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Computas AS

Knowledge Management in the Petroleum Industry

Active Knowledge System for Integrated Operations (AKSIO)

David Norheim, Computas AS, Norway

dn@computas.com



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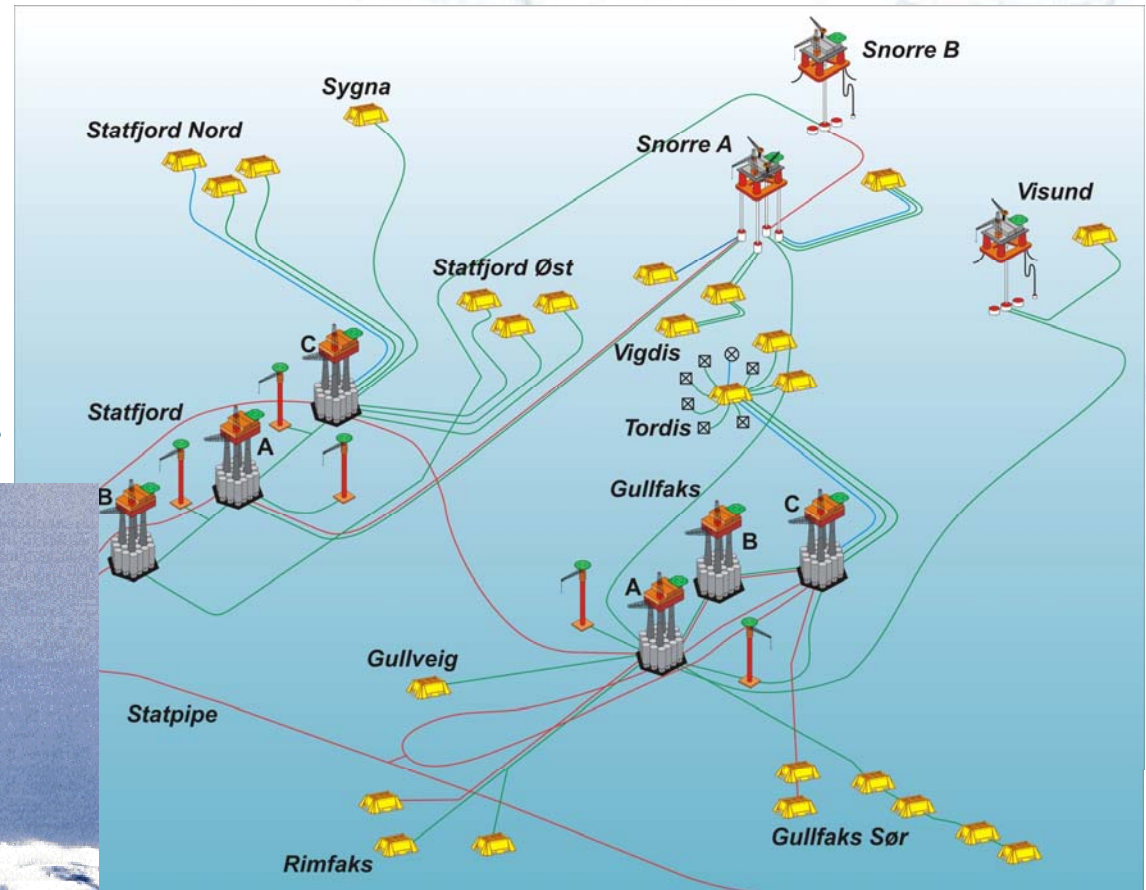
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Outline

- Introduction
- Knowledge transfer
- A semantic approach
- Preliminary results
- Prospects

A complex and knowledge-rich business

- Challenging environment
- Complex technology
- Large-scale operations
- "99.9%" requirements



