epsis
Integrated operations

Combining two approaches for ontology building

W3C workshop on Semantic Web in Oil & Gas
Houston, December 8-9, 2008

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Jennifer Sampson, Sr. Ontology Engineer
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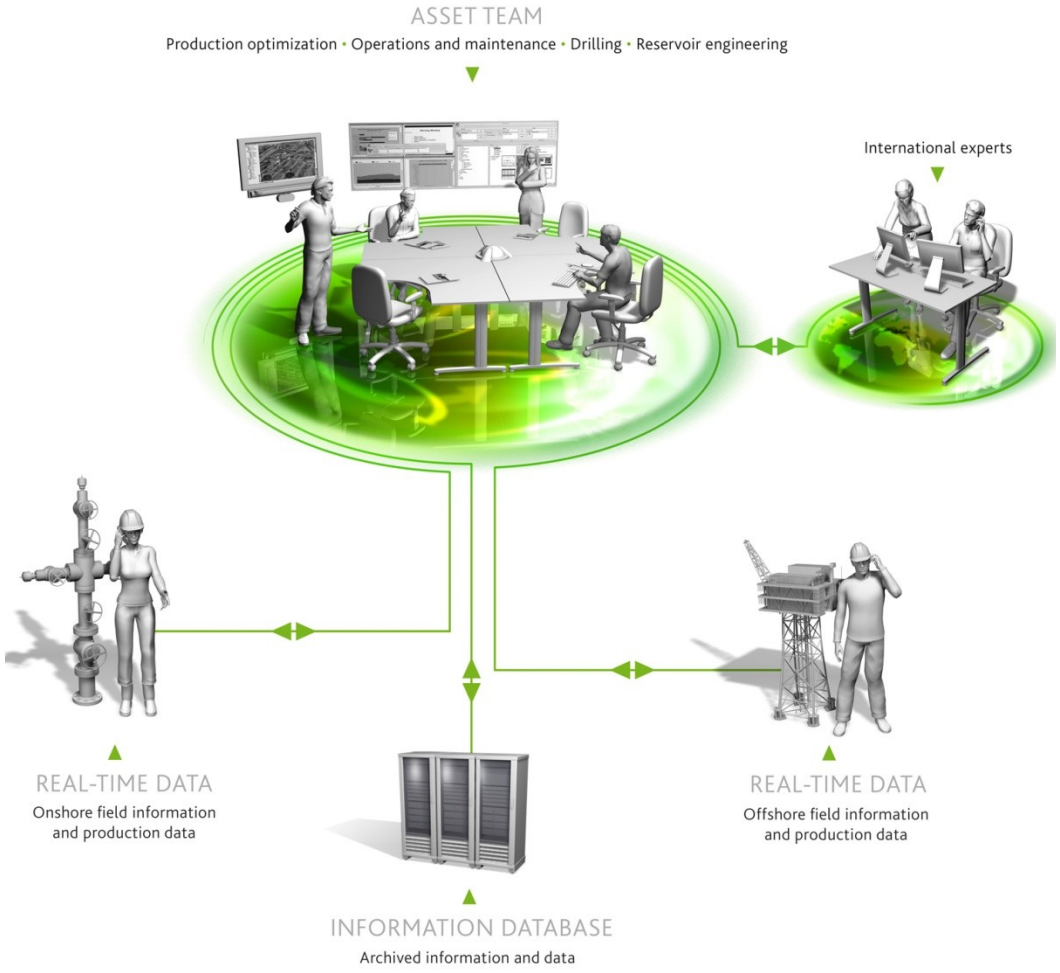
Outline

- About Epsis
- About Integrated Operations
- Informed decision making
- Top-down and bottom-up ontology development
- Examples
- Conclusions

About Epsis

- Solely focused on Integrated Operations
- Based in Bergen, Norway
  - Office downtown Houston
- Established in 2002
- Currently 45 employees
- Solutions:
  - Business consultancy
  - Collaborative solutions
- Technology lines:
  - Collaboration and Visualization Technologies
  - Real-time Decision Support Technologies



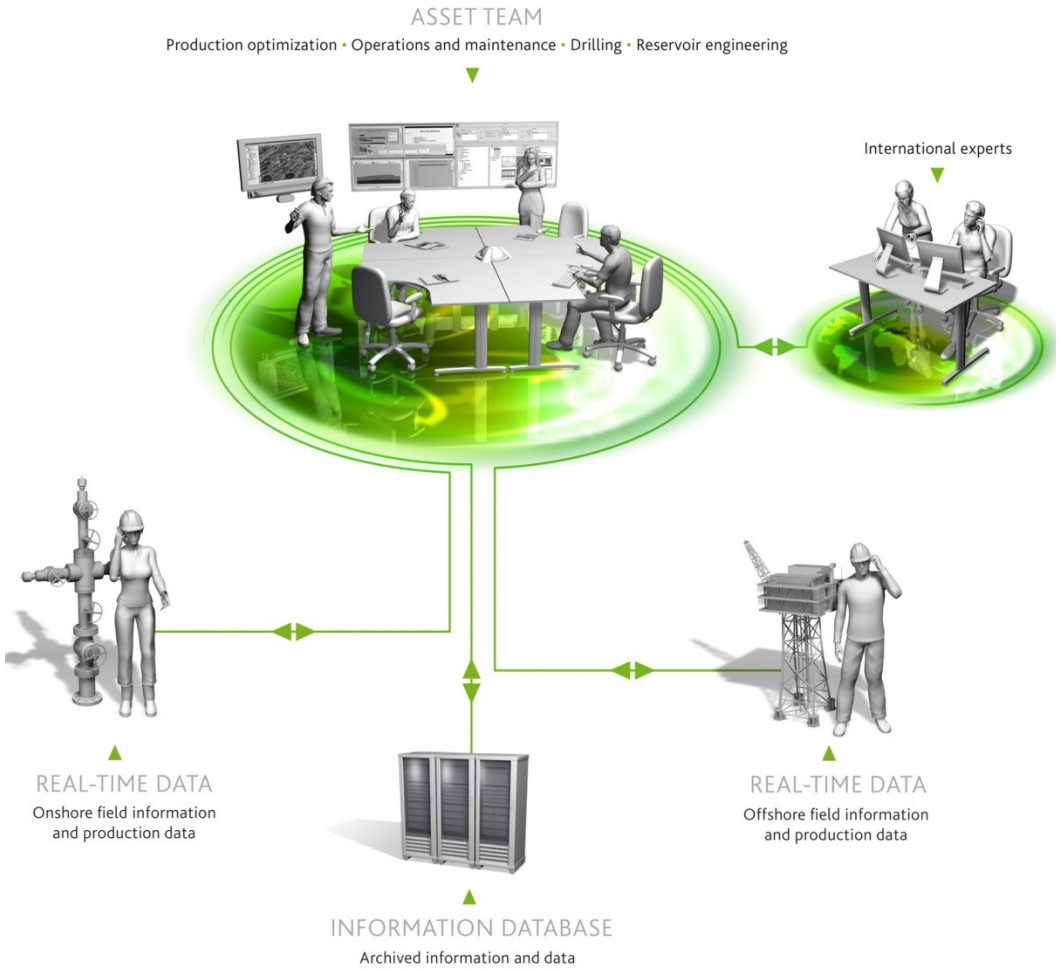
Semantic technologies and projects at EPSIS

