Energistics & ISO 15926

PCA Member Meeting & Forum

20-21 October, 2009

Hotel Nikko

Kuala Lumpur, Malaysia

Randy Clark

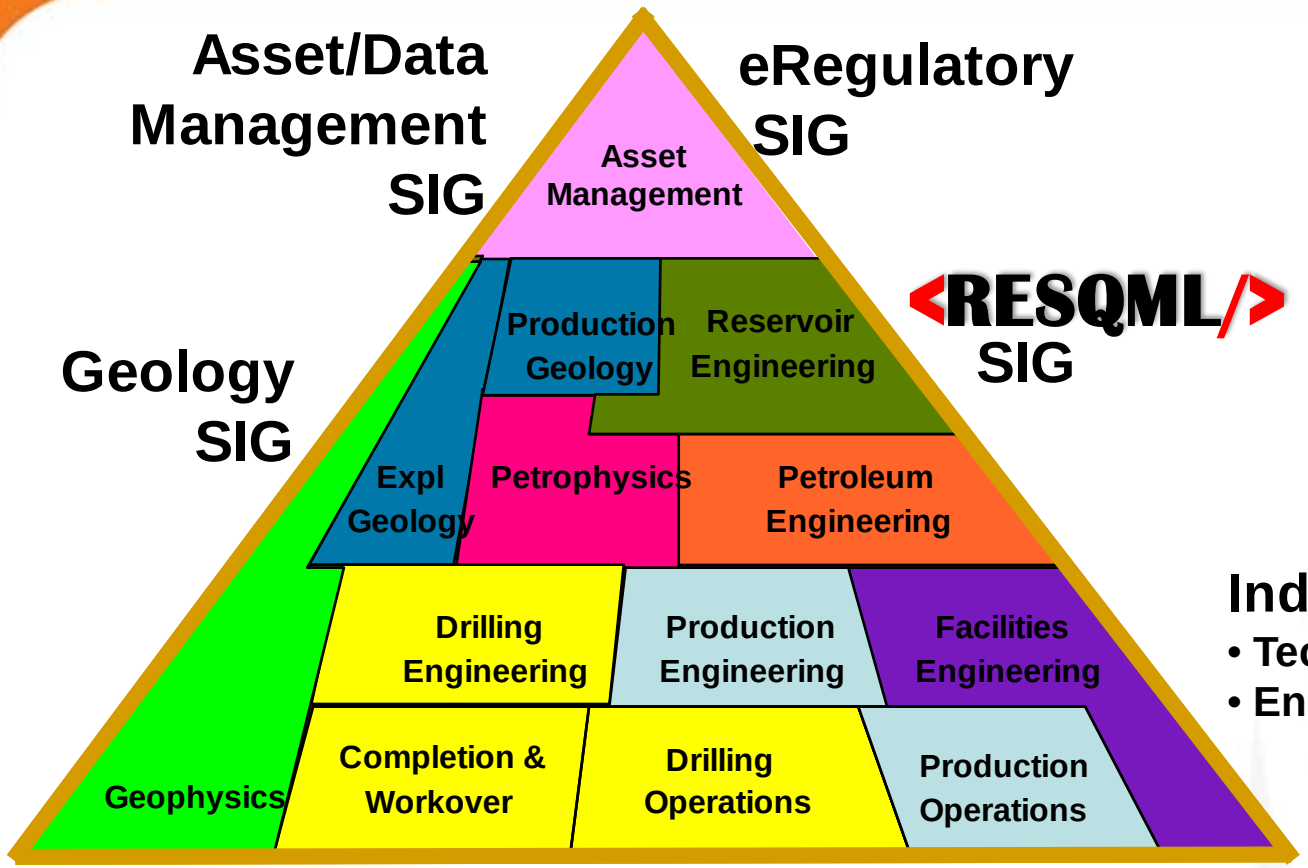
President & CEO

Energistics, Houston USA

Agenda

- **Introduction**
- **Overview of Energistics Standards**
  - WITSML Standards
  - PRODML Standards
  - RESQML Standards
- **Energistics & ISO 15926**
  - Vocabularies
  - Illustrations of Mapping

Energistics Subject Areas



Asset/Data Management SIG

eRegulatory SIG

<RESQML/> SIG

Geology SIG

Industry Services SIG
- Technical Architecture
- Energy Identity Trust

<energyML/>

Geophysics SIG

<WITSML/> SIG

<PRODML/> SIG

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WITSML™ Drilling Standards

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"

An Open Information Transfer Standard for the Oilfield

<WITSML/>

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WITSML Special Interest Group Members

- First published in 2001
- Version 1.4 now released
- 50+ Companies
- Hosted and Facilitated by Energistics
- Semi-annual Events

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Why WITSML?

Adoption of WITSML is driven by…

- Ease of data sharing
- Real-time capabilities (internal and marketplace)
- Increase in use of real-time collaboration and monitoring centers
- Portability of WITSML compliant products & services

And so…

- **WITSML is an enabler**
  - Especially in a multi-vendor environment
  - Improves operator's and service company's ability to distribute information to internal and external experts, services and tools without boundaries

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What is WITSML?

- WITSML is a drilling communications standard which defines the transfer of real time information between different systems in a consistent way leading to more effective data integration.
- WITSML facilitates real time decision making which should have a direct impact on drilling performance.
- WITSML is a collaborative effort.
- WITSML is open to all to implement

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WITSML Data Object Schemas (XML)

General
- Well
- Message
- Operations Report
- Real Time
- Wellbore
- Wellbore Geometry
- Risk

- Coordinate Ref Sys
- Drill Report
- Attachment

Surface Logging
- Mud Log

Surveying
- Survey Program
- Target
- Trajectory

Logging While Drilling
- Log → Well Log (includes Wireline)
- Formation Marker

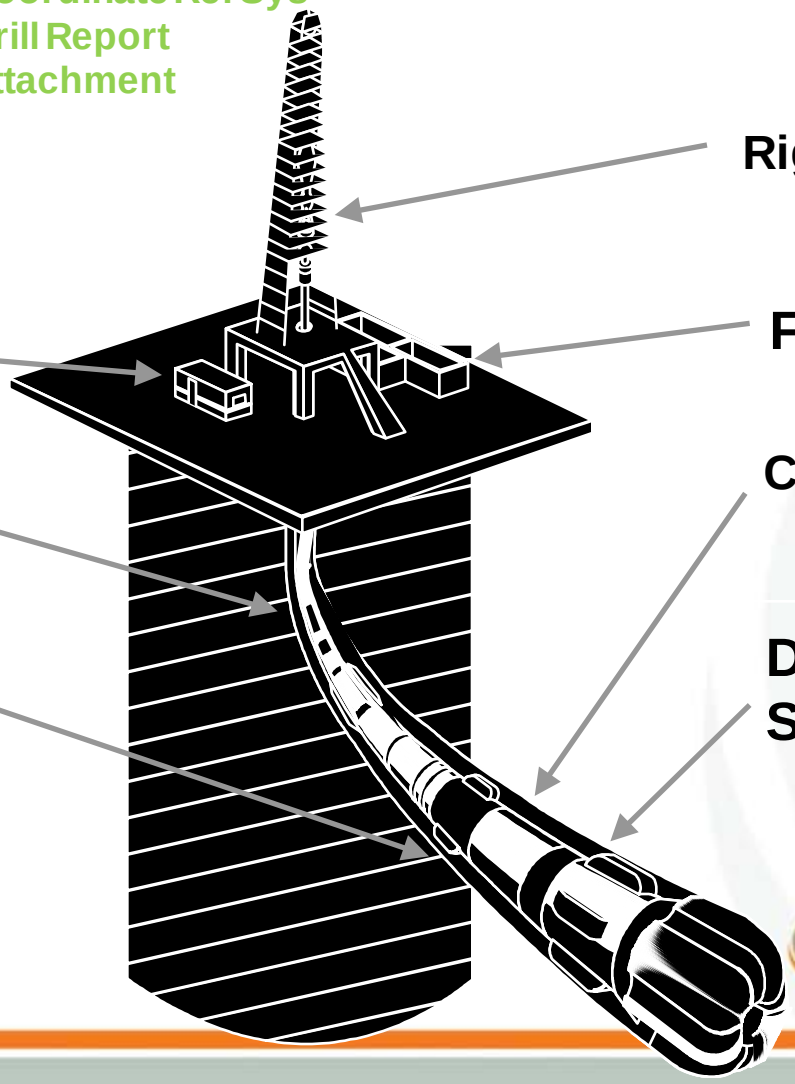
Communication
- Subscription
- Server Capabilities

