

W3C Workshop on Semantic Web in Energy Industries; Part I: Oil&Gas

Position paper

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Semantic Technology for Knowledge and Work Process Management in the Oil & Gas Industry

1. Introduction

Economic as well as safety-related issues call for strict attention to Knowledge Management in the oil & gas industry, in order to “not make the same costly error twice” and in order to reduce the impact of “the big crew change”. The industry was an early pioneer in adopting KM practices and tools, but many challenges still remain to be solved. We believe Semantic Web technology can be an effective tool in the KM arsenal, and conducted on an early application experiment with the Drilling & Well Division of StatoilHydro.

Work processes are related to KM, in that a process can be seen as codified piece of “know-how” knowledge, and we therefore believe that a semantic approach to Business Process Management (BPM) ought to be investigated. With students at the University of Oslo, we did a preliminary study of applying semantic technology to BPM.

2. AKSIO – Active Knowledge System for Integrated Operations

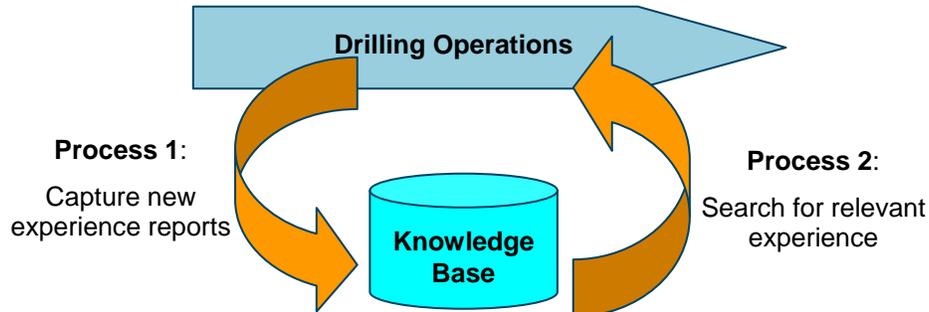
Some of the remaining KM challenges alluded to above include:

- Unsystematic and insufficient registration and quality assurance of new experience
- Lack of common terms for discussing and describing experience
- Insufficient tools to search for relevant experience
- Inadequate linking of “tacit” (human experts) and “explicit” knowledge (data bases)

As a result of not properly addressing those issues the industry suffers losses every year. By providing improved KM solutions some of the losses can be prevented.

AKSIO is a work process-enabled knowledge management system that supports experience transfer in oil&gas operations, initially focusing on drilling operations. Drilling is a technically sophisticated and highly complex domain demanding expert knowledge. Learning from previous projects is a key success factor.

Experience transfer in AKSIO is a social activity that can be supported by information technology. It involves a Knowledge Base of experience reports and two Work processes for knowledge creation and knowledge reuse, respectively.



AKSIO provides timely and contextual knowledge for drilling processes. Experience reports are processed and annotated by experts and linked to various resources and specialist knowledge networks. The system allows retrieval of experience reports through the support of a drilling domain ontology. Core functionality of the system is provided by careful application of Semantic Web technology, including ontology-based annotation and ontology-driven retrieval of content.

The main contributions of the AKSIO project are listed in the following table.

Area	Contribution
Knowledge base	Developed domain (drilling) ontology in OWL Augmented base experience reports with RDF meta-data
Knowledge capture (Process 1)	Created work process with roles for drill crew and discipline specialists Developed software tool for rich annotation of experience reports
Knowledge reuse (Process 2)	Created work process for drill planning teams Developed software for combined semantic and text-based search

The project developed a complete set of pilot software applications and tested them in several controlled experiments. Detailed information on AKSIO can be found in a separate paper¹.

Experimental results showed that by eliminating noise and adding precise annotation we were able to improve the quality of the experience reporting for cross-project knowledge reuse. Furthermore, pilot tests suggested that we were able to improve precision and recall for experience searches. Unfortunately, the project was not continued beyond the pilot stage.

¹ Roar Fjellheim and David Norheim: "Improved Experience Transfer by Semantic Work Support", in Emerging Technologies for Semantic Work Environments: Techniques, Methods, and Applications, Idea Group, Inc., 2008

3. SemTask – Semantic Task Support in Integrated Operations

A work process is defined as “a set of coordinated tasks and activities, both manual and automated, whose purpose is to accomplish a specific business goal”. BPM (Business Process Management) practice falls broadly into two categories:

- *Design the work*: Prescribe and model how work processes should be carried out.
- *Do the work*: Actually carry out the prescribed processes, manually or by computer.

Wrt. IT support, the current practice in the oil & gas industry is largely limited to the first stage, documenting processes in the form of online manuals to be consulted by the personnel carrying out the work. We believe that efficient support for the second stage, work execution, will result in dramatic improvements in increased productivity, reduced cost, and enhanced HSE. Furthermore, we believe that Semantic Technology can be a key enabler to achieve those benefits.

One specific approach was investigated by students at the University of Oslo under our supervision². The aim for their work was to show how a unified ontological treatment of work processes and the information that the processes deal with, enable efficient process execution and can support users in performing information-rich tasks. The main contributions of the work are:

- An architecture for SemTask, an active support system for work processes based on Semantic Web technology
- An OWL-DL ontology for BPMN, resulting in a standard storage format (serialization) for BPMN diagrams
- Description of (parts of) a Daily Production Optimization work process in BPMN/RDF
- An execution model for SemTask to connect tasks, data sources, and decisions; as well as an execution engine relying on rules

4. Position

The two cases we have described, in addition to experience from other domains and insights from other groups, have convinced us of the applicability and value of Semantic Web technology in the industry. However, we have experienced difficulties in scaling early pilots to fully deployed systems. There may be several explanations for this, including a lack of knowledge of this technology in the industry and relative immaturity of some required pieces, such as automated annotation systems and other development tools. We believe that these obstacles can be overcome and we intend to continue our work on applying Semantic Web technology to demanding knowledge and process management task in the oil & gas industry.

² A. Blomsköld, F. Klingenberg: “SemTask – Semantic Task Support in Integrated Operations”, MSc. Thesis, Univ. of Oslo, Dept. of Informatics, Aug. 2008