WHEN TRUST MATTERS

OCX for floating wind, an opportunity

Elling Rishoff, Tore Christiansen & Ole Christian Astrup

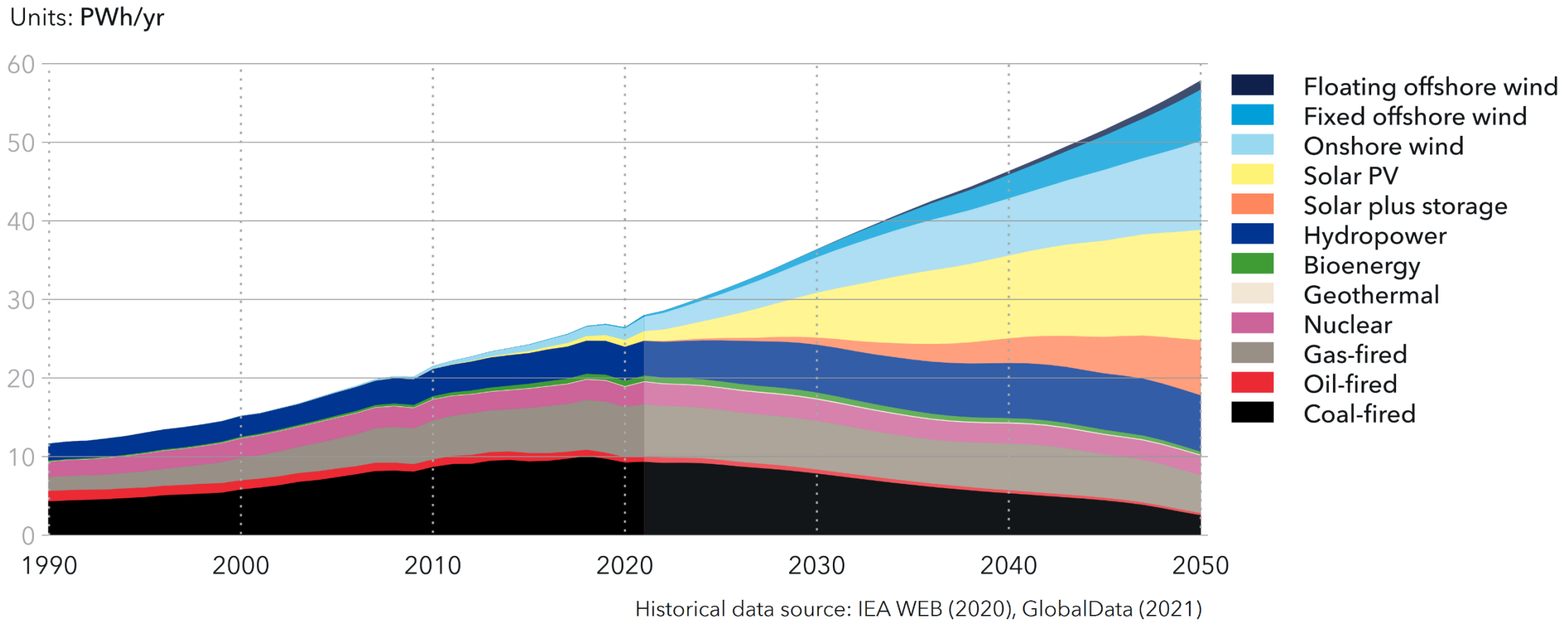
09 November 2022

Industry analysts are pointing the emerging offshore wind industry in the following direction:

“New operating models and new consortia have to be amassed
that can bring traditional and emerging industries together – with regulators that offer a trustworthy regime that attracts investors”

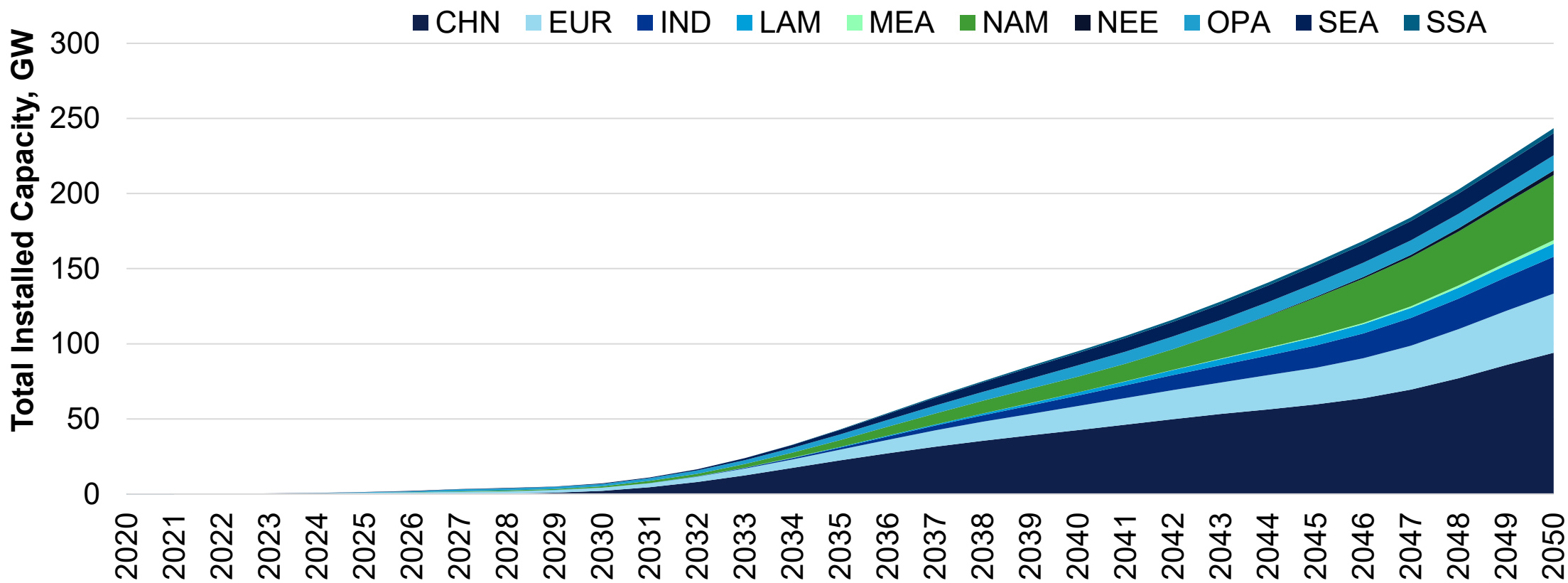
264GW of worlds electricity generation will come from floating offshore wind in 2050

World grid-connected electricity generation by power station type



Historical data source: IEA WEB (2020), GlobalData (2021)

Europe to lead the developments in most of the 2020s, but will be passed by Asia in 2030s and North America in 2040s