- Chairing POSC Caesar Association's (PCA) Special Interest Group for Reservoir and Production
- Extension of Oil and Gas ontology (ISO 15926)
  - Reservoir and Production
    - Include Daily & Monthly Production Reporting (done)
    - Extension for production optimization (on going)
    - Refinement for automatic reasoning using Smart Agents
  - Health, Safety and Environment
    - EnvironmentWeb terminology in PCA's RDL (current)
  - Operations and Maintenance
    - Assist DNV with extending ISO 15926 (current)
- Pilot for Reservoir and Production for Integrated Operations in the High North JIP

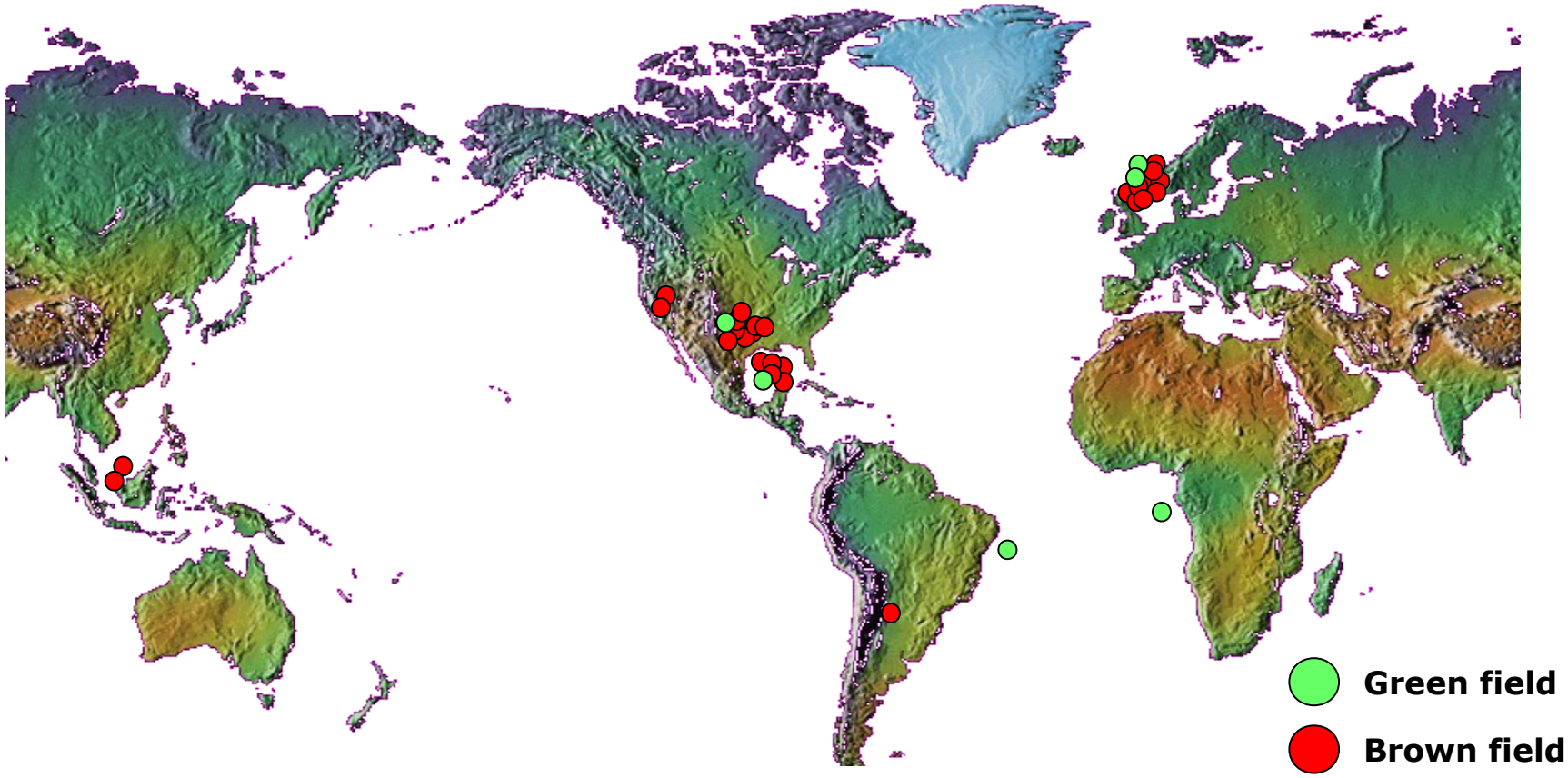
Integrated Operations: what is it?