Rig Instrumentation
- Rig / Rig Equipment
- Cement Job

Fluids Systems
- Fluids Report

Coring
- Sidewall Core
- Conventional Core

Directional Drilling Systems
- Tubular /
- Bit Record
- BHA Run



Original
Updated
Added

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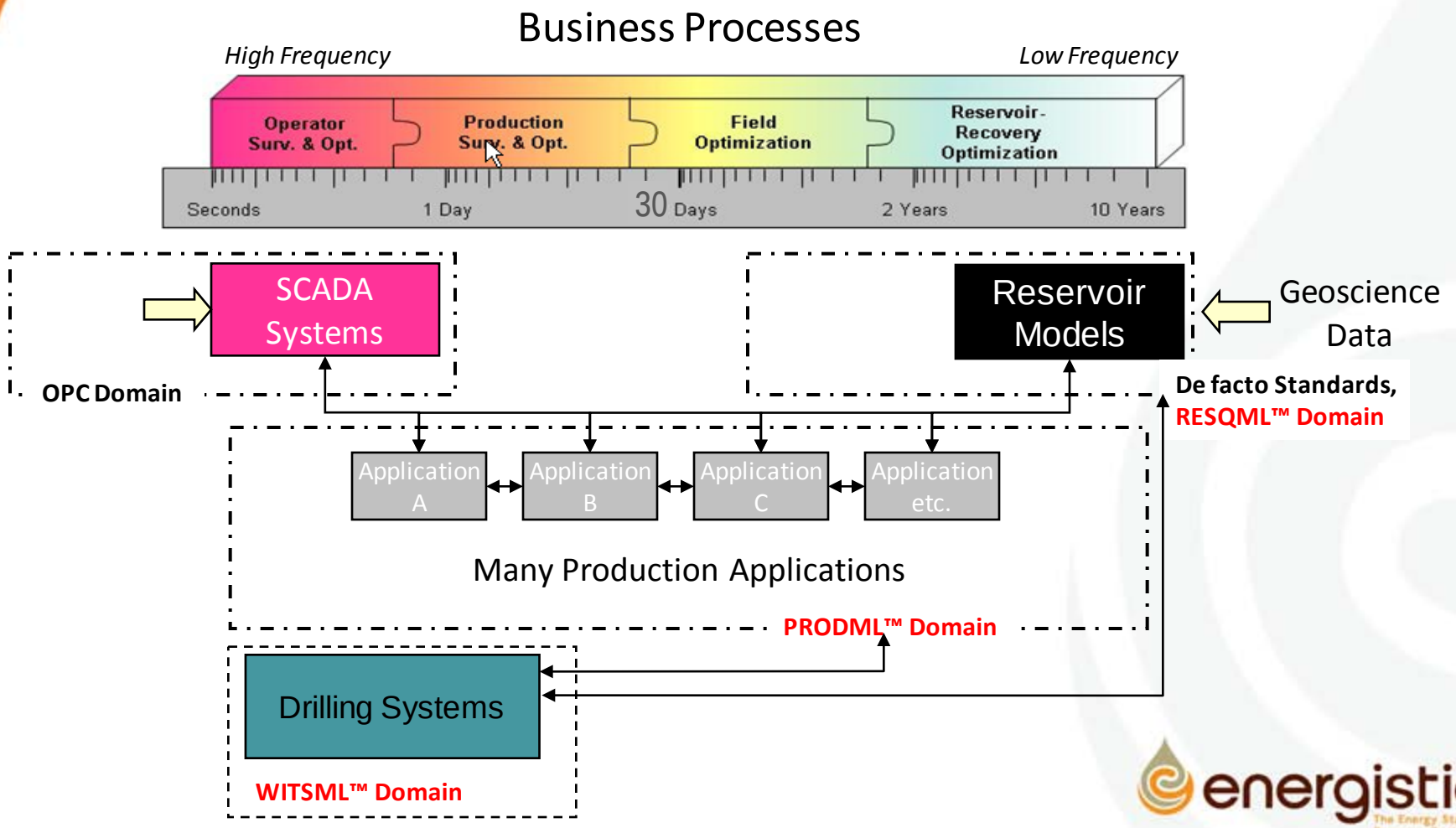
Source: BakerHughes/Paradigm

Position in the E&P Business Processes



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Product Certification Program

- Initially self certification
- Product certification programme now available
  - Server test suite #1
    - Trial run at November 2008 WITSML SIG Working meeting
    - Currently optional, to become required for new and renewed certification from end 2009
    - Testing run by / on behalf of Energistics
    - Focus on data in key objects
    - Standard query list, query tool and data set
  - Future
    - Expand object coverage
    - Dialects
    - WITSML client tools

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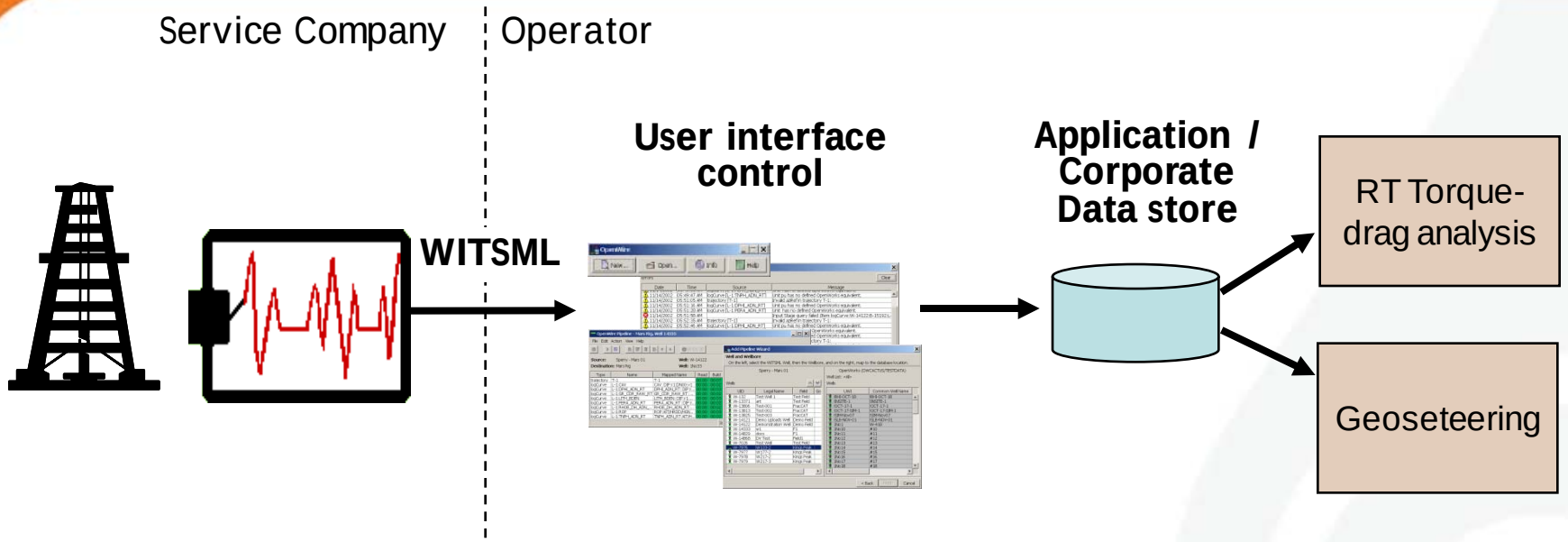
Service Contractor to Operator



- Enhanced situational awareness
- Real-time engineering analyses in certified corporate tools
- Linear and most commonly uni-directional

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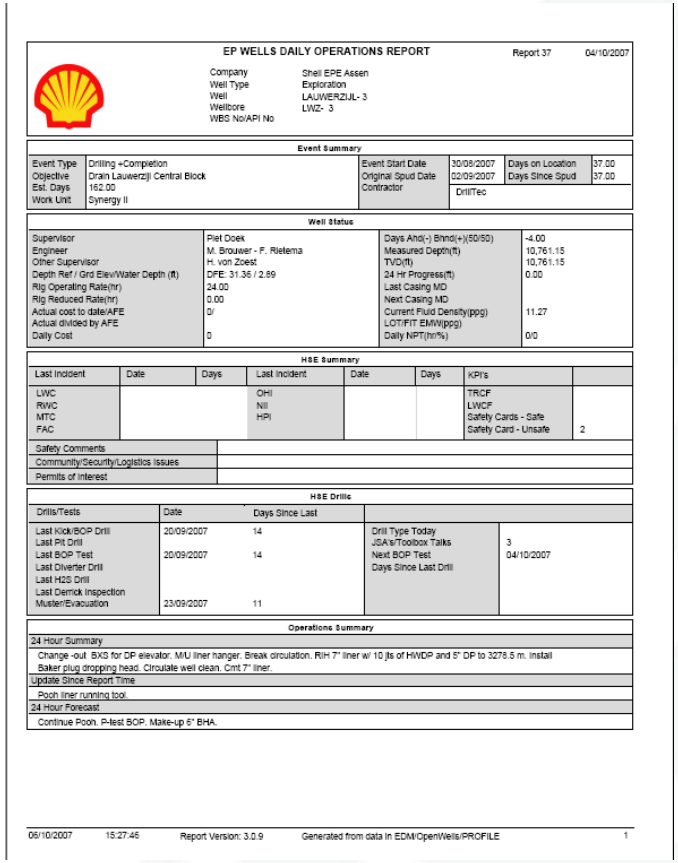
Inter-Operator and Operator to Government

- Partner reporting
- Government reporting
  - E.g. Norwegian NPD
- Increased automation
- Query-able data vs. pdf



EP WELLS DAILY OPERATIONS REPORT Report 37 04/10/2007

Company	Shell EPE Assen
Well Type	Exploration
Well	LAUWERZIJL- 3
Wellbore	LWZ- 3
WBS No/API No	

Event Summary

Event Type	Drilling +Completion	Event Start Date	30/08/2007	Days on Location	37.00
Objective	Drain Lauwerzijl Central Block	Original Spud Date	02/09/2007	Days Since Spud	37.00
Est. Days	162.00	Contractor	DrillTec		
Work Unit	Synergy II				

Well Status

Supervisor	Piet Doek	Days Ahd(-) Bhnd(+)(SD/SO)	-4.00
Engineer	M. Brouwer - F. Rietema	Measured Depth(ft)	10,761.15
Other Supervisor	H. von Zoest	TVD(ft)	10,761.15
Depth Ref / Grd Elev/Water Depth (ft)	DFE: 31.35 / 2.89	24 Hr Progress(ft)	0.00
Rig Operating Rate(hr)	24.00	Last Casing MD	
Rig Reduced Rate(hr)	0.00	Next Casing MD	
Actual cost to date/AFE	0/	Current Fluid Density(ppg)	11.27
Actual divided by AFE		LOT/FIT EMW(ppg)	
Daily Cost	0	Daily NPT(hr/%)	0/0

HSE Summary

Last Incident	Date	Days	Last Incident	Date	Days	KPI's	
LWC			OHI			TRCF	
RWC			NII			LWCF	
MTC			HPI			Safety Cards - Safe	
FAC						Safety Card - Unsafe	2

Safety Comments	
Community/Security/Logistics Issues	
Permits of Interest	

HSE Drills

Drills/Tests	Date	Days Since Last		
Last Kick/BOP Drill	20/09/2007	14	Drill Type Today	
Last Pit Drill			JSA's/Toolbox Talks	3
Last BOP Test	20/09/2007	14	Next BOP Test	04/10/2007
Last Diverter Drill			Days Since Last Drill	
Last H2S Drill				
Last Derrick Inspection				
Muster/Evacuation	23/09/2007	11		

Operations Summary

24 Hour Summary

Change -out BXS for DP elevator. M/U liner hanger. Break circulation. RIH 7" liner w/ 10 jts of HWDP and 5" DP to 3278.5 m. Install Baker plug dropping head. Circulate well clean. Cmt 7" liner.

Update Since Report Time

Pooh liner running tool.

24 Hour Forecast

Continue Pooh. P-test BOP. Make-up 6" BHA.