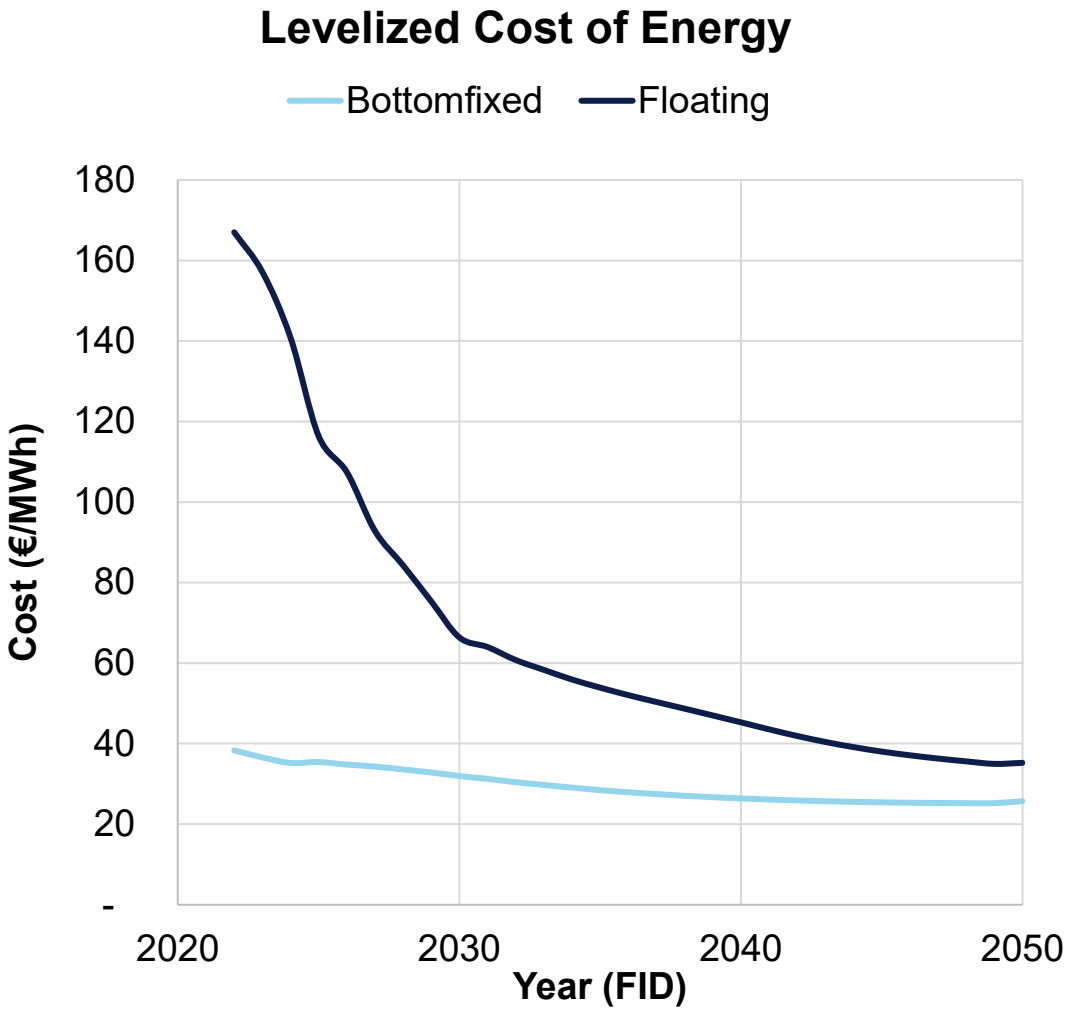
UK project pipeline: platform concepts

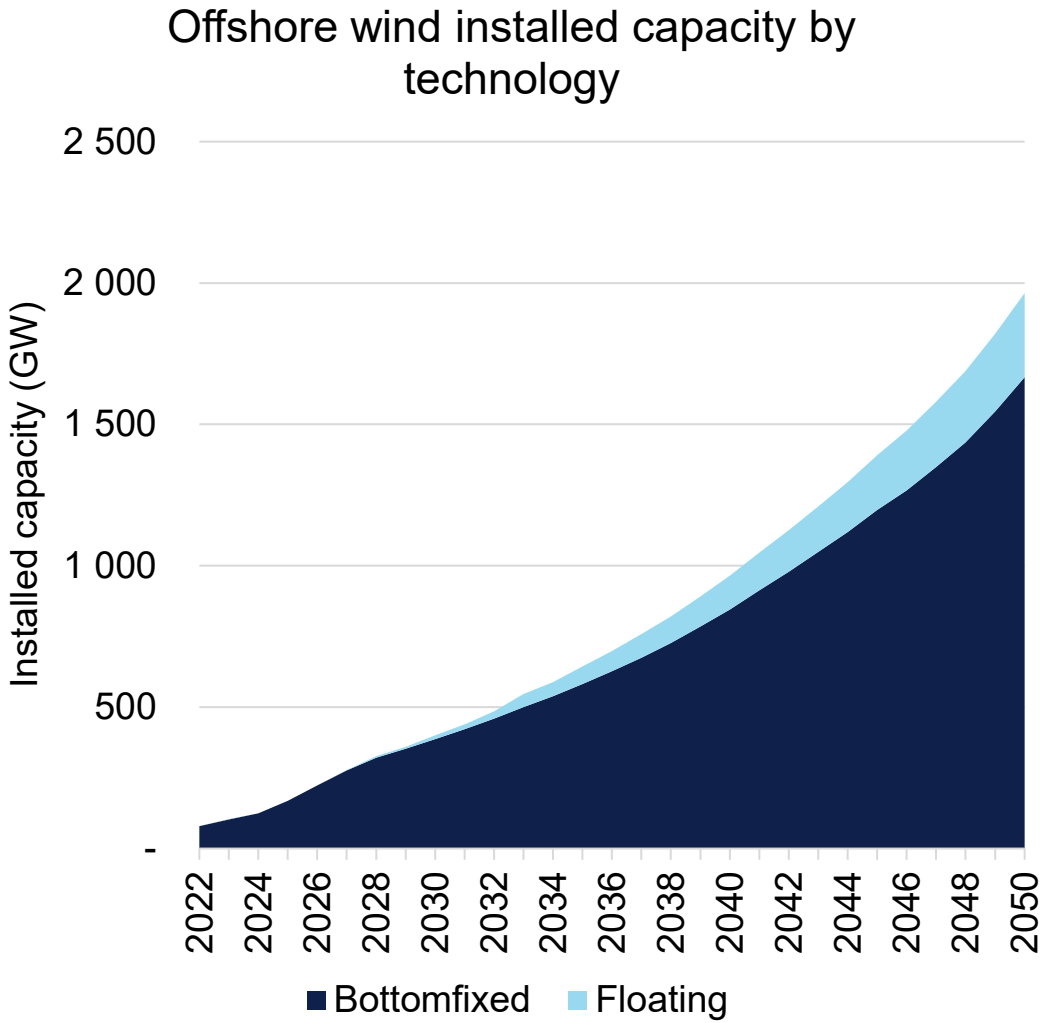
Semi-subs dominate near term projects

No-one looking to spar buoys – depth required at all project stages

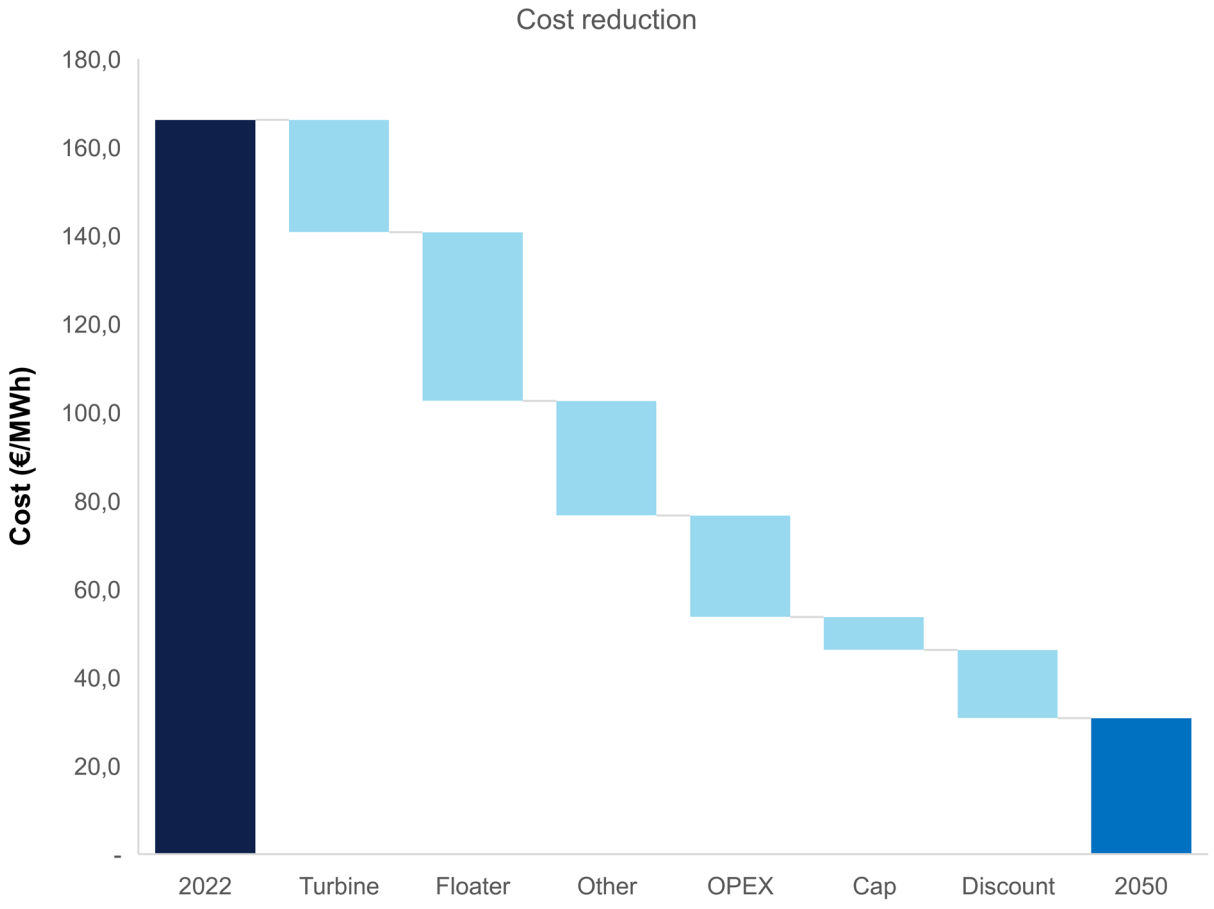
Wind Farm	Windfarm Status	Geo Region	Country Name	Foundation	Turbines	Capacity MW	Year	Month
Floating Energy Allyance NE8	Concept/Early Planning	Europe	United Kingdom	Floating: Barge - Concrete	60	960.00		
Trivane Demonstrator	Concept/Early Planning	Europe	United Kingdom	Floating: Barge - Steel	1	1.00	2024	April
Pembrokeshire Demonstration Zone	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		180.00		
Draig y Môr	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		100.00		
White Cross	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified	8	100.00		
Whirlwind Offshore Wind Farm	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		300.00		
Gwynt Glas	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		1,000.00		
CampionWind	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		2,000.00		
MarramWind	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		3,000.00		
Northland Power N2	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		1,500.00		
Celtic Deep phase 1	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		98.00		
Celtic Deep phase 2	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		300.00		
Morwind	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		300.00		
Celtic Sea Ocean Winds	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		400.00		
Celtic Sea RWE Renewables	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		400.00		
Aurora	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		1,000.00		
Merlin	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		300.00		
Central North Sea Electrification	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		250.00		
Orcadian Microgrid	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		105.00	2025	June
Neos	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		25.00		
Olympic Wind	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		1,300.00		
Shetland NE1 - Ocean Winds	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		500.00		
Shetland NE1 - Mainstream	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		1,800.00		
Shetland NE1 - ESB Asset Development	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		500.00		
Llywelyn	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		300.00		
Petroc	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		300.00		
Ossian	Concept/Early Planning	Europe	United Kingdom	Floating: Not Specified		2,610.00		