Integrated Operations (IO) is the integration of people, processes, and technology to make and execute better decisions faster. It is enabled by the use of real time data, collaborative technologies, and multi-disciplinary work flows.

Similar to i-Field, Smart Field, Field of the Future, Digital Oil Field of the Future,...



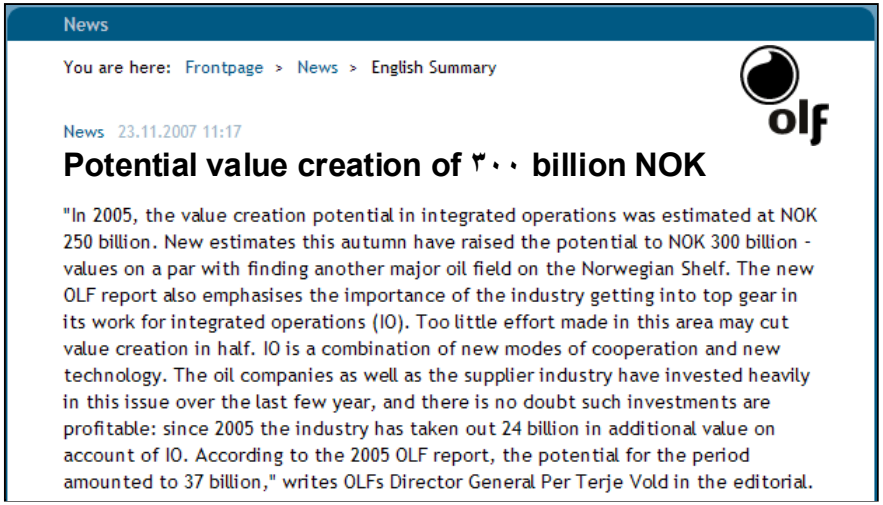
Epsis has been part of about 50 assessments of opportunities within Integrated Operations worldwide



Business Case for Integrated Operations:
The assessment on the Norwegian Continental Shelf

- Value creation potential of Integrated Operations on Norwegian Continental Shelf (NCS) estimated at: **42 billion USD**

- Focused elements:
  - Increased reserves
  - Accelerated Production
  - Reduced Operation costs
  - Reduced Drilling costs



News

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olf

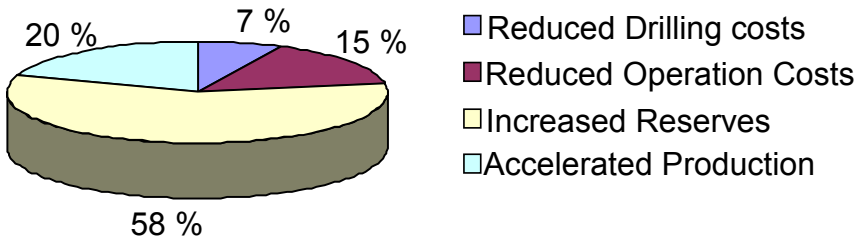
News 23.11.2007 11:17

Potential value creation of ٣٠٠ billion NOK

"In 2005, the value creation potential in integrated operations was estimated at NOK 250 billion. New estimates this autumn have raised the potential to NOK 300 billion - values on a par with finding another major oil field on the Norwegian Shelf. The new OLF report also emphasises the importance of the industry getting into top gear in its work for integrated operations (IO). Too little effort made in this area may cut value creation in half. IO is a combination of new modes of cooperation and new technology. The oil companies as well as the supplier industry have invested heavily in this issue over the last few year, and there is no doubt such investments are profitable: since 2005 the industry has taken out 24 billion in additional value on account of IO. According to the 2005 OLF report, the potential for the period amounted to 37 billion," writes OLFs Director General Per Terje Vold in the editorial.

Study from the Norwegian Oil Industry Association (OLF, www.olf.no).
Oil prices used: 50 USD/bbl (2008) to 30 USD/bbl (2015)
Net Present Value over the next 10 years (7% discount rate)

Value distribution



Integrated Operations: Generations

Focus: Optimization

GENERATION 2:
Data-to-Information
Intelligent Prediction
Smart agents
Integrated scheduling

era decide

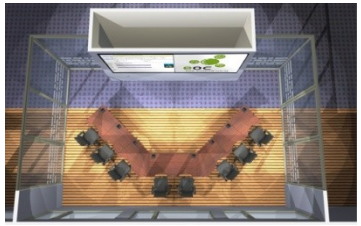
Focus: Collaboration

GENERATION 1:
Work process mgmt.
Collaboration
Visualization

era connect

era visual

GENERATION 0:
Collaboration Centers
Data infrastructure
Change management



Focus: Infrastructure

Modified after olf

Integrated Operations: Current status

Generalized – regional differences may occur

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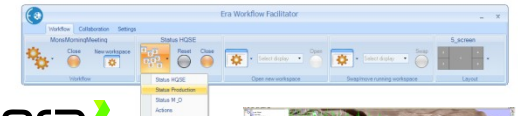

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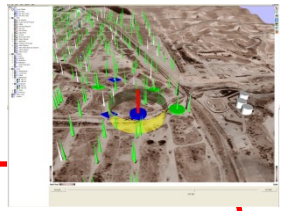

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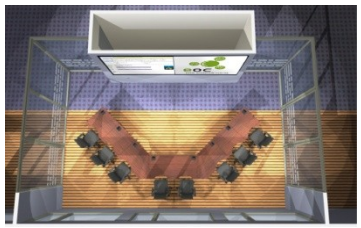

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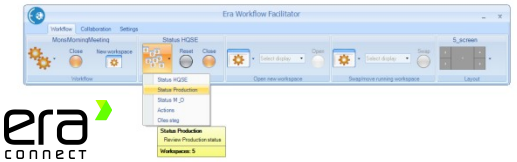

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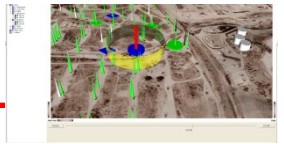

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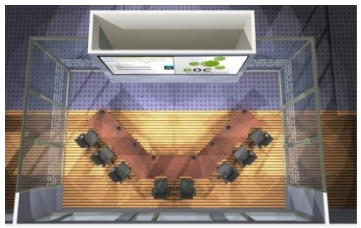

Focus: Infrastructure

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Biggest gain yet to come!

