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Production Data Standards: The PRODML Business Case and Evolution

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Abstract

PRODML™ is a set of production data standards, initiated by 13 upstream oil and service companies with the industry standards body Energistics (then POSC) in 2005. In November 2006, PRODML Version 1.0 was released. The focus was on production optimization processes which could produce results implementable within a day. The domain was from perforations through to start of processing on the surface. The objective was to enable plug and play integration of current upstream applications while supporting a variety of optimization processes.

In 2007, the PRODML community, now expanded to 23 companies, worked on extensions addressing production reporting, the use of a common “flow network model”, and into “smart wells”.

This paper, authored by experienced members of the PRODML community, explains the evolution from a concept to “do something about production data” into a well-defined series of interoperable services, with a defined future path.

A practical approach to the implementation of an integrated production optimization “analytic environment” will then be described, illustrated by a richly detailed and broad-based real life case study as deployed by Chevron.

The strategy that current members have set for the next three years will be outlined. This covers expansion of the “footprint” of PRODML, (reflecting the need for a clear understanding of business drivers for end-users and for developers), functionality (supporting above all a focus on “usability” – ensuring that PRODML expands while remaining accessible and quick to pick up for new developers), support, and governance.

Introduction

Major energy companies embarked on innovative production technological initiatives beginning early in this decade driven by market needs for increased production coupled with increasingly challenging producing opportunities. This step change was heralded with terms, such as integrated, instrumented, future, and digital. There was no question that the changes in the world of managing production operations would require new procedures, new technologies, and new data solutions for acquisition, processing, and analysis.

This situation led the founders of what became the PRODML initiative to realize an opportunity to leverage each others efforts by defining and achieving a supplier-neutral framework of standards. This framework would enable energy companies to apply their expertise to innovate and compete using commercial product solutions from vendors who in turn apply their expertise to innovate and compete. The vision is of a healthy solution marketplace with a vibrant energy company environment all geared to define how to operate and optimize production in innovative ways with greatly reduced development costs. Savings were projected for first-of-a-kind optimization solutions and even greater savings for optimization solutions adapted from previous successes.

Coordinated in an open, non-competitive way by Energistics, the PRODML initiative was formed to define and demonstrate a new optimization framework during 2006 and refine the framework in 2007. Formal specifications were released as PRODML Version 1.0 in late 2006 (1) and updated Version 1.1 specifications are due to be released before mid-2008. Twenty-three companies, led by seven energy companies, actively developed ten meaningful implementations in the context of pilot projects during 2006 and 2007 to develop the standards and act as tangible proofs that the PRODML framework is viable. (2), (3)

While the PRODML community set out target use cases for the participants to address, it was the individual energy companies that chose the producing field context and the configuration of commercial and in-house software components used to achieve the optimization value loop. Participants were encouraged to engage in diversity and indeed they did. Among the ten pilot implementations, some involved no more than few wells while others addressed more than a thousand wells. Optimization challenges varied from gas lifted well rate management to multi-well surveillance to highly instrumented field management to complex fluid capacity management.

The rest of this paper is structured as follows: first the business rationale behind the use of PRODML is described. Next the principles involved in deploying a PRODML-enabled framework are discussed and illustrated by means of the example of a successful, full-scale deployment led by Chevron as part of the 2007 activities. Finally, the future direction for the initiative, as envisaged by the membership at the end of 2007, is described in terms of technical standards, asset kind scope, services, and governance.

1. Business Rationale and Experience

Introduction

PRODML is designed to be a key enabler for the next transformational step in intelligent field development for an environment where demographics are shifting, locations are worldwide, and assets and their tools for operations may be new or old. An industry standard framework enables consistency of process versus consistency of tools. PRODML provides a way to plug and play pieces until the optimization solution is right for an asset.

This point will be made by describing what is meant by an analytic environment and why one is needed. The way that PRODML is an enabler for the environment will be described as well as what is being done to enhance the capabilities of these Standards. Some of the macro benefits will be described and the reader will be walked through the concepts behind good workflow development practices.

What is an analytic environment?

First, as the name implies, this is an environment for making analysis. It could easily be expanded to include that this is an environment for making analysis in preparation for a decision. What is a decision? It is the endpoint of a workflow. A well defined workflow must have a beginning and an end point. It is the analysis that fits in between that PRODML helps to enable. The asset must set the endpoints. The goal of this initiative is to make sure the asset team can get to the decision using known tools already in place, with the flexibility to change as users change or the complexity of analysis changes (always using tools that are fit for purpose)