TwinHub	Consent Authorised	Europe	United Kingdom	Floating: Semi-Submersible Platform	4	32.00	2010	July
Salamander	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform		100.00	2026	June
Muir Mhòr	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform		798.00		
Magnora-Technip	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform	33	495.00		
Blyth Offshore Demonstrator - phase 2	Consent Authorised	Europe	United Kingdom	Floating: Semi-Submersible Platform	5	58.40		
Green Volt	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform	30	480.00	2024	April
Stromar	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Concrete	62	1,000.00		
Broadshore	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Concrete	31	500.00		
Bellrock	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Concrete	75	1,200.00		
Pentland Floating Offshore Wind Demonstrator	Consent Authorised	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	1	12.00	2025	January
Erebus	Consent Application Submitted	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	10	100.00	2027	January
Dolphyn Project - pre-commercial	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	1	10.00	2025	January
Dylan	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel		300.00	2028	January
Pentland	Consent Application Submitted	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	6	100.00	2026	April
Dolphyn Project - full scale	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	400	2,000.00		
Beech North	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	70	1,500.00	2024	January
Aspen	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel		1,500.00	2024	January
Beech South	Concept/Early Planning	Europe	United Kingdom	Floating: Semi-Submersible Platform - Steel	70	1,500.00	2024	January
Cluaran Ear-Thuath	Concept/Early Planning	Europe	United Kingdom	Floating: Tension Leg Platform		1,008.00		
SENSEWind Demonstrator	Concept/Early Planning	Europe	United Kingdom	Floating: Tension Leg Platform	1	2.00	2023	Septemb
Avalon	Concept/Early Planning	Europe	United Kingdom	Floating: Tension Leg Platform	1	1,500.00		
North Channel Wind 1	Concept/Early Planning	Europe	United Kingdom	Floating: Tension Leg Platform - Steel	20	300.00	2027	June
North Channel Wind 2	Concept/Early Planning	Europe	United Kingdom	Floating: Tension Leg Platform - Steel	7	100.00	2027	June
EMEC test site - phase 1	Concept/Early Planning	Europe	United Kingdom	Floating: Various		7.00		
EMEC test site - phase 2	Concept/Early Planning	Europe	United Kingdom	Floating: Various		230.00		
EMEC test site - phase 3	Concept/Early Planning	Europe	United Kingdom	Floating: Various		230.00		

