WITSML™

and

Intelligent Oilfield Operations

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MIT Data Center
M-Alliance: Applications in the Petroleum Industry
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Law of Disruption

Source: Downes & Mui, “Unleashing the Killer App”

Social, political and economic systems change incrementally, but technology changes exponentially.
Oil fields of the future: real-time oil and gas operations

new capabilities – much more data; much more exposure
The basic approach of all “smart technology” is measure-model-control

- measure system properties
- model actual vs desired behaviour
- derive required correction parameters \((\text{adaptive control})\)
- implement control

\[\Delta\]

IntOPS = Integrated Operations

Source: Shell
**Time Scales (10^6 range)**

- **Business Headquarters**
  - Capacity Planning Design: [months/years]
  - Operational Planning: [months/years]
  - Scheduling: [days/months]
  - Supervisory Control: [minutes/hours]
  - Regulatory Control: [sec/minutes]

- **Well & Surface facilities**
  - Flow, pressure and temperature in wells and separator
  - Fuel injection to produce heat out of a boiler
  - SCADA systems for coordinating flow stations and pipelines
  - Gas distribution/optimization on a pipeline network
  - Monitoring wellheads, multiples and flow stations
  - Opening and closing wells or partial completions
  - Adjusting well operating parameters

- **IntOPS**
  - Planning drilling and workover resources
  - Supply Chain Management & Market and customer demands

- **Model**
  - Asset life cycle and installed based maintenance or growth
  - Supply Chain Management & Market and customer demands

- **Source:** Saputelli SPE 83978
The Problem?

- **Theorem 1**: 50% of the problems in the world result from people using the same words with different meanings.
- **Theorem 2**: The other 50% of the problems results from people using different words with the same meaning.

*Stan Kaplan, Risk Analysis, Vol. 17, No. 4, 1997*
Some facts
Not-for-profit consortium
Founded in 1990
Location: Houston, London
Members + SIG Members: > 80

Oil
BP, ChevronTexaco, ExxonMobil, Hydro, ONGC, Pioneer, Shell, Statoil, Total…

Service / Software
Halliburton, Paradigm, Schlumberger, Baker Hughes…

Government / Regulatory / Noncommercial
US DOE, US DOI, UK DTI, Norwegian NPD, IFP…
POSC Standards / SIGs

- E&P Catalogue Standards
- Industry Dictionary
- Business Objects
- NDR Meetings
- Reference Data Standards
- Practical Well Log Standards
- Data Store Solutions SIG
- eRegulatory SIG
- IntOPS SIG

XML exchange standards, design guidelines, profiles
WellHeader, WellPath, WellLog, LogGraphics, ProductionML, etc.
Two parts of Information Transfer

- Mechanical
  - The letter and the envelope
  - The mail service
- General
  - The message content and meaning
  - The transport medium
- Electronic / Internet
  - eXtended Mark-up Language (XML)
  - Internet technologies (http, Web services etc.)
Standards – a Refresher

- A Standard is a set of agreements to do something in a common, shared way
  - Agreements of need, design, usage, evolution
- “Ascribe to standards those things that are routine and uncontroversial. Compete on those things that are new and differentiate ones products and services”. After W. Edwards Deming
Benefits of Standards

• Statoil: Standards based Data Management save $10MM+ per year
• Standards enable quicker, cheaper, better business analyses and decisions
• Examples in other industries (telecoms, railways, internet, ...) and some in E&P demonstrate the benefits of standards to all players
Standards … from a major operator’s point of view

• It is better to be common than to be the best
• We will get common before we get best
• Claim
  – Savings of $100 Million / year due to internal standardization

But we have learned that …
• Standardizing Data Models is not sufficient
• Shared content must also have a standardized representation
• Content must be described “neutrally” with respect to usage
• Loose integration via internet exchange is very powerful
Industry Barriers - after Gartner

• Lack of Integration - too many data sources
• Lack of timeliness of information
• Inconsistency of available sources of information
• Inaccurate / poor quality information
• Inability to access information

Gartner Claim -
Quality and Access are not significant issues for E&P?