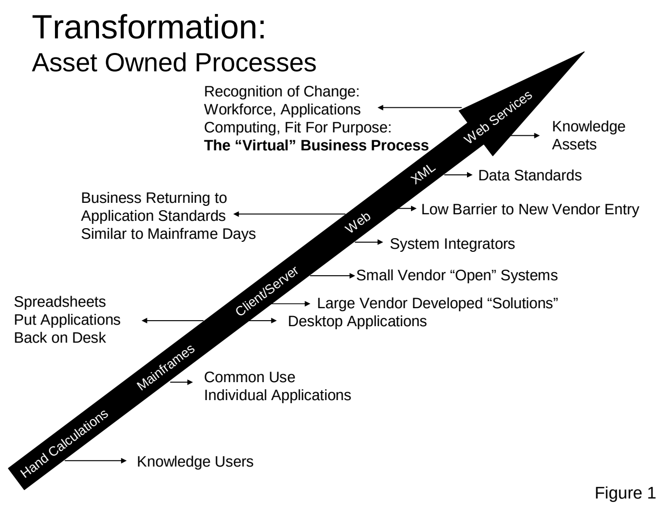

Figure 1

Figure 1 shows in graphical form, the progression of computer assisted processes over the years. There have been many players trying to supply the field with tools to do the job at hand. There are a few problems here, hence the progression through time. The key point is that with each new technology advance – the process ownership has not returned to the asset – until now.

There are obvious challenges:

- It is obvious from the chart that across the enterprise, not everyone has moved through the advances at the same pace. For this new "virtual" workflow environment to be a success, it will have to be able to work with legacy as well as new processes.
- Significant asset user participation is required to ensure use and to eliminate the need for "shadow systems" that plague the enterprise today. The asset team has a demonstrable role in development.
- Standards efforts are more opaque when simply rolling out products. It is difficult to put a value on changes resulting from an enterprise rollout of a piece of software or a database.

"Why do I have to take the next step?"

"There are some great products out there … why will I have to make a change?" Think again about Figure 1, what is the progression and where are you?

Are you:

- Doing everything by hand?
- Using a centralized system or mainframe?
- Using spreadsheets or flat file databases?
- Using desktop stand alone packages?
- Using a single vendor solution?
- Using a vendor's small "open" product that you

mix with other applications?

- Bringing in a system integrator to help make all of your connections?
- Starting to use small web based vendor products?
- Using data standards?
- Starting to use web services?
- Standardizing web services based on known data schema such as those defined in the PRODML Standards?

When you look at your asset and the systems in use, you will probably answer yes to more than one of the questions above … so how does this initiative help?

The analytic environment plays directly to the business need to make decisions. These decisions have a number of dependencies. The dependencies of particular interest to the intelligent field practitioners are:

- Access to data – The count of SCADA tags at most assets is orders of magnitude higher than in the past. Engineers are already quoting a large percentage of their time spent looking for data. In this instrumented environment, how can value be gained from data by applying it to the decision making process. This is one type of “low hanging fruit” in the process. PRODML can be put to work today to expose data interfaces as web services that any application can access.
- Knowledge capture – In the learning organization (and recalling current demographic shifts), providing a way to build knowledge into processes is important to ensure the quality of decisions. The discussion to follow on workflows will show an organized approach to “building in knowledge” as a workflow using PRODML’s data object schemas and web services interfaces.
- Speed – a significant part of intelligent field development is trying to bring all available expertise to the table at decision making time. This means that work done by the production and reservoir engineering staff needs a timely path for integrating their input into the process. The industry is moving towards real time decision making and changes are required to integrate across functional boundaries. This paper will show a fairly straightforward way to build workflows without consideration of process theory and resulting networks.

How is PRODML used in building a workflow?

The PRODML Standards provide a coherent framework for defining and achieving production optimization value loops. The PRODML specifications bring together practical software component interfaces with meaningful data structures and semantics. The interface specifications based on underlying Web Services technology describe the behavior and protocols that allow software components to reliable interact with each other. The data structure and semantic specifications based on XML technology define the vocabularies from which the data passed through the interfaces are derived. The scope of PRODML data structures already covers flow network configuration, volume and related measurements, and well test results. These data specifications will evolve as PRODML is refined and addresses a wider span of optimization challenges. Innovative uses of PRODML elements allow the plug and play of data sources, vendor software applications, and end users. When combined with more static types of data, such as pipeline or well information, PRODML will support activities such as building nodal or pipeline networks on the fly.

PRODML as it is will likely meet typical asset optimization workflow needs. A lot of work has gone into building specifications that work in the production domain and the pilot implementation list (See the table in Figure 10 and associated notes below) is testimony to PRODML’s usefulness. Performance in high well-count assets was also proven during these pilot implementations.

Another key point when looking at the pilot implementations is that several have performed plug and play operations to show that best of breed applications can be incorporated without disrupting the underlying workflow. This is a key concept in that one can build simple now to get going, monitor your results and then build in complexity as needed to improve decisions.

Where is the value?

The value proposition related to workflows will be discussed below. Here are some major elements of value creation related to PRODML that should be considered:

- The time spent in defining the data specifications in the PRODML Standards means that PRODML users will not have to perform the same process and then negotiate with each user/vendor to implement what has been defined.
- The broad participation in the PRODML initiative means that any partners and vendors involved in working on an asset are likely capable of working with PRODML.
- Many common processes have multiple systems that can be consolidated into a usable solution configuration using PRODML.
- The available PRODML training and documentation mean that internal expertise can be developed easily.
- A company’s data sources can be Web Services enabled using PRODML for use with PRODML compliant applications.
- A company’s in-house applications can be

integrated using PRODML.