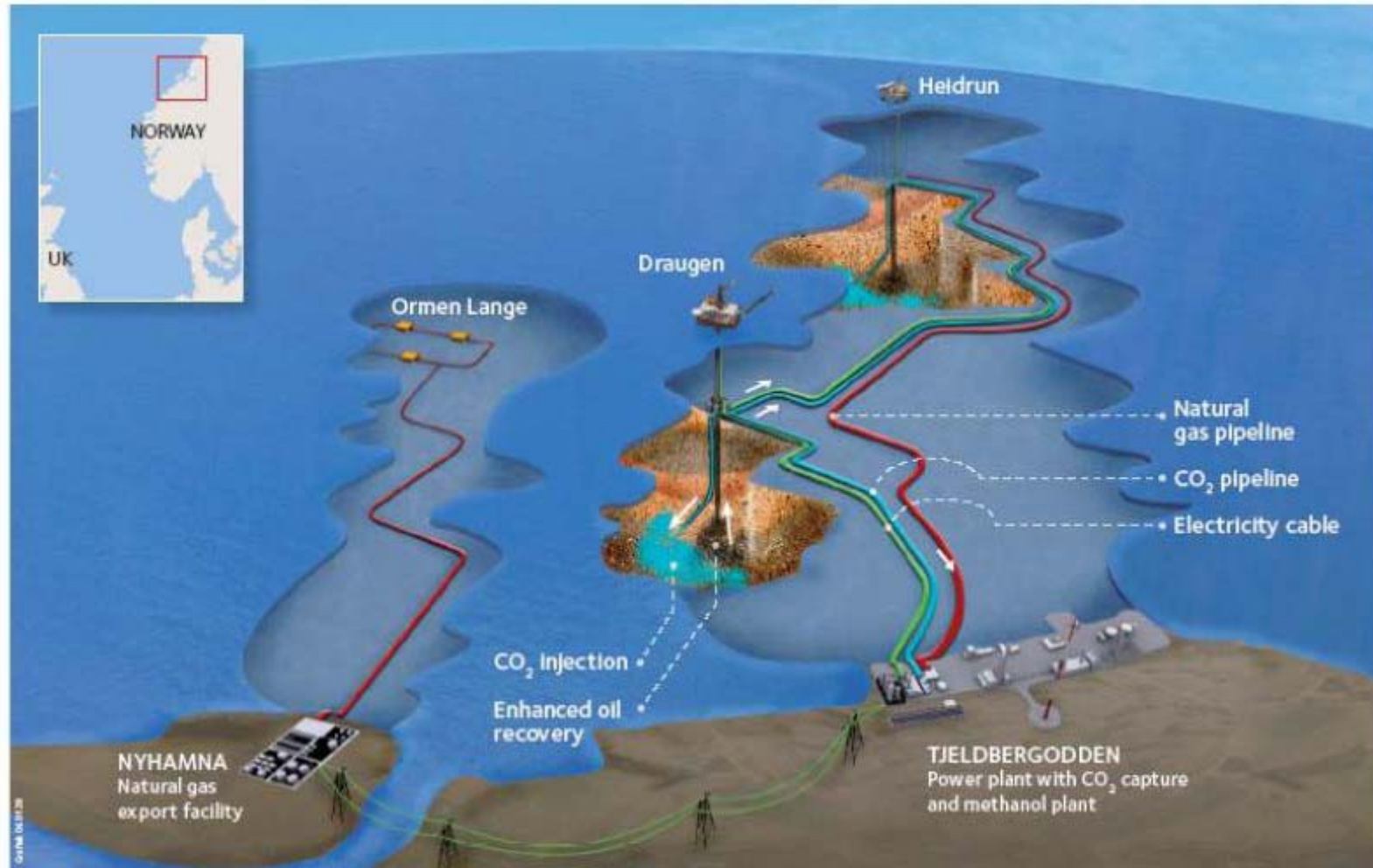


Complex technology required and used

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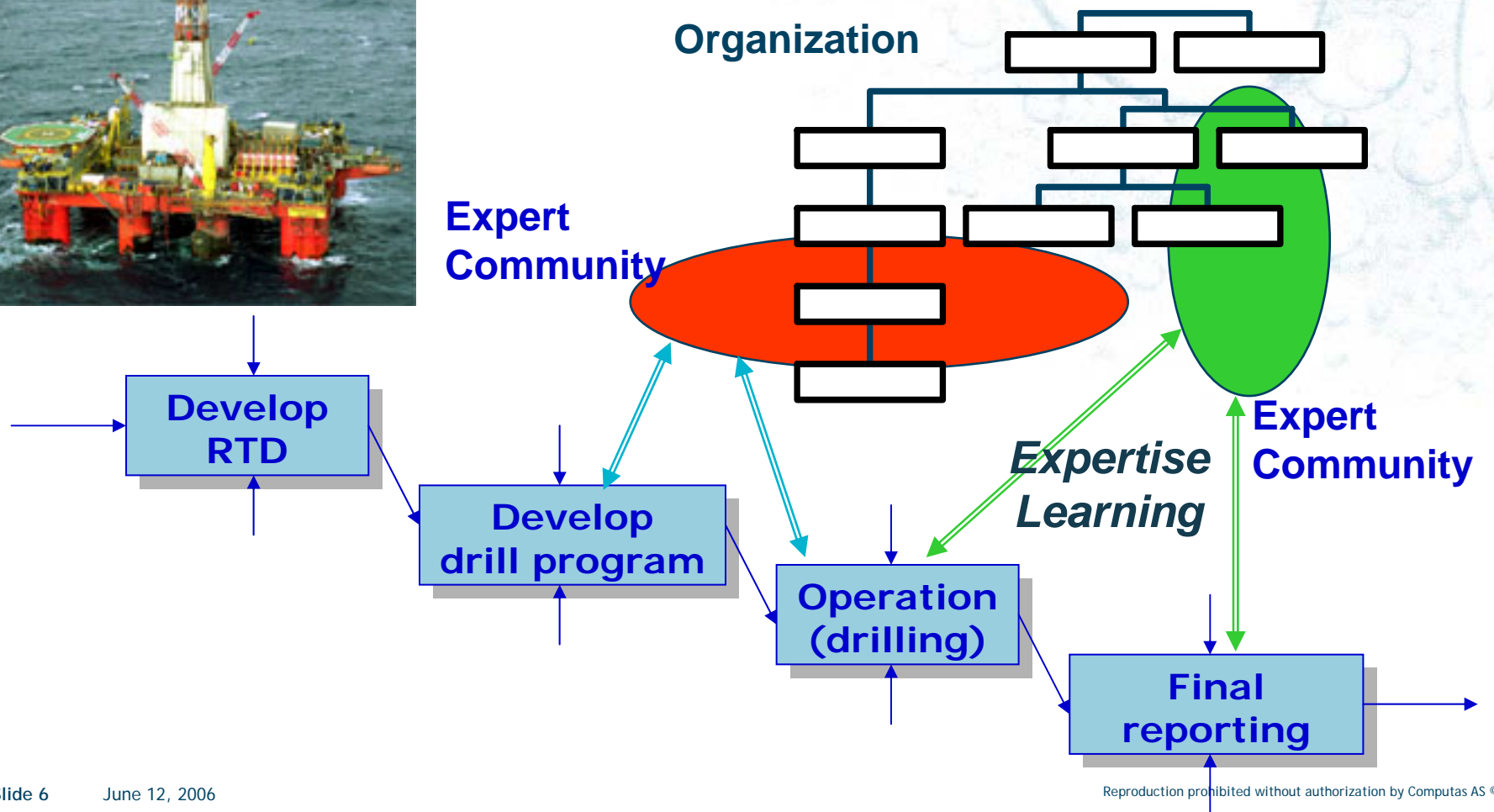
Complex technologies & new opportunities



Drilling - process and organization



Typical cost: \$1-2 mill./day



Knowledge management in drilling (Statoil)

Knowledge in networks	Communities of Practice Informal networks External knowledge sources
Documents and IT	Governing documents Best practice BoB Extranet Employee portal Other databases
Competence management/HR	Competence transfer/job rotation Competence mapping Education (B&B School)
Process-integrated knowledge	Peer-to-peer reviews Morning meetings DBR (Daily Drill Report)