06/10/2007 15:27:46 Report Version: 3.0.9 Generated from data in EDM/OpenWells/PROFILE 1

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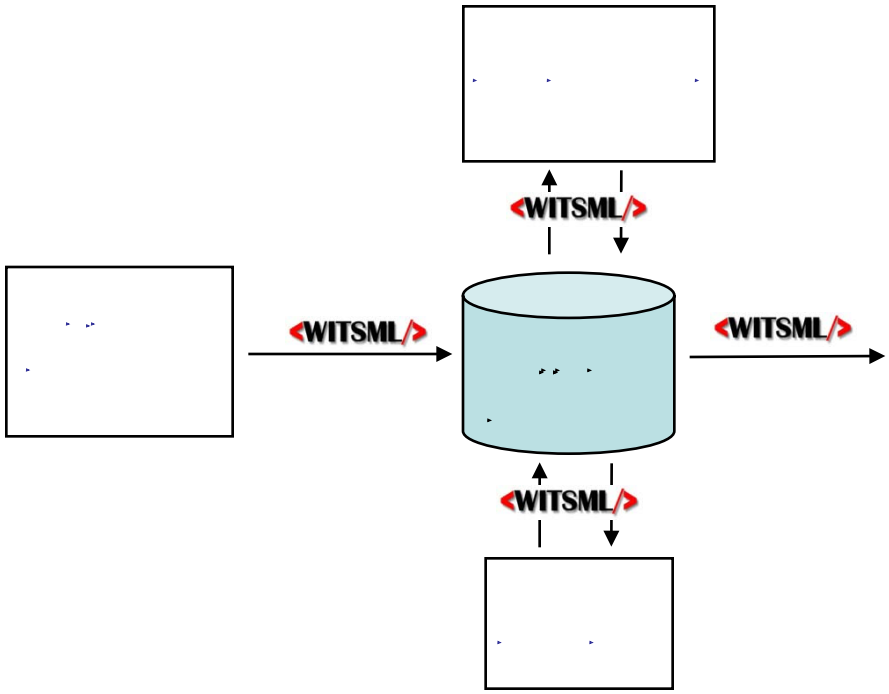
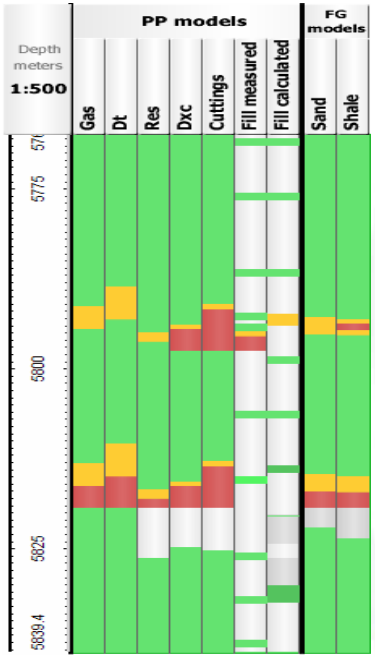
More Complex Workflows

- Opportunity for Operator to apply Intellectual Property and gain competitive advantage
- Opportunity for Service Companies and Software Vendors to compete for delivering components even if not incumbent provider





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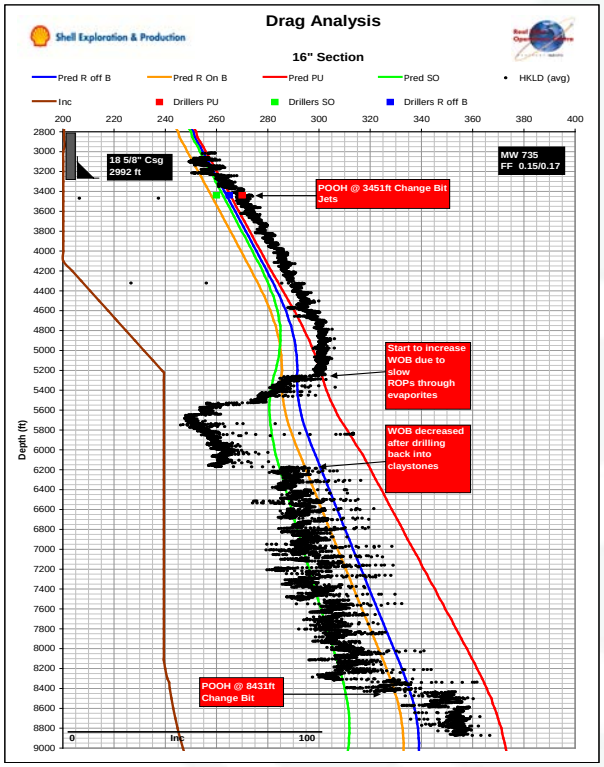
Summary and Recommendations

- WITSML is delivering value today
- Use WITSML to get the right data to the right person at the right time for:
  - Real-time validation and optimization to improve drilling performance
  - Enhanced situational awareness in support of better and faster decisions



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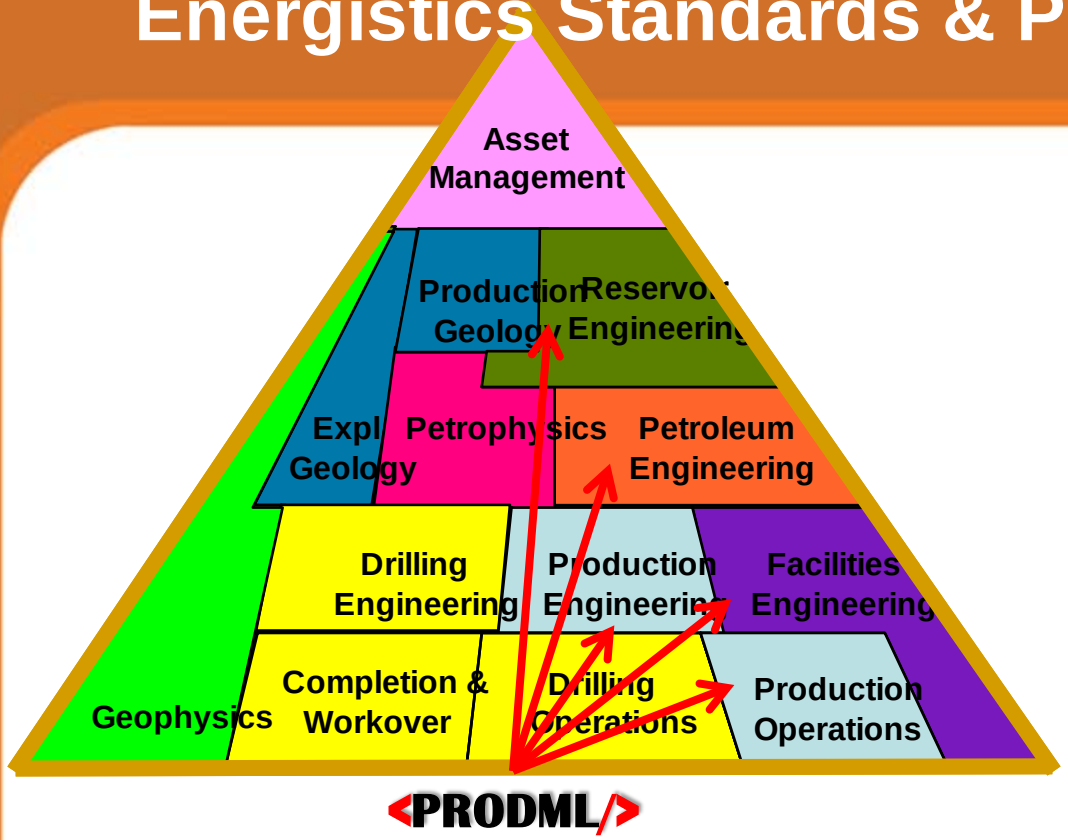
PRODML™ Production Standards

Energistics Standards & PRODML



Energistics schemas standardize information exchange

Energistics standards are key components in today's IT Enterprise Architectures

Energistics standards reduce the lifetime cost of information exchange in the Energy industry.

PRODML enables standardized reporting

PRODML enables easier, cheaper application integration

PRODML enables the vision of Digital Oil Fields now

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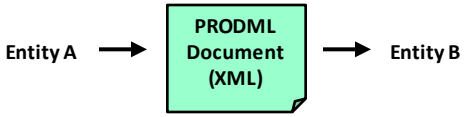
An Overview of PRODML (PRODuction xML)

- **Is a data exchange mechanism: facilitates integration between software tools to turn raw production data into valuable information.**
- **Aim is near-real time optimization: achieved by making changes in existing producing configuration, within 1 day.**
- **Enables Digital Oil Field: beyond single surveillance and optimization "loops" by providing single source of authoritative info.**

Classifications of PRODML Capabilities

Data Transfer

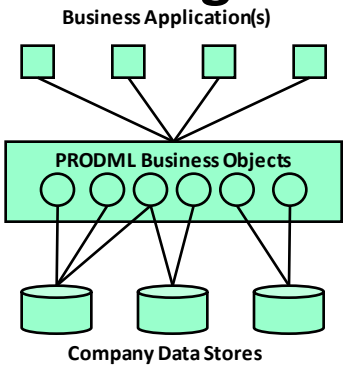


PRODML **schemas** as exchange format between entities.

Established Uses :
Production Reporting:
- Op Co. to Regulator
- Op Co. to Op Co.

Activities
- NOJV reporting
- Well Services to Op Co. Excel-to-PRODML.