Focus: Optimization

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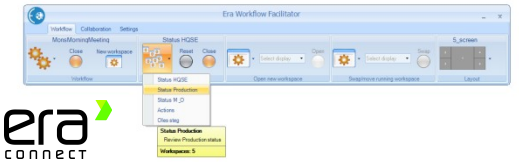

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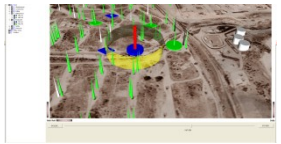

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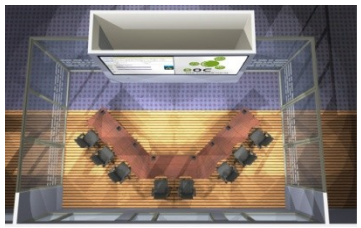
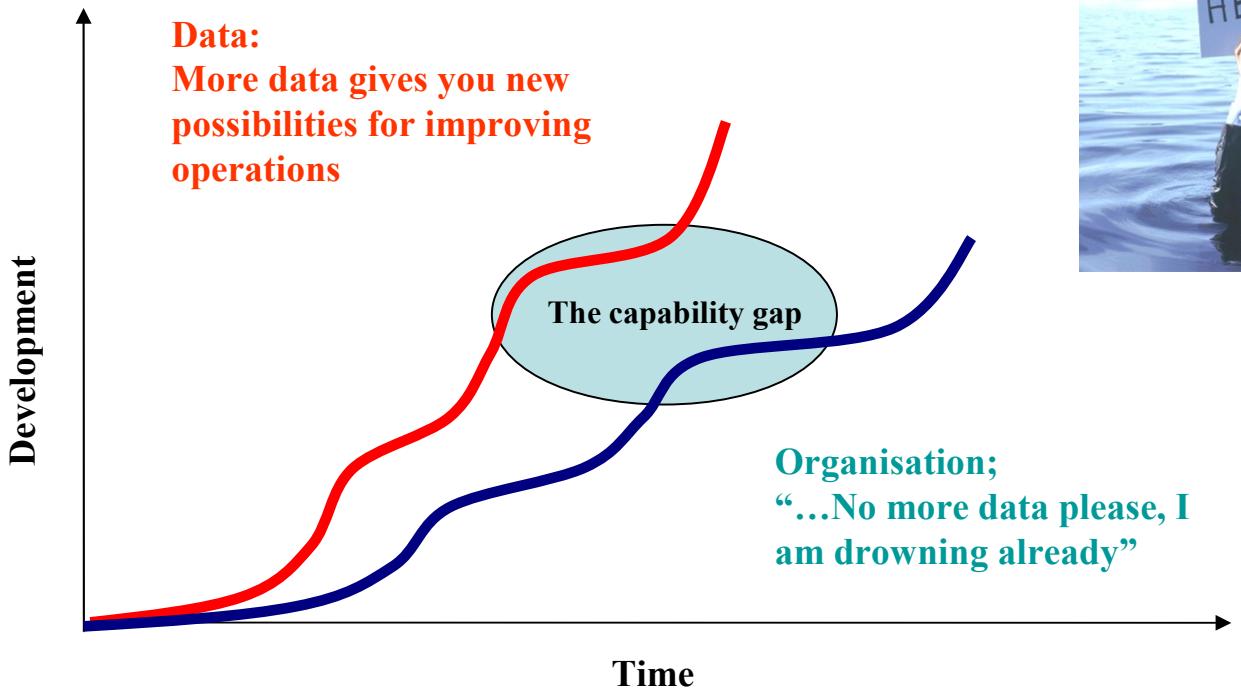


