

DL @ Aibel

DL 2019 Industry Panel, June 19th

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About Aibel

- Aibel AS is a leading supplier of services related to oil, gas and renewable energy
- Around 4,000 employees
- More than a hundred years of proud history
- A global company with roots in Norway

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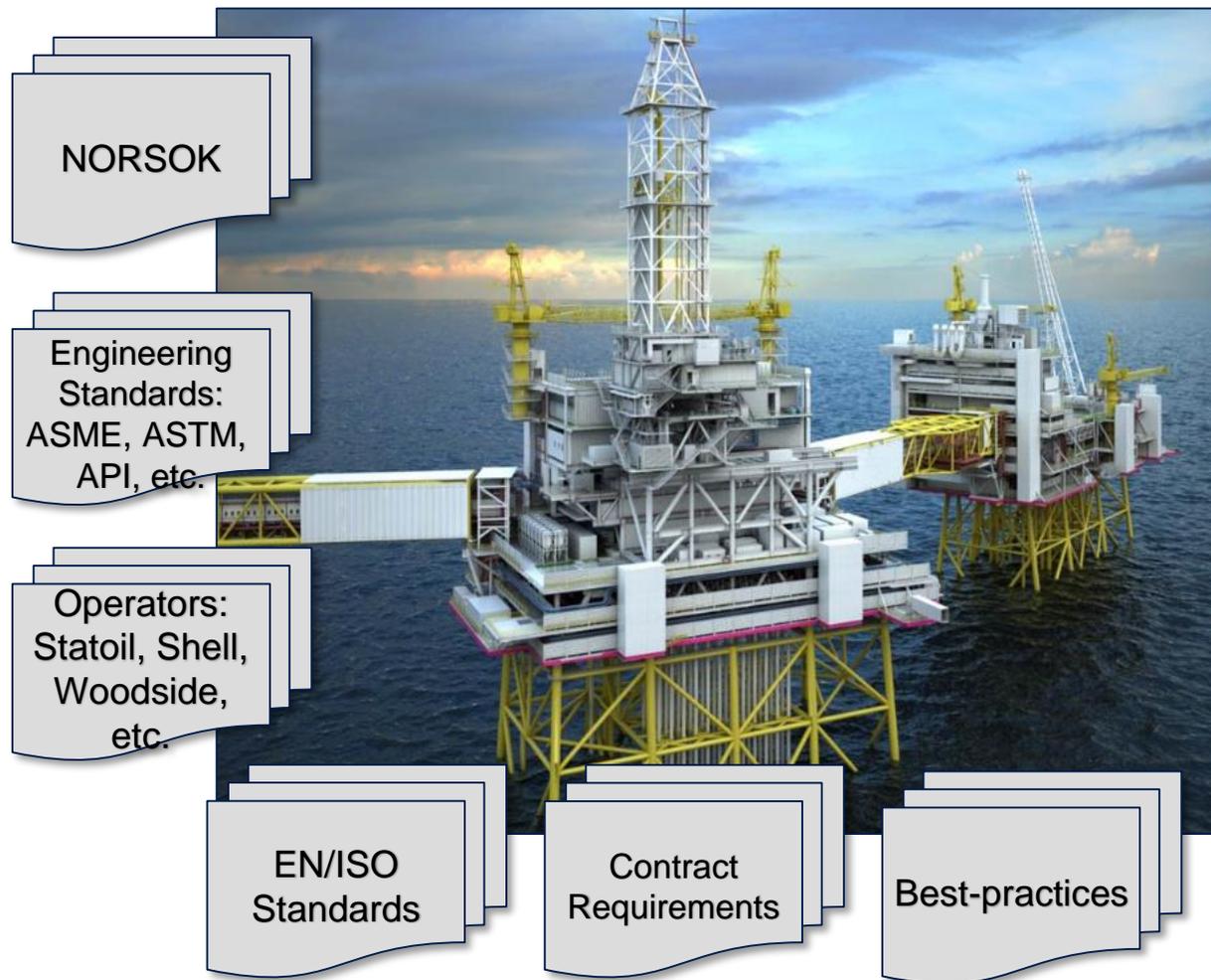
Company overview

