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ISO/TC 184/ SC4 “Ontology-based interoperability”

PCA community update

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Lars Berthinussen

Oslo
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From documents-based approach ….

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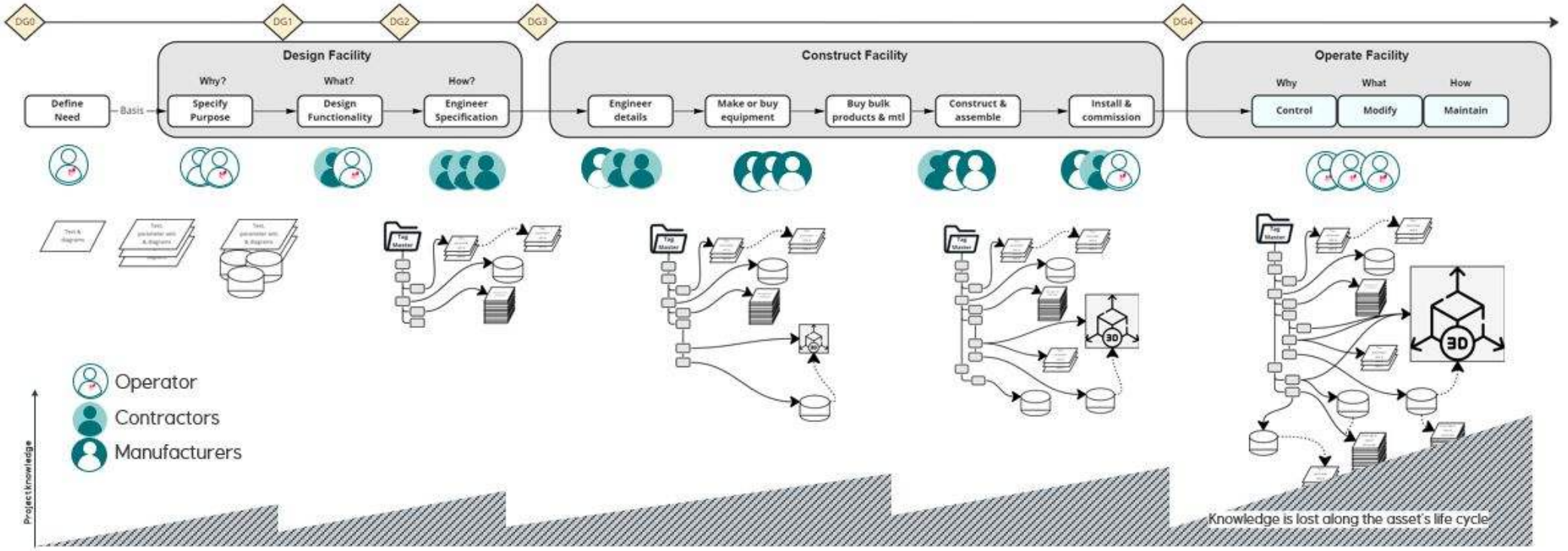

Consequences:

- Automation of manual procedures is difficult
- Risk of safety and quality breaches
- Loss of information
- Labour-intensive document handling
- Lost business opportunities