- A company can build standard processes for enterprise deployment without enforcing use of specific applications, which saves on purchase and training costs.
- A company can link processes across traditional functional barriers.
- A company can build processes that can have varying levels of complexity or fitness for purpose.
- A company can encourage use of models through on-the-fly builds.
- Integration of applications is simplified.

Hitherto, gaining some of these benefits involved activities that required the use of costly outside services. The use of the PRODML Standards should enable a reduced cost to implement. In addition, using the principles of workflow development can lead to better, more informed decisions.

Workflow

A workflow is a pattern of activity that has purpose, is repeatable, and is reliable. This definition alone is not broad enough for an industry that operates around the globe. For the oil industry, the definition of workflow expands to be a *repeatable* pattern of activity across *diverse* assets with *multiple approaches* to the same tasks. Due to the nature of operating across the globe, a workflow becomes a "virtual" abstraction as the diversity of components across assets is being managed. The "virtual" workflow environment is enabled, in part, by the PRODML Standard. This paper will show how the PRODML Standards can be used to start putting a company's workflows together so that increased value can be achieved.

Characteristics of a workflow

To help refine the above definition of a workflow, some qualifiers will be added. A workflow:

- should systematically organize components;
- should define roles, for operator personnel, for vendors and for automated systems;
- must have endpoints that effectively define the purpose of the process;
- needs defined information exchanges (such as those defined as part of the PRODML Standards);
- needs visibility of information flow;

… and looking ahead to results, a workflow:

- leads to achievable results;
- has a process that can be documented and learned;
- enables measurement of results.

A systematic organization of components

When thinking about a workflow, most people will immediately think to start drawing a sequence of boxes. This is the process of laying out the components of a workflow, each of which is unique, needed to complete the task, and potentially used and re-used in the process. In a "virtual" workflow, there is a need to segregate these components into a generalized form. For production optimization loops, it appears that, in general, that there are a few high level categories of components in workflows:

- A Trigger – something has to cause the workflow to run;
- An Orchestrator – something that can direct data traffic in an order that we define;
- A Data Layer – the IT domain that will contain accessible real time, episodic or calculated data, such as allocations and model parameters;
- Calculators – tools to perform fit-for-purpose calculations / models;
- Rules – Requirements for operating;
- Visualization / User Interface – for interacting with individual components and asset teams;
- Defined interfaces for interactions between components, i.e., data specifications coupled with application interface specifications.

These components come together to form the backbone of the "virtual" workflow and may be represented as in Figure 2.

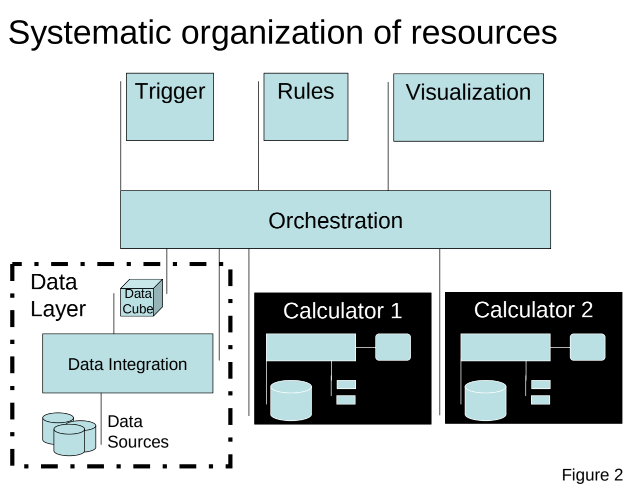

Figure 2

Defined Roles

Having organized how the components of a workflow interact, the next challenge is to understand and define roles for the components. This is an important and challenging step in that these roles will almost always cross functional boundaries and is a common point of failure. Referring back to Figure 2:

- A Trigger can be an endpoint of a process, taking its cue to start from a prior process, or from a schedule or from user input.
- An Orchestrator is the store of asset knowledge about how a process works. In the oilfield today, companies are looking for ways to leverage successes and knowledge across a broad range of assets. So a company may have a role in

establishing "standard" ways of doing things. Whether centrally or locally designed, orchestrators often cross functional boundaries, requiring that all stakeholders are involved in development.

- A Data Layer is the domain of the IT and SCADA groups. One of the most potent applications of the described workflow design is the ability to separate the IT/SCADA role from the technical applications and the work process itself. With this approach, the delivery of requested data is the core activity for the data layer.
- The Calculators are the internally developed or vendor developed applications that may be as simple as a trend analysis to something as complicated as a full-scale simulation. Again, the emphasis is on the roles where each component works to its strength. The vendor applications often function as black boxes to the work process, returning values as requested by the Orchestrator. This approach to thinking about calculation engines is needed because all too often, vendor applications are rejected because of cross-departmental interest in data stores and visualization. The roles must be defined so that the application can do its job, which might require data storage for speed or calculated values and might need visualization or either results or internal calculation progress.
- Rules (or operational constraints) must be set locally, based on regulations or reservoir management. This is a role that must stay with the asset, though guidelines may be recommended centrally. Examples of local rules might be allowable values, such as fracture pressures in injection wells, etc.
- Visualization in the context of the workflow should be able to accomplish a few things. One role is to be able to pass information to a cross functional asset visualization component. That data transfer should not be confused with the visualizations required to manage the process (transaction progress), or to show results from calculations (vendor visualizations).
- The last component is actually the thread that weaves the workflow together. PRODML provides specifications that enable the components to interact and pass data in a consistent and understandable manner. This is the foundation of the "virtual" workflow, as any component can be exchanged for an equivalent one while supplying the same form of results. This provides the capability to standardize a process across the enterprise without needing to standardize all of the specific components.