The AKSIO project

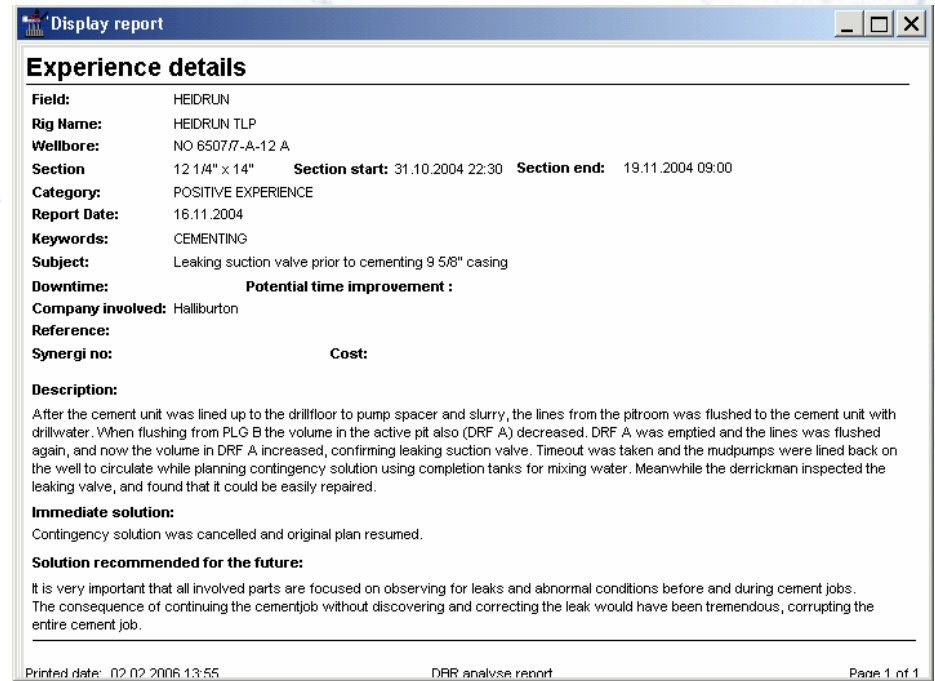
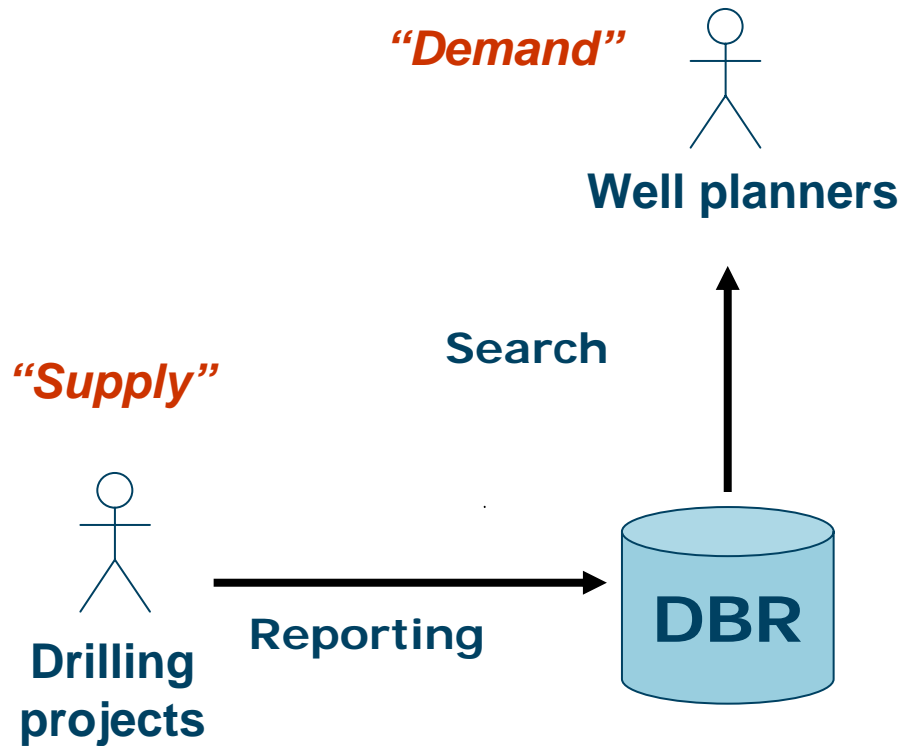


- Develop, test and evaluate an active socio-technical system (work process supported by technology) for improved KM in integrated drilling operations
 - Provide decision makers with the best available knowledge in a task-relevant, timely, and contextual manner
 - Provide feedback loops for capturing and integrating new knowledge (and deleting obsolete knowledge)
- Hypothesis
 - The active knowledge system must be completely embedded in main work processes and be part of ordinary work

AKSIO use case - Knowledge transfer



Knowledge transfer via databases?