300GW Floating wind in 2050 and 80% cost reduction





Key drivers for costs reduction



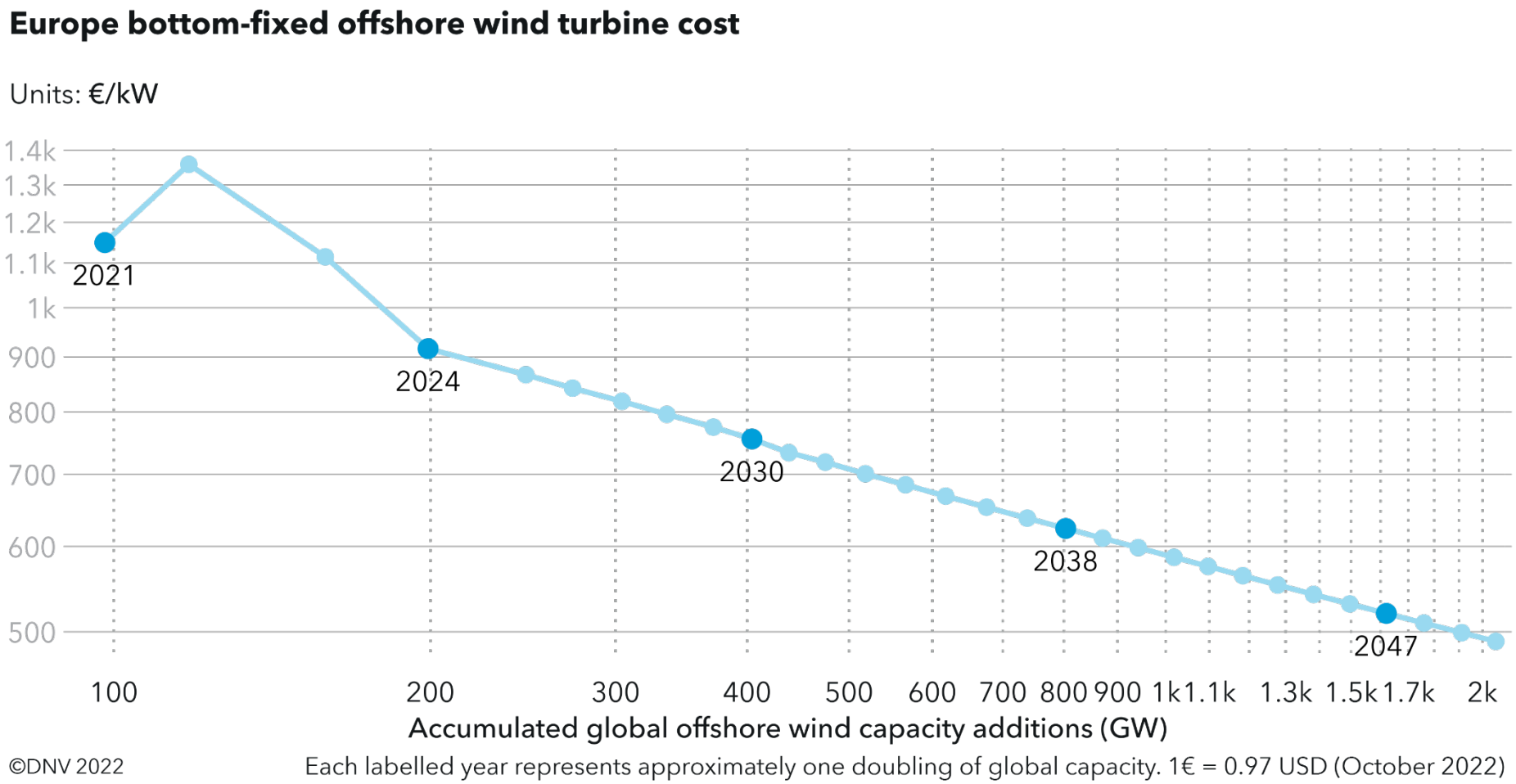
- Larger windfarms
- **Cooperation and sharing**
- Financial incentives
- Competition
- Larger wind turbines
- Reduced risk
- Reduced cost of capital
- **Standardisation**
- **Technology development**
- **Industrialisation**
- Construction and operational experience
- Higher capacity factors
- Longer lifetime

Installed wind capacity

	2021			2030			2040			2050		
Units: GW	Onshore	Bottom-fixed offshore	Floating offshore	Onshore	Bottom-fixed offshore	Floating offshore	Onshore	Bottom-fixed offshore	Floating offshore	Onshore	Bottom-fixed offshore	Floating offshore
North America	151	0.04	0	271	29	2	463	65	11	691	150	31
Latin America	39	0	0	98	29	0	180	55	0.1	334	120	7
Europe	194	27	0.11	289	118	8	418	221	42	505	379	60
Sub-Saharan Africa	4	0	0	12	0	0	24	5	0.1	66	16	3
Middle East and North Africa	16	0	0	59	18	0	135	35	3	254	78	14
North East Eurasia	5	0	0	15	11	0	27	22	0.4	29	41	5
Greater China	304	23	0.01	801	120	2	1 541	282	34	2 072	582	99
Indian Subcontinent	42	0	0	103	17	0	197	50	8	417	124	38
South East Asia	5	0.8	0	27	15	0	97	37	7	304	97	27
OECD Pacific	15	0.2	0.01	58	28	2	134	65	15	169	115	17
WORLD	**776**	**51.0**	**0.12**	**1 733**	**385**	**14**	**3 216**	**839**	**120**	**4 841**	**1 703**	**300**

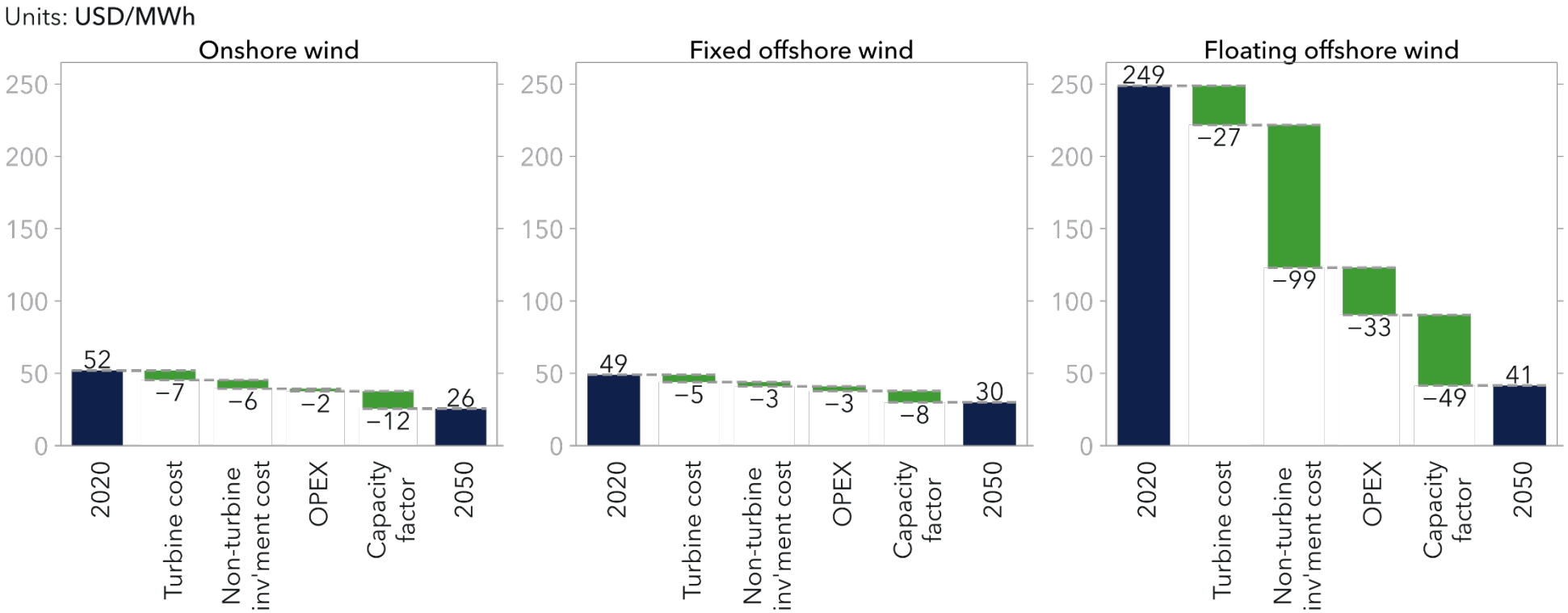
End of year capacity

Fixed offshore wind turbine cost learning curve



Drivers of change for levelized cost of wind

Drivers of change for the global average levelized cost of wind between 2020 and 2050



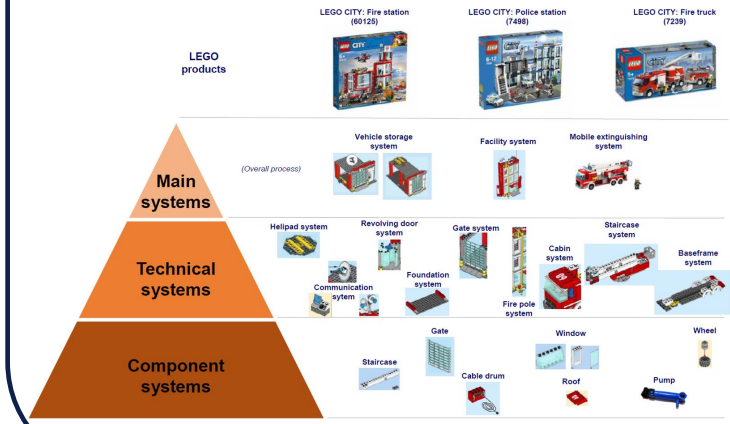
DNV OCX STRATEGY for floating offshore wind