Source: Magnus Oanes Knædal, Equinor

…to information model-based approach

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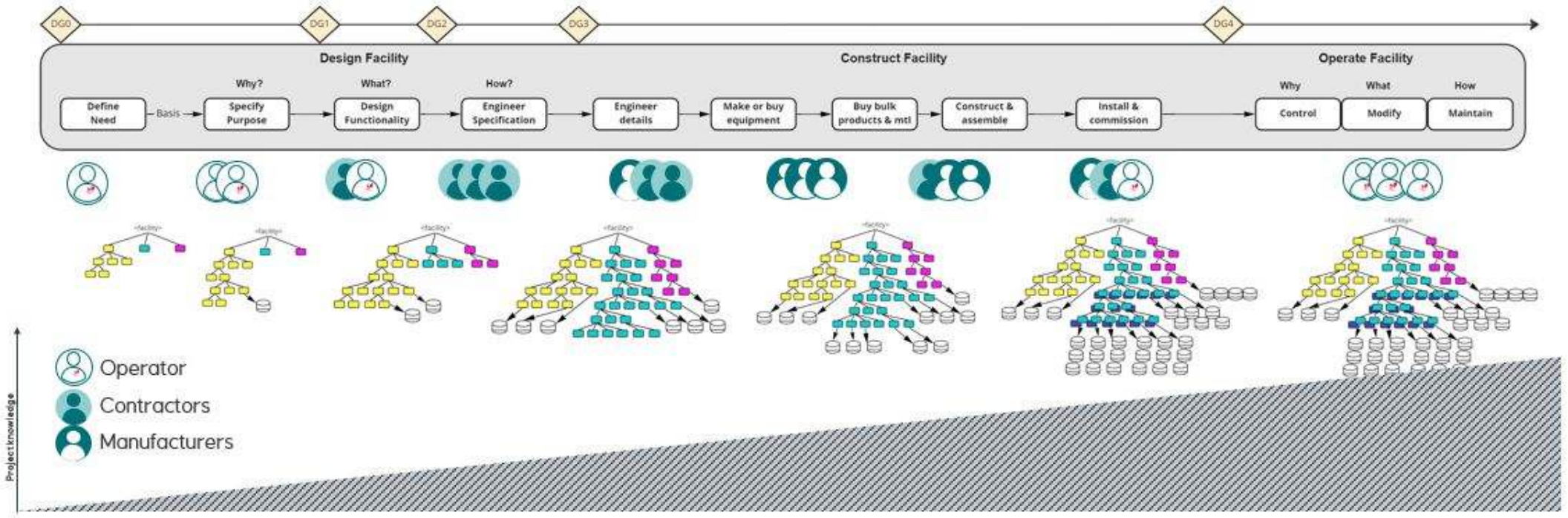
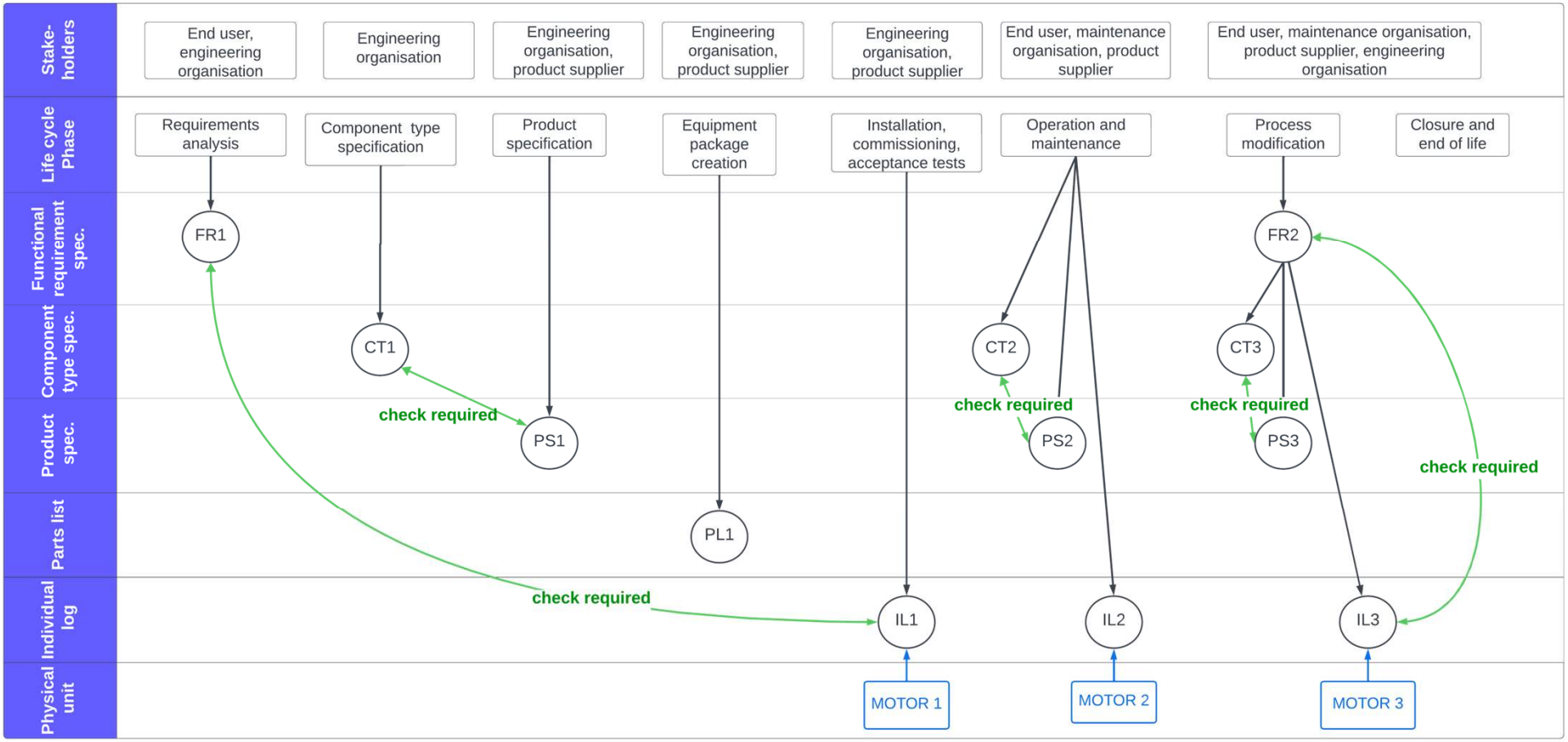


Added values:

- Become more effective by hindering loss of information during handovers
- Automation of manual procedures possible using machine integrable information models
- Reduce cost and time spent by the possibility of building in smartness
- Improved safety and quality by better control of technical information
- New business opportunities by combing information in new ways