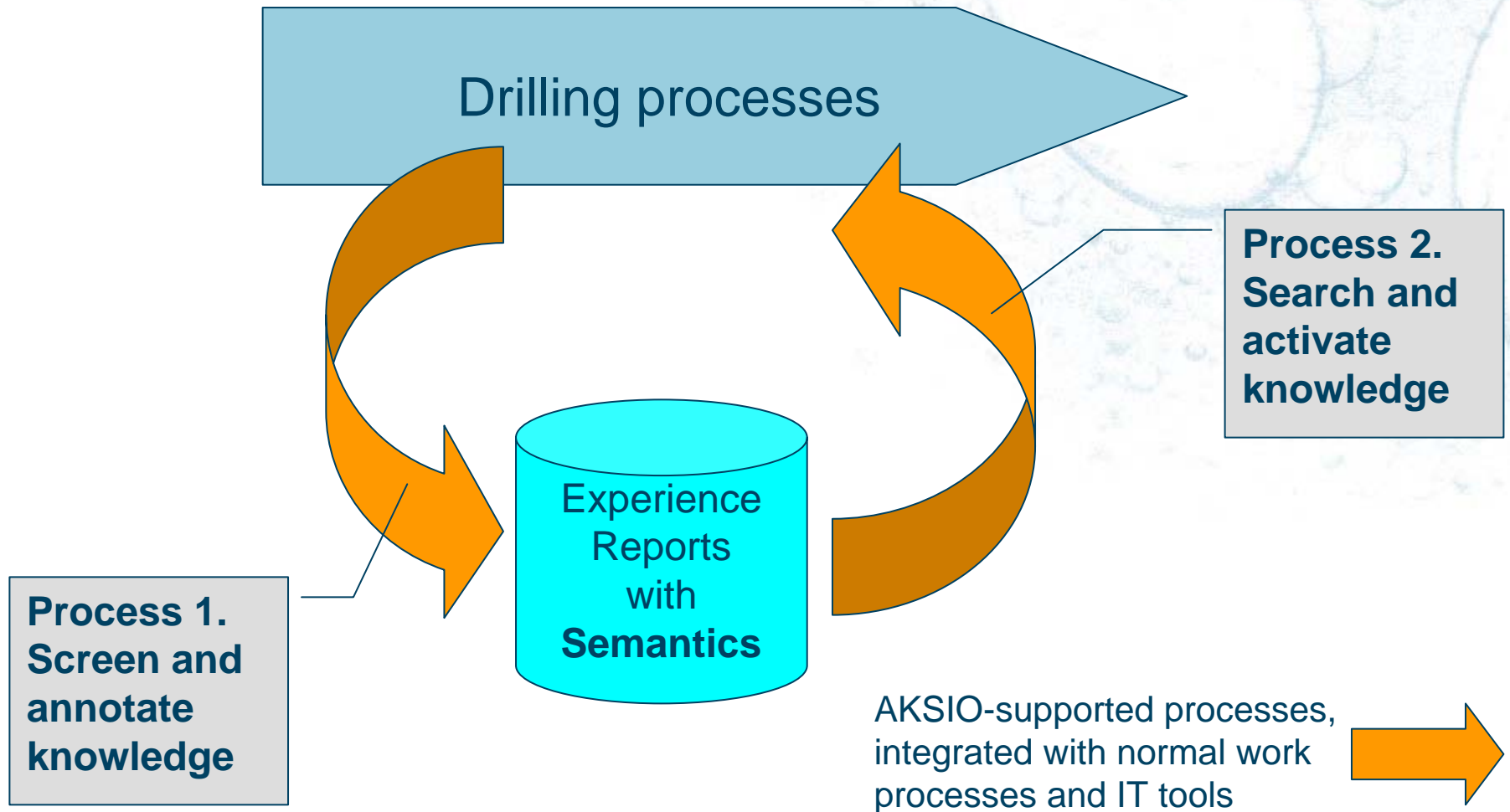


- Passive process not efficient
- Active facilitation required!

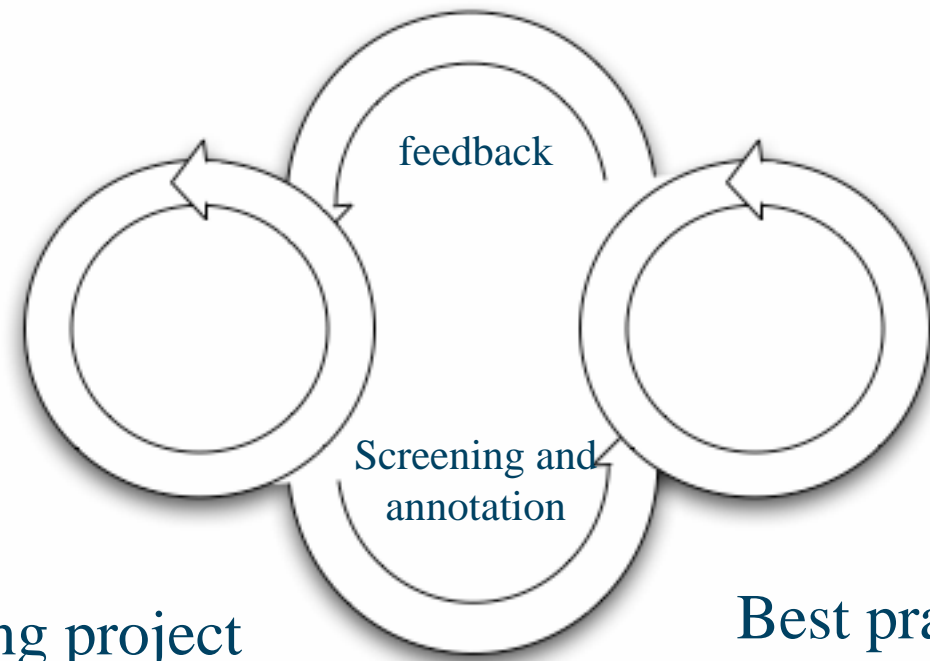
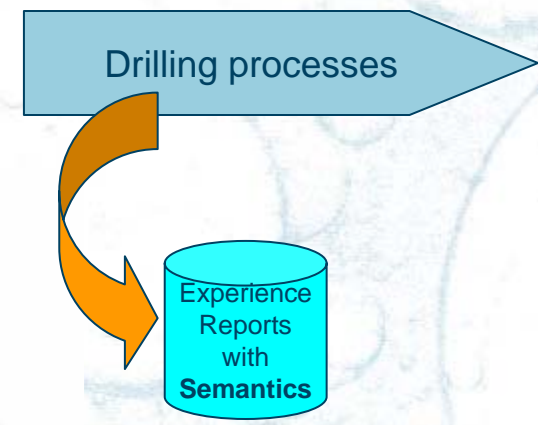
1997-2006:
 8577 experience reports