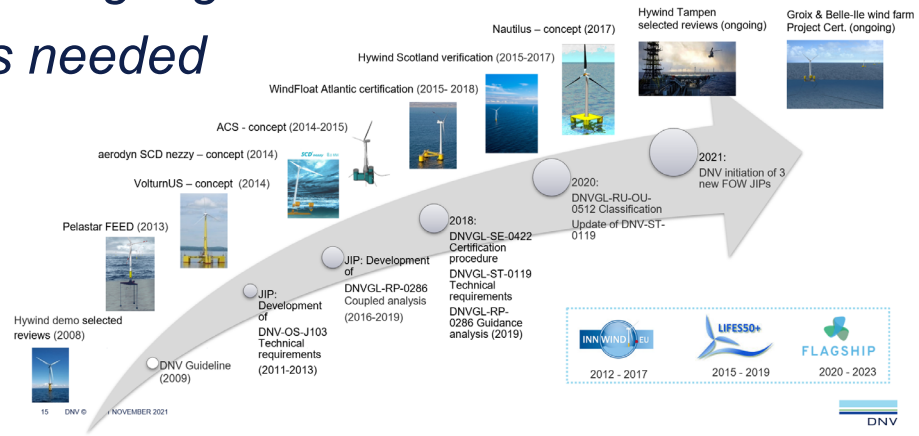
The promise, potential and plan for 3D mode-based approval

09 November 2022

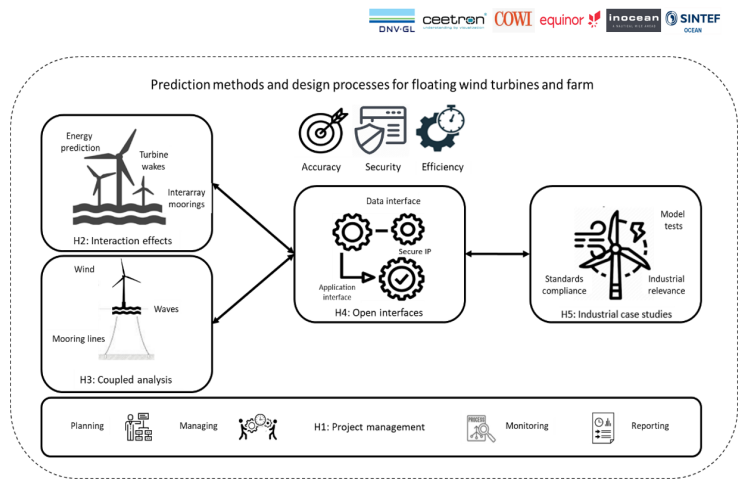
One common digital lifecycle Green asset language spoken across the entire value chain is needed

Approved IEC/ISO 81346 Part 10





Rules, Standards & RPs



Next Generation CAD/CAE Software

DNV

Our test playfields

Playfield #1: MI Execution Model program

Playfield #2: NorthWind FlowSite

Playfield #3: DS PAS Readi program

Playfield #4: ImproveFlow

Playfield #5: TIM Wind Denmark

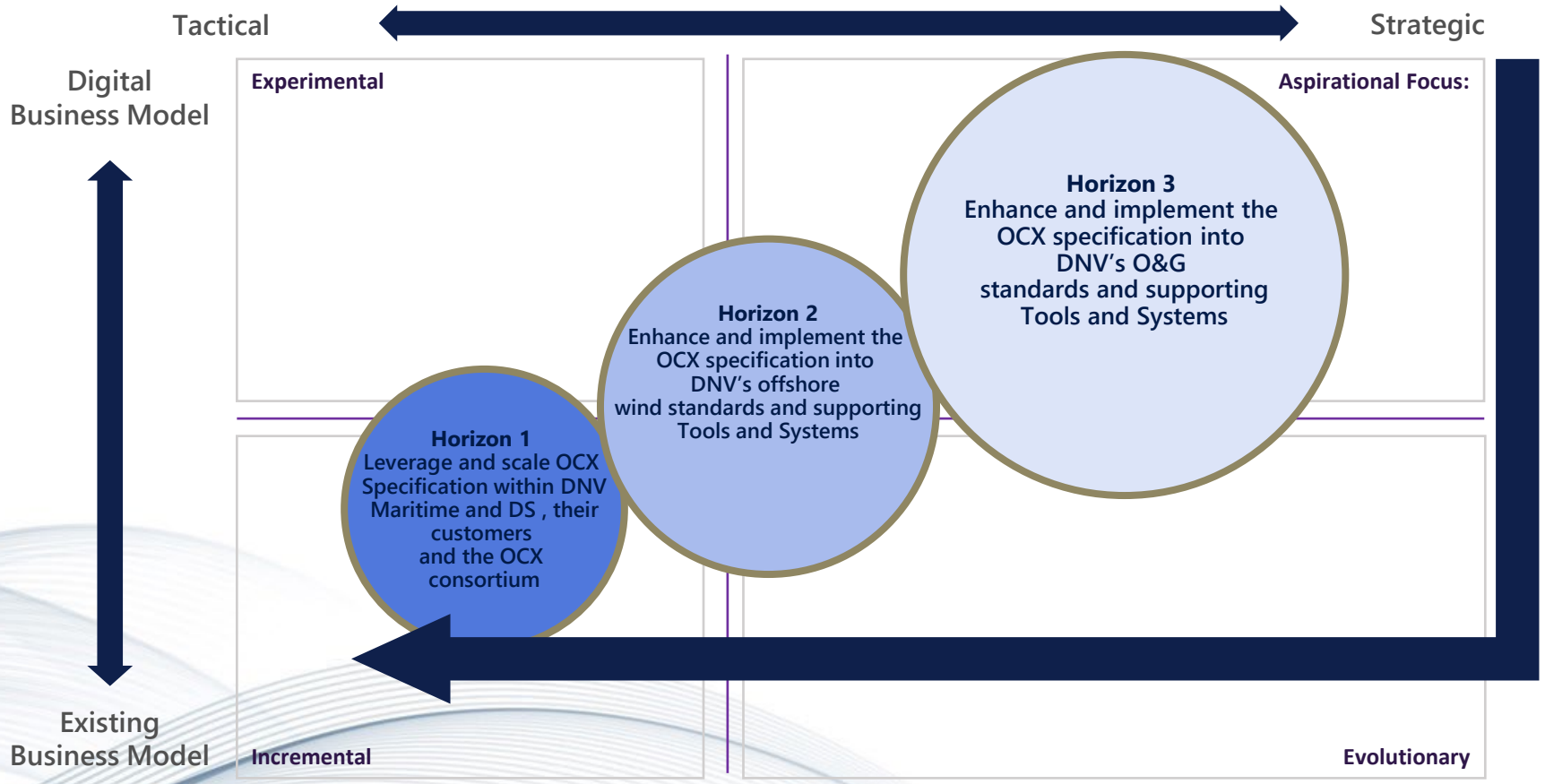
Playfield #6: ES Requirement management program

The OCX value proposition

- DNV value proposition is to leverage and adapt OCX schema V2.8.6 into O&G (the READI JIP) and Offshore Wind industries. Execution of the OCX strategy will enhance the interoperability specification for all consortium partners and allow manufactures and DNV to engage in complete sharing of the digital workflow using a common specification for 3D models.
- The specification will enable CAE tools to become a service to CAD, PDM and Digital Twin solutions. Furthermore, the emerging OCX specification will be a natural part of DNV ontologies which will define and test how DNV can use information models, software and platform technology to transform business models and lifecycle operating models.
- The value delivered by the format will be determined by the amount of usage and realized when DNV and its partners adopt, adapt and accept the specification in their digital journey to "do it right, do it better and do it differently"