Focus: Infrastructure

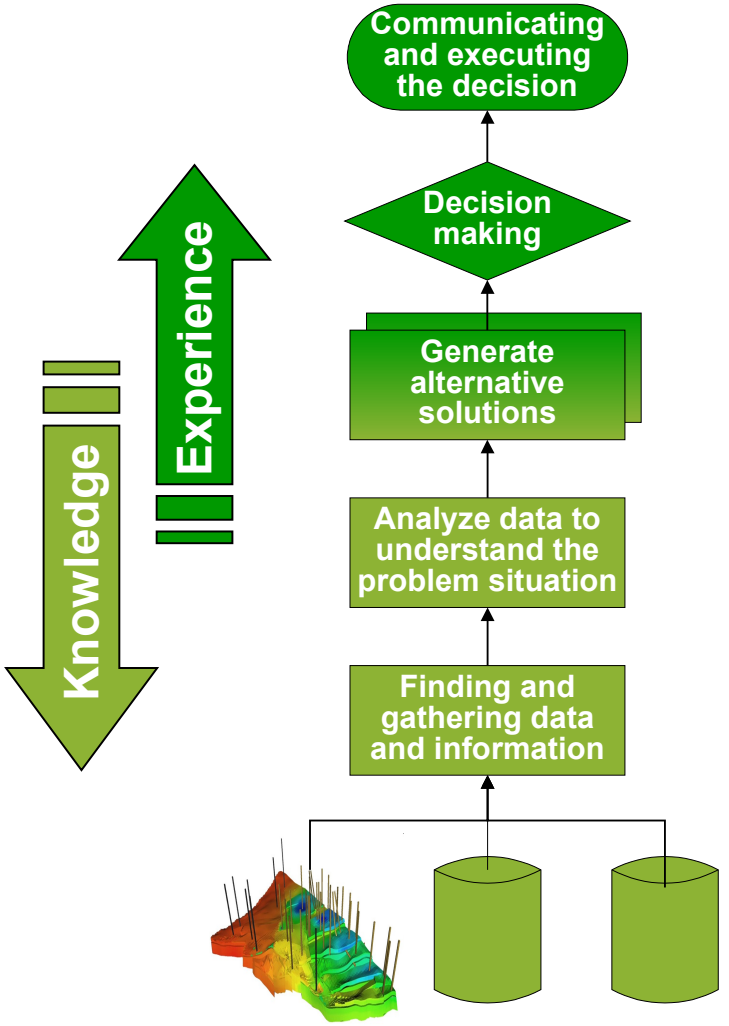
Modified after olf

One of the main challenges is “data overload”

- Terabytes / Petabytes of data are available!
- Processing capabilities (tools/resources) have not seen a proportional increase



Solution: better informed decision making



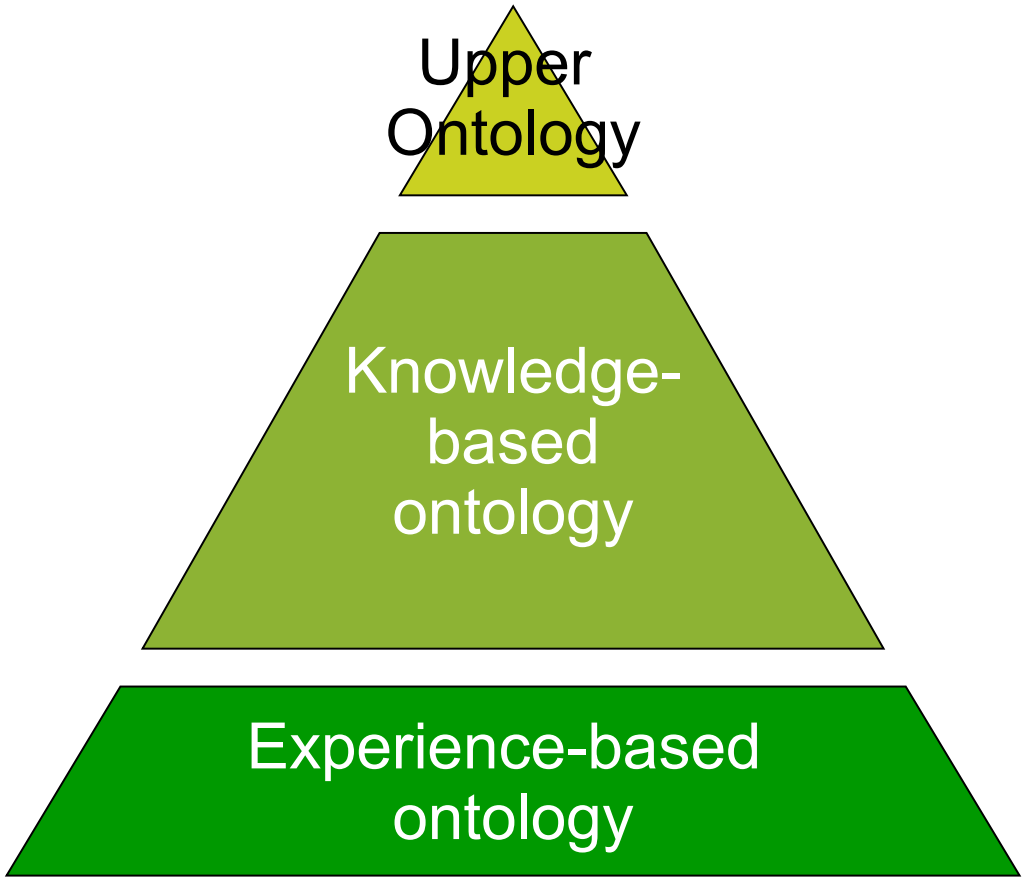
- Typical decision making for science-based professions
- Specialists apply both **knowledge** and **experience** for informed decisions making
- First part mainly knowledge gathering
- Second part more based on experience
- Both parts important for efficient decision making