- 1754 positive
- 6823 negative

Active and facilitated transfer



Improving the quality

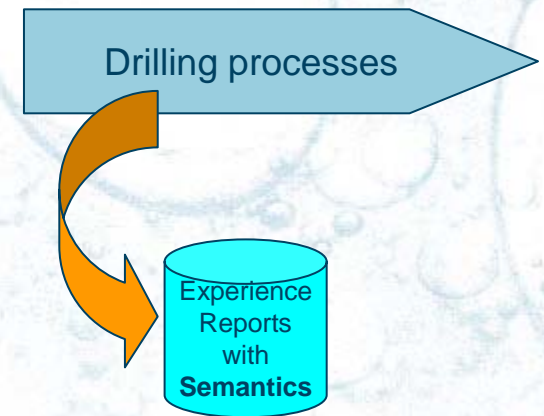


Drilling project
Experience reuse

Best practices
Governing documents

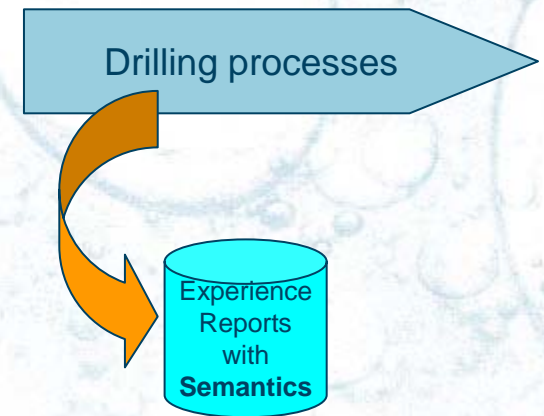
Screen and annotate knowledge

- A systematic process involving the knowledge source (e.g. driller) and one or more discipline specialist(s)
- The specialists review new experience reports, may discard reports, and supply semantic annotation for retained reports
- The result is a Knowledge Resources Map that significantly adds value to experience reports



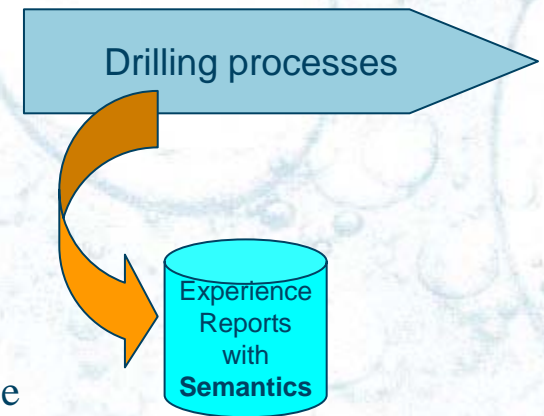
Semantic technologies in annotation

- “Deep” sources
 - Daily drilling report
 - Health Environment Safety
 - LDAP/SAP
- Drilling ontology (OWL, Protegé)
- Storing the experiences annotations in a knowledge map (RDF, Jena)
- Screening and annotation interface
 - Under study: Semi-automatic annotation
 - Integrated in MS Sharepoint platform

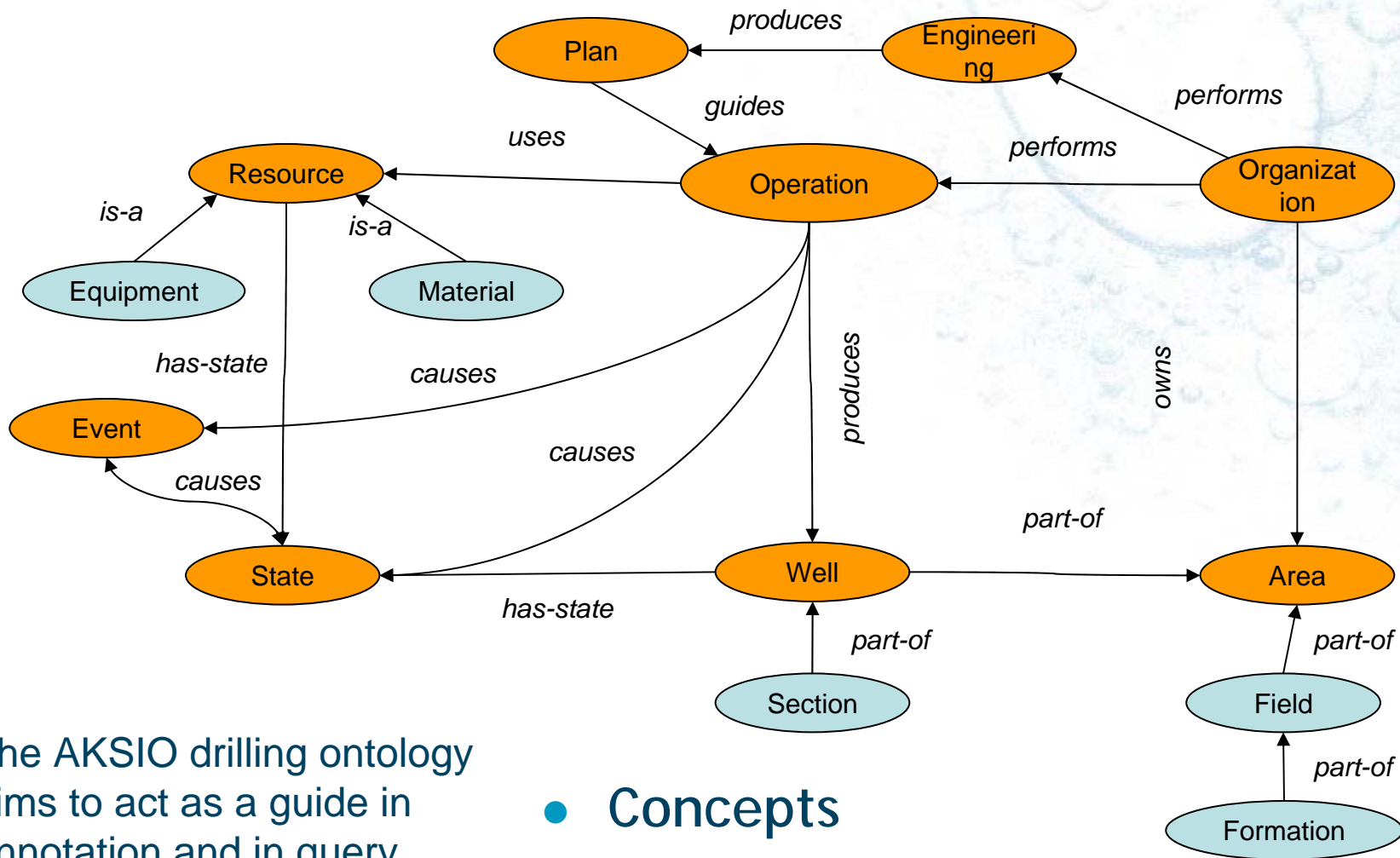


The drilling ontology

- Initial evaluation of existing industry taxonomies as platform for ontology
 - Can be a challenging task, taking years of consortium work to create, and to agree on
 - Exists in the oil sector (Posc Ceasar), but..
 - often don't match the use of the application use
 - possibly too heavy-weight or complex for simple use
 - particular challenges in visualization
 - AKSIO aims to use IIP in the future
- Scoping:
 - Question driven ontology scoping, to create organic approach
 - "Which pressure-related problems are most frequent in this type of geological formation?"