Source: Magnus Oanes Knædal, Equinor

Through life documentation for one `object' in a plant



Adapted from IEC 81346

Manual checking still happens

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IOGP S-729D (1.0) Procurement Data Sheet for Control Valves
Common Items

JIP33 JOINT INDUSTRY PROGRAMME

Description	Purchaser requirement	Purchaser requirement UOM	Supplier offered value	Supplier offered UOM	Additional notes
General					
Conformity assessment system (CAS) level :	D		D		
Project country :	input data		input data		
Project region :	input data		input data		
Plant environmental location :	select		select		
Climate classification :	select		select		
Environmental classification :	input data		input data		
Units of measurement :	select		select		
Normative reference base standard :	select		select		
Minimum ambient temperature :	input data	select	input data	select	
Maximum ambient temperature :	input data	select	input data	select	
Minimum network air supply pressure :	input data	select	input data	select	
Maximum network air supply pressure :	input data	select	input data	select	
Actuator control equipment (accessories)					
Cable entries for actuator control equipment (accessories) :	input data		input data		
Position indication achieved through :	select		select		
Tubing size :	input data	select	input data	select	
Tubing and fittings material :	select		select		
Pressure gauge for air filter regulator :	select		select		
Air filter regulator body material :	select		select		
Air filter regulator wetted parts material :	select		select		
Positioner housing material :	select		select		
Positioner type :	select		select		
Positioner mounting :	manufacturer's standard		manufacturer's standard		
Positioner input signal and protocol :	select		select		
Positioner gauges :	select		select		
Limit switch type :	input data		input data		
Limit switch mounting :	select		select		
Position transmitter type :	input data		input data		
Position transmitter output signal and protocol :	select		select		
Position transmitter supply voltage :	input data	select	input data	select	
Solenoid valve reset type :	auto reset		auto reset		
Solenoid coil insulation :	select		select		
Solenoid valve coil voltage :	input data	select	input data	select	
Solenoid valve body material :	select		select		
Booster, quick exhaust, air-lock relay body and wetted parts material :	select		select		

No common labels

No common units

A shared ontology is a key enabler for change

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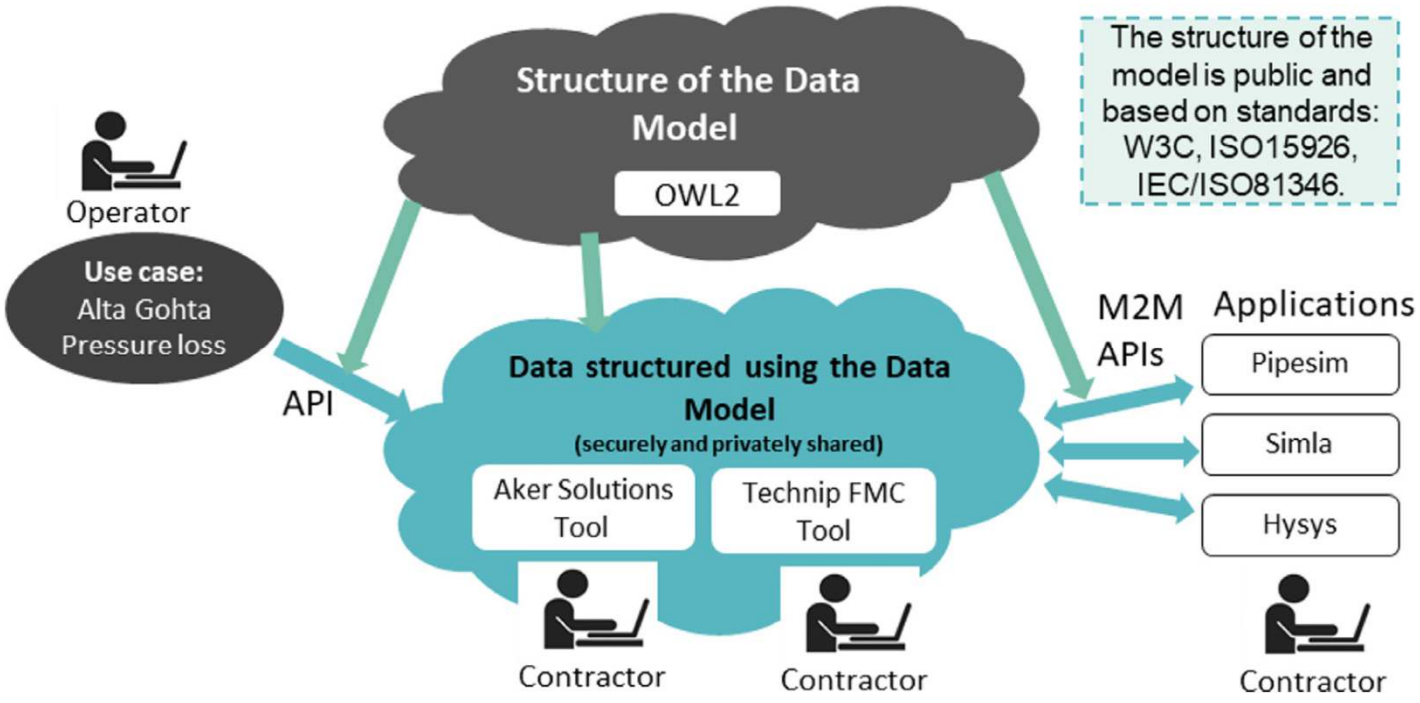
An Ontology is a collection **of terms, relational expressions** and associated natural-language definitions together with one or more formal theories designed· to capture the **intended interpretations of these definitions** [ISO/IEC 21838-1]