End Points

How are the beginning and end points of a workflow provided? In the past, vendors were relied on to provide analytical solutions. Vendor tools are powerful and often self contained. They do little to address the questions of where the workflow starts and ends. This has been one of the weaknesses of the use of vendor tools and a reason that many great vendor tools have failed to find a place in the day-to-day work of the industry. It is also a weakness of our management processes, since frequently we are asked to build end to end workflows around generic concepts rather than fixed points.

To provide a working example, let's look at the concept of water injection and ask the question, "What will you do if you are given the task of building an end to end workflow around water injection?" This would seem to be a basic function of production / reservoir engineers. It seems well defined, with sufficient study of many years. It embodies a significant portion of the oil industry's day to day business. So, why is this task generally found to be so hard? It is hard because it needs a structure that allows nested workflows. We can call them processes, building blocks or any other name, but the key is that we can define these individual pieces that make up what we might call *water flood management*.

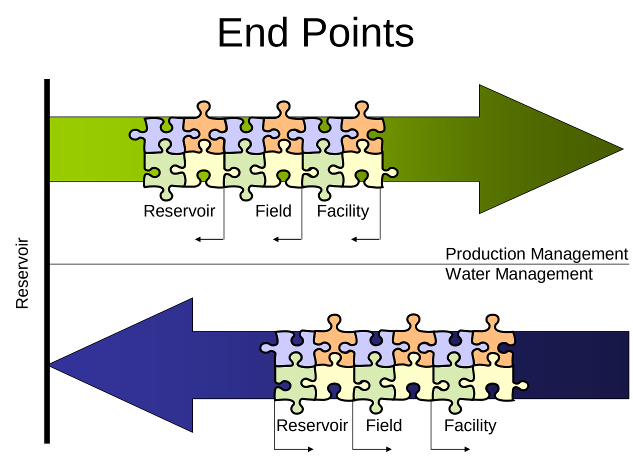

Figure 3

This is not a trivial task. Figure 3 tries to represent the problem facing anyone attempting to put together an end to end workflow around water injection. Let's break this big picture down into manageable components that over time can become the building blocks that an asset uses to manage water injection projects. First, the process of breaking the overall workflow into distinct processes with defined endpoint enables the solution developer to represent to management what is being built, how it fits into the bigger picture, and even how the building blocks are scheduled to be delivered.

In Figure 4, building blocks are broken out with an attempt to show the end points. We need to know the production volumes in order to make a forecast of water coming into the treatment plant. We need to use the water coming into the treatment plant to understand if there is a capacity issue and to understand if we need to increase or decrease production from wells in the field. We need to know how much water is leaving the plant in order to manage our field distribution system to get water out to the injection wells at some target rate.

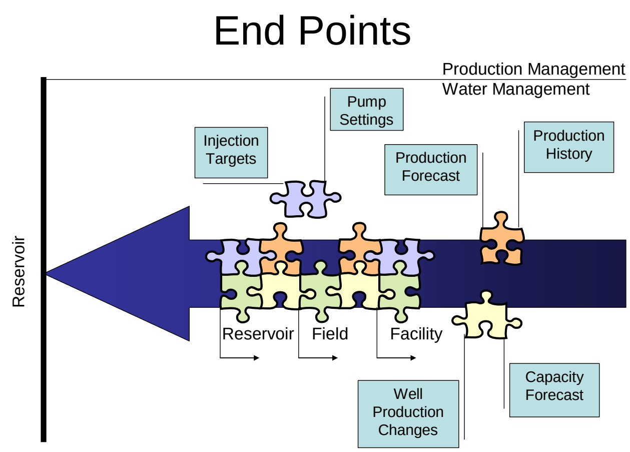

Figure 4

This is an attempt at showing how having obvious end points make processes easier to define for the developer and easier to understand for the user in the asset.

Defined data interchanges

In Figure 2, there are a number of component interactions implied by each line back to the Orchestrator. Each of these lines actually represents two interactions in that for each PRODML *request* there is a following *response*. It seems intuitively obvious that having a framework based on Standards makes it possible to quickly configure interactions of data flowing among components versus having to work with each supplier of data individually to determine how they will make data available and in what form the data will arrive. The latter requires constant attention to changes versus a more controlled release of new versions when using a framework based on Standards. The use of Standards also enables the operator to plug and play vendor applications and models that are fit for purpose. It performs another task by abstracting the production technology supplier from the IT/SCADA world. An interaction is limited to making a request to another component, rather than having to get into the details of the data sources and their unique formats. This is a great time and cost savings as crossing functional boundaries can be as difficult as crossing boundaries between vendors.