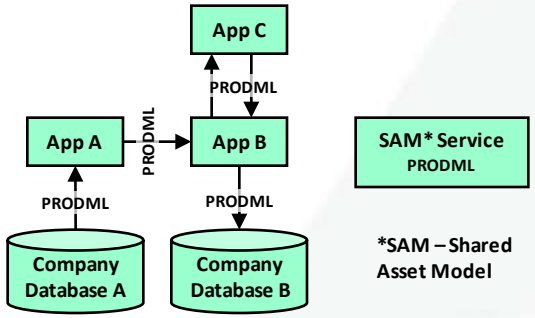
Data Integration



PRODML **schemas /web services** to map data for apps & data stores, simpler workflows
Established Uses:
- Production Reporting, DTS

Activities:
- Transient Testing

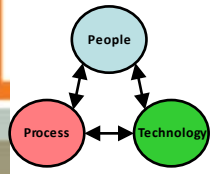
Work Flow Automation



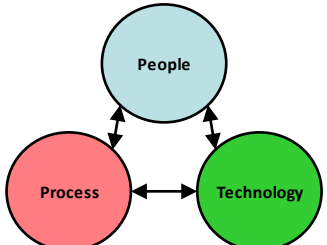
PRODML **schemas /web services/asset model** to automate business processes.
Proof of Concept:
- DTS

Activities:
- Publication first release

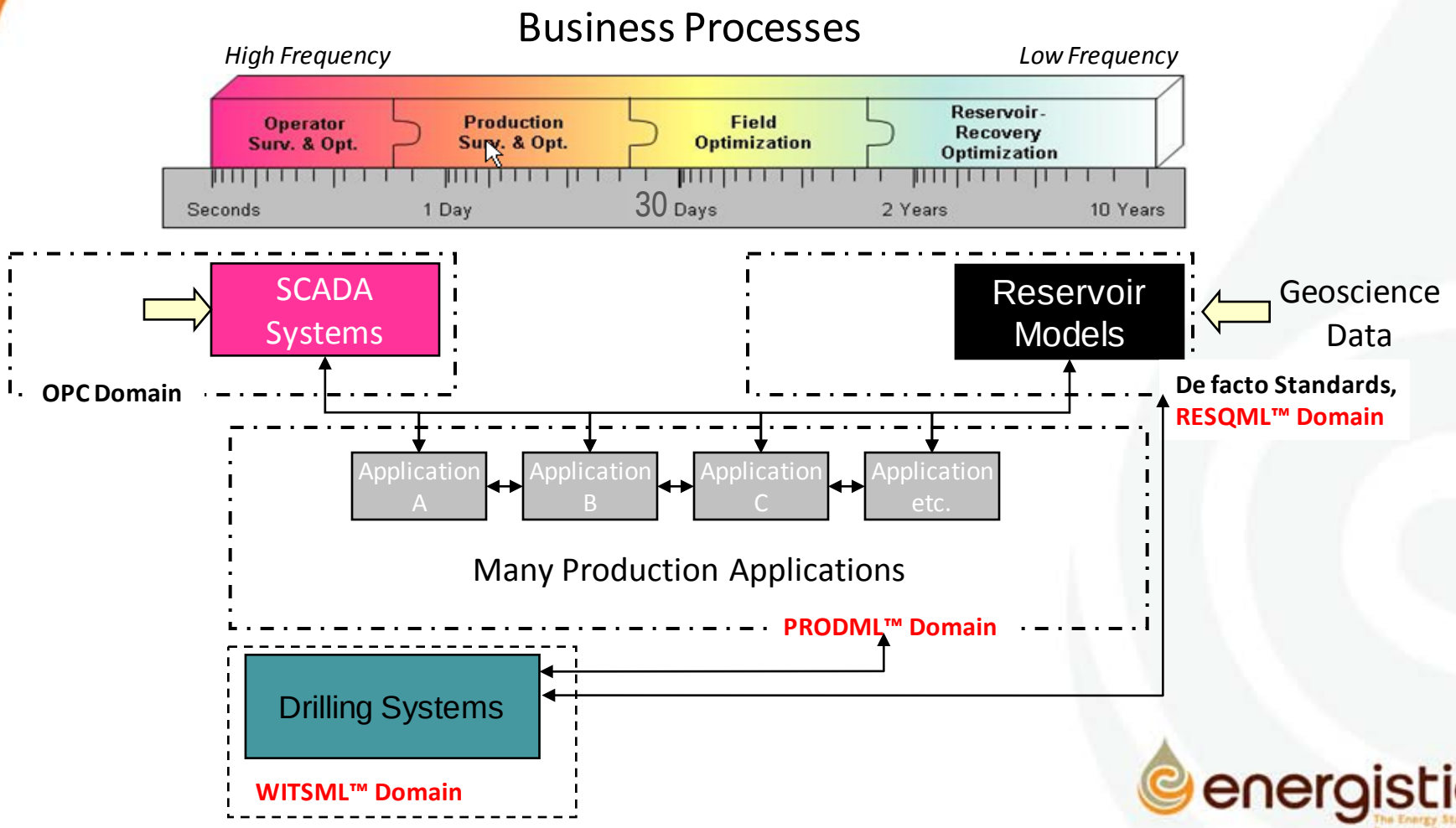
Base Business — **Business Transformation / Smart Fields**



Increasing potential business value
Increasing complexity (People-Process-Technology)



Position in the E&P Business Processes



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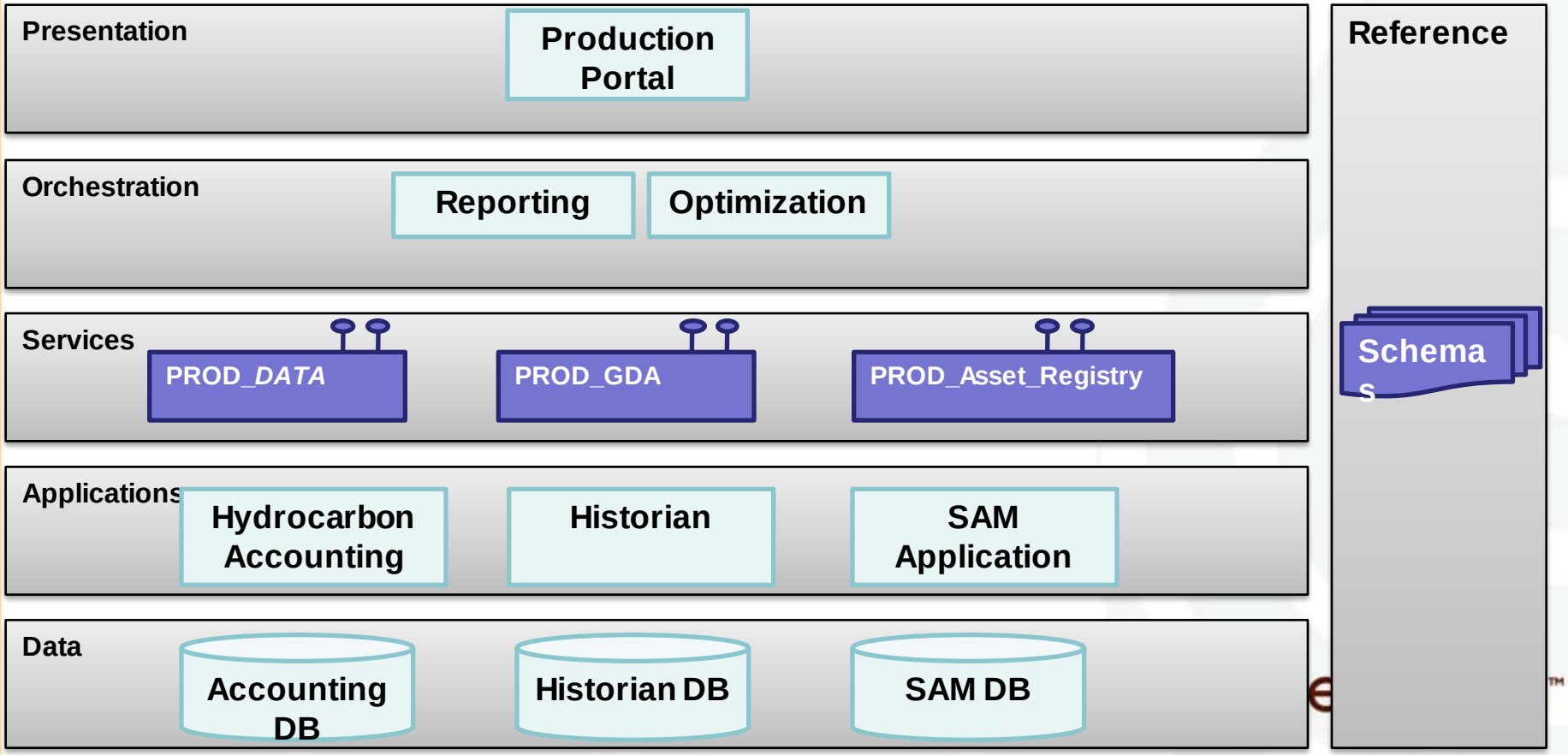
PRODML Standard – Description & *Solution Kinds*

1. **XML Schemas for common data objects**
   - Can be used to define XML files, transferred by any method (***Data Transfer***)
2. **Web Services bound to specific schemas**
   - Enable application- to -application or –data store integration (***Data Integration***)
3. **Generic Data Access & Shared Asset Model**
   - GDA Supports any data object
   - SAM is common repository of asset info
   - ***Workflow Automation***
   - **Note:** started after major review concluded Solution 2 did not meet all needs of the Digital Oil Field

Enterprise Architecture Positioning

Example Applications



Current Areas of PRODML Standards Use

- **Production reporting is widely used today:**
  - Used by multiple major operators in over 30 fields in North Sea, USA and Africa
  - Using both Data Transfer & Data Integration solution models
- **Live deployments and commercial products providing limited workflow automation have been made or are under development by multiple operators and vendors**
  - Well test validation
  - Wireline formation testing
  - WAG fluids management
- **Future: Digital Oil Fields**
  - Multiple operators are at the pilot stages of Workflow Automation solution models, for applications such as well test validation.

How would my Company get started?

- PRODML is NOT an “All or Nothing” decision
- A company can start using the schemas and can extend them for testing purposes – requesting changes to the standards when needs are clear
- Well test is a popular starting point as a common process which is simple in PRODML
- The recent GDA adds: ease of use, standard query mechanisms, identification and options, and plug-and-play with (PRODML compliant) third party systems

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Examples:

1. Data Transfer: Reporting with XML files (Statoil, BP, TietoEnator)
2. Data Integration: Web Services/XML (Statoil, AspenTech, Petex, Schlumberger, TietoEnator)
3. Workflow Automation: using SAM & GDA (Shell, Infosys, OSI, Weatherford, PDS)