- Annual turnover of approximately 10 billion NOK – among Norway's 100 largest companies
- Long term maintenance and modifications contracts
- Present on half of the offshore installations and 4 onshore terminals in Norway
- Deliver new platforms and modules
- Successfully entered into offshore wind market

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Managing Complex Requirements



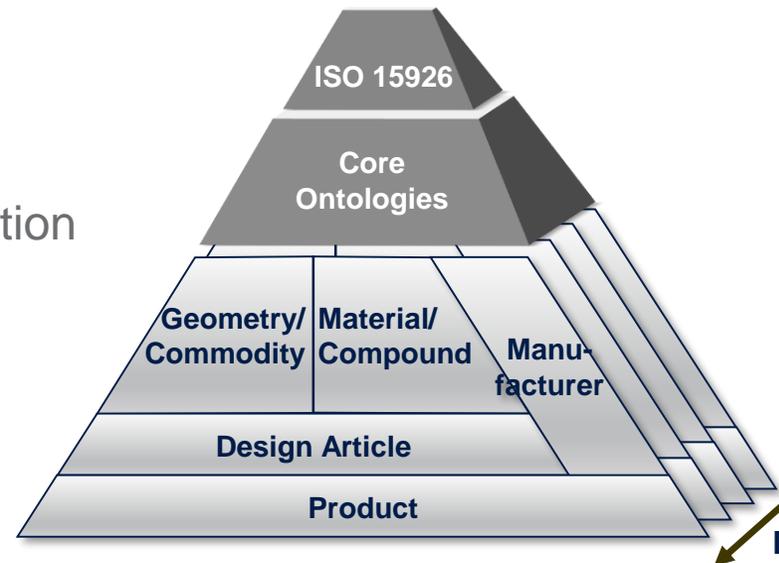
- Types
- Geometry
- Pressure classes
- Fire classes
- Explosion ratings
- Materials
- Certificates
- Manufacturers
- Revisions
- +++



Cost Estimates
Material Catalogs
Interchangeability
Efficiency
Digitalization
Reuse
Data Exchange
Master Data
Automation

The Material Master Data (MMD) Ontology

- Expressed in OWL 2.0
- Modular: 230+ ontology modules
 - Imports public ontologies whenever possible: SKOS, PAV, ++
- Focus on *classes* (T-box) rather than *individuals* (A-box)
- Three primary sources:
 - Protégé/Turtle files
 - Excel-/database tables
 - Programmatically generation
- Focus on *reasoning*:
 - Consistency checks
 - DL queries



Key Figures

Axioms	1.840.769
Logical axioms	535.512
Declaration axioms	106.674
Class count	98.133
Object property count	135
Data property count	723
Individual count	20.412
SubClassOf	505.376
EquivalentClasses	745
DisjointClasses	27
AnnotationAssertion	1.198.266

DL expressivity ~ *SHOIQ*

The World's Largest
Industrial Ontology...?

Engineering Domains: Piping, Structural, etc.

Annotations Usage

Annotations: ASME B16.5 Pipe Flange NPS 1 1/2 CL150 Weld Neck Raised Face

Annotations +

rdfs:label [type: xsd:string]

ASME B16.5 Pipe Flange NPS 1 1/2 CL150 Weld Neck Raised Face

rdfs:comment [type: xsd:string]

Design article weights are calculated using the same formular based on actual wall thickness and density.