A simple drilling ontology (top-level)

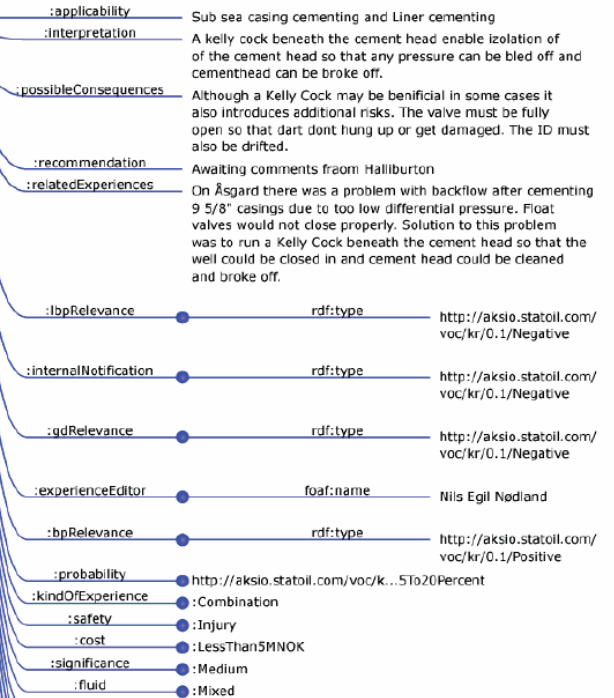


The AKSIO drilling ontology aims to act as a guide in annotation and in query formulation/expansion

- Concepts
- Relations

Knowledge Resource Map

- Original experience report
 - + Discipline leaders' comments
 - + Rich ontology-driven categorization
 - + References to other experiences
 - + References to governing documents
 - + References to experts and other relevant people
 - + Recommended follow-up



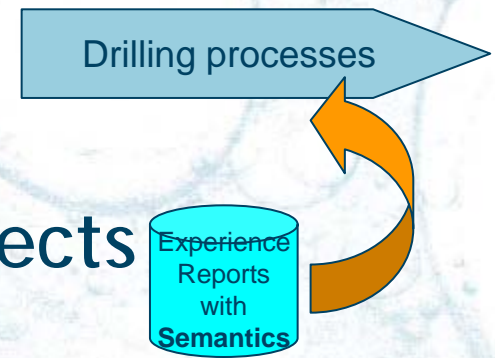
- Interlinked "Web of knowledge and expertise"

Lessons learned (use case 1)

- Screening: Suppress up to 60% of experience reports as irrelevant, too specific, etc.
- Annotation (qualitative assessment): Significantly increased understandability and reuse potential
- Need to semi-automate the annotation
- Hard to navigate in an ontology for the end user
- Move towards using a common drilling ontology

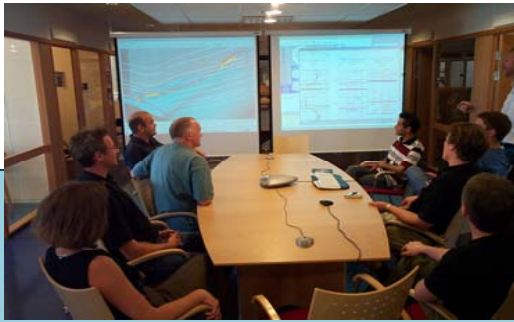
Search and activate knowledge

- Systematic reuse of knowledge from previous drilling projects in planning and executing new projects
- Main ideas
 - Let the context of the use situation suggest what to search for and how to present the results
 - Embed search activation in work process/tools
 - Exploit the ontology-enabled annotation of the experience reports to do smart search

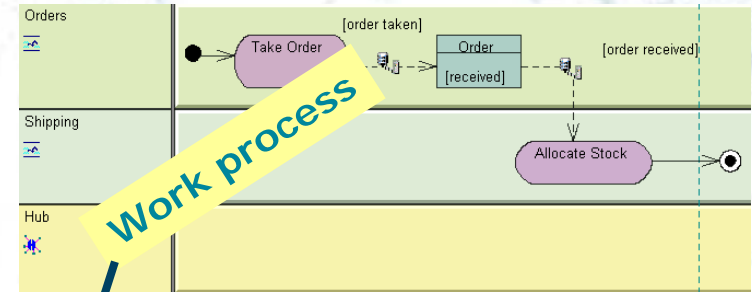


Context-driven knowledge activation

Well planning group
Collaborative decision making



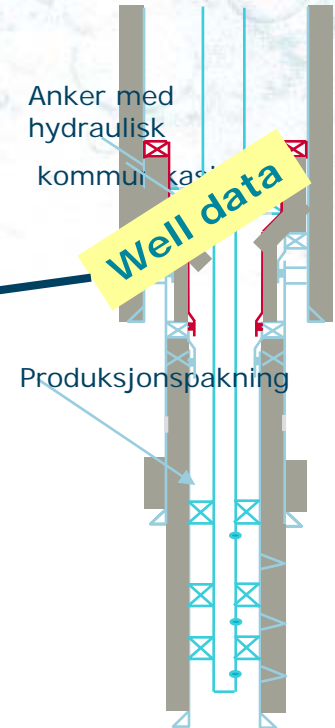
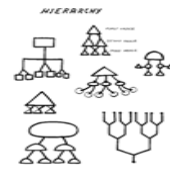
User