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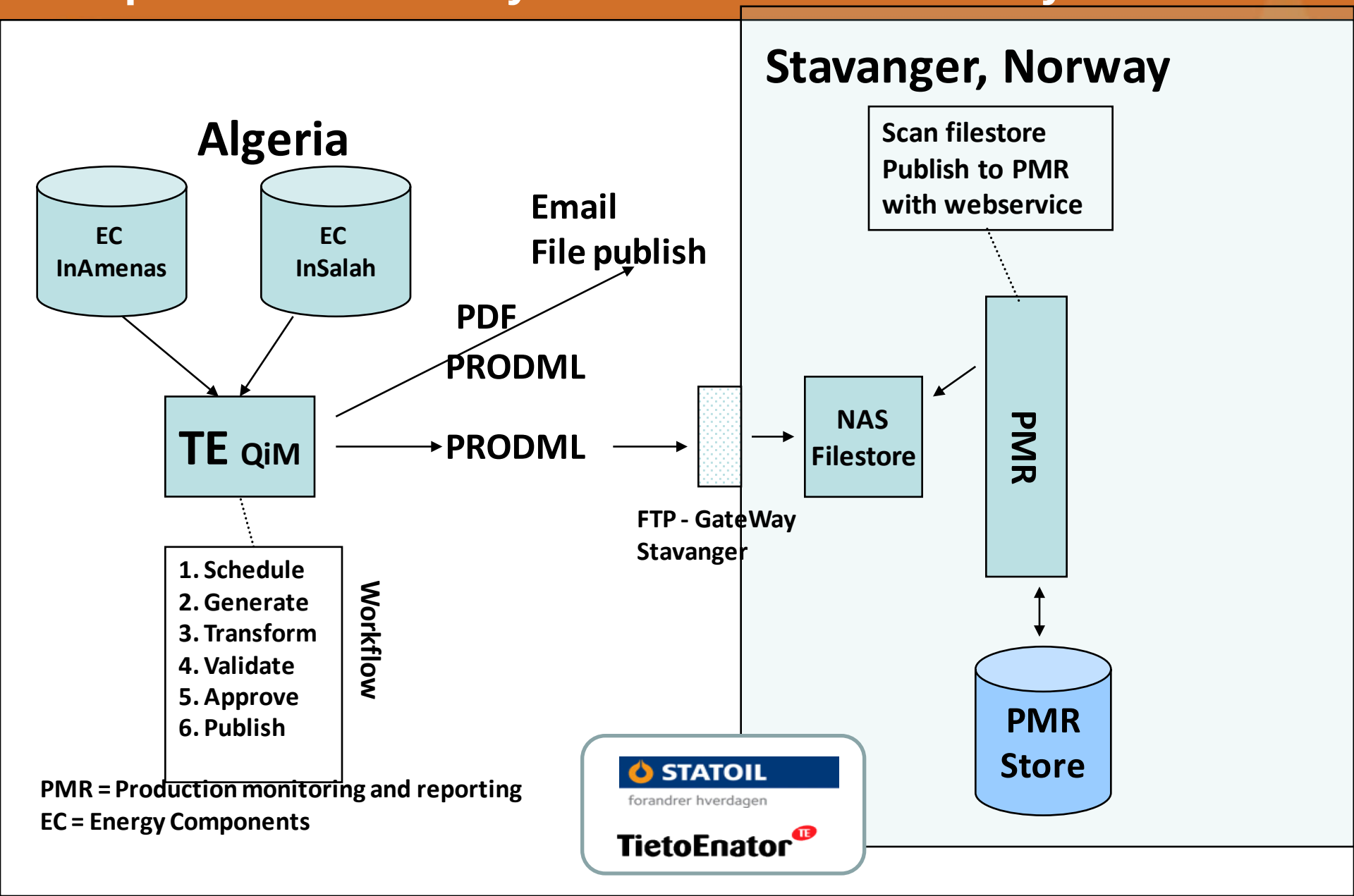
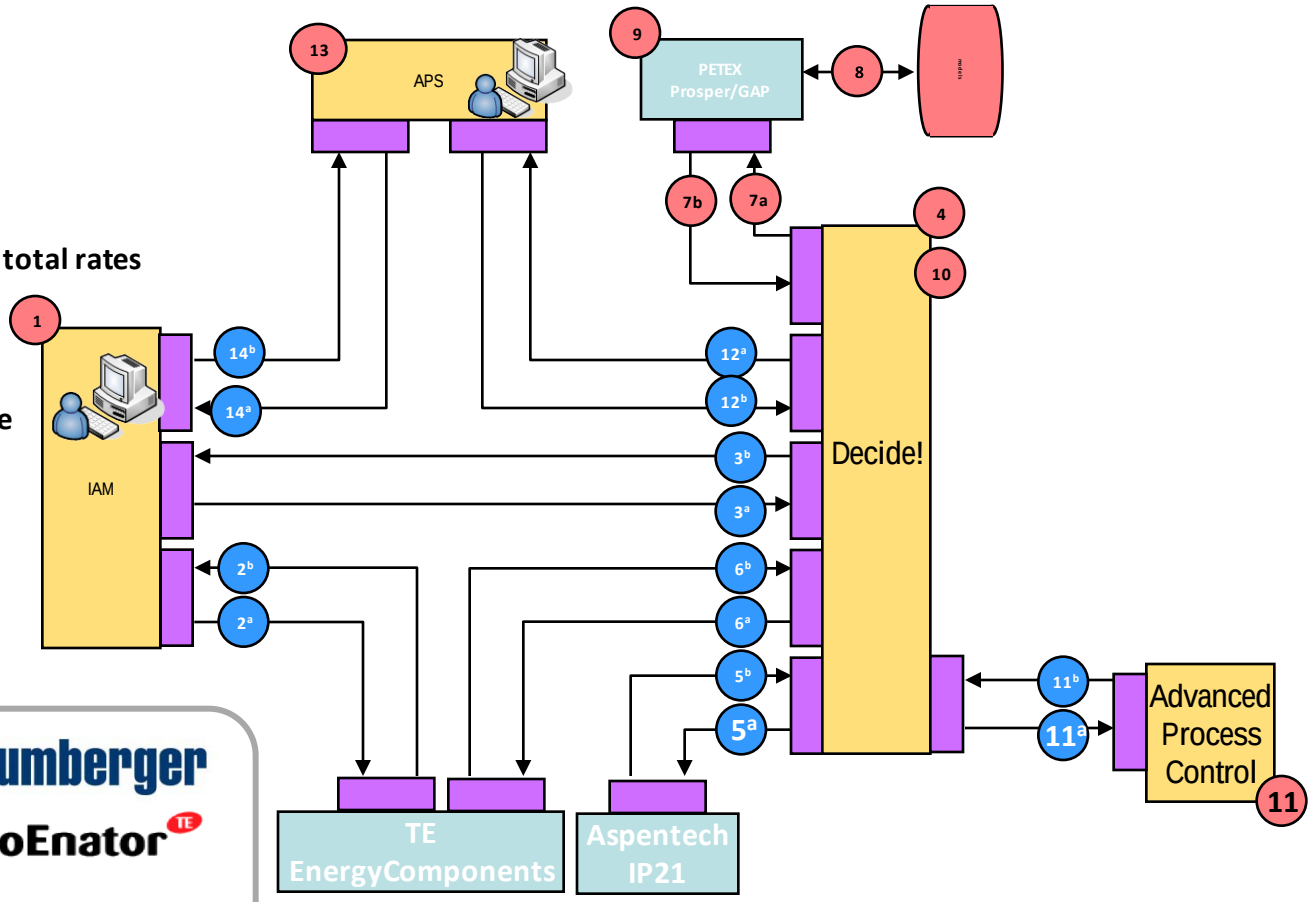
Statoil 2007: report to Sonatrach and get data to partners over very low network availability



Statoil 2007: Run smart wells at optimum level by determining zonal P_{res} & compare with models

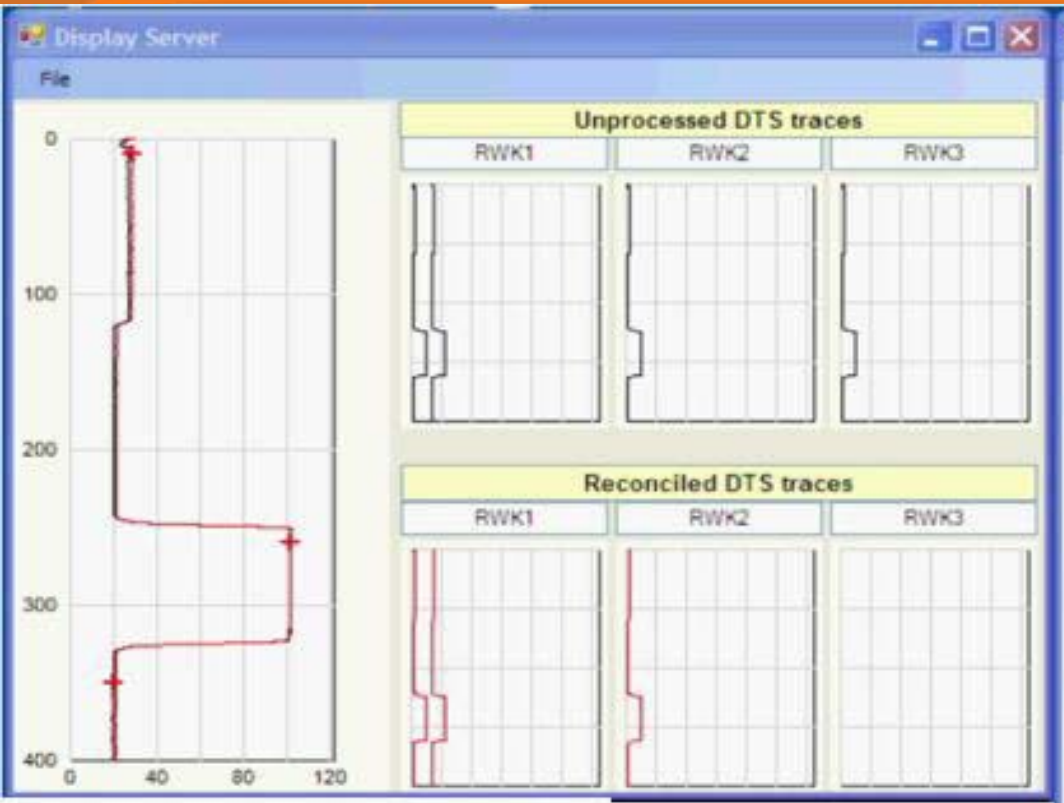
1. Set up IAM model
2. Historical P&I data are collected
3. Set P&I Targets
4. Trigger time base every X minutes
5. Poll Data Historian
6. Poll well information
7. Pressure per zone, calculate zonal & total rates
8. Determine well type
9. Simulate well performance
10. Calculate reservoir pressure per zone
11. Calculates choke positions
12. Alarm if targets or constraints are not met
13. Do the cause analysis
14. Trigger an update of the IAM model