Abbreviation [type: xsd:string]

FLW

'CAD Description - Geometry' [type: xsd:string]

FLG WN CL150 RF

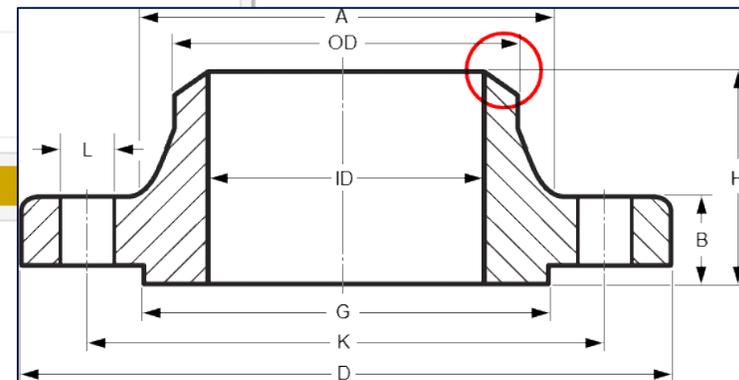
Description: ASME B16.5 Pipe Flange NPS 1 1/2 CL150 Weld Neck Raised Face

Equivalent To +

SubClass Of +

- 'ASME B16.5 Pipe Flange NPS 1 1/2 CL 150'
- 'has Flange Hub' some 'ASME B16.5 Weld Neck Flange Hub'
- 'has Flanged End' some 'ASME B16.5 Raised Face Flange Face NPS 1 1/2 CL150'
- 'has Pipe End' some 'ASME B16.5 NPS 1 1/2 Butt welding end'
- 'Metal Volume Based on Geometry dm^3' value "0.333"^^xsd:double
- 'Pipe Flange Weld Neck'
- 'Raised face height_mm' value "2.0"^^xsd:double
- 'Specified Length Through Hub mm' value "60.0"^^xsd:double
- 'Specified Outside Diameter of Flange mm' value "125.0"^^xsd:double
- 'Specified Thickness of Flange mm' value "15.9"^^xsd:double
- 'Surface Area_dm^2' value "3.13"^^xsd:double
- 'Wall Thickness Base for Metal Volume mm' value "3.68"^^xsd:double

General class axioms +



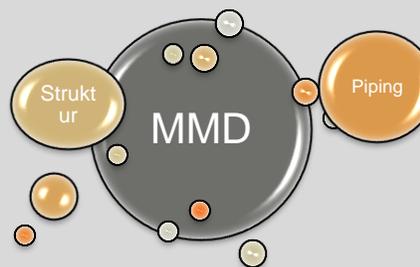
The MMD System

Hermit
OWL 2 Reasoner Service

AVEVA™



Export to Engineering,
CAD & ERP



Oracle 12 Database
+ Spatial & Graph

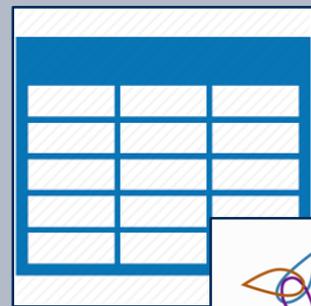
WSH LO DIN25201 M20 TR3101 A4 200HV

Item	Item Name	Item Description	Item Code	Item Status
1	WSH LO DIN25201 M20 TR3101 A4 200HV			

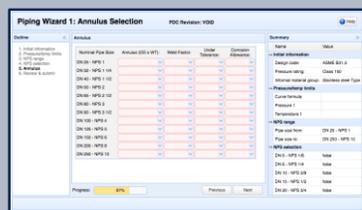
```
Query class expression()
"Pipe Flange" and
"Pressure Rated Object CL300" and
"has Flange End some 'AGRE B1.6.5 Gasket Contact Face'" and
"has Flange Hub" some "Well Neck Flange Hub" and
"has Pipe End some 'AGRE B1.6.5 Bolt Welding End'" and
"Nominal Pipe Size" some xcc:double(1..63)
```

Linked Data Publishing
and DL Queries

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Ontology Development



Bulk Creation of
Design Articles & Products

Gains

- Data quality (elimination of duplicates)
- Material catalogs containing only valid components
- Reduced ordering of incorrect components
- Basis for decision support/automation
- Basis for semantic Digital Twin

Pains

- Reasoning performance (HermiT classification currently takes ~20 minutes)
- Reasoning over ontology & huge number of individuals
- Interface/abstraction between ontology and software
- Specification/extraction of ontology subsets
- Temporal reasoning/lifecycle considerations

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