AKSIO – An application of Semantic Web technology for knowledge management in the petroleum industry

ISWC2005 Poster Submission

Roar Fjellheim, Computas AS, Norway, raf@computas.no

David Norheim, UniK and @semantics, Norway, david@asemantics.com

Abstract

The AKSIO project is developing an integrated system to support operations of offshore oilfields. The system will provide timely and contextual knowledge for work processes. AKSIO supports collaborative work in teams with members from the offshore platform, onshore operations centre, individual specialists, and suppliers. It will link databases, applications, specialist knowledge networks, and real-time data from the field to a visual representation of the work process. Core functionality of the AKSIO system is provided by careful application of Semantic Web technology, including ontology-based annotation and smart retrieval of content.

Introduction

The management of offshore oil & gas fields, in the North Sea and elsewhere, is moving towards *integrated operations*, i.e. integrated work processes (including planning, drilling & well operations, production, and maintenance), real-time data from the field, on-shore operation centres, and massive use of IT for on-line monitoring, analysis, and decision tasks. For integrated operations to succeed, it is critically important to provide appropriate and timely knowledge to decision-making personnel involved in drilling operations. The challenge is to provide support in a situation with decreasing personnel levels and higher reliance on individual expert resources.

AKSIO focuses on knowledge and IT-enabled knowledge management (KM) for successful implementation of the integrated operations concept. Knowledge is recognized as a critical resource for achieving business results in the oil & gas industry, but KM is often not well connected to core work processes. KM research focuses on issues like communities-of-practice, narratives, innovation, organizational issues, as well as purely IT-oriented aspects. In the AKSIO project, Semantic Web technology is being used as a foundation for building more intelligent knowledge support to operations.

Work processes

Planning and executing a drilling operation is a highly complex undertaking, and is governed by an overall work process, as indicated in Fig. 1.

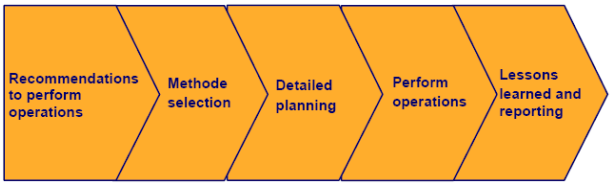

Figure 1. The overall work process for a drilling project.

The three first stages of the process are all concerned with *planning*, starting with a business proposal to drill for oil in a certain geological area, and ending with a detailed plan for the operation. Several types of expertise need to cooperate to make a high-quality drilling plan, such as geologists, geophysicists, petrophysicists, drilling engineers, reservoir geologists, etc.

The operation phase uses the detailed plan to carry out the actual drilling work. Depending on experience gained during drilling, the detailed plan may be revised "on-the-fly". Such experience is documented in an experience data base and can be used as a basis for the reporting phase as well.

The definition of the drilling work process seems to indicate a sequence of steps. However, many of the stages are overlapping, often in order to save time for the subsequent stages. The potential for better integration of planning and operation activities are considerable. In particular, studies have shown that there is a need for improved feedback of knowledge from the operations phase to planning of subsequent drilling projects, as well between the operations phases of different projects.

Design concepts

The major aspects of the AKSIO concept are illustrated in Fig. 2. Engineers and other decision-making staff at an onshore operations centre perform work tasks as part of certain work processes. To make the best decisions, they access data sources (historical and real-time data), use specific IT tools, and interrogate colleagues in knowledge networks for specific pieces of knowledge. Knowledge must be timely and contextual relative to the decision task and work process at hand.

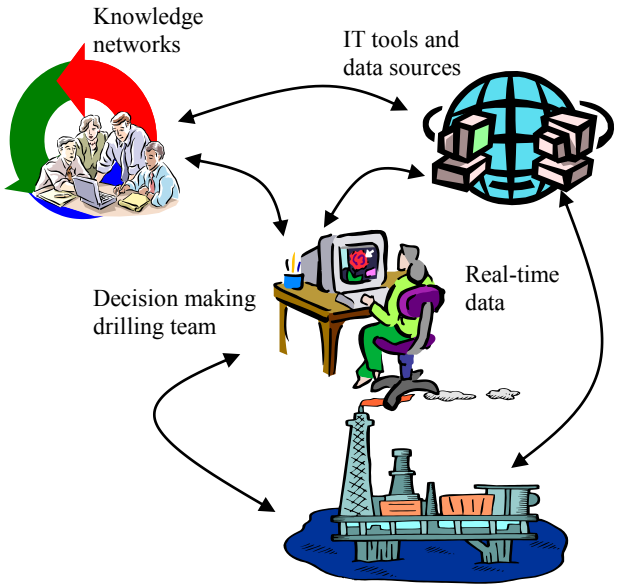

Figure 2. AKSIO combines knowledge management, decision support, and real-time data tracking

The services to be offered by the AKSIO system include:

- Sustained knowledge creation and sharing (between different fields and work process phases)
- Manual and autonomous monitoring of the drilling process – situation assessment
- Solicited as well as unsolicited ("active") guidance during performance of work process operations
- Assistance in identification of needed information sources (human, databases, documents)

Services are to be embedded in the tools already used by oil company personnel to carry out their daily duties.

Semantic Web technology

Semantic Technology plays an important role in realizing the AKSIO design concept: The first version of the system focuses on experience transfer from ongoing drilling operations to planning of subsequent operations. The scenario involves the following Semantic Web technologies:

- A *drilling ontology* has been established to serve as a common vocabulary for planning and operations (OWL)
- Experts *annotate* operational experience reports with semantic markers to increase its reuse potential (RDF, annotation client). The annotation is a collaborative process involving "first-line" operators and "second-line" expertise networks. Later versions of AKSIO will investigate automated/assisted annotation
- *Semantic queries* are used to retrieve experience material with high precision and recall (SPARQL). Retrieval modes include both pull by end-users and push by active invocation of contextual knowledge based on e.g. semantic profiles of domain objects, such as wells.
- A centrally maintained *knowledge base* holds the ontology and metadata required (triple store, Semantic Web Services), linking people, experience reports, annotations, queries and ontologies.

Annotation and query functions are embedded in the *work processes* and IT tools normally used by the personnel in question. The IT tools (based on Microsoft Sharepoint technology) are augmented to communicate with the AKSIO knowledge base.

Conclusions

Key innovative elements of AKSIO are real-time knowledge and process management. The underlying tools borrow from Semantic Web technology. AKSIO will enable drilling engineers to make the best informed and optimal decisions, and will bring state-of-the-art semantic technology to a new arena.

Acknowledgements

The AKSIO project is carried out by a team consisting of researchers from Norwegian organizations Statoil ASA, Hydro ASA, Computas AS, Institute of Energy Technology, Det Norske Veritas, The Norwegian University of Science and Technology, and UniK (University Graduate Studies at Kjeller). The project is supported by The Norwegian Research Council through grant PETROMAKS 163365 (2004-2007).