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Interoperability improves reservoir modeling, simulation software

RESQML picks up where RESCUE left off.

AUTHORS

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An extensible markup language (XML)-based data exchange standard helps address the data-incompatibility challenges faced by petrotechnical professionals when using the multiple software technologies required for reservoir modeling and simulation. RESQML – the successor to RESCUE, the data exchange standard used since the late 1990s – delivers an industry-defined common data format that helps to facilitate interoperability among the many software technologies, thereby allowing petrotechnical professionals to focus on oil and gas domain work.

Incompatible data formats

Reservoir modeling and simulation is a lengthy, data-intensive, and iterative process. To perform this work, petrotechnical professionals use a broad range of software technologies, some commercial products and others developed in-house, each with its own often proprietary data format.

This data communications conundrum means that professionals must spend time extracting, reformatting, and importing data to and from different applications along the subsurface workflow – time that could be spent on analysis and interpretation of that data to improve exploration and recovery of hydrocarbons.

Business factors driving need

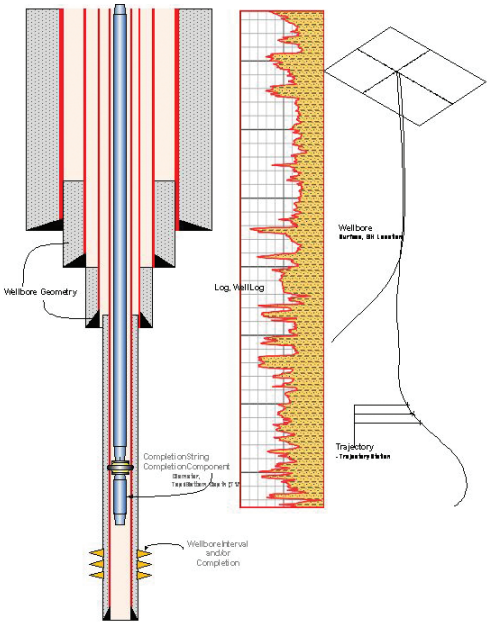
When using the technologies, users need to transfer entire models or key portions of them across applications or platforms without reformatting data or losing critical information. For example, they must be able to exchange data types independently without being required to carry the entire dataset, support giga-cell models and unstructured grids, and retain stratigraphic relationships and naming conventions. These types of data transfers occur between different technologies along the modeling and simulation work flow and between partners in joint ventures who may use different tools and technologies.

This data incompatibility is also costly for developers of these technologies – both commercial companies and in-house teams – who must develop custom "connector" or translator pieces that become obsolete with new versions and consume programming resources that could be used to enhance domain functionality.

Regulatory requirements also are driving data needs. For example, the US Sarbanes-Oxley Act requires that E&P companies retain and reproduce reservoir models used to develop publicly reported reserve numbers for seven years.

Data exchange standards, developed by and for the industry, help address these issues, facilitating data flow and allowing petrotechnical professionals to focus on domain problems instead of reformatting data.

The awareness and importance of standards is growing, as evidenced by the number of industry and vendor events that include standards in the agenda, news coverage in industry media, and editorials by industry experts.