Looking again at Figure 4, demonstrates that a solution developer will likely be building not one, but a number of building blocks within the intended end to end workflow. Each building block multiplies the number of interactions and the complexity faced in putting together the building blocks. The implication of many interactions is time and complexity. Before this leaves an impression of being too daunting a task for an engineer, recall that a very small number of general-purpose data and interaction specifications are defined in the PRODML Standards. A large variety of uses can be achieved by specializing the constructs as appropriate for each interaction of each defined workflow.

Visualization

Visualization is actually a number of concepts:

1. Providing data to a cross functional working environment similar to a control room
2. Providing a way to view the output from an individual part of the building block such as a view of the tank level, a production forecast or a recommendation
3. A method for viewing / management of the workflow by providing a running look at the interactions in a system similar to a developer debugging environment

While seemingly an end point, the visualizations are the means for user understanding of and input into the workflow. Taken together with the opportunity to view “over the fence” from one work teams building block to another adjacent block and this is the core for building high-performance cross functional teams.

Determining value

The real driver for getting down to this level is that here we find measurable value.

We have the packaged workflow or building block. It is complete with interactions looking down for data and interactions looking up to supply visualization data. It is self contained and usable by this or other workflow. The actual count of building blocks is measurable.

There is knowledge capture in that the work process is now defined. It is valuable that knowledge can be deployed over more than one asset. Propagation is therefore a value measure. Note that the technical end of the application is being deployed with hooks for a standard way to tie into the IT/SCADA world and the asset’s visualization demands.

The first three measures of value are what can usually be determined from an application deployment – did the package get out, at what cost, and how many? It is the defined endpoints that provide the keys to measuring value from the building blocks. It is also the key to understanding where the value is coming from – providing transparency into how the building blocks enabled operations to make gains.

Here we return to the 2007 PRODML pilot implementation done by Chevron. The focus was water management and consisted of four building blocks designed to be the first blocks to provide a view across the water management workflow while recognizing that in an environment that is continuously improving, these will be replaced over time with more sophisticated models.

In the first building block (Figure 5), the process is providing the facility operators with a forecast of incoming water over the next seven days. Since this includes maintenance, one decision that can be made using this building block is the scheduling of maintenance to manage water throughput. The second result is to provide a target for today's production to the next building block.

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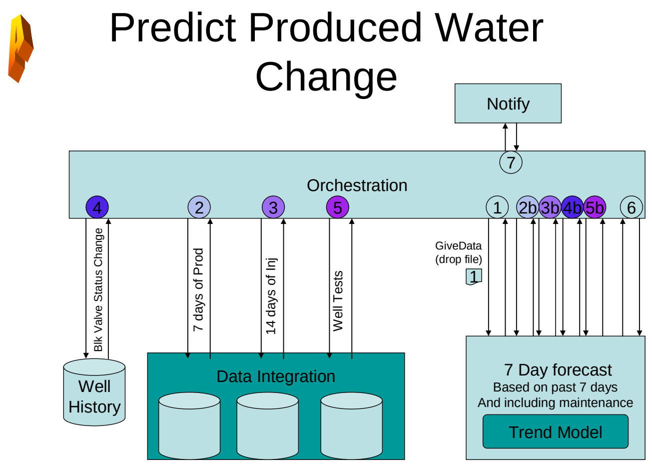

Figure 5

From the knowledge of what the throughput for the day will be, the operators can now determine the expected change in holding capacity (tank level) and can move into building block B (Figure 6). Here the decision is whether producing wells should be opened to provide more water throughput or closed to reduce throughput. The decision as to what is opened or closed uses a simple WOR sorting, but this is an example of an intersection point with another workflow building block developed by the production / reservoir engineers.

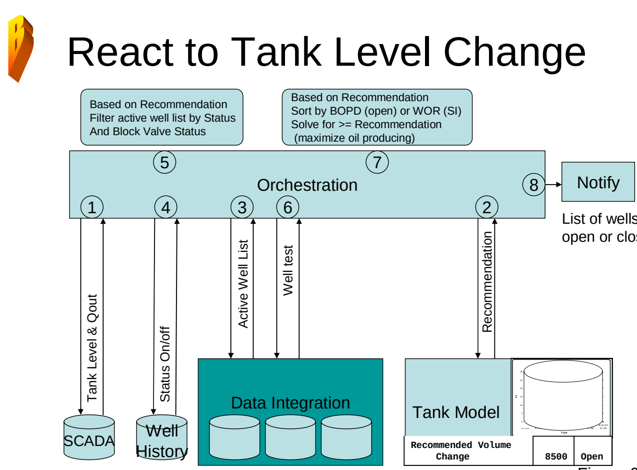

Figure 6

An output from the building block in Figure 6 is the amount of produced water available for injection. The next workflow building block, shown in Figure 7, looks at available injection wells, their target injection rates and permits the calculation of the amount of makeup water required. Given that requirements don't always match with the pipeline network and that in this case, there are two delivery systems with intersection points, the decision here is to optimize which links are open / closed to provide the closest injection to target based on the available water. There are potential additional building blocks around delivery of makeup water and for setting of injection targets.

