SAVE: An Alliance for Reservoir Simulation Software Integration

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Summary

Simulation Application View of Epicentre (SAVE) is an industry alliance formed to meet practical end-user needs for an integrated reservoir simulation software environment. This alliance of application developers and end users created an atmosphere where competitors worked together evolving standards to achieve integration by use of existing commercial applications.

Introduction

Oil companies are demanding improved work-flow performance from their multidisciplined teams. Integration, including the use of reservoir simulation, is expected to improve the effectiveness of business decisions regarding reservoir performance.[1-5] For integration to be effective, business processes and software need to be adapted. Software developers, venders, and oil companies alike do not have sufficient resources to satisfy independently the needs of the E&P industry.[6] Only through industrywide collaboration will an integrated environment be realized. The potential benefits of this are a 25% to 50% improvement in the efficiency of engineers[7,8] and a 40% reduction in the cost of information systems.[9]

SAVE (**Fig. 1**) is an alliance of oil companies and application venders chartered to produce applications based on an integrated, standard view of reservoir simulation. This joint-industry project was established in 1995 to unite users and venders, focusing their energy and expertise in these following areas.

1. Integration. This is the ability of two or more applications to use the results of each other's actions.[10]
2. Interoperability. This is the ability of two or more applications to cooperate effectively so that a common goal is accomplished and data are managed consistently.
3. Data sharing. This is the ability of two or more applications to use information interchangeably so that the data remain consistent while being manipulated by multiple processes.
4. Application portability. This is the ability to install an application without customization other than compiling and linking to local, implementation-specific libraries.
5. Data portability. This is the ability to move data from one site to another without alteration of meaning.

History

In 1994, several oil companies and venders independently began to experiment with integrating reservoir simulation gridded data. The basis for their work was a logical data model (Epicentre™) developed by the Petrotechnical Open Software Corp. (POSC).[11,12] As Mobil, ERC/Tigress, Intera, and Western Atlas Software experienced similar issues, they created an informal work group to define extensions to the data model for corner-point and unstructured grids. The workgroup recognized benefits of collaboration and complementary expertise. To maintain the momentum and broaden participation and scope, SAVE was created to integrate reservoir simulation technology across company and competitive boundaries.

The SAVE alliance now includes the following venders: Geomath, Geoquest Reservoir Technology (formerly Intera), Landmark Graphics, Petroleum Information, Petrosystems, OGCI Software, Schlumberger, ERC/Tigress, and Western Atlas Software. The following oil companies provide sponsorship: BP Exploration, Chevron, Elf Aquitaine, Mobil, Norsk Hydro, Saga, Saudi Aramco, Shell Intl. E&P, and Statoil. Limited management and consulting expenses were paid, and active vender particpants received partial reimbursement for time and travel. Other venders participated on a nonfunded basis. Reimbursement for the cost of participation is estimated at about 10% to 20%. A formal memorandum of agreement developed between all the parties governs SAVE.

SAVE's open environment broke traditional barriers and enabled unprecedented collaboration. For example, software developers shared previously proprietary reports and sample code. This openness created a productive environment to meet the project's objectives.

Results

SAVE has focused on four areas of data used in reservoir simulation: wellbore geometry, well events, gridded properties, and production data. For each area, application experts identified the relevant data and, in conjunction with data modelers, mapped this data to Epicentre. This mapping described the placement of each data item within the data model and represented the consensus of the participants. Whenever flaws in Epicentre were discovered, POSC implemented corrections and enhancements.

Once the data model mappings were completed, sample data were loaded into a database and developers modified their applications to access this information. These applications were tested for interoperability and performance. The following areas of the data model were validated through mapping, loading, and retrieving.

1. Three-dimensional grids with conventional, radial, and corner-point geometry.
2. Initialization and time-dependent gridblock values.
3. Wellbore geometry, well completions, and perforations.
4. Well production history.

Enhancements were made to Epicentre, including addition of reservoir simulation restarts, improvements in local grid refinement and grid coarsening, and extensions to connect wells to gridblocks.

SAVE targeted two areas during the performance testing: gridded properties and production data. Results showed that gridded data performance was not a major concern, but that production data access was far from satisfactory. SAVE required rapid, efficient storage and retrieval for the following simulation activities.