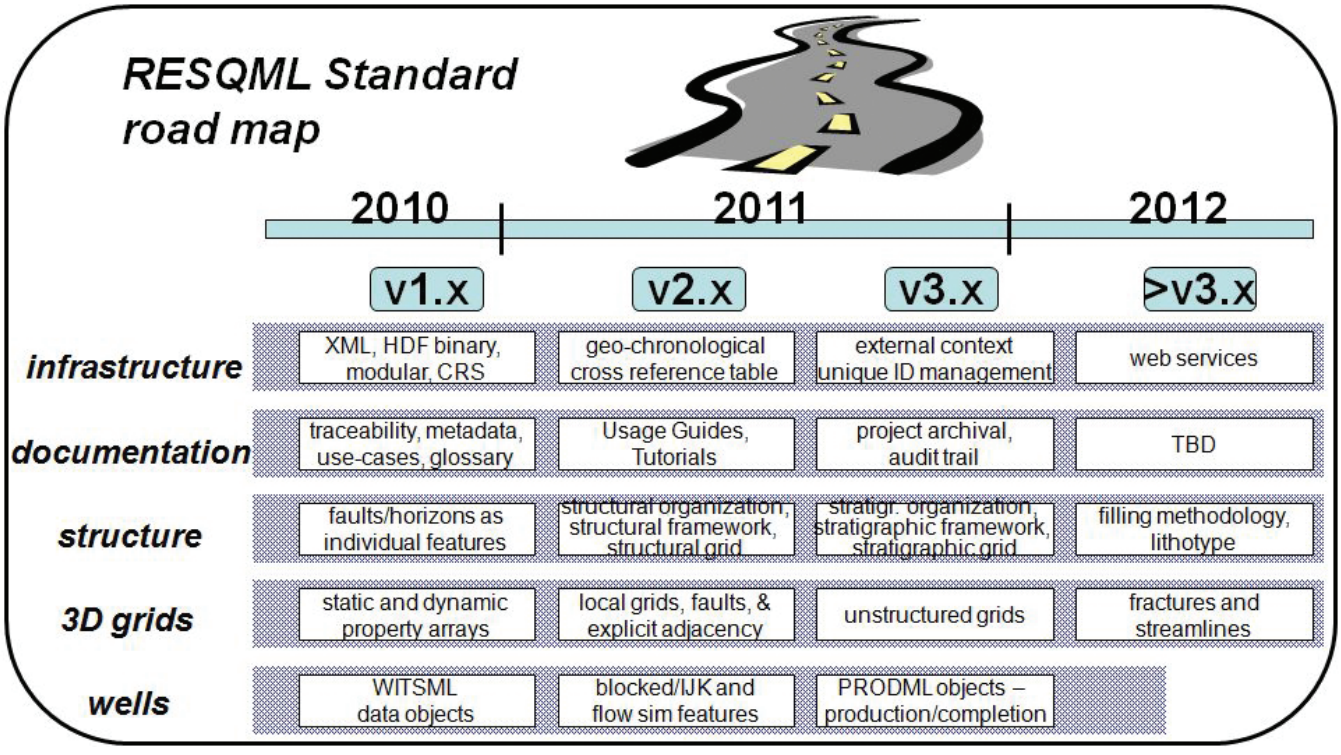


RESQML integrates with companion XML-based standard WITSML to use these well-related components. (Figures courtesy of Energistics)

From RESCUE to RESQML

Since the late 1990s, RESCUE – an E&P industry data exchange format for 3-D gridded reservoir models, horizons, faults and structural models, and associated well data – has been adopted by many operators and software vendors.

With advances in computing and



Features for the near-term plan for RESQML development will include the ability to handle or address structure, 3-D grids, wells, infrastructure, and documentation.

the advent of new data structures and technology, the RESCUE standard is becoming obsolete. In 2008, the RESCUE consortium elected to take the best practices from the existing RESCUE standard and upgrade to a next-generation XML-based solution and to transfer stewardship to Energistics, a not-for-profit global E&P consortium facilitating the development of XML-based data exchanges standards for drilling and production, WITSML and PRODML, respectively.

Integrating E&P domains

One goal is for the E&P industry to integrate not only the reservoir modeling and simulation processes but all E&P domains. This type of cross-domain integration is expected to eliminate or reduce tasks like manual data exchange, allowing petrotechnical professionals to focus on, improve, and transform E&P operations.

By joining forces with Energistics, RESQML benefits from the data, standards, lessons learned, and best practices of WITSML and PRODML for maximum consistency, integration, and value.

Table 1. *Key differences between RESCUE and RESQML. The goal of RESQML is not to copy the RESCUE functionality, but to provide a foundation that maximizes the capabilities and efficiencies of the XML-based technologies.*

	RESCUE	RESQML
Data Retention	Losse	Lossless
Technology	C++ API with Java wrappers	XML scheme complemented with binary transport capabilities (HDF)
Level of Data Exchange	All data within the model treated as a single set	Finer granularity enables the exchange of independent entities
Documentation the schema	Reference to methods	Guidance on how to use
Robustness	Designed for only one reservoir	Designed for multiple reservoirs

For example, both well and production data are used extensively in reservoir interpretation, modeling, and simulation. Instead of reinventing the wheel, RESQML leverages the required data objects from WITSML and PRODML, and those standards also benefit and use data from RESQML.

RESQML Version 1 capabilities

RESQML Version 1 is suitable for commercial use and provides a foundation that maximizes the capabilities and efficiencies of the XML-based technologies.

RESQML features will include the ability to handle or address structure, 3-D grids, wells, infrastructure, and documentation.

Structure

- Horizons and faults are expressed as a topological framework;
- Transfer of surfaces without reference to a 3-D grid helps address a previous issue with RESCUE; and
- Proper 2-D grid rotation is available.

3-D grids

- Explicit representations of faults eliminates geometric searches and ambiguities among software providers;
- Efficient sequencing enables fast loads;
- Multiple reservoirs can be handled;
- "Blocked" or "IJK" wells are upscaled to a 3-D grid;
- Unstructured grids are addressed; and
- Microfractures and streamlines are included.

Wells

- WITSML objects such as well, well bore, trajectory, formation marker, and well log are handled;
- PRODML objects such as production and completions data are included; and
- Well categories related to flow simulation, such as perforations, scheduling, and rates are addressed.

Infrastructure

- A human-readable RESQML document is enabled with standards such as a combination of XML and hierarchical data format (HDF) – a set of file formats and libraries designed to store and organize large amounts of numerical data;
- Optimal data management performance is achieved through use of HDF;
- A modular approach for storing and transmitting data ensures coherency of data and enables easy updates; and
- A coordinated reference system from which all objects are referenced ensures proper location and orientation of objects in a model.

Documentation

Often cited as an issue with RESCUE implementation, the RESQML documentation set provides:

- Traceability through rich XML descriptions;
- Ability to retain searchable metadata, incorporation of standard Dublin Core elements (a metadata standard), and Energistics common data elements from WITSML and PRODML through XML;
- High-level user stories and detailed use cases to guide both business and technical staff in implementation;
- A glossary of relevant terms; and
- Archival data project through a documented audit trail.

Organization

Like RESCUE, the RESQML standard is developed by a large group of contributors from across the industry including operators/E&P companies, service and software companies, and data standards specialists. Individuals from these companies participate through the RESQML special interest group, which is composed of a steering committee, a use case team, and several technical teams.

Participation from operators and E&P companies is vital. These companies define requirements and drive the prioritization and implementation of features.

Participation from service and software companies ensures that standards are sufficiently flexible to work with their respective technologies. Additionally, adoption of vendor-neutral data-exchange standards helps with product integration and uptake by the industry.

Technology is no longer a limiting factor for integrating software along the E&P value chain – data incompatibility is. Industry-developed, vendor-neutral data-exchange standards have a solid track record of improving interoperability. Not only do these standards enhance the efficiency and cost-effectiveness of operations, but they also provide the ability to consistently and reliably archive data, both for internal recordkeeping and for regulatory compliance. E&P