DNV·GL

Digital Solutions

# DL for industrial applications: A wishlist

## DL 2019 Industry Panel

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# Wishes for improved reasoning services

- Use module hierarchies
- Support change management
- Optimise for different tasks

# Aibel's MMD ontology: A success story

80 000 classes, 200 ontologies in an imports hierarchy

Upper ontology ISO 15926, PAV, SKOS

Core modules Textbook definitions

Industry standards Normative specifications

Project designs Specialised classes to plant specifications

Product types For procurement; manufactured types

DL reasoning is a necessity; OWL 2 is the basic language.

# The enterprise ontology – vocabulary

Vocabulary development:

- Align vocabularies across domains, disciplines, standards
- Avoid duplicate definitions
- Build a sound hierarchy of modules

Recent OWL *explanation* facilities have great value.

# The enterprise ontology – asset models

Example of MMD supported project: “Johan Sverdrup DP” offshore plant

- 3,200 piping product classes
- 550,000 piping product individuals

The industry needs “lifecycle” asset models, built on DL semantics

# The enterprise ontology – usage

Ambition: Automate complex, but trivial work.

- Capture requirements in a formal language
- Validate solutions – the asset in development and operation

We need a reference vocabulary for integration across project/plant lifecycle, between disciplines, between stakeholders and vendors, and across thousands of specialised software applications.

# Obstacles to adoption of ontologies in industry

- Lack of people who understand formal vocabularies
  - ontology specialists
  - domain specialists
- Managing modules – methods and tools
  - QA toolkit?
- Integration with industrial applications and databases

# Need for standardisation through industry bodies

The bulk of terminology used to describe industrial artefacts and processes is subject to standardisation.

A comprehensive turn to ontologies for industrial data will require the current standards organisations, like ISO, IEC and others, to be directly engaged in creating, publishing, and maintaining ontologies. Current efforts are small-scale and limited to upper ontologies.

This will require a trusted framework of methods and software

- toolkits for building comprehensive, sound vocabularies
- reasoning support to find solutions and exchange results

# Wish: Managing the hierarchy of ontologies

In an industry that adopts ontologies at a large scale, there will be thousands of modules. We need reasoning tools to support building sound hierarchies.

- control dependencies
- define subsets for special purposes

For example

- if an axiom is moved from one module to another, the meaning is unchanged – but this means a lot to later updates
- redefinition of a class in a subordinate module is unhealthy – identify and suggest a fix

# Wish: Managing ontology change

With two ontologies, find

- difference – what changed between versions?
- union – what follows from both?

The modular ontology evolves with updates at different intervals

Upper ontology and Core *Should be* rare

Industry Standards 5 years

Designs and products Daily additions

How to see what changed between two versions of an ontology hierarchy?

# Wish: Faster reasoning

- "Pre-compile" that which rarely changes
  - Upper and core modules
  - Modelling patterns for common facts
- Support common constructs that OWL handles poorly
  - E.g., temperature/pressure curve approximations
- Support for asset models – large number of individuals

# Wish: Extended language

- "Diamond" patterns in class definitions
  - as in, a class of equipment defined according to role in processes
- Normative modalities
  - as in, accepted deviation from requirements without inconsistency

# Thanks!

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