The vision and planning horizons

North Star Vision



Our vision is that DNV shall be leading in digital structural assurance and assurance of structural digital assets in the following industries: Shipping, Offshore Wind and O&G

A standard that defines rules for reference designation systems

RDS
Reference Designation System

a common language

ISO/IEC **81346** Standard Series
Industrial systems, installations and equipment and industrial products

Structuring principles and reference designations

ISO 81346 Parts

- Part 1: Basic rules (IEC 81346-1:2022)
  Part 2: Classification of objects and codes for classes (IEC 81346-2:2019)

- New standard this year
  RDS-PS Part 10: Power Systems (ISO/IEC 81346-10:2022)

- Replaces
  RDS-PP Part 10: Power Plants ISO/TS 81346-10 (2015)

DIFFERENT ASPECTS

= Function aspect

- Product aspect

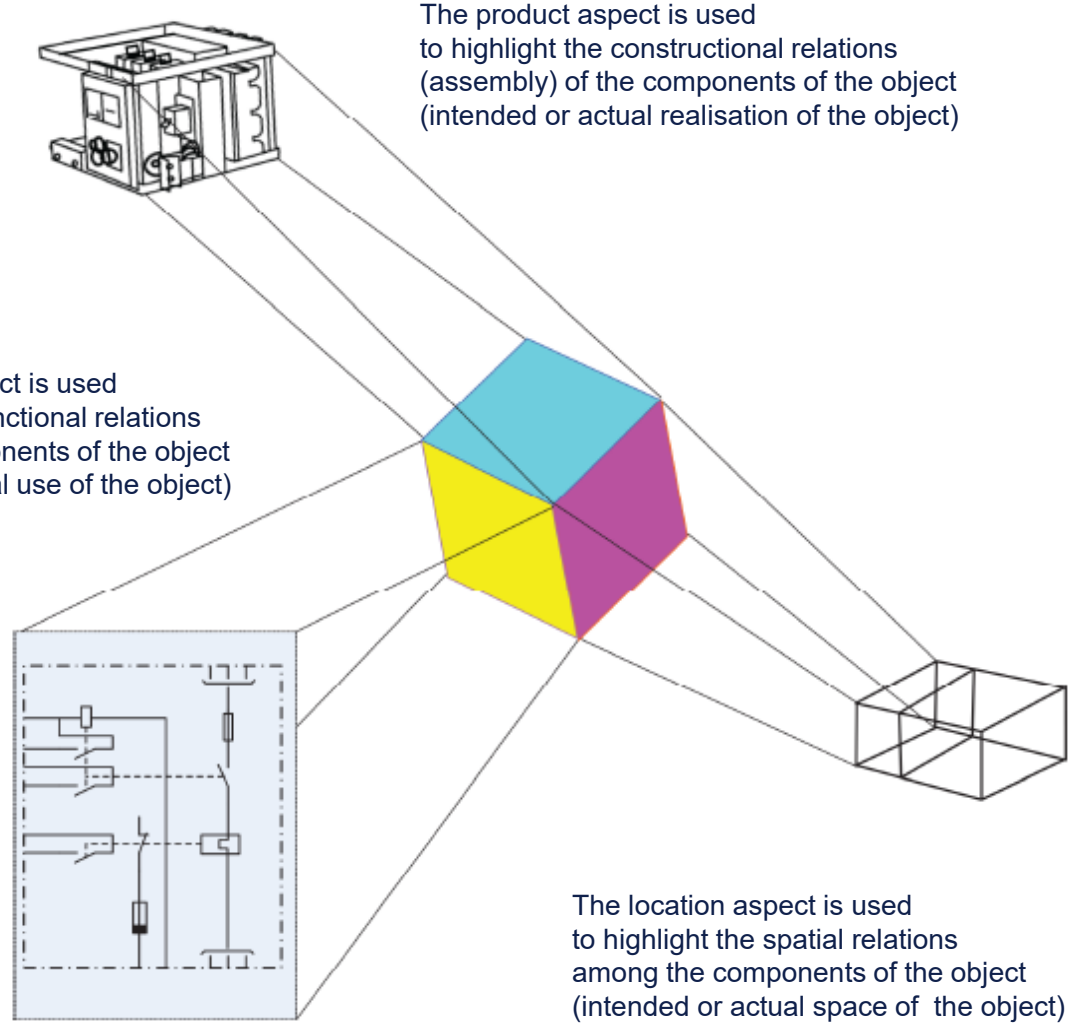
+ Location aspect

% Type aspect

The type aspect is used to highlight the defined set of characteristics of the group with identical properties to which the object belongs

The product aspect is used to highlight the constructional relations (assembly) of the components of the object (intended or actual realisation of the object)

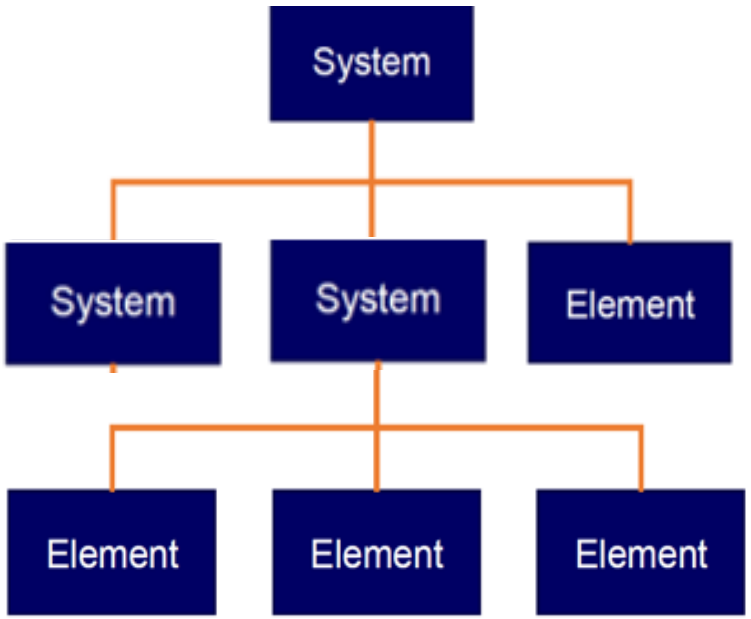
The function aspect is used to highlight the functional relations among the components of the object (intended or actual use of the object)