Typical questions to be answered

Knowledge

Experience

Two approaches for ontology building:
Top-down and Bottom-up approach

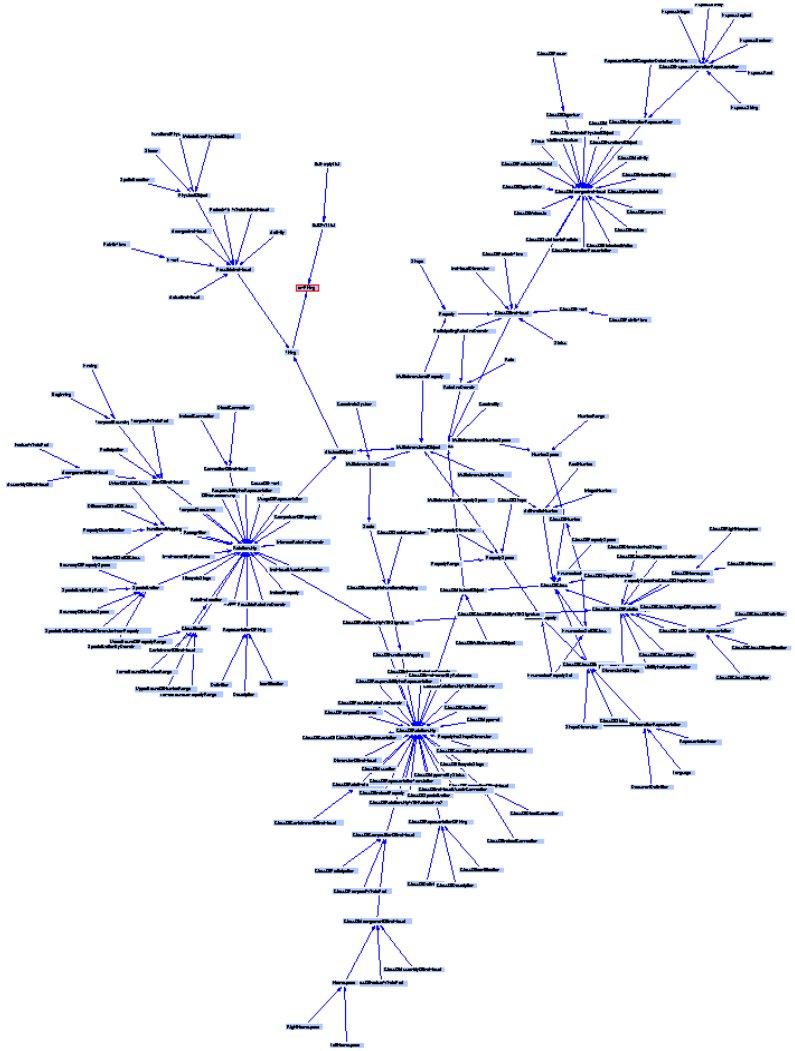


Top-down ontology:
- Knowledge representation
- Static
- Rich semantics
- Non-competitive, open standard
- Ensures interoperability

Bottom-up ontology:
- Captures experience
- Close to application
- Dynamic
- Less structured
- Competitive, proprietary

Top Down Approach Example

- Environment Web Ontology development



Environment Web Project Background

- Official database for emissions and discharges from the offshore oil and gas industry
- Operated by EPIM and OLF (Norwegian Oil Industry Association)
- Used by the authorities and industry
- The purpose of the project is to include terms and definitions from the EW database and EW reporting systems in the ISO 15926 (RDL)

EW to ISO 15926 – Top down approach

- We create an EW ontology which, after a QA process, is uploaded to part 4 of the ISO 15926 standard
- The new EW terms in part 4 are linked to the upper ontology (part 2 of the ISO 15926).
  - EW terms in the RDS can be used as a reference point for all systems using EW terms
  - Interoperability with other reporting systems
  - Annotate EW reports using ISO 15926 definitions

Top down approach

Domain Experts Discussion/information sessions

EW Database + XML schema

Guidelines + Info duty regulations

(Årlige Utslippsrapporteringen)

Extracted list of new terms to be added to the ISO 15926 (RDL)

Existing EW terms in RDL

New EW terms with textual definitions

ISO 15926

Check Part 2 - Upper ontology

What kind of thing is this in ISO 15926?

Upload of EW terms to ISO 15926 RDL

QA of new terms and definitions

Example set of new concepts

ACUTE POLLUTION	class_of_compound	An environmentally hazardous compound, such as chemicals, oil or gas, that is accidentally discharged to the environment, and that must be reportec
ACUTE POLLUTION TO SEA	class_of_compound	An environmentally hazardous compound, such as chemicals, oil or gas, that is accidentally discharged to sea and that must be reported according to
ACUTE OIL POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of oil.
ACUTE DIESEL OIL POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of diesel oil.
ACUTE CRUDE OIL POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of crude oil.
ACUTE FUEL OIL POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of fuel oil.
ACUTE WASTE OIL POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of waste oil.
ACUTE OIL POLLUTION TO SEA OTHER THAN DIESEL OR CRUDE OIL OR WASTE	class_of_compound	An ACUTE POLLUTION TO SEA that consists of oil. other than diesel, crude oil, fuel oil, or waste oil.
ACUTE CHEMICALS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of chemicals.
ACUTE CORROSIVE CHEMICALS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of corrosive chemicals.
ACUTE ENVIROTOXINS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of environmental toxins.
ACUTE CHEMICAL POLLUTION TO SEA OTHER THAN CORROSIVE CHEMICALS OI	class_of_compound	An ACUTE POLLUTION TO SEA that consists of chemicals, where the discharged chemicals can not be classified as corrosive chemicals, envirotoxi
ACUTE OIL BASED DRILLING FLUIDS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of oil based drilling fluids.
ACUTE WATER BASED DRILLING FLUIDS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of oil based drilling fluids.
ACUTE SYNTHETIC DRILLING FLUIDS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of synthetic drilling fluids.
ACUTE NON OIL BASED DRILLING FLUIDS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of non-oil based drilling fluids.
ACUTE FLAMMABLE CHEMICALS POLLUTION TO SEA	class_of_compound	An ACUTE POLLUTION TO SEA that consists of flammable chemicals.
ACUTE POLLUTION TO AIR	class_of_compound	Gas that is accidentally discharged to the environment and that must be reported according to relevant environmental regulations.
ENVIRONMENTAL TOXIN	class_of_compound	Environmental toxins are any chemical or substance that are toxic, slowly degradable and/or accumulates in living organ

