Work Group '06 Execution

Approach

Process

The development process for PRODML in 2006 took learning from the WITSML™ initiative which successfully established a similar set of specifications for the drilling domain.

•The work was carried out by a team from a variety of companies. This team was kept as small as practical, yet had access to sufficient resources. During the define phase, selected parties were invited to participate.

•All deliverables were intended to end up in the public domain.

•After delivery of the first phase, PRODML was transferred to Energistics (previously, POSC) for custodianship and further development.

•The team published their progress and invted comments from outside groups as appropriate.

Scope

The first version of PRODML was intended to support data exchange between applications for near real-time optimization. In this context, real-time optimization is defined as optimization that can be achieved by making changes in the existing production configuration that can be effectuated within one day.

Further considerations are:

•The scope was set by what could reliably be delivered within a one year period.

•The interoperability was limited to applications in the office domain, including the data historian.

Use Cases and Flows

To focus the process, two use cases were expressed. The development process was to analyze these use cases and to extract process and data flows that could be used to efficiently design and implement closed loop operations to support the use cases.

Each flow consisted of applications and standardized messages between them expressed in XML.

The applications were expressed in generic terms and the messages and data objects were designed as generically as possible.

Development Process

The various flows were developed in a staged fashion. At various points during the development cycle, experiences were exchanged to balance continuous rework during development and incompatibilities upon completion.

•A flow was first described on paper and was circulated for review in terms of XML specifications and messages.

•A proof-of-concept test was then set up between applications to demonstrate the interoperability.

•After multiple flows were designed, a formal reconciliation step was included to create a solution that could be easily maintained and would be easy to use. This step was primarily an IT activity to abstract out common elements into a proper object hierarchy.

•The flows were demonstrated in pilots at real sites of the participating energy companies.

•The specifications were offered for public comment.

•All comments returned by the public were captured and analyzed by the teams. The actions on these comments were publicized and the final specifications were handed over to Energistics.

An Example Use Case

Setting

One example use case consisted of an offshore field with a series of wells producing oil and gas.

The gas is contaminated with CO2, but the percentage varies widely across the field. The oil production is limited by the amount of gas that can be sold to the customers; flaring is contractually penalized. The gas is delivered to two facilities: a power plan and an LNG plant. Both of these customers have a swinging demand. The power plant has a daily deman variation of about 50%.

There are frequent opportunities to sell additional LNG cargoes; the penalty for missed contract-cargoes is high.

Some of the oil wells are free flowing, but the majority utilize artificial lift, mostly gas lift. The lift gas is obtained from the gas system, sometimes requiring additional compression. The gas plant contract specifies the maximum acceptable contamination as a percentage, the LNG plant as a tonnage. A comprehensive blending system is available to mix the production from different gas sources to meet contractual requirements regarding contamination.

Constraints

•The focus is day-to-day optimization and must be accomplished by manipulating the existing operational facilities.

•Planned changes to this infrastructure, however, must be taken into account.

•Not all wells and facilities can be utilized all of the time, because of scheduled maintenance and the inaccessibility of certain assets that cannot be remotely operated during parts of the year.

•All elements of the production system must be operating within their limits, e.g. maximum draw down, minimum and maximum flow rates, etc.

Business Objective

The company wishes to operate the field in an optimum manner, meeting the gas contracts with maximum permissible contamination and producing maximum amounts of oil. In addition, the company wishes to closely monitor all facilities to detect all variations from expected behavior in a timely fashion.

The Methodology

The basic methodology that underpins the operation of the field is based on simulating the performance of the field in different configurations and selecting the configuration that optimally meets the demands. The tools required to do this are:

•Modeling tools for reservoir, wells, and surface facilities that produce models with adequate accuracy to predict the performance for short and medium term.

•Simulation and optimization tools that can advise an optimum configuration of the production facility. These tools are used for planning purposes (maximum two years planning horizon), but also in response to events (cargo opportunity, equipment outage, etc.).

•Tools to gather actual performance information. When direct measurements are made, they can be retrieved from a data historian. Where direct measurements are not available, the data must be retrieved from reconciliation programs or other data processing tools.

•Monitoring tools to compare the actual with modeled behavior and to advise on corrective action as needed.

•Execution tools to implement the selected configuration.

The Work Flows

Component work flows

Several work flows are used to construct and maintain models of the reservoir, wells, and surface facilities. The purpose of these work flows is twofold, namely:

1.to make sure that the models are sufficient to support the production work flows and

2.to detect malfunctions in the production system at an early stage.

The work flows are:

•Modeling.

This process is used to create models of the individual components of the production system that can be used to predict the performance of the component with known accuracy. Models are used for reservoirs, wells, and surface facilities and are valid within a specified time window.

•Simulation

The simulation processes are integrated with the forecasting process of the production work flow. The individual models, combined with the operational settings, yield component performance.

•Execution

•Monitoring and Reconciliation

The monitoring process continuously acquires data from various places in the production system. Sometimes this data can be used immediately. Sometimes the data must be processed before it represents a reliable indication of the performance at the desired location. In particular, where production is measured accurately only at a few points, re-allocation of contributions of the various wells must be computed to be able to assess how well the model is doing.

•Analysis and Advisory

The analysis process compares modeled behavior with actual performance at regular and frequent intervals. If the difference between these exceeds a preset level, advisory processes will be invoked to determine the root cause of the difference. The possible causes include unexpected behavior of the reservoir, such as gas breakthrough or drop in reservoir pressure, but also malfunctions in the processing system, such as stuck valves, etc.

Production Work Flows

These work flows contain the steps for model-based control of a production facility.

•Modeling

The purpose of the modeling step is to compile a computer representation of the entire asset that can be used to reliably forecast the behavior of the real asset in various configuration and under a range of operational conditions. This process involves compiling a total asset model from the separate component models that constitute the production system.

•Forecasting

The forecasting process is used to predict the performance of the asset in a particular configuration and operational condition.

•Optimization

The optimization process is used to select an optimum configuration of the production system to meet business requirements. This process uses input from other sources to constrain the number of available configurations and conditions. The optimization process is tightly coupled to the forecasting process.

•Execution

The execution involves implementing the selected operational configuration by manipulating the appropriate controls (DCS setpoints, valves, etc.) either remotely or manually. As far as the first version of PRODML was concerned, data exchange between the office domain and the field controls were outside of the scope.

•Monitoring

The output of the new configuration is monitored (or computed) at the delivery point and compared to the desired production. If the deviation from the desired level and composition exceeds preset ranges, the feedback control process is activated.

•Feedback Control

The feedback control process uses the models to minimize the difference between actual and desired output. The new configuration is activated.