Search metadata

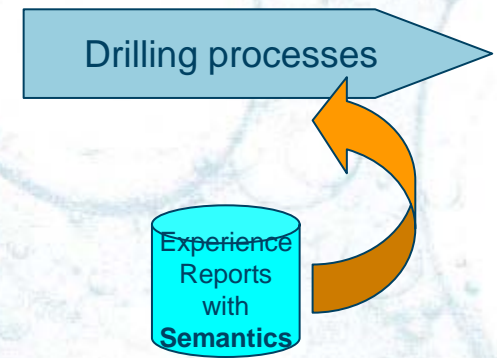
Well data

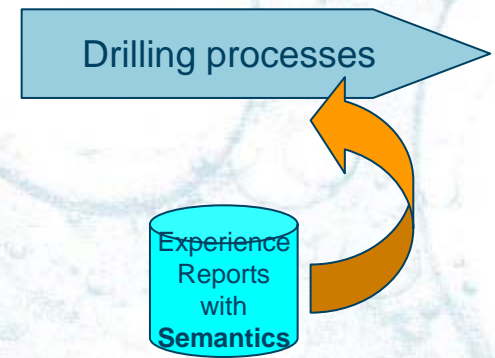
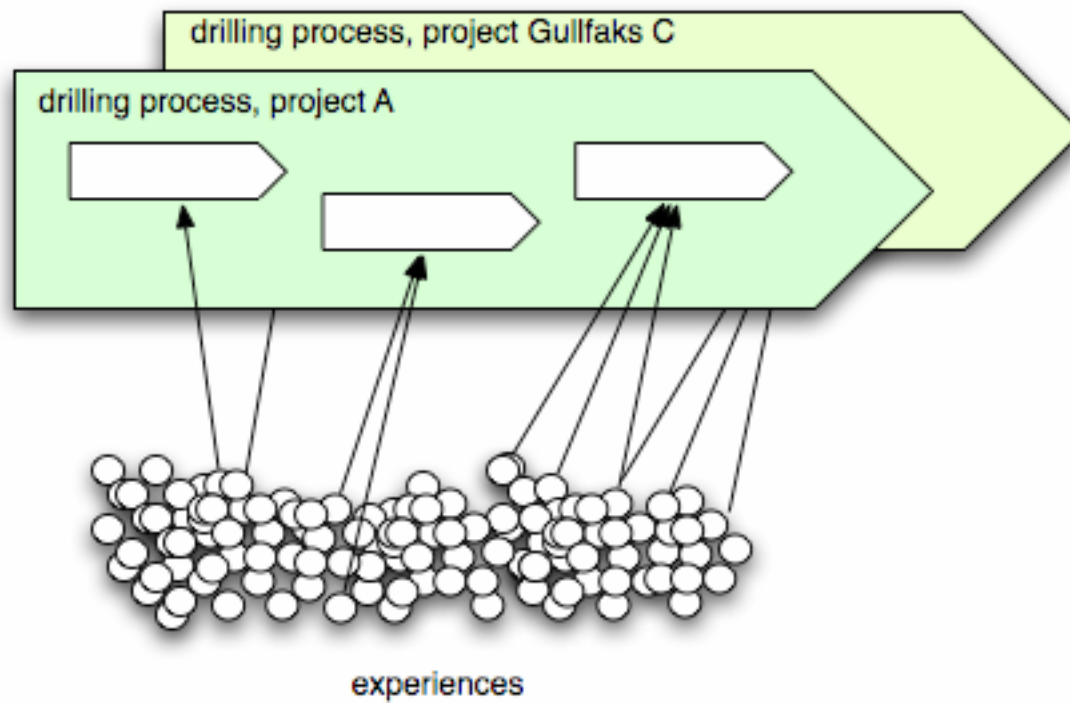
Task-relevant, timely,
and contextualized
information



Challenges

- **How easy is it to extract the contextual information?**
 - How formal is the work process in the first place?
 - In Statoil most is formalized in word documents and excel spreadsheets...
- **Visualizing the results**
 - Clustering - we have more knowledge than Google, so why not use it?





Ontology-enabled active search

- Normal key word search

- Search for experience on *Cementing*

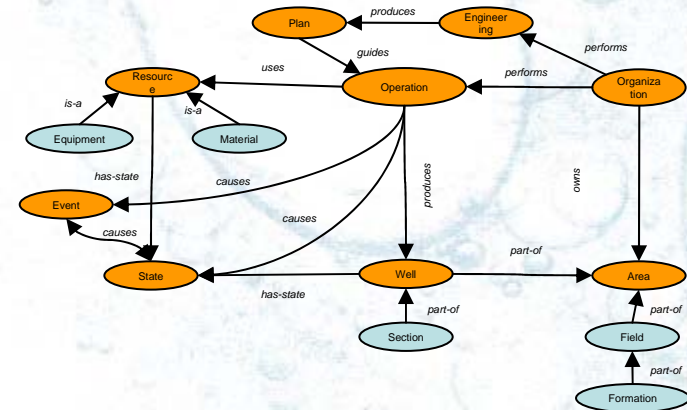
- Query expansion tactics

- Concept specialization and generalization:
e.g.
 - Expanding *Bridge Plug Retainer* to *Cementing*

- Concept relations

e.g

- “Do we have experience with *Gyro* equipment when used for *Wireline* operation”
- “Do we have experiences with *Pack-off* causing *Stuck Pipe*?”
- “Which *pressure* related problems have we met in *Tare formation*?”