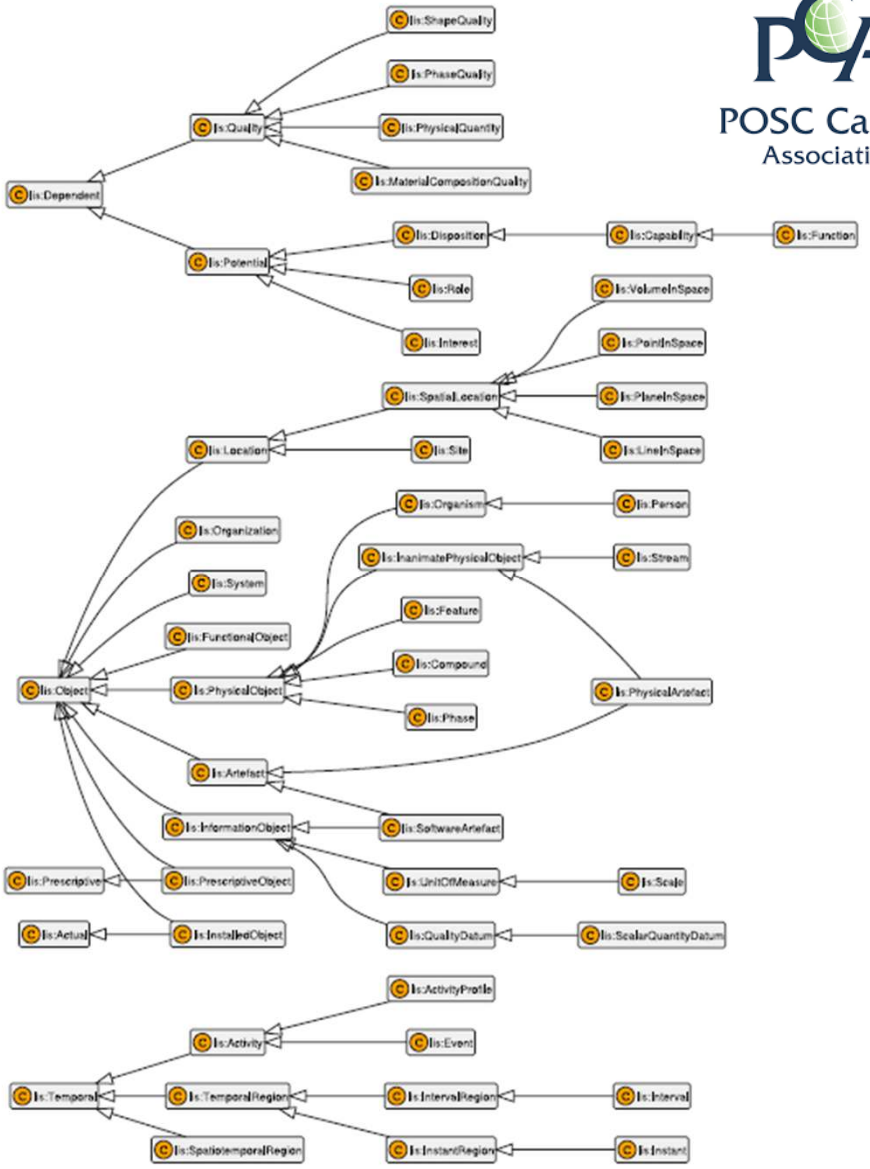


Cameron, David B., et al. "*The Digital Design Basis. Demonstrating a framework to reduce costs and improve quality in early-phase design*." Digital Chemical Engineering 2 (2022): 100015.

What is IDO?

IDO is intended for industrial data and information, to **build vocabularies** and **manage asset models** that employ reference data libraries (RDLs) and **exploit OWL DL.**
IDO is intended for use in **all life cycle phases** of industrial **assets** and **processes**.
In scope