RDL - explorer

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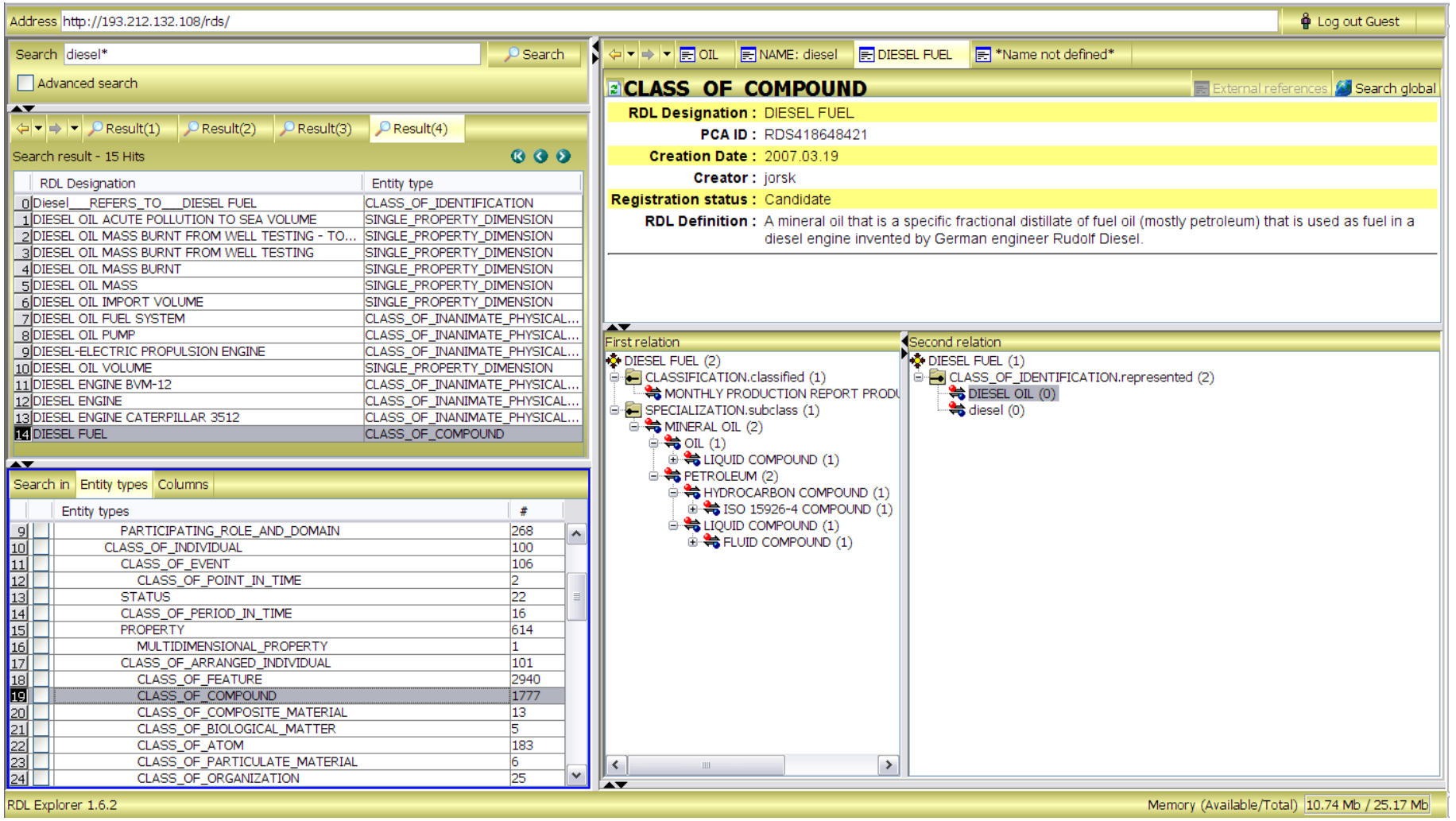
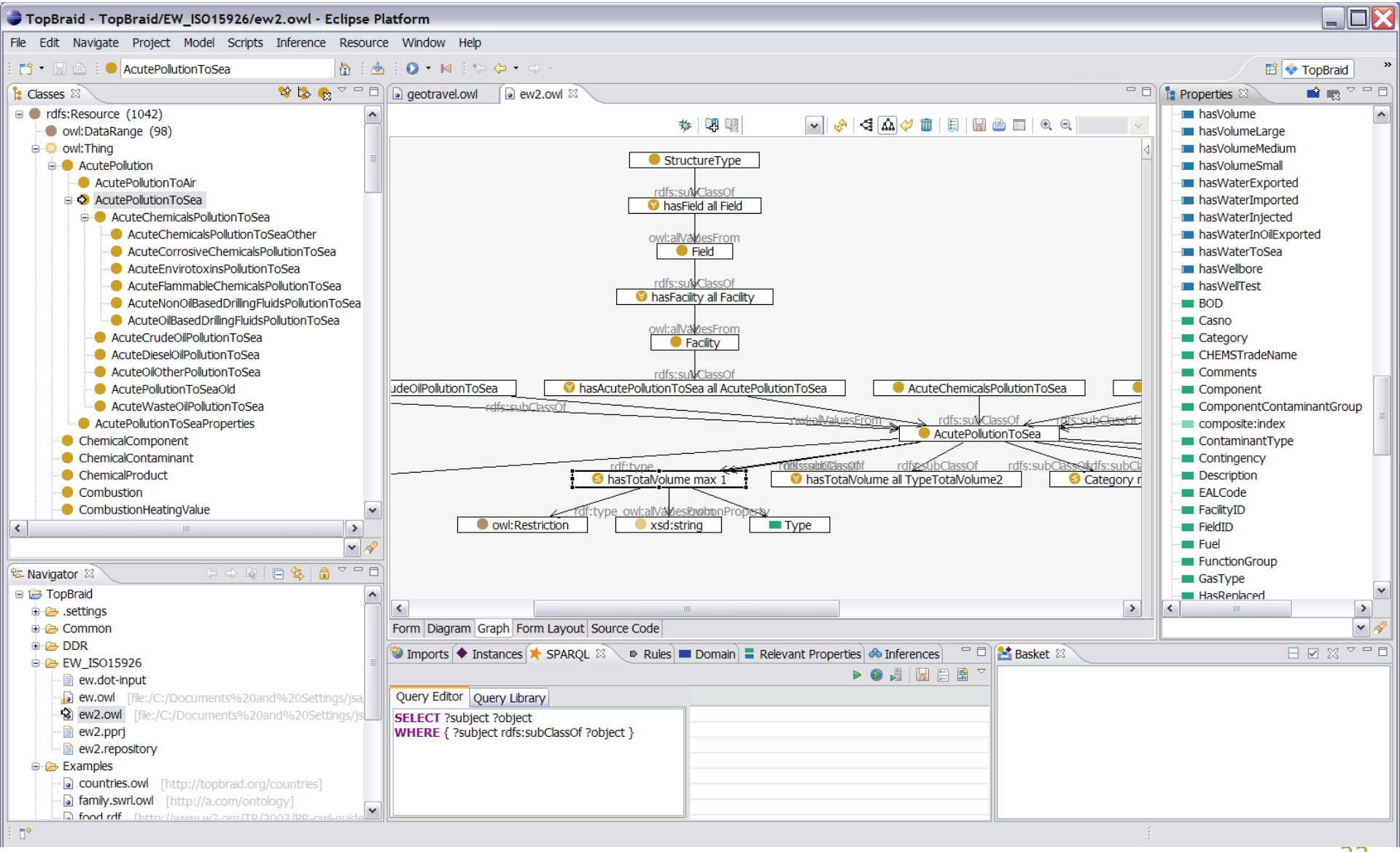