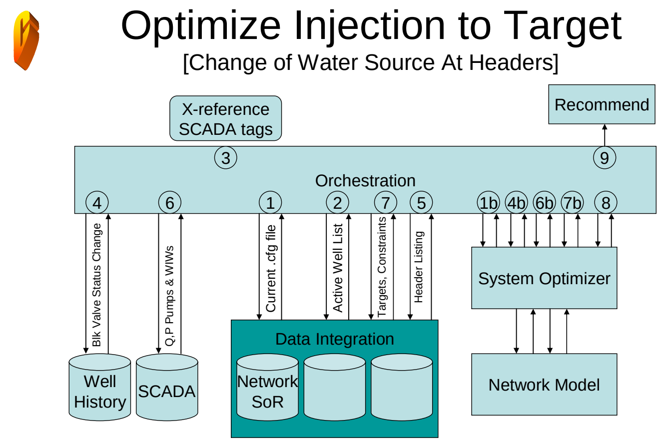

Figure 7

Now that we have water to our injection wells, how do we manage the wells? The final building block serves two purposes. At the highest level, it provides cross functional visualization across the entire system. As you drill down into the visualization, you build information related to the injection well performance, maintenance and maintenance results. The decision here is to determine which wells need remedial action. Figure 7 shows the basic orchestration, but hides the complexities of the drilldown as the same processes are repeated.

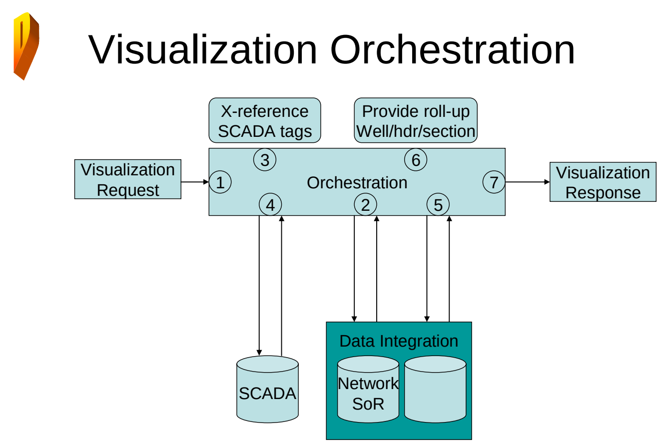

Figure 8

In a six sigma type environment, the value for each of these building blocks can be demonstrated by measuring current performance and how that measurement is changing over time. These are the kind of value numbers needed by the asset to justify expenditure

Meeting the challenge of building workflows and / or their component building blocks is a high hurdle. The very concept of people, “your users”, being able to define their own pattern of activities in completing a task is an iterative and sometimes long process. PRODML, along with sound objectives, are enablers for capturing real workflow value at the asset level and from there, the enterprise.

2. PRODML Future Evolution

PRODML continues to evolve guided by the requirements provided by the Energistics PRODML Special Interest Group (SIG) members together with lessons learned from implementations and deployments.

By the end of the summer of 2007, PRODML leaders assessed progress and worked out a road map leading to achieving the full vision of covering all asset types and all production-domain business processes. A further significant part of that assessment was an analysis and determination of remedial actions to ensure the ability of PRODML to become fully integrated into commercial products – both through adaptations for current products and through designing PRODML into next generation products.

The following sections describe the future direction as defined by the member companies at the end of 2007. This comprises:

- o A roadmap that shows the expansion of the coverage to include further asset kinds beyond those already addressed;
- o A technical architecture description that explains how the software services will be augmented by new services to enable more agile deployments (while maintaining compatibility with the current services);
- o A description of the support services and governance model to be provided by Energistics for the PRODML SIG and its Work Groups guided and assisted by the member companies.

Roadmap

The road map sets out targets for developing and demonstrating PRODML capabilities through 2010 by which time the following use cases will have been addressed: reservoir development management, artificial lift (ESP, SRP, etc.), integration with facilities maintenance and process simulation, NOJV reporting, and more. This will represent a total of five years of development of the PRODML Standards, which is considered an aggressive but achievable target. Success will be determined entirely by the willingness of companies in the industry to support and adopt the PRODML Standards and, in particular, by the willingness of operators to specify the requirement that PRODML be part of solutions that they configure and deploy using PRODML-enabled commercial products.

Figure 9 shows in diagrammatic form the relationship between business processes occurring in a producing asset, and the existence of different data and application domains and related standards. The top part of this diagram shows processes from high frequency ones – real time controls and data gathering for example, through to low frequency ones – reservoir recovery optimization for example. Below that, the different domains are shown inside dotted-line boxes. These are:

1. The real time and close to real time domain is that of SCADA and related systems, where there is a dominant standard, OPC.
2. The reservoir modeling/Geoscience domain in which there are a number of de facto vendor-defined “standards.”
3. The production domain which falls between the previous two and which is characterized by the existence of many applications, ad hoc development such as the use of spreadsheets and point to point integrations, and which is the target domain for PRODML.
4. The maintenance systems domain which will in future increasingly link to the production domain.
5. The drilling domain which will increasingly become the province of the WITSML Standards, an Energistics’ sister set of standards to PRODML. Again, data from this domain needs to cross into the production domain.