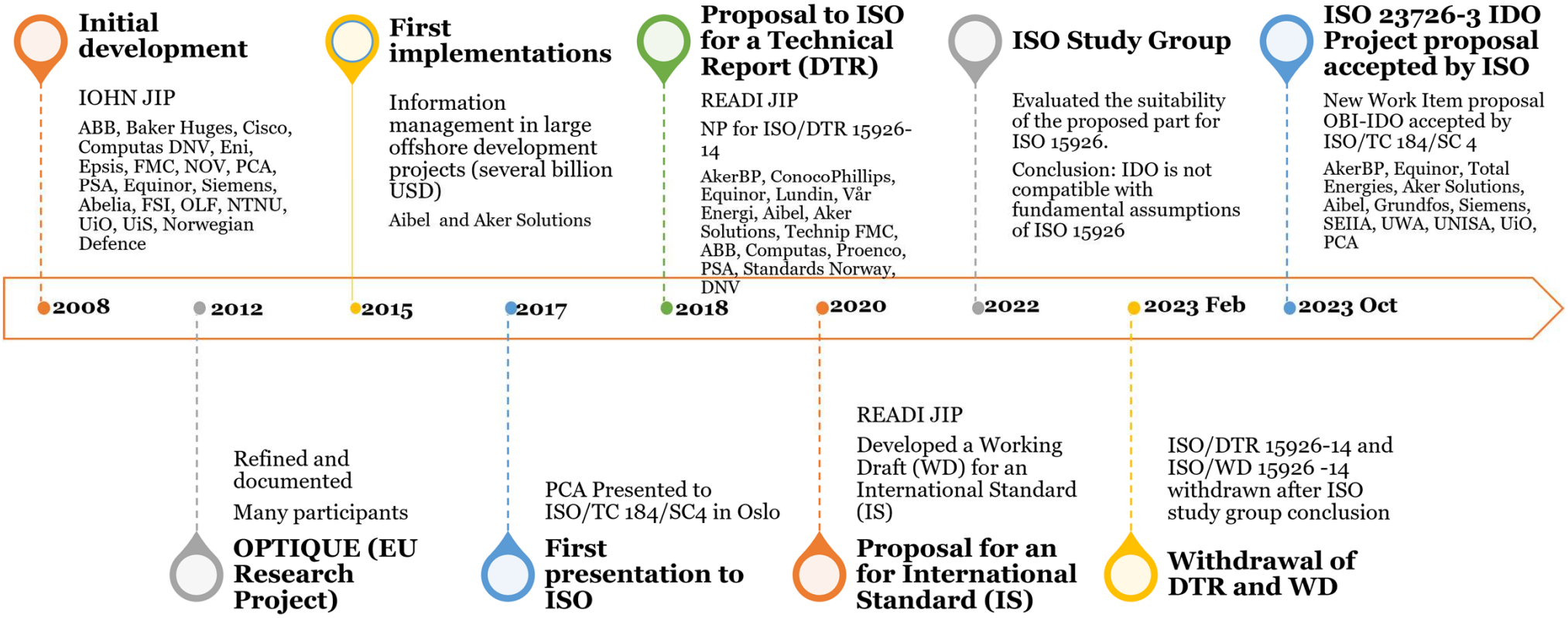
- Overview and principles of IDO,
- Definitions of classes and relations,
- Industrially relevant use cases,
- Re-usable representation patterns



IDO is part 3 in ISO/CD 23726
IDO is managed by ISO TC184/SC 4/WG26
Project manager: Pål Rylandsholm

https://rds.posccaesar.org/ontology/lis14/

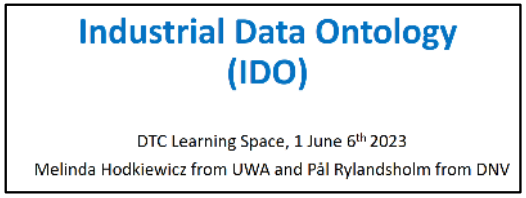
IDO's 20 year journey to today

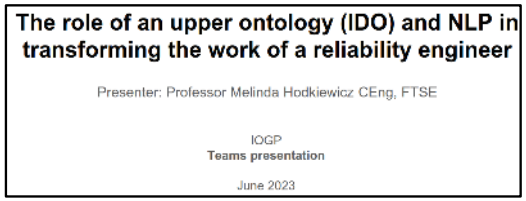


2023 was a big year

- May 2023 – New work item proposal submitted to ISO/TC 184/ SC 4 (SC 4) by Standards Norway
- June 2023 – SC 4 assigned the standard number ISO 23726-3 to the proposed standard. SC 4 Resolution to launched a ballot for the proposal and establish a Work Group (WG 26) responsible for developing ISO 23726
- October 2023 – Ballot closed (12 countries - Yes, 2 - No), hence the project started under ISO.
- Nov 2023 – ISO AW 23726 WD (working draft) WG 26 comment period.
- Jan 2024 – IDO WG26 group addressing comments from SC 4 ballot and WG 26 participants
- Feb 2024 – IDO WG26 and IDO community meeting in Oslo
- Next ISO TC 184 SC4 meeting in Korea in May 2024