Source: Dan Miklovic (apr 2005)
Gartner on Standards

• … Industries with strong rich standards and companies that have strong rich standards just do better from an economic perspective …

• E&P Standards needed to support
  – Regulatory reporting
  – Asset M&A
  – Portfolio Review
  – Production Optimization

Standards shift the competitive focus
Standardizing IT helps companies get to ‘Core’ better

Source: Dan Miklovic (apr 2005)
WITSML™ – WWW.WITSML.ORG

Wellsite Information Transfer Standard Markup Language

“The ‘right-time’ seamless flow of well-site data between operators and service companies to speed and enhance decision-making”

A New Open Information Transfer Standard for the Oilfield
Drilling Issues

- Maximize well productivity
- Minimise formation damage
- Avoid pressure problems
- Steer the drill bit
- Find and stay within hydrocarbon zone
- Requires a combination of different measurements from different companies and collaboration among disciplines (Drilling, Geology, Reservoir)
Sample WITSML Data Flow

Source: Schlumberger
Data Objects: Original, New, Updated, Draft

Bottom Hole Assembly Run
Cement Job
Conventional Core
Fluids Report
Formation Marker
Log → Well Log (includes Wireline)
Message
Mud Log
Operations Report
Real Time
Rig / Rig Equipment
Server Capabilities
Sidewall Core

Subscription
Survey Program
Target
Trajectory & Trajectory Station (includes planned & calculated well path)
Tubular / Bit Record / Open Hole
Well
Wellbore
Wellbore Geometry
Risk
Completion / Well Mechanical
Regulatory Permitting and Reporting
Production Activity and Volumes
Distributed Temperature Survey (→1.3.1)
Image Calibration
WITSML Messaging

The WITSML standard comprises two sets of specifications – one for vocabulary, one for transport:

• **Data Schema Specifications** – define XML vocabulary for WITSML drilling information (data objects)

• **API (Application Programming Interface) Specifications** – defining an optional set of interfaces exchanging WITSML data objects. In particular, the API defines the client-server behavior (Store) and Publish/Subscribe (Publish) interfaces.
WITSML Store Interface

STORE Interface

Client [Requestor Endpoint]

request

response

Server [Provider Endpoint]

Methods
GetFromStore()
AddToStore()
UpdateInStore()
DeleteFromStore()
GetVersion()
GetCapability()
WITSML Publish Interface

PUBLISH Interface

Subscriber [Requestor Endpoint]  Publisher [Provider Endpoint]

request(once)

response(s)
(many)

Methods
Subscribe()
GetVersion()
GetCapability()
• WITSML started as a collaborative effort to update the widely used WITS standard for moving drilling data between rig and office based computer systems
• WITSML is designed for the standards of today's “always on” Internet environment while still accommodating those rigs not yet “Wired”
• WITSML is a POSC standard that is published and available to all to implement
• Real world use of WITSML is happening NOW
• The scope of usage is being extended based on practical experience and pragmatic needs via the WITSML SIG
BP Vision

- Automation of many manual processes in current Drilling Data workflows
  - Contractors (Service and Drilling) automatically push data into our corporate data stores
  - Partners can automatically pull data (Not images) for morning reports into their data stores
  - Operators can push statutory reporting data for statutory reports
  - Contractors can share data with one another at the rigsite

- A single standard to make the vision possible, reducing industry costs
• Wellsite data to RigLink/WITSML Server
• Real time via subscription
• Batch via file transfer etc.
• WITSML API calls from 3rd Party systems
Global acquisition & access of RT drilling data

- Depth based project data db
- Timebased drilling data db (Coming soon)

Source: Statoil
Integration Value Hierarchy

- Integration & Automation
- Work Practices
- Data Practices
- Data Entry, Q.C., Retrieval Tools
- Data Model
- Applications
- Hardware

Impact Area for WITSML

- Work Flow Integration
  More time doing engineering tasks less on tasks that can be automated

- Data Management
  Easily find and use accurate data

- Foundation Technologies
  Standard Desktop and Engineering Tools

Based on ExxonMobil slide, June '04
Timeline: Participation, Seminars, Releases

Enhancements:
- Well Path
- Mudlog
- Wireline, etc.