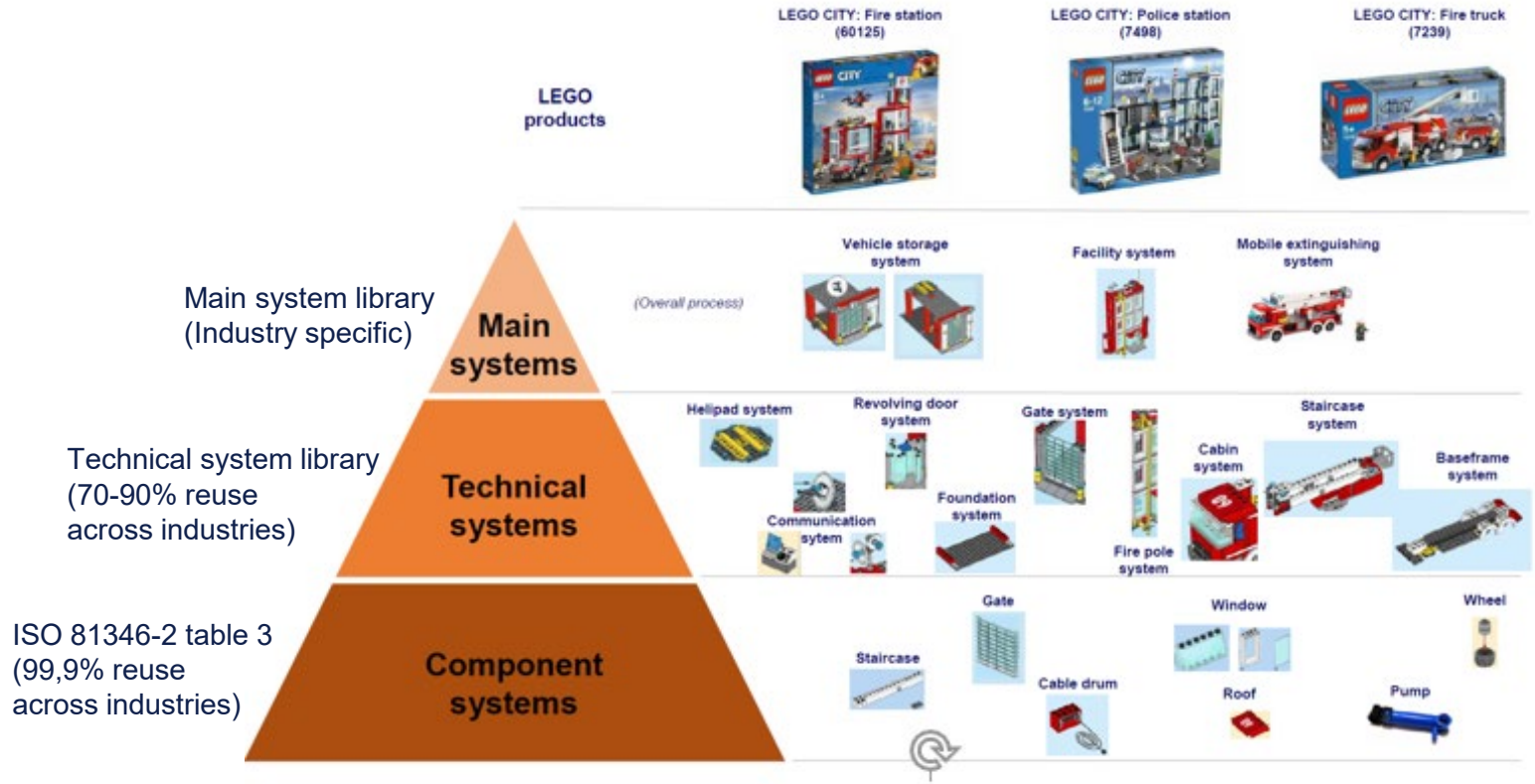


The location aspect is used to highlight the spatial relations among the components of the object (intended or actual space of the object)

DNV

SYSTEM OF SYSTEMS





Source: https://81346.com/english/

DNV

THE RDS SYSTEM LIBRARIES

Different tables for different industries

General classification	Power systems	Construction works	Aircrafts	Oil & Gas	Infrastructure
					
Part ***2***	*Part* ***10***	*Part* ***12***	*Part* ***TBD***	*Part* ***TBD***	*Part* ***TBD***

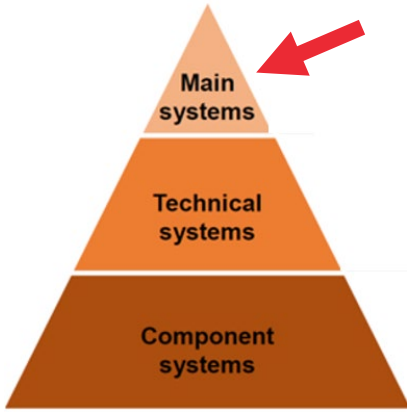
DNV

Classification scheme for Power Supply systems

Table B.1 — Classes of power supply systems

Class code	Class definition	Preferred term	Examples
A	Power supply system transforming energy or energy carrier	Energy transforming system	Boiler, fuel cell system, generator, parabolic concentrator system, photovoltaic system solar heating, power-to-X system, production unit, turbine
B	Power supply system transporting electric power	Electrical transporting system	Cabling, distribution line, electric vehicle supply system, substation, transmission, transmission line
C	Power supply system transporting energy or energy carrier, excluding electric energy	Transporting system	Coal transport system, condensate system, cooling water system, feed water system, gas transport system, inlet, penstocks, steam system, tunnels, waterway
D	Power supply system supporting the energy production process	Supporting system	Cleaning system, crane and lifting arrangement, emergency start-up system, internal electrical supply system, lubrication system
E	Power supply system for collecting and storing energy for subsequent retrieval	Storing system	Bunker system, catchment area, coal mine, creek intake, electrochemical storage system, gas storing system, geothermal reservoir, heat storage system, mechanical energy storage system, reservoir, waste bunker
F	Power supply system managing energy supply and generation	Managing system	Communication system, control system, SCADA system, supervising system
G	Not to be applied	N/A	N/A

Letters not used in this table are reserved for future standardization.

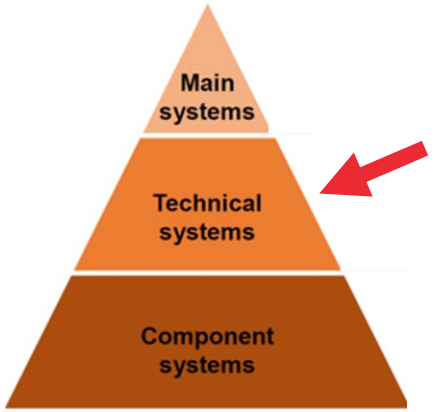


Classification scheme for Technical systems

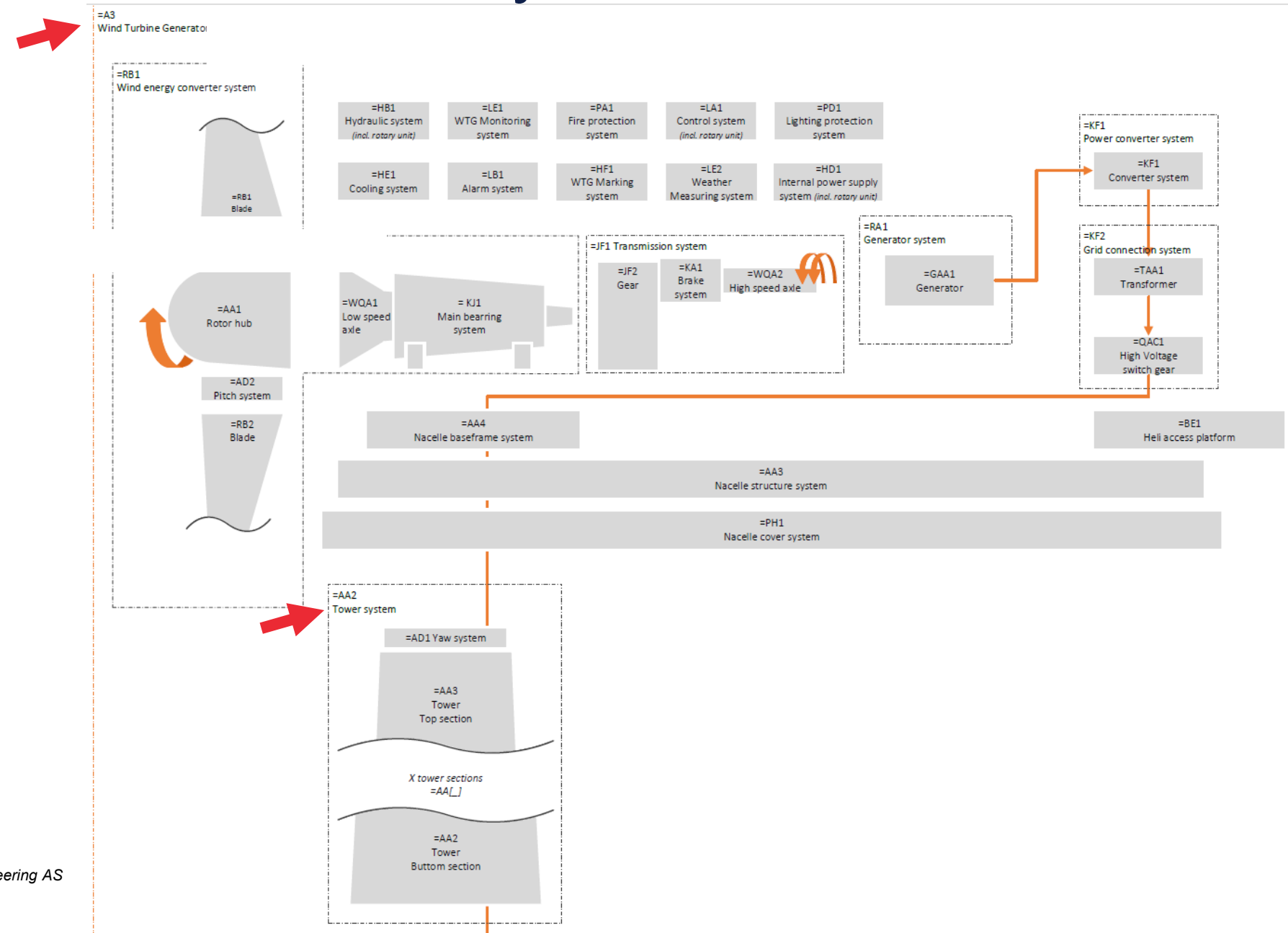
Table B.2 — Classes of technical systems