Industry presentations

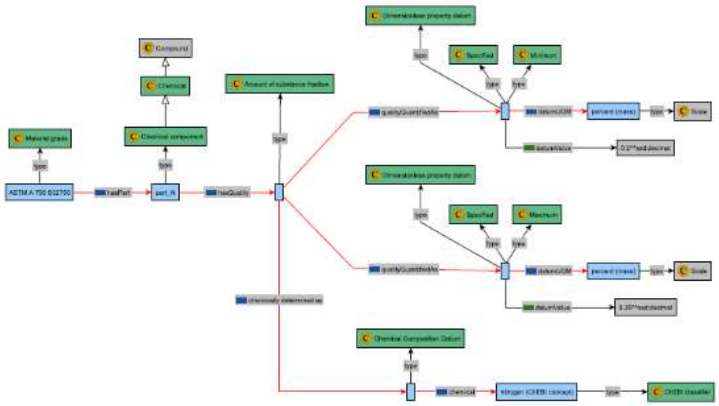


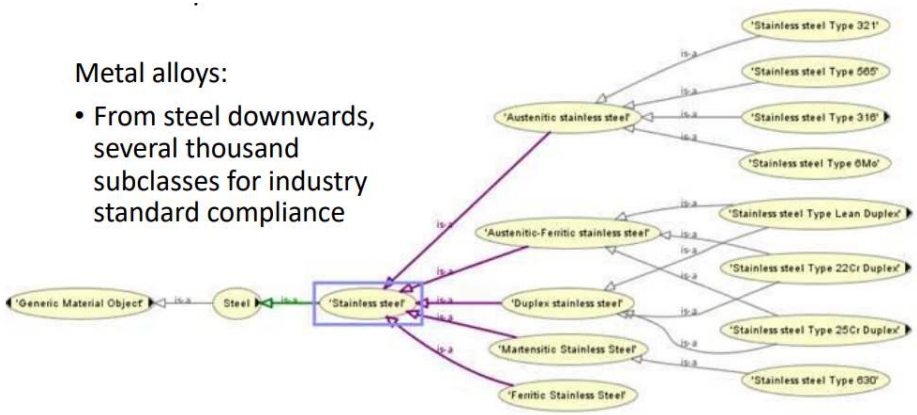


IDO exists today and is being used in industry

Aibel Material Master Data (MMD) Ontology

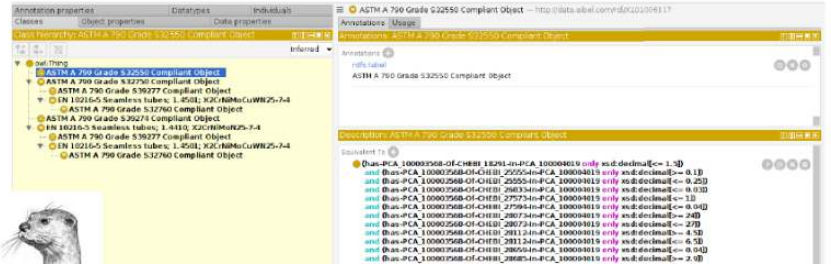
- Enabled removal of more than 300,000 duplicate classes in the engineering data base
- Supports selection of product classes that match design constraints
- Supports requirements management





Exploit ontology reasoning for discovering overlapping industry standard specifications

By reasoning over the OWL class representation we can discover relationships between different material grades and material grade standards.



Refs: Aibel's MMD Ontology, Arild Waler, 2021, https://emmc.eu/wp-content/uploads/2021/10/Waaler_MMD_ECONTO2-min.pdf
Classification and exchange of industry standards using OWL ontologies, Gervers, A., Hansen, C.Skjaeveland, MG, Ontocommons Poster, June 2023

IDO is supported and applied in several industries

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Use cases in development

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- UC1 – Pump with firmware (Grundfos) – published*
- UC2 - Pumpstation, (SEIIA)
- UC3 - Supply chain in chemical industry (SEIIA)
- UC4 - Asset model transformation, from UML to IDO (SEIIA)
- UC5 - Valve ontology (Aibel)
- UC6 - FMEA,Failure Mode & Effects Analysis (UWA)
- UC7- Pump Life Cycle (Dexpi)

- * 2 page summary in ISWC publication: https://hozo.jp/ISWC2023_PD-Industry-proc/ISWC2023_paper_418.pdf

Take valves as an example

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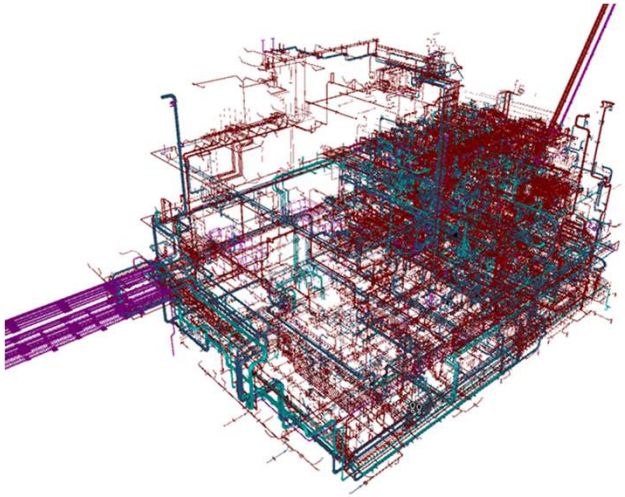
- Valves provide safety critical control and isolation functions in high hazard industries.
- A single facility can have **3800 valves** with a cost of **US$ 35m**[1].
- Specifying these **2400 different types of valves** (and associated piping) involved **54 pipe** specifications and **1700 design material** numbers.
- There are multiple stakeholders in the valve selection, installation, operation and maintenance life cycle.