V1.0, V1.1, V1.2, POSC custody

Austin, Stavanger, Aberdeen, Calgary, Paris, Houston, Stavanger

WITSML Project Participants
WITSML SIG Members
Oil Co's
Data Objects: Original, New, Updated, Draft

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Survey Program
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Trajectory & Trajectory Station (includes planned & calculated well path)
Tubular / Bit Record / Open Hole
Well
Wellbore
Wellbore Geometry
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Completion / Well Mechanical
Regulatory Permitting and Reporting
Production Activity and Volumes
Distributed Temperature Survey (->1.3.1)
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Bottom Hole Assembly Run
Cement Job
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Log ➔ Well Log (includes Wireline)
Message
Mud Log
Operations Report
Real Time
Rig / Rig Equipment
Server Capabilities
Sidewall Core
Process

POSC
Board of Directors

Management & Staff

Membership

SIG participants may be POSC Members or non-members
SIGs are standards user communities

POSC energy eStandards:
WITSML, PWLS, Epicentre, etc.

WITSML SIG

Participants

Integrated Ops SIG

Well Log SIG

Other SIGs
SIG Teams

Steering Committee

- Plan and review SIG activities;
- coordinate semi-annual meetings, seminars, exhibitions; discuss and agree on future plans

Technical Teams

- Recognize and agree on detailed requirements; correct and improve; first-line reviewers

Use Case & Requirements Team

- Identify and agree on areas of expansion; organize study and requirements sub-teams

Implementation Support Team

- Share experiences using WITSML-enabled products; facilitate user dialogue; recommend improvement
Document References

- **WITSML Standards**
  - Specifications (data, interfaces)
  - Sample data
  - Startup toolkit

- **WITSML Community**
  - Records of past events: presentations, notes, agendas
  - SIG Contact information
  - Test Server availability information
  - Mailing lists and Discussion Forums
  - Issue tracking; draft specifications for review

- **Web Sites**
  - [www.witsml.org](http://www.witsml.org) and [www.posc.org](http://www.posc.org)
Benefits

• Active and visible WITSML community
• Shared funding of WITSML custody, support, and promotional activities
• Active outreach to align WITSML with other initiatives
  – Within POSC, the expansion of WITSML architecture across all technical E&P data transfer standards: Integrated Operations (Production), Well Log (Wireline), Regulatory, Laboratory, Reference, etc.
  – Within the industry with other industry groups: UKOOA and US MMS (well path), PPDM (use of POSC exchange and reference standards), Government agencies (regulatory), XML and SOA (OASIS, W3C, OpenGIS, OpenGroup), etc.
• Vendor neutral promotion of WITSML use and maintenance of WITSML specifications and materials
Why has the WITSML initiative been successful?

The Right Initial Players - clear focus
BP & Statoil with Baker, Halliburton, Schlumberger, and NPSi

Strong Commitment
Initial funding by oil companies; Oil & service companies remain engaged after initial delivery

Effective Processes
Practical, incremental approach
Clear focus on target outcomes - through implementation
Frequent communications - steering & technical teams

Choice of Technologies
XML, SOAP

Comprehensive Output and Documentation
XML Schemas + Server API + sample implementation

Openness / Evolution
Public seminars and presentations
Transfer to POSC in early ’03 -- commercially neutral custody, publication, promotion and evolution

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Integrated Operations

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{Smart Field, Digital Oilfield of the Future, eField, iField…and Intelligent Oilfield Operations}
Does this sound familiar?