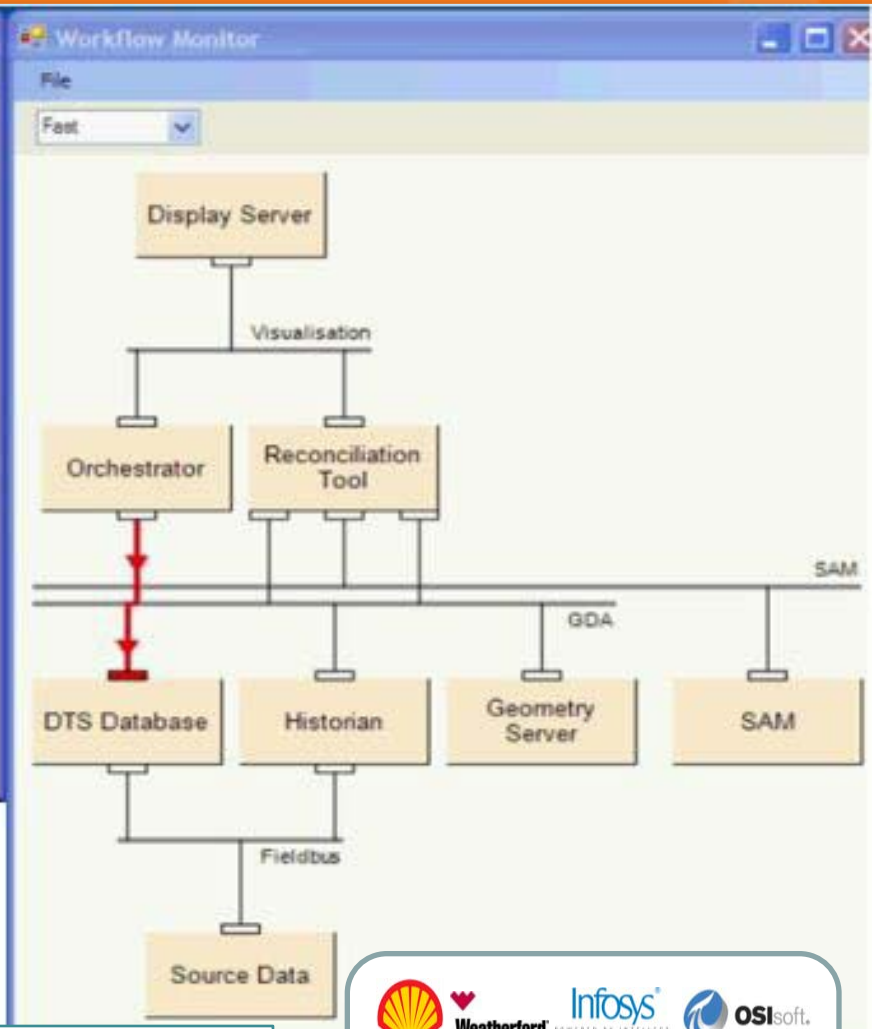


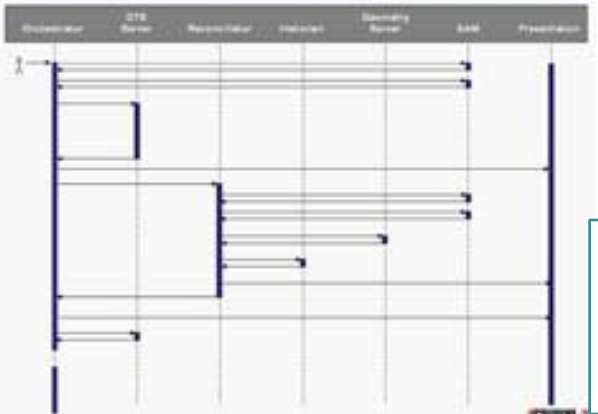
STATOIL
forandrer hverdagen
Schlumberger
aspentech
TietoEnator
Petroleum Experts

Shell 2009: V2.0 Services, Proof of Concept

Distributed Temperature Reconciliation







Workflow automation (above)
Orchestration (right)
Sequence diagram (left)

Weatherford · Infosys · OSIsoft · Microsoft · energistics · pds etrotechnical

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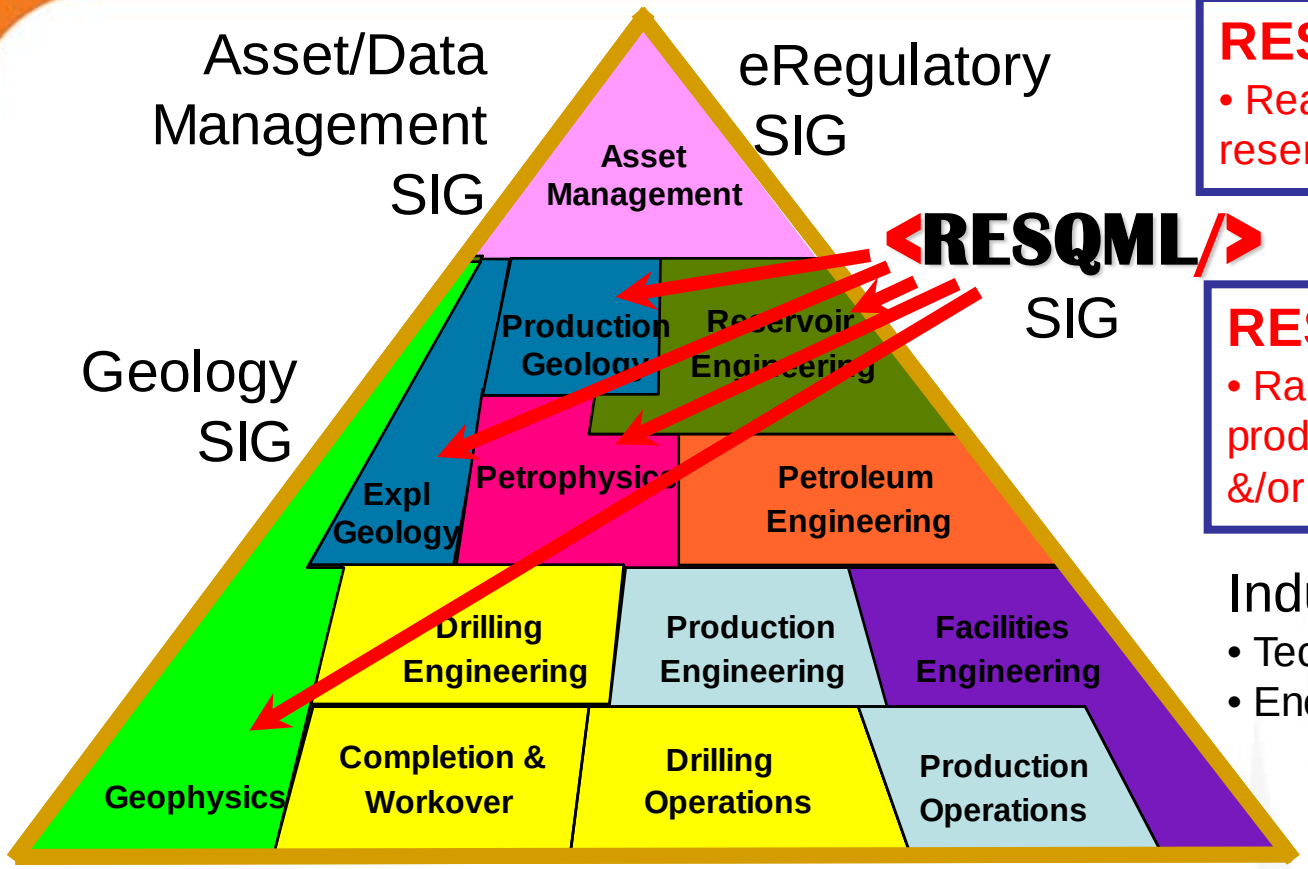
RESQML™ Reservoir Standards

Including geological and geophysical model exchange

Energistics Subject Areas
RESQML™ SIG initiated 1 Jan 2009



RESQML + WITSML
- Real-time updates of 3D reservoir models while drilling

RESQML + PRODML
- Rapid integration of production history to validate &/or calibrate models

Industry Services SIG
- Technical Architecture
- Energy Identity Trust

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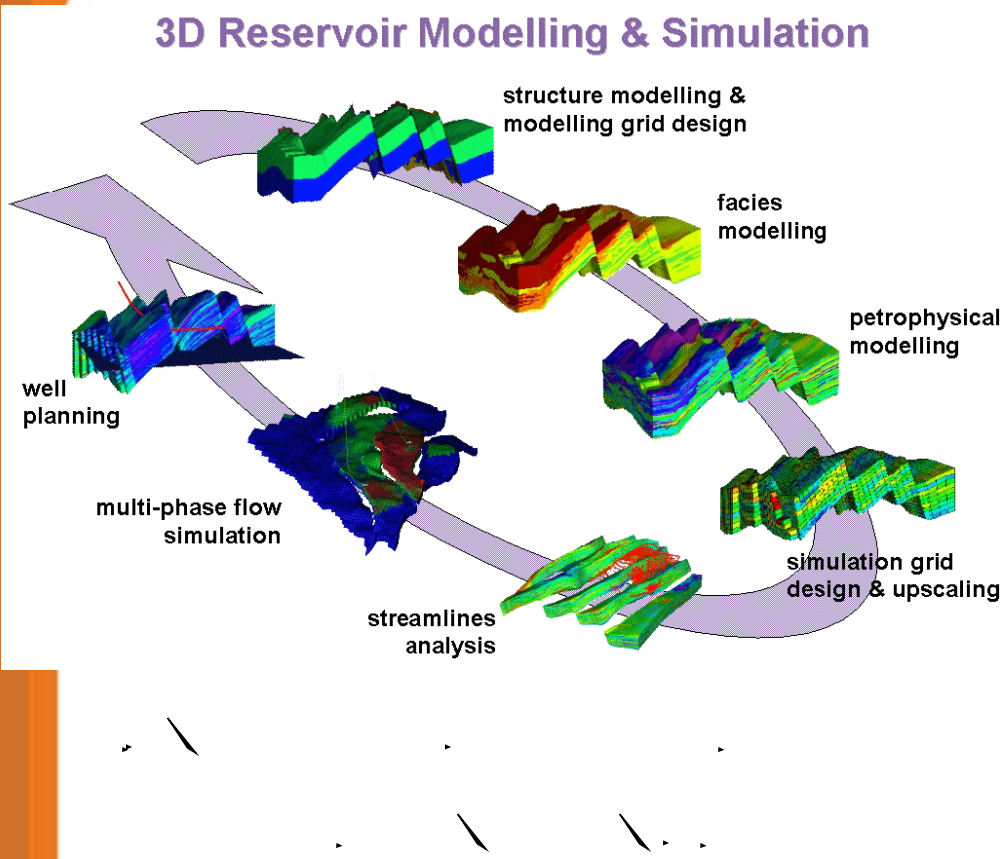
Why Build A 3D Reservoir Model?