Johan Sverdup drilling platform

1. Johan Sverdup drilling platform data, Gjellan,Ontology for Engineering and Procurement, IIOW 2019, Oslo

Motivation for the valve use case

- Quality control in the selection of **each** individual valve is vital.
- Engineers must ensure that
- - the valve design specification (VDS) delivers on the functional specification, and
- - the selected valve product is consistent with the VDS.
- Each stakeholder (engineering organisation, facility owner, valve product supplier, maintenance contractor) has their **own labels and identifiers** for describing valves and their parts.
- This **lack of semantic interoperability** in data exchange leads to **quality control errors** and inhibits the use of **machine reasoning** for risk management and productivity improvements.

Example of a VDS

All the VDS for the Johan Sverdu
drilling platform are online at
https://tr2000.equinor.com/index.j

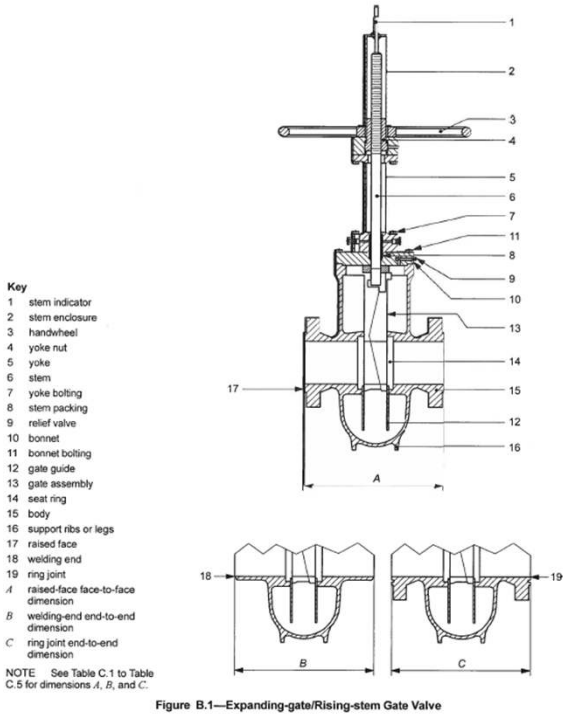


Figure B.1—Expanding-gate/Rising-stem Gate Valve

TR2000

Start | Plants | Datasheets | Pipe Components | Doc Space | PED | Manufacturers | Bolt Tension

[Print] [Guide

Equinor Europe
Europe

Plant Specific Datasheets

All Datasheets

Datasheet Selection
VDS Search
New TR2000 VDS
Old TR2000 VDS
Old Hydro VDS
Old Norsok VDS
Plant Specific VDS
MDS Search
VSK Search

Export

Piping and valve specification	Doc.no. TR2000	Sec.no. 4	TR2000			
	Area	Rev.no.	Rev.date	Status:	Page:	Of:
Valve data sheet: GDDC201J	**Europe**	**D**	**14.01.2015**	**O**	**1**	**1**

VALVETYPE : Gate Double Expanding
CODE : API 6D or ISO 14313
SIZE RANGE : 3" - 36"
RATING : CL600

Maximum design pressure :	Barg	102.1	102.1	100.2	93.2	90.2	87.6	83.9					
At temperature :	°C	-29	38	50	100	150	200	250					
Minimum operating temperature:		-29			Maximum operating temperature:			200					

PORT DESIGN : Reduce bore, Through conduit
END CONNECTION : RTJ flanges to ASME B16.5 up and including 24", ASME B16.47 series A above
END TO END DIM : ASME B16.10 Long pattern -any non defined sizes to be agreed with Purchaser
HOUSING DESIGN : Bolted bonnet
TRIM DESIGN : Double expanding (i.e. expanded in open and closed position).
: Renewable, fixed seats
: Bi directional sealing
: Gate shall be open in stem raised position
STEM SEAL DESIGN : Packed gland or stuffing box
: Outside screw and yoke
STATIC SEALS : Manufacturer standard
MOUNTING POSITION : Valve to be mounted with stem in vertical position
SPECIAL DESIGN REQ. : Firesafe to API 6FA or ISO 10497