“Send this claim report to legal and have them print it out for accounting. Then have accounting re-enter it into the system and send it to the adjusters in the field. Have the field update the numbers. Then get it back to me so I can update the reinsurance company. And hurry.”
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Smart Systems

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- **IntOPS**
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Source: Saputelli SPE 83978
IntOPS SIG

- DTS
  - Produce and published initial specification in Q2 of ’05
  - Follow-up with pilot testing
- IIP (integrated Information Project) - Norway
  - Participate in Steering Committee and working groups
  - Collaborate on daily production reporting XML schema
- Production Data Transfer Standards Development
  - Exploit existing work to produce draft specifications
  - ProductionML draft - March 2005
  - Production Reporting draft & Pilot - Fall 2005
  - PRODML Project
Integrated operations

External experts
Service Company’s onshore operation centre
Control room offshore
Remote collaboration room

Real time data

Knowledge
Decisions
Actions
Data integration
Information
Visualisation

Stavanger
Bergen
Aberdeen
Trondheim
Scope of the Project (IIP)

- To integrate the following information in one standard
  - 4C / 4D seismic
  - Drilling and logging
  - Well production
  - Safety and automation system
  - Monitoring and operation of subsea system
  - Maintenance system data
  - Reservoir reliability data

- To investigate real time decision support systems that
  - Classify and retrieve information using Web Ontology Language (OWL)
  - Use rule based notification
  - Visualize subsurface and operational data
  - Automatically link production control and reservoir simulation tools (option)

Surface - Well - Subsurface Integration!
Simplified single well subsea field development

Surface control module

Surface equipment

Umbilical

Subsea control module

X-mas tree

Downhole equipment

Riser

Flowline

Measured Flow Rate Oil
Measured Flow Rate Gas
Measured Flow Rate Water

Measured Wellhead Pressure
Measured Wellhead Temperature

Measured Downhole Pressure
Measured Downhole Temperature

Production reporting
Scope

Control signals
Fluid flow
Petroleum Industry Data Dictionary (PIDD)

• What is the PIDD Dictionary?
  – The content of the PIDD Dictionary consists of intellectual contributions from several corporations, regulatory agencies and the United States Government. These organizations have donated staff, who compiled, edited and clarified the content.
  – The PIDD Dictionary content is used by industry standards organizations, corporations and government bodies.

• What is the Objective for the Dictionary?
  – Those who created the content of the Dictionary intend that the content be made available and accessible to the industry without restriction.

• Who Manages the Content? Who owns it?
  – The Dictionary Work Group of the PIDX Standards Subcommittee has responsibility for the content of the Dictionary. This Work Group is also responsible for Dictionary modifications and maintenance.
  – PIDX owns the content and is entitled to administer it.
  – The American Petroleum Institute (API) holds the copyright of the content.

• Web Sites:
  – http://www.pidx.org
  – http://w3.posc.org/pidd
PRODML: A Shared Solution for Upstream Oil and Gas Companies to Optimize Their Production

- PRODML is a dynamic project to help each producer independently optimize its oil and gas production. PRODuction XML, or PRODML, will develop commercial software products within 12 months to improve data exchange and work process efficiency in production optimization.

- This collection of companies, known as the PRODML Working Group include: BP, Chevron, ExxonMobil, Shell, Statoil, eProduction Solutions, Halliburton, Invensys, Kappa Engineering, Microsoft, OSIsoft, Petroleum Experts, Schlumberger, Sense Intellifield, TietoEnator, and POSC.

- PRODML will build on the earlier success of WITSML™, a similar XML-based standard for drilling information. WITSML™ (Wellsite Information Transfer Standard Markup Language) is now an open industry standard maintained by POSC (Petrotechnical Open Standards Consortium). PRODML will extend the WITSML™ effort to include data needed for field production optimization.

- Production optimization involves integrating real time data from specialty, multi-vendor software applications and streamlining work processes to enable oil and gas field operational efficiencies. PRODML will develop the necessary XML-based data exchange solutions as an open industry standard. After a working PRODML pilot is launched, POSC will maintain the standard and make it publicly available.
Questions?

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