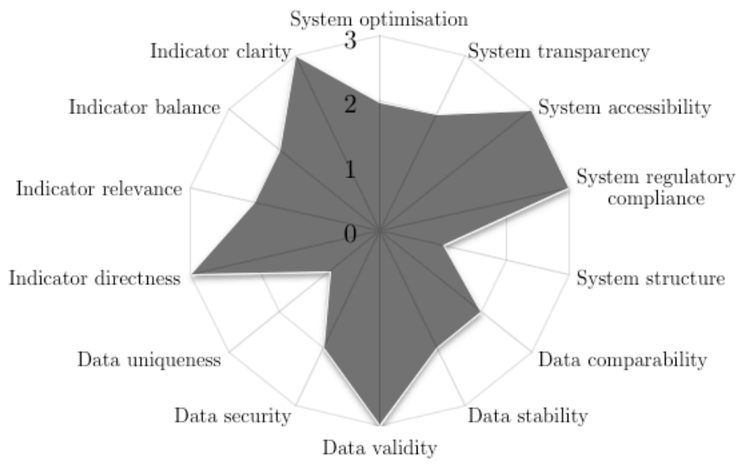
An integrated approach is suggested by the industry, to describing performance through a Production Assurance (PA) framework. Application in an operations environment may be done through a Production Assurance Program (PAP) [10]. This provides as a basis for improvement processes, aiding in finding opportunities and measures to improve performance [11]. Norwegian legislation in requires operations to be documented and made available to the authorities, including monitoring of produced oil and gas, deposit and production process. Critical parameters for production are to be reported daily [12-14].

Case

A petroleum production company operates several Floating Production, Storage and Offloading vessels (FPSO) worldwide. It has implemented a management system using KPIs to measure company performance. A total of thirteen KPIs are defined within HSE (8), Quality (3) and Production (2). For production the KPIs are Overall Equipment Effectiveness (OEE), an aggregated indicator using availability, quality and production to demonstrate facility performance, and Production Utilisation Factor (PUF), which presents performance of the stakeholders on the units in terms of planned and actual produced petroleum. The PUF have two dimensions: time (day/month/year) and stakeholder (contractor/operator/field).

Unique contracts that determine rates, incentives and penalties associated with operation regulate the units. Some have a daily rate, providing a flat payment to the contractor. Service rates, charter rates and rates reliant on operational expenses are also used. Environmental factors such as emissions and spills may trigger negative tariffs, while a good production profile may provide bonuses.

Four important phases may be defined in the performance monitoring: collection of data, validation of data, generation of tangible information and presentation of results. These must all be of a sufficient quality if the performance monitoring system is to be successful. A common ICT infrastructure is utilized on- and offshore. Variables are measured and registered in plant information (PI) system. A Daily Report Application (DRA) is used offshore to oversee and validate reported data. Reports generated by DRA are stored and is the main documentation on past performance. The company uses an intranet for communication, document management and various portals. An information screen is used to present operational performance across the company, showing both unit and overall performance, daily, monthly and annually.



Criteria	Description
System optimisation	The system shall aid to maximize revenue and minimize losses through prevention of sub-optimal operations and losses
System transparency	The system must be transparent. Users must understand and trust functions and processes within it.
System accessibility	Contents should be accessible and readily available when needed, also possible to export to desired use.
System regulatory compliance	The design and use of the system shall fulfil regulatory requirements to formats, functions and structure.
System structure	Indicators should combine to make out a Performance Management System. These should have an as close-as-possible perspective to the actual performance.
Data comparability	Data should be of same or be able to convert to common format.
Data stability	The data stream should. Equipment and processes used for data sourcing should be reliable.
Data validity	Sufficient integrity of data. Statistic invalidity is avoided. Sufficient volume and resolution. Verification possible..
Data security	Data in the system shall not be able to manipulate. Access shall be restricted to wanted users.
Data uniqueness	Duplication of should be avoided and not overlap; the volume of data should be as streamlined as possible.
Indicator directness	Metrics should be close to operations. Should be calculated by using data as close as possible to the source. Aggregated or modified data is not optimal to use in the indicator calculations
Indicator relevance	Reflect success critical areas and strategic objectives of operation. Provide valuable insight in that actual state of operations and be integrated into normal activities.
Indicator balance	There must be a balance in the number of indicators and what areas of operation they are applied on.
Indicator clarity	Indicators should be intuitively understood. They should be clearly defined, what is measured shall be unambiguous in characteristic time periods.

Analysis

A system that monitors and presents performance is established in the company despite the lack of a formal structure and objective. It fulfils the regulatory requirements as posed by the industry and Norwegian authorities. The role that the system has in optimisation of operations has improvement potential; it has a performance-log emphasis. The system is visible in the day-to-day operations through generated reports and implementation in daily routines, but there is lack in overall system documentation which may provide transparency in structure and functionality.

Data is registered in accessible formats, but lacks in standardisation. Duplication of data is a major issue, large data volumes is reported in an unstructured manner. No significant periods of lacking data is found, but increased standardisation of reporting would ease stability and usability of data. The company works well in ensuring that the data that is reported is validated. Security is however an issue.

The indicators are based on validated data directly from production and are clearly defined in accessible documentation. It may be discussed how oriented the indicators are in success critical or strategic areas. Since the company relies on contracts the indicators should reflect the money-making aspects of these. General KPIs common for all units may not do this. While the number of KPIs in production relative to the total count is low, the balance is acceptable, since there are a total of nine variations of PUF.

Results

The criteria that have been generated may serve as a tool for assessment of a performance monitoring system in offshore oil and gas production. By utilizing the criteria on the case a broad perspective of the performance monitoring system in the company has been established, revealing strengths and weaknesses. The directness of indicators, accessibility of system, compliance with regulations and validation of data are all considered as positive. Two areas distinguish themselves as critical, being the reporting system structure and data uniqueness.

The company should develop a holistic strategy performance monitoring, using production assurance and the performance management system framework as a viewfinder. An integrated approach that takes into account the success critical factors is important. Further a review of the database structure and utilization should be carried out. In addition reporting system transparency and optimisation, data comparability, stability and security, and indicator balance and relevance all have room for improvement. The following may serve as step-stones for further development of the system:

- Initiate a project to revise the performance monitoring system, orienting it towards success critical objectives according to above mentioned factors
- Standardise tags for reporting and restructure the database
- Establish an action plan to improve remaining areas with improvement potential

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