1. Retrieving oil rates for one well (history plotting).
2. Getting all oil rates for a given time (mapping).
3. Finding all properties of a well at a given time (material balance).

SAVE developed a reservoir simulation process description and concluded that acceptable performance was no more than a 10% increase in elapsed time for typical overnight simulation runs. Database tuning efforts only brought performance to about an order of magnitude of this criterion. However, end users were unwilling to sacrifice integration for the sake of performance. Changes to the data model were proposed, and subsequent tests showed this criterion was met while still providing integration. The corrections and enhancements identified by SAVE will be incorporated into the Epicentre data model.

A detailed technical report (ftp://saicpd.com/pub/SAVE) provides descriptions of data model mappings, guidelines for data model usage, discussions of the business process, and performance testing results.

Future

The success of this alliance allowed initiation of similar projects with the SAVE alliance model, most notably Reservoir Characterization Utilization of Epicentre (RESCUE). This alliance is focusing on reservoir characterization and is working closely with SAVE

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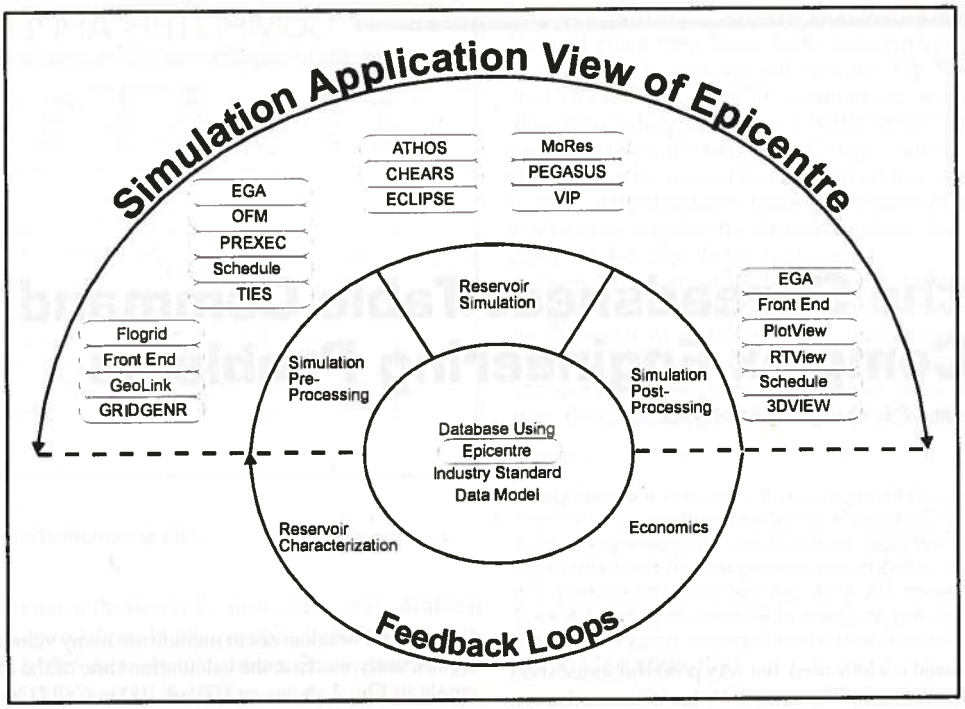

Fig. 1—Scope of SAVE from a business perspective.

participants on the 3D upscaling process. RESCUE is considered to be critical to SAVE in achieving integration between geological and reservoir engineering data and applications.

During the short life of the SAVE project, several oil company reorganizations and vender acquisitions have occurred. As the result, the business drivers have changed, requiring SAVE to evaluate the impact of these changes during the second quarter of 1996. Once the impact has become clear, a proposal representing the new business environment will be developed. We expect that this proposal will allow new participants to join and to cover additional topics. Specific topics that have been proposed include fluid/rock interaction data (e.g., capillary pressure curves and relative permeability data) and fluid data (e.g., PVT behavior). Fluid data are considered to be of special importance across the E&P business. The proposal should be available in the first half of 1996. **JPT**

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