MATERIALS

	ITEM	SUBITEM	MATERIAL	MDS
Δ	HOUSING	Body/bonnet	ASTM A105	CF205
Δ		Body/bonnet	ASTM A216 WCB	CC201
Δ		Body/bonnet	Bar A105	CB201
Δ	INSIDE TRIM	Stem	Min 13Cr	SV101
Δ		Gate	Min 13Cr	SV101
Δ		Seat	Min 13Cr	SV101
		Hard facing	Tungsten carbide on closing member seal surface and seat seal surface	ZH201
Δ		Other materials	Min 13Cr	SV101
	SEALS	Packed gland	PTFE based rings	PG102
		Stuffing box	Graphite packing; T < 300degC	PG201
		O-rings	Not allowed	
Δ	PRESSURE RETAINING BOLTING	Bolting	Bolt material shall be selected according to MDS	XN501
Δ	AUXILIARY CONNECTION	Plugs	ASTM A182 F316	SF306
Δ		Bleed plugs	ASTM A182 F316	SF310
Δ		Injection fitting	ASTM A182 F316	SF311
Δ		Blind flanges	ASTM A105	CF202
Δ		Blind flanges	ASTM A516 70	CS101
	OUTSIDE TRIM	Bolting	Min SS316 for bolts 10mm and smaller, min hot dip galvanized carbon steel for larger	VN105
		Wrench/handweel	Min SS304/316 or painted hot dip galvanized nodular iron	
		Stem protector	Min SS304/316	
		Grease nipple	Min SS316	
	SPECIAL MAT.REQ.	Wetted parts suitable for sour service to NACE MR0175 / ISO 15156-2 region 2		

MISCELLANEOUS REQUIREMENTS

	ITEM	VSK Reference	DESCRIPTION
Δ	GENERAL	V 738	
Δ	TESTING	V 737	
	EXTERNAL COAT	V 733	If not otherwise specified in order, this valve shall be supplied with the default coating system
Δ	MARKING	V 718	
	OPERATOR	V 721	
Δ	SHIPMENT	V 715	
Λ	DOCUMENTATION	V 727	

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What information sources are needed to create a VDS?

- Specific valve type (e.g. ball valve, gate valve etc.)
- Parts of valve assembly (e.g. body, bonnet, stem)
- Valve design features (e.g. full bore/ reduced bore, top/ side entry, etc.)
- Relevant design codes (e.g. ASME B16.10, API 6D)
- Process design data (pressure and temperature, fluid type and properties, intended function at location)
- Geometric constraints (dimensional data)
- Material constraints and selection philosophy
- Valve product type documentation
- Industry pressure-temperature curve data for different piping and valve classes

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Lego analogy for industrial ontologies

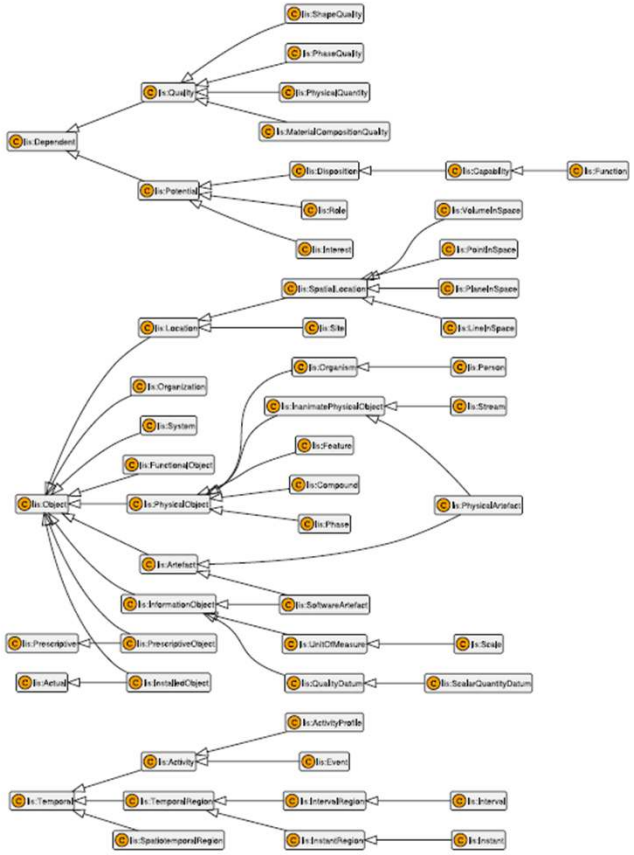
Each class is like a Lego brick in terms of dimension, number of interfaces and purpose.

All Lego bricks conform to a common specification (grammar).

Anyone can make new bricks that hook into existing bricks providing they conform to the specification.

Certain pieces are not meant to connect to other pieces when making engineered systems, this will be obvious when you ‘run the reasoner’.

We can build ‘projects’ much quicker by using the Lego that already exists.



Questions?

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"IDO seems like it can help to transform the industry, I can see how it could improve our workflows but how do we get started?"

"What technical capabilities do we need to build and how do we build them?"

"How can we bring our engineers along?"

"How ready is this?"

"How do I learn more and get involved?"

"What training is available?"

Value proposition for IDO

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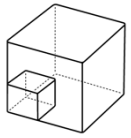
 **Improve productivity**

 **Scalable**

 **Reproducible**

 **Standardised**

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Thank you

Contact details for more information

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