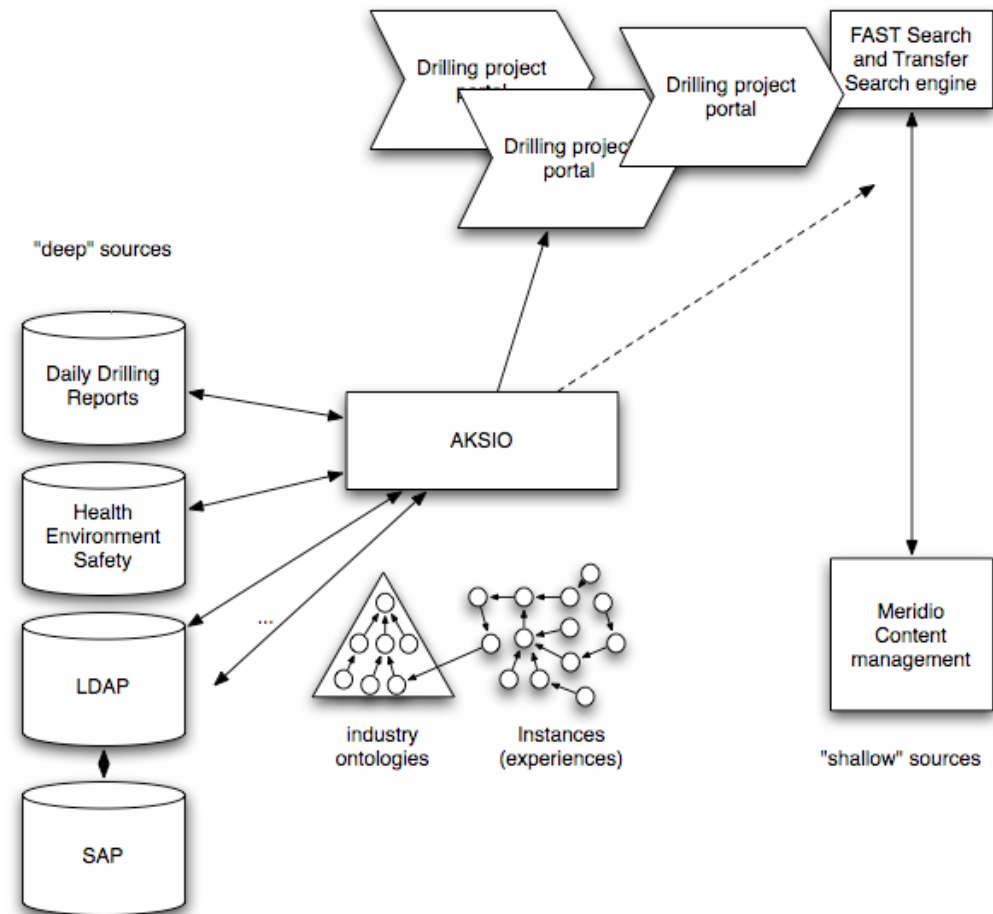


Preliminary experimental results

- **Process 1. Screen and annotate knowledge**
 - Screening: Suppress up to 60% of experience reports as irrelevant, too specific, etc.
 - Annotation (qualitative assessment): Significantly increased understandability and reuse potential
- **Process 2. Search and activate knowledge**
 - Work in progress
 - Expected benefits: Increased and more systematic reuse of knowledge, timely and relevant information
 - Challenge finding the required contextual info

Technical platform

- “Deep” sources
 - Daily drilling report
 - Health Environment Safety
 - LDAP/SAP
- Knowledge map containing ontologies, annotations and references
- Microsoft SharePoint
 - User interface push and tasks generation
- Future indexing by FAST Search & Transfer



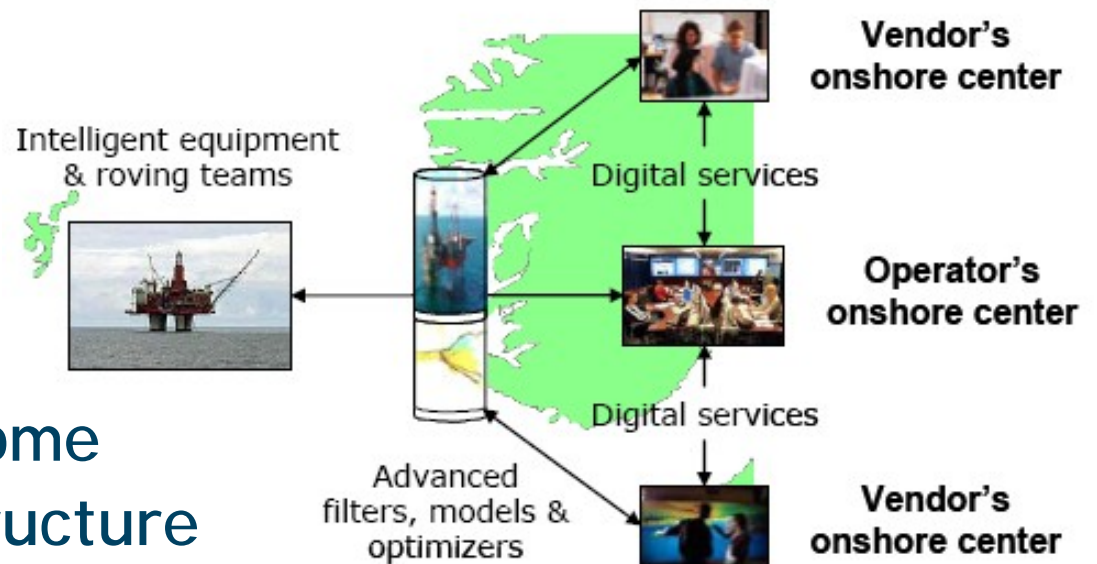
Ongoing tasks

- Semi-automated annotation
- Using other domain ontologies
- Visualization and navigation of search results
- Integration with commercial search tools (FAST)
- Participate in creating a semantic web community in the oil and gas sector
 - Started in April with a two-day conference

Prospects - the Semantic NCS?

- OLF vision for integrated operations

- Integrated operator and vendor centers and delivery chains



- Knowledge and learning must become part of the infrastructure as digital services

- Challenge: sharing knowledge and experiences between organizations in the chain (it is hard enough to share information)

Semantic Web Collaboration

- Aim to create a larger international community in the sector using W3C standards to facilitate interoperability and knowledge transfer in the oil and gas industry
 - Started with a two-day workshop in Stavanger in April
 - Collaborative work involving oil companies, suppliers, research and supporting industries



NTNU



AKSIO acknowledgements

- **NFR PETROMAKS (Pr. no. 163365/S30)**

- 3 year duration: 01.08.2004 - 31.07.2007
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- **Partners**

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- Hydro ASA
- Computas AS
(*Coordinator*)
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(*Subcontractor*)
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- Norges Teknisk-Naturvitenskapelige Universitet (NTNU)
- Universitetsstudiene på Kjeller (UniK)
- Institut Français du Pétrole -
(*Associated*)

Summary

- AKSIO focuses on knowledge management in integrated oil drilling operations
- Uses semantic technology to retrieve knowledge in contextual and timely manner
- The project designs, implements and verifies real scenarios using semantic technology
- Preliminary results are encouraging and point towards future semantic solutions