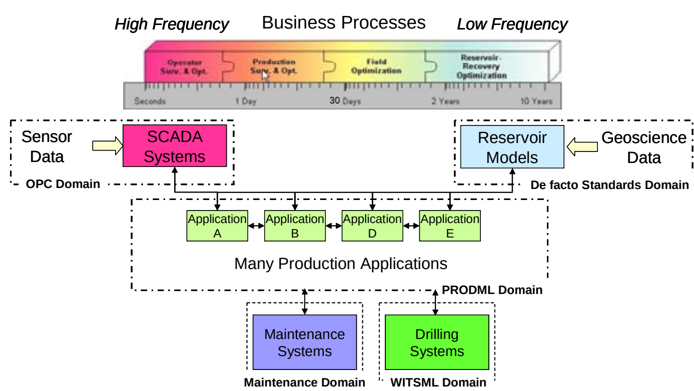

Figure 9 – PRODML in the Context of Business Processes

Recognizing the need for the asset type coverage to expand, e.g. to other forms of artificial lift, as well as business process coverage to deepen, e.g. by enabling drilling systems to provide well completion data, the roadmap has been drawn up. Figure 10 shows the roadmap in tabular form. The five years of the PRODML development are shown across the columns (the first two columns representing the already-completed 2006 and 2007 years). The rows represent the business process kinds which are also shown on the “time-cycle” division at the top of Figure 9. The categories, which are approximate and for ease of understanding rather than definitive, are:

1. Operator surveillance and optimization. These are the intra-day processes such as ensuring production systems are performing to expectations, relatively simple optimization and daily reporting. The well data associated with different well and lift kinds has been categorized here as a foundation data level. The use cases to be covered are seen spread across the years as follows:
    a) Gas lift optimization, referring to lift gas allocation with different well and plant availability.
    b) Gas lift and flowing well surveillance, referring to the use of production data combined with well models in order to highlight discrepancies, provide alarms, provide virtual flowmeters etc.
    c) Downhole sensors extends the data that can be described in a well to pressure, flow and temperature sensors at specific points down a well, and to distributed temperature sensing (DTS).
    d) Daily reporting covers operator daily producing asset reports.
    e) Reporting NOJVs extends reporting to non-operator joint venture partners.
    f) ESP wells covers the downhole and surface data associated with Electrical Submersible Pumps and associated systems,
    g) SRP wells covers the analogous data for Sucker Rod Pumps.
2. Production Surveillance and Optimization. These are processes typically happening over periods of a few days to a month. “Real time data” is used in the sense that data acquired from real time systems is important, but the processes happen in an offline mode. The use cases are:
    a) Smart well offtake optimization covers the ability to describe setpoints of downhole flow control valves.
    b) Fluids capacity forecast enables data to be identified as forecast rather than history and for historic data to be transformed into decline curves.
    c) Smart well optimization with downhole allocation adds multi-zone allocation to the well flow data model, with zones assigned to specific depth intervals.
    d) Fluids capacity optimization brings in extra details in and use of, surface production well tests.
    e) Well completion transfer and referencing enables well completion data to be defined, such as well trajectories, casing depths and sizes and tubular and other completion components.
    f) Welltest validation adds more detail to production well test data such as fluid details and quality status.
    g) Integration with facilities maintenance adds to the ability to report the status (historical and future, planned and unplanned) of components in the production system.
3. Field Optimization processes typically are performed over periods of a month or more. (Note that many of these processes can be automated to run on any time basis and that the timelines suggested here are illustrative of current practice rather than future possibility). The following use cases are covered:
    a) Shared network model with change propagation enables applications to share a common network model, meaning the configuration and identification of “units” such as wells, pipes, manifolds and separators. Change propagation means that a change, e.g. a new well added, is detectable and transferable by each application.
    b) Shared network model with different detail level deals with the fact that applications ideal diverse levels of detail for the network model, e.g. flow allocation may need less detail than process plant simulation.
    c) Reservoir voidage and monitoring adds the ability to report reservoir data such as transient tests, drainage area pressure, flow unit voidage replacement etc.
    d) Integration with process simulation gives the ability to transfer detailed fluid properties, handling constraints etc. from the production domain into the more detailed process domain and vice versa.
    e) Monthly regulatory reporting will engage the regulatory bodies to find standard data content suitable for statutory reports.
4. Reservoir Recovery Optimization refers to the long-term reservoir planning, with the aim of maximising economic exploitation of the reserves in an oil or gas field. Such planning is typically performed on an annual basis. The use case covered is:
    a) Reservoir - Production Development Planning which will introduce the integration with full-field reservoir simulation, including supplying the production data required for simulation, sharing the “static” data such as well configurations, and passing forecasts back to the production (shorter timescale processes) domain.