Examples

- "Hazardous waste is not Acute Pollution,
  …i*t consists of various waste streams collected onboard platforms with hazardous environmental properties which make them illegal to discharge."*
  - e.g. drainage water from the platforms containing oil is collected onboard and sent to land for further treatment. Another example is drilling cuttings with drilling mud.

    But…
- *"If Hazardous waste is accidentally discharged to sea, it is reported as an Acute pollution in EW."*
  - e.g. oily drill cuttings which were injected into the seafloor at Visund was reported as Acute Pollution in 2007, when it was discovered that the storage in the ground leaked to the sea floor surface.

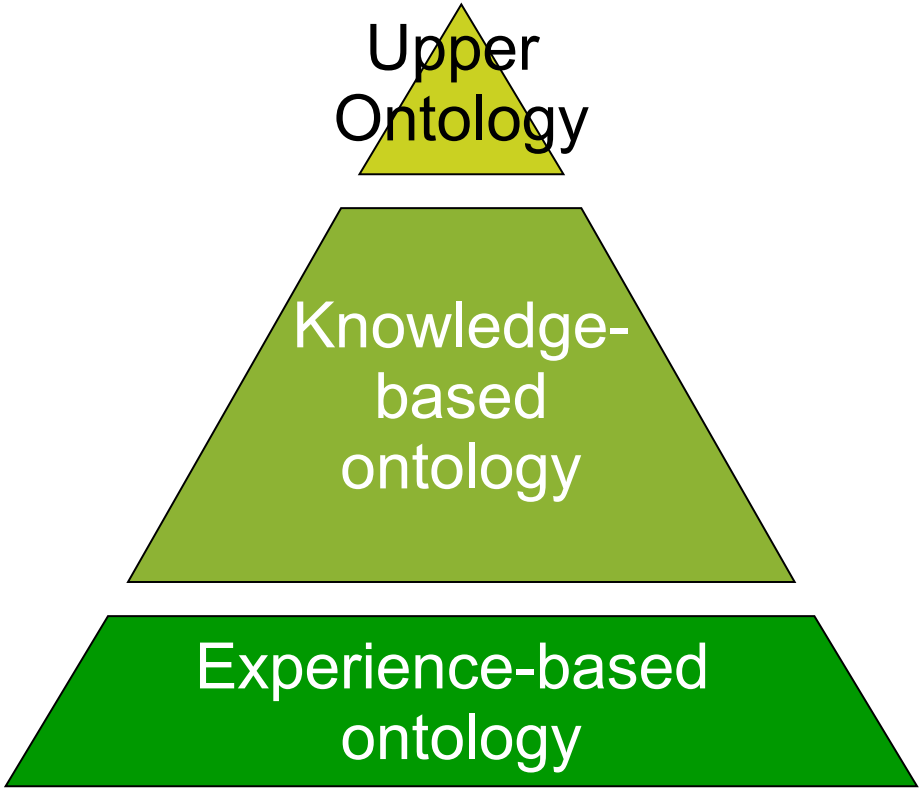


Bottom-up approach: Crime investigation tool for Dutch police

- Domain issues
  - Aspects: 2 ontologies: crime and law
  - Scope: crime scene scenarios on 5 distinguished levels of organizational detail
- Vocabulary issues
  - Concepts and properties
    - Offenders, victims, goods, resources
  - Concepts and relations
    - Scenarios
    - Heuristics and pattern comparison; serial behavior
- Modeling issues; building the ontology interactively
  - BRAINS system for crime investigation
  - Completing a model by (i.e. finding missing components/property values)
    - Text mining
    - Semantic pattern recognition

Crime investigation

Advantages of combined approach



- Two complementary approaches
- Top-down approach:
  - Knowledge representation
  - Rich Semantics
  - Open standard
  - Interoperability
- Bottom-up approach:
  - Captures experience
  - Close to application
  - Dynamic

Conclusions

- Integrated Operations status:
  - IT infrastructure in place
  - Collaborative workflows currently being implemented
  - Next step: solving data overload challenge
- Informed decision making is based on knowledge and experience
- Two approaches to ontology building:
  - Top-down approach:
    - Suitable for knowledge representation in a specific domain
  - Bottom-up approach:
    - Suitable for capturing experience from a group of individuals

Questions / comments

Bottom-Up approach: Methodology

- Domain issues
  - Aspects: Which viewpoints do I need to distinguish?
  - Scope: What level of detail/specialisation do I need to consider?
- Vocabulary issues
  - Concepts and properties
    - What (concepts and propositions) are we talking about?
  - Concepts and relations
    - What kind of topologies of concepts are allowed?
    - What kind of dependencies exist between properties? (mathematical, statistical, heuristics, …)
- Modeling issues; building the ontology interactively
  - Building a model by instantiating concepts in components
  - Interactively building the model by:
    - Applying property dependencies
    - Comparing model structures