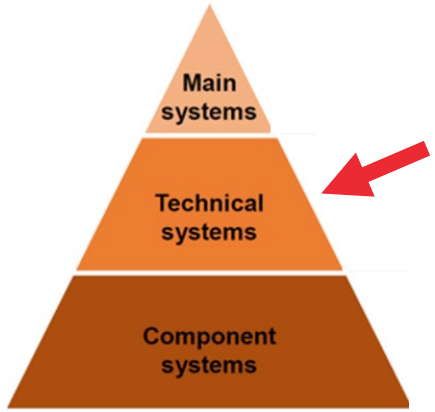
Class code	Sub-class code	Class definition	Preferred term	Examples
A		**Technical system which forms structural support**	**Structural system**	
	AA	Structural system forming a load supporting frame	Support frame system	Frame system, integrated structure, nacelle structure, structure system, supporting frame structure, rotor hub, WTG tower section system
	AB	Structural system providing foundation	Foundation system	Concrete foundation, floating foundation, jacket, monopile, spar, template suction foundation, tension leg platform
	AC	Structural system holding a supply or distribution system	Routing structure system	Cable routing, pipe bridge, pipe support
	AD	Structural system providing base for access	Access support system	Access platform, escape way, helipad
	AE	Structural system providing protection against undesirable environmental impacts	Casing system	Airlock system, casing, containment system, housing, shielding,
H		**Technical system supplying**	**Supply system**	
	HA	Supply system for gaseous matter	Gas supply system	Air supply, burning gas supply, emergency air generation system, inerting system, mixer, ventilation unit
	HB	Supply system for liquid matter	Liquid matter supply system	Chalk milk supply, creek intake, fuel supply, hydraulic oil, water supply
	HC	Supply system for solid matter	Solid matter supply system	Coal supply
	HD	Supply system for electrical energy	Electrical power supply system	Backup supply system, electrical power generation, electrical supply system, emergency supply system,

NOTE Letters not used in this table are reserved for future standardization.

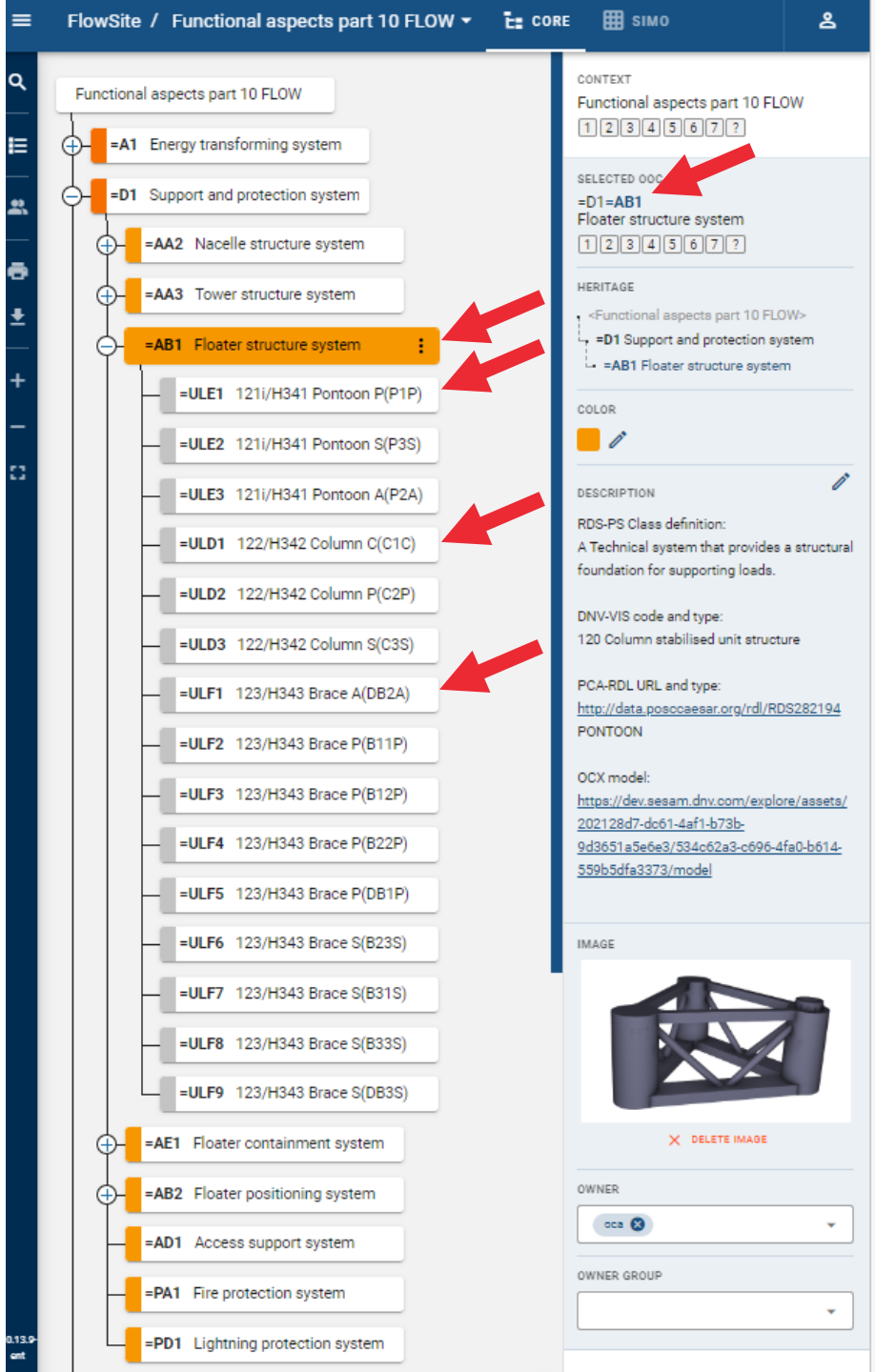


