MULTI-CLOUD RESERVOIR DESIGN
WITH STANDARD FORMAT DATASETS

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Agenda

» Energistics & Standards
» The Reservoir Design Challenge
» Solution and Demo Description
» Trusted Data
Our Industry Understands Standards

» We have standards for practically everything:
  • Offshore structures
  • Tubular goods
  • Valves and wellhead equipment
  • Drilling structures and equipment
  • Well cement
  • Drill, completions and fracturing fluids
  • Well control equipment
  • Subsea production equipment

» We also have data standards…
How Are Standards Developed & Made Available?

» Energistics is not a vendor. We are a non-profit industry organization.

» We have served the industry for nearly 30 years

» Our 110+ members include leading E&P companies, oilfield service companies, software vendors, system integrators, & regulatory agencies

» Our standards are the result of open collaboration between our members, through industry workgroups facilitated by Energistics

» In short, the standards are created by the industry and for the industry

» They are freely available from Energistics
Key Members: Global Impact, Industry-Wide
Energistics Spectrum of Upstream Data Standards

**UNIVERSAL INTEROPERABILITY**

<table>
<thead>
<tr>
<th>DRILLING/WELL</th>
<th>PRODUCTION</th>
<th>RESERVOIR</th>
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<tbody>
<tr>
<td>&lt;WITSML/&gt;™</td>
<td>&lt;PRODML/&gt;™</td>
<td>&lt;RESQML/&gt;™</td>
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- Defined by collaboration between member SMEs
- Coherent set of standards to eliminate data ‘friction’
- Goal is to cover all key activities in upstream
- Shared components enable cross-functional workflows
- ETP = new ‘Netflix-like’ capability for streaming data
Well Information Standards: WITSML™

» Consistent high-quality transfer of wellbore and drilling-related data
  • Real-time data transfer
    ✓ Reference objects – Well and Wellbore
    ✓ Growing objects – Log (time, depth), Trajectory, Mud Log, etc.
    ✓ Snapshots in time – with “report” information
  • Real-time monitoring of drilling operations
  • Move well-related data between applications
  • Only vendor-neutral analytic (data lake) format
  • Archival history of drilling operations
Production Standards: PRODML™

» Consistent, high-quality transfer of production-related data

• Data transfer to production surveillance centers
  ✓ Real-time measurements from sensor through analysis
  ✓ Static configurations of production and surface facilities
  ✓ Regulatory and partner reporting
  ✓ Movement of analyses from service company to operator

• Move production-related data among databases and applications

• Only vendor-neutral analytic (data lake) format

• Archival history of production operations
Reservoir Standards: RESQML™

» High fidelity transfer of earth model data across applications and vendors

• Sharing earth model data across asset teams
• Movement of data through the seismic to simulation workflow
• All kinds of grids
• Traceability via metadata
• File-format-neutral archival of earth model at key decision points
• Only vendor-neutral analytic (data lake) format
The Reservoir Design Challenge
The Reservoir Design Challenge

» Very large number of wells
» Increasingly multi-disciplinary workflows
» Data shared (partners, data rooms, vendors)
» Diversity of software solutions
» Diversity of cloud platforms - multinimbus
» Prevailing formats (e.g. LAS) are simple but limited
» Verify data (takes time) or trust it (blind)? Difficult choice!
The Good, the Bad and the Ugly
A Standards-based Solution – EPC + HDF5

» EPC – Energistics Packaging Convention
  • Specialize the Open Package Conventions (previously Microsoft)
  • One package contains all the files (zip)
  • XML based
  • Explicit mapping of relationships between files
  • Compressed

» HDF5 – Hierarchical Data Format
  • Widely used in scientific computing
  • Efficient for large vectors or arrays
  • Used for HPC, but we use as a transfer medium
A standard solution

EPC (compressed XML)
- Data
- Relationships
- Metadata

HDF5
- Large data objects
- Hierarchical

Source System

Destination System

WRITE

READ
Benefits of completeness

» The package (2 files) contains the involved dataset information
  • Reference information mandatory and standardized
  • Relationships managed explicitly

» For the receiving party
  • Assurance that all relevant data is there, and properly referenced
  • Minimizes data verification workload
SEG 2019 - Live Demo As Proof of Concept

» Goal: show viability of standardized file transfers
» Dataset: complete dataset of GoM field
» Software: 6 commercial packages
» Workflow: enrich reservoir model, simulate and display

Note: each software system can perform much larger parts of workflow
RESQML 2.0.1 Demonstration

Grid creation

Facies modeling

Fracture porosity

Results visualization

Reservoir simulation

Property calculation
Execution of the PoC Demo

» Each application read the transfer package
» A transformation or editing of the data was performed
» The new version of package was exported
» One step involved transfer to a separate cloud and back
» In all the demonstration lasted 45 minutes
» Any step could have been skipped or substituted
Trusted Data
Critical Elements of Trusted Data

» Establishing trust/confidence in the data before acting on it

» Data Assurance (much more than data quality)
  • Trusted source
  • Sensor operating in range
  • Properly calibrated
  • Compliance with contractual provisions
  • Transmitting Data Assurance among users/systems

» Data Provenance (audit trail)
  • What has been done to the data?
  • What applications and what parameters?
  • Identify the users.
So How do Energistics’ Standards Help?

» Energistics’ WITSML, PRODML and RESQML standards all include:
  • Data Assurance object – supports data governance processes for data analytics
  • Activity object – tracks what has been done with the data

» Data Assurance uses business rules between data provider and consumer
  • Data is checked for compliance and exceptions automatically flagged & sent

» Activity Object
  • Captures parameter picks, applications & users to convey prior history of data

» Benefit
  • Reduces time and resources needed in data preparation and validation
  • Establishes trust that data is fit for purpose
  • Data does not need to be perfect or complete
Will You Always be Able to Access Your Data?

- O&G data has relevance spanning several decades
- What may seem of little use today may be critical tomorrow
  - Information Technology changes rapidly
  - Application vendors update apps and data structures frequently
  - Today’s dominant vendors may be replaced by others 15 years from now
- Archiving is therefore not just a physical problem
  - The format of an archive is the dominant risk
- An industry-defined and industry-sponsored standard is the only solution
  - Self-descriptive and always decipherable
  - Inclusive of all metadata needed to properly understand the data
  - By archiving in Energistics standards, the data will be “future-proofed” and readable
Conclusions

» Reservoir datasets are increasingly sophisticated
» Solutions require a diversity of software solutions
» Cloud-based software and data storage are more common
» More analytics and other (un-) supervised data ingestions
In Closing
THANK YOU!

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