Year	2006		2007		2008		2009		2010
Use Cases	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)	
Op. surv. & opt.	Gas Lift Opt.	G/L & flowing well surveillance	Downhole sensors PTQ, DTS	Daily reporting	Reporting NOJVs		ESP wells		SRP wells
Prod. surv. & opt.	Smart well offtake optimiz-ation	Fluids capacity forecast	Smart well opt with downhole allocation	Fluids capacity optimiz-ation	Well completion transfer & referencing	Welltest validation			Integration with facilities maintenance
Field opt.			Shared network model with change propagation		Shared network model with different detail level	Reservoir voidage and monitoring	Integration with process simulation		Monthly regulatory reporting
Res. Recov-ery opt.									Reservoir-Production Dev Planning

Figure 10 – PRODML Five-Year Roadmap

It should be noted that while the roadmap as shown in the table in Figure 10 shows specific future years in which the use cases will be addressed, this order is intended to be flexible. It has been drawn up from current knowledge of priorities and can largely be re-prioritized depending on the needs of end-users. It can be seen in Figure 10 that the lower frequency business processes, e.g. the reservoir related ones, are projected to be completed later in time than the high frequency processes. This partly reflects the perceived priorities of "Intelligent Fields" programs, and also the fact that the high frequency business processes have data requirements that are a foundation for other processes, e.g. the ability to model basic well production data for different well types.

Technical Architecture

An examination of the ten pilot implementations completed in 2006 and 2007 confirms that there are repeatable patterns in the roles taken by software components interacting through PRODML interfaces to achieve diverse optimization purposes. Repeatable roles include components that monitor real-time measurements, components that run simulations or otherwise project future conditions, components that access saved measurements, components that provide authoritative information about the producing asset and its facilities and equipment (i.e., shared asset modules), and components that help drive optimization processes through defined steps and condition testing (orchestration modules). PRODML aspires to supplement the current PRODML interfaces based directly on the XML object schemas with service-oriented interfaces for SOA/Web Services interfaces for interactions between well-defined types of components derived from the reference XML object schemas to ensure data integrity and consistency.

To deploy PRODML-based applications in the field a certain amount of configuration is required, in particular related to a common way of identifying the components whose data needs to be exchanged. To facilitate this process PRODML is now defining specifications for a Shared Asset Model and associated services. This model is intended to provide the following functionality:

1. A high level overview of what components are installed in a specific production system, as well as their logical and physical connections.

2. References to services that can provide detailed information about individual components in the asset. An example would be a reference to a database server that holds historical data for a particular sensor, or a well modeling service capable of providing simulation services for a given well.

3. An identity service which uniquely identifies individual components in a globally unique manner to be used by PRODML servers and clients.

The Shared Asset Model will provide operators with a single interface through which asset-related information can be entered and maintained. PRODML clients and servers can use this model to find out what assets are available on a given installation and which server can be contacted for more information.

Over the past two years the validity of the PRODML concept was proven. It is, however, recognized that the learning curve for new software developers was longer and more difficult than it necessary. To address this, the PRODML SIG is making updates to the specifications that will reduce the complexity of application development to better support large-scale PRODML deployment.

In addition to the existing XML document-oriented data objects, which will continue to be used primarily for reporting purposes, a lighter-weight approach to achieving application interactions is being defined that will be more suitable for developing PRODML servers and clients involved in production optimization processes.

The specifications for these additions will be posted on the PRODML pub Web site early 2008 for public review and will be part of the next version of the PRODML Standards. It is anticipated that commercial products implementing the Shared Asset Model services will become available during 2008 following a publicly available reference implementation to be developed by the PRODML SIG.

Strategy and Governance

The PRODML community was left with the question of how to continue the success achieved to that point in time. It was determined to make two fundamental changes: a focus on field implementations instead of pilot implementations and an effort to define re-usable, well-defined types of optimization solution components instead of separately designing solution configurations on a case-by-case basis.

The community wants to enable a growing and widespread use of PRODML in the industry. This means growing the ongoing support services available from Energistics, including Help Desk, FAQ, public Web, training, and tools. It means inviting industry organizations to become participants in the user community, Energistics' PRODML SIG. It means conducting a PRODML field deployment portfolio management activity to promote implementations of the progressive use cases on the road map. It means conducting technical workshops where new development areas for PRODML growth are tested and demonstrated. Further PRODML evolution will be driven by actual field implementation requirements.

As a key element in the Energistics industry standards organization, the PRODML community will participate actively in Energistics efforts to coordinate data and technical standards architecture evolution among PRODML, WITSML™ for drilling, and other Energistics subject area communities to ensure maximum sharing and consistency. The PRODML community looks to Energistics to facilitate ongoing PRODML community activities and increase the scope of PRODML support services, program management, and liaison with related industry and cross-industry standards. With a focus on business value generation and marketplace presence, the usage of PRODML standards will grow among energy companies and investment in PRODML-based products will grow among vendor companies.

Access to PRODML Standards

The PRODML public Web site, http://www.prodml.org, provides information on these enhancements, examples of the pilot implementations, and a developer's toolkit for downloading.

Conclusions

A new release of the PRODML Standards is expected prior to mid-2008. The intent of this paper has been two-fold. In the first, it is meant to show the status and evolution of PRODML and in the second, it has shown the value opportunity in using PRODML.

The capabilities of data systems continue to evolve towards their original promise of putting more power into the hands of the user, transforming his/her capabilities. PRODML is a part of that transformation and good practices in developing workflows will enable you to capture the value from the new "virtual" workflow environment.

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