- 3D Detailed Geologic Static Model
  - Understanding the resource in place
  - Understanding the play type
  - Well targeting
- Upscaled Flow Simulation Model
  - Performance prediction in the absence of dynamic data
  - Starting point for a history match when dynamic data is available
  - Prediction of reserves per well
  - Prediction of new processes in an existing field

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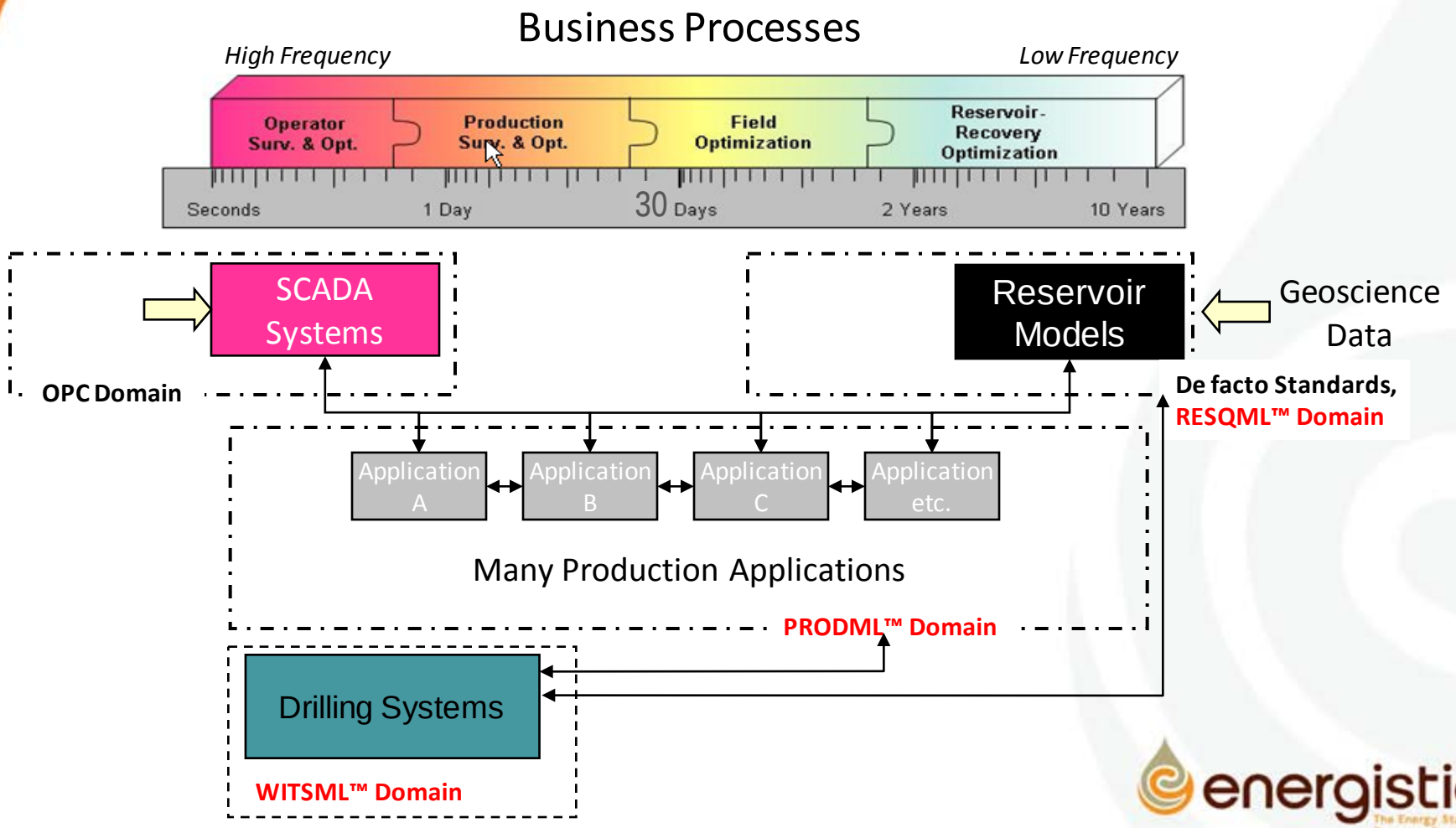
Position in the E&P Business Processes



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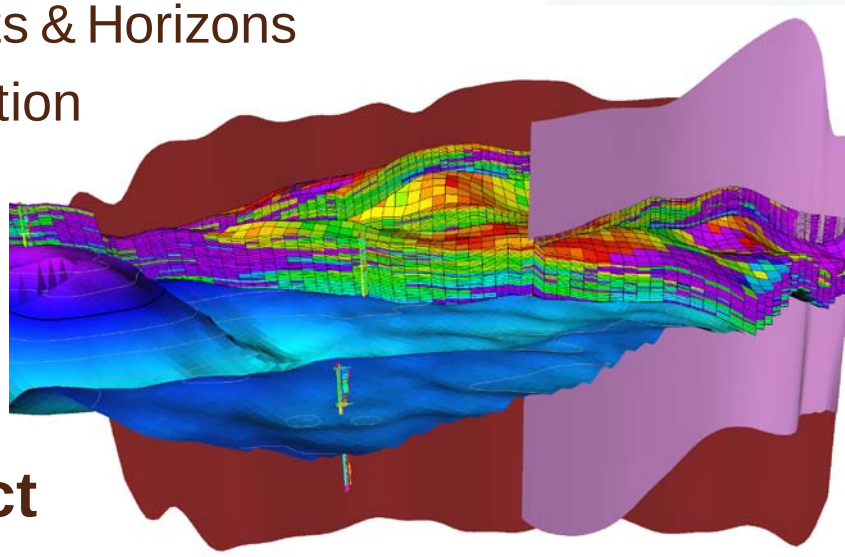
RESCUE Consortium – 1 / 3

- **Initiated in 1995, RESCUE is a Joint Industry Project managed by Energistics (formerly POSC). The acronym 'RESCUE' stands for *REServoir Characterization Using Epicentre***
  - http://www.posc.org/rescue
- **The purpose was to provide a forum for the development of an open standard for the transfer of data from "geomodels to upscalers", specifically through the use of the POSC Epicenter data model**

RESCUE Consortium – 2 / 3

- **Delivery of the standard replaced Epicenter with a collection of binary flat files to describe:**
  - Structural Framework: Faults & Horizons
  - 3D Grids: Static and Simulation
  - Wells: Especially Log Data
- **To ensure a common implementation a set of Class Libraries were developed under contract to the RESCUE project, and are the vehicle of choice for implementing an API to the RESCUE standard.**



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RESCUE Consortium – 3 / 3

- **RESCUE Organization**
  - Mike Castleberg, Program Manager
  - Rod Hanks, Class Libraries
  - Oil Company Chair
- **Oil Company Sponsors**
  - Shell, BP, Total, StatoilHydro
- **Vendors**
  - 20+ Current Members delivering commercial applications with RESCUE readers &/or writers
- **ILAB's "Interactive Laboratories"**
  - Multi-vendor testing and development
  - Oil company guidance
  - Genuine collaboration

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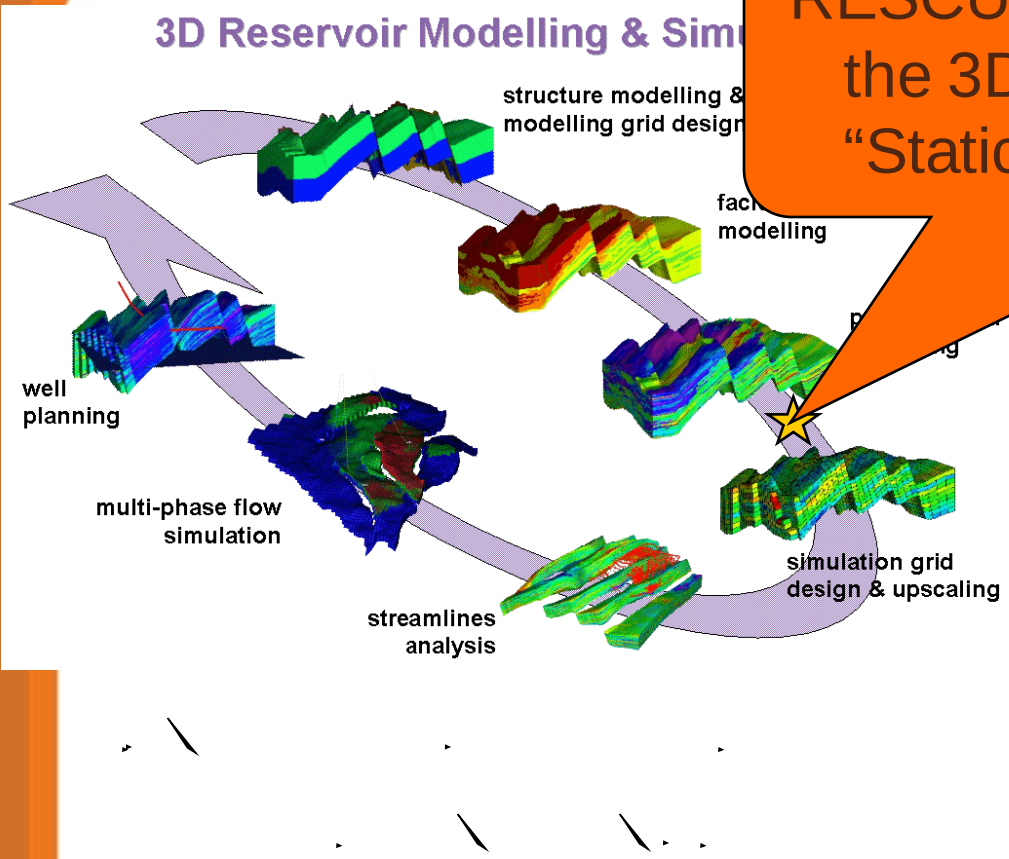
RESCUE in the Workflow
Initial Scope: Static to Dynamic



RESCUE provides for the transfer of the 3D Reservoir Model from the "Static" to the "Dynamic" Domain

- **RESCUE**
  - **3D Grid is the primary data**
  - **Faults / Horizons / Wells associated with the grid**
- **Provides a link from Geologic to Simulation Vendors**
- **Workflow has been extended to support better multi-vendor reservoir characterization**

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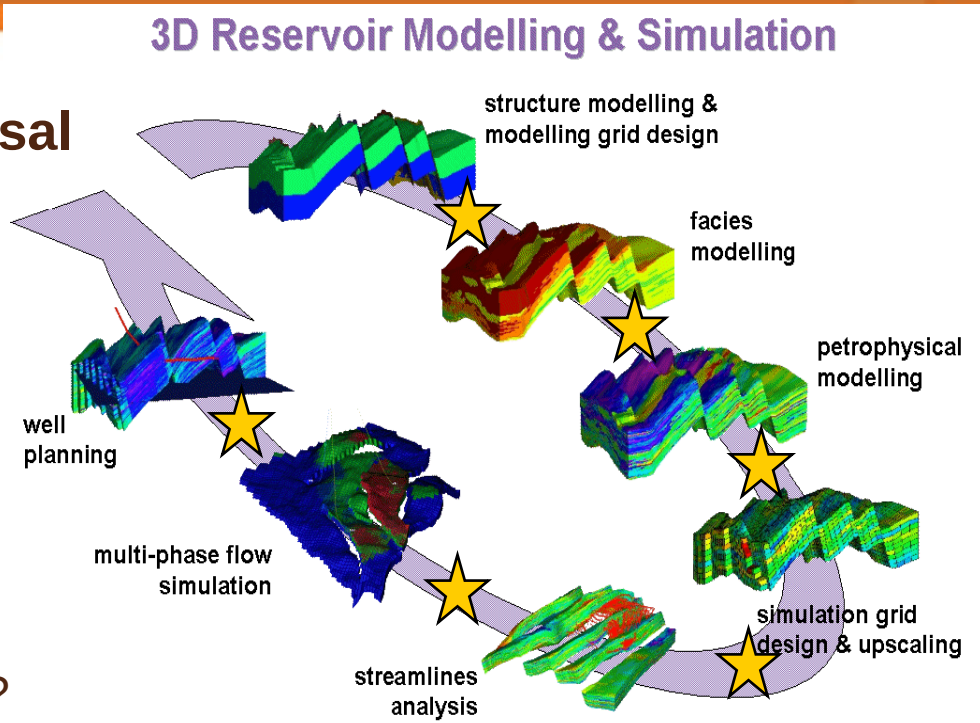
RESCUE in Use

- **Deepwater GOM Appraisal**
  - Large Structure
  - Partially Subsalt
  - Structurally Complex
  - Potentially Complex Channel Architecture
  - Faults & Fault Seal?
  - Connected Volumes?
  - Reserves per Well?
  - Performance Prediction?



- **RESCUE used to combine multiple analyses since no one application could provide adequate technical assessment**
  - Partial updates can be managed in RESCUE now, but it takes user skill and specific application experience

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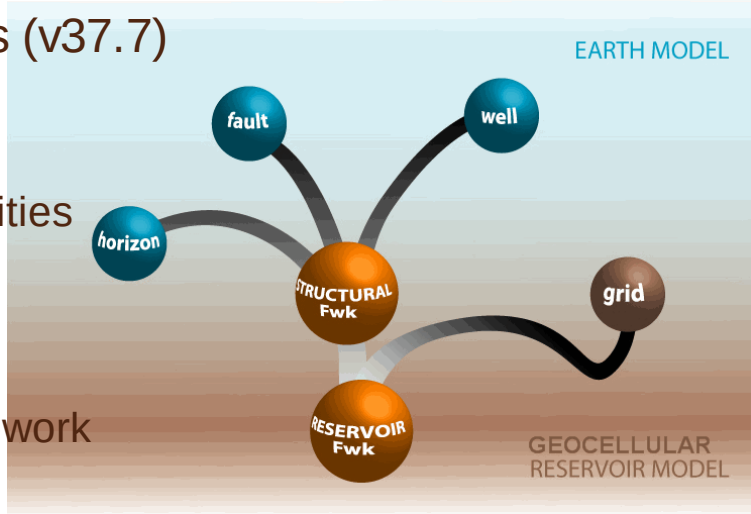
RESQML™ Team Structure

- **Steering Committee**
  - Scope, Direction, Marketing
- **Use Case Team**
  - Workflows, Processes, and Requirements
- **RESCUE**
  - Maintenance of the existing libraries (v37.7)
- **Technical Teams**
  - Infrastructure
    - Binary, ASCII to Binary, Shared Utilities
  - Wells
    - WITSML with RESQML extensions
  - Structural "Earth Model"
    - Faults, Horizons & Structural Framework
  - GRID "Reservoir Model"
    - 3D Grids, Properties & Cell Connections
    - Discretized: Faults, Horizons & Well Perforations



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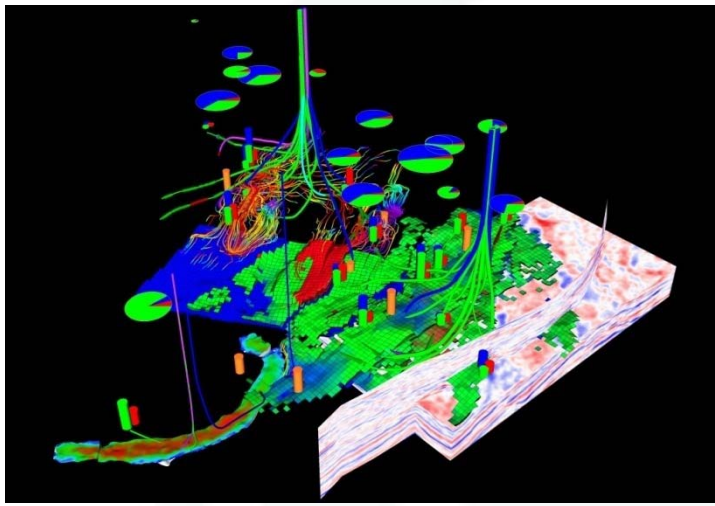
RESQML™ Requirements

- Support for partial model transfer and updates
- Enhanced integration with 3D/4D Seismic data
- Commercial / Life of Field data integrity
- Managing Risk & Uncertainty
- Geomechanical Support
- Giga-Cell Models
- Unstructured Grids



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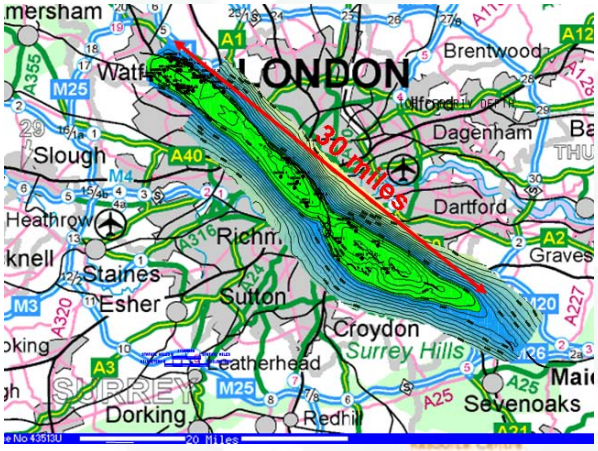
RESQML™ Roadmap

- **RESCUE v37 remains the standard in production use until RESQML™ enabled applications render it obsolete**
- **2009: Version 0.0**
  - As of today, we are four months into the new Energistics SIG and are making good progress towards an XML-based standard based on relatively simple models
- **2009: Version 1.0**
  - By year end, first standard published for vendor comment & prototype implementation
- **2010: Version 1.N**
  - Revisions of 1.0 plus new features
- **2010/11: Version 2.0**
  - First release in commercial vendor tools

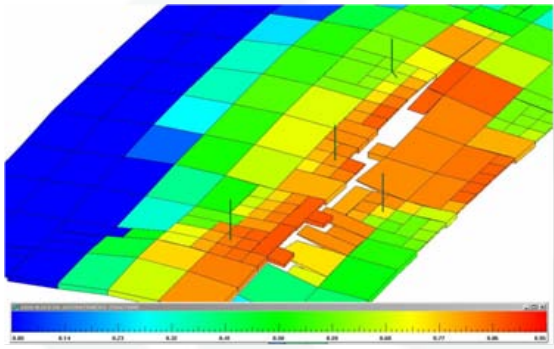


RESQML™ Roadmap - Structural

- **Version 1.0**
  - Faults and Horizons transferred as individual objects
- **Version 2.0**
  - Faults and Horizons in a Structural Framework
  - Rich set of representations, e.g., tri-surfaces, 2d grids, scattered data, etc.
  - Discretized faults, horizon & structure on the GRID
- **Version 3.0**
  - Multiple realizations
  - Enhanced metadata
  - Rule based (?)

RESQML™ Roadmap - GRID

- **Version 1.0**
  - Single / Multiple Corner Point Grids
  - Numerical Local Grid Refinement
  - Straight / Piecewise Linear / Spline Coordinate Lines
  - Multiple layering schemes
  - Static and Dynamic cell properties, with packing
  - Non-Standard Adjacency (Pinch-out & Faults)
- **Version 2.0**
  - Geometric Local Grid Refinement & Coarsening
  - Seismic Volumes / Tartan Simulation Grids
  - Node based properties (geomechanics & seismic)
- **Version 3.0**
  - Radial Grids
  - Streamline-based unstructured grids
  - Unstructured Cell Indexing and Truncated Grids
  - 2.5D and 3D PEBI Grids



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“Energistics and ISO 15926”

PRODML / WITSML Vocabularies

- **WITSML Standards**
  - Rig equipment and instrumentation
  - Drilling tubular components and drill string components
  - Wellbore fixed components
  - Completion equipment and instrumentation
- **PRODML Standards**
  - Production flowpath equipment and instrumentation
  - Gathering system equipment and instrumentation
  - Artificial Lift equipment and instrumentation

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PRODML Vocabulary Development

- **Current activity to assess needs and cross-reference to sources**
  - Needs
    - Functional components / items – not composition, nature, etc.
    - Association with quantities measured, estimated, etc.
    - Linkage with other domains, e.g. maintenance (MIMOSA), ERP (SAP), planning/engineering design and construction (ISO 15926),
  - Scope
    - Correlation with high-level equipment classifications, e.g. basic concepts from ISO 15926 Classes of Inanimate Physical Object
    - Correlation with wellbore spatial and geoscience concepts
    - Correlation with producing asset aggregations, such as subsets of assets, assets, and organizational roll-ups.

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Illustrations of mapping with ISO 15926

- **Functional Component Classes for PRODML cross-reference with ISO 15926 Classes of Inanimate Physical Objects**
  - Casing [RDS13029297]
  - Compressor [RDS14286497]
  - Controller [RDS289844]
  - Flowline [RDS80665386]
  - Flow Meter [RDS417464]
  - Mandrel [RDS7606608]
  - Liner [RDS1128104]
  - Pressure Meter [RDS417374]
  - Riser [RDS414809]
  - Separator [RDS13047965]
  - Temperature Meter [RDS417329]
  - Valve [RDS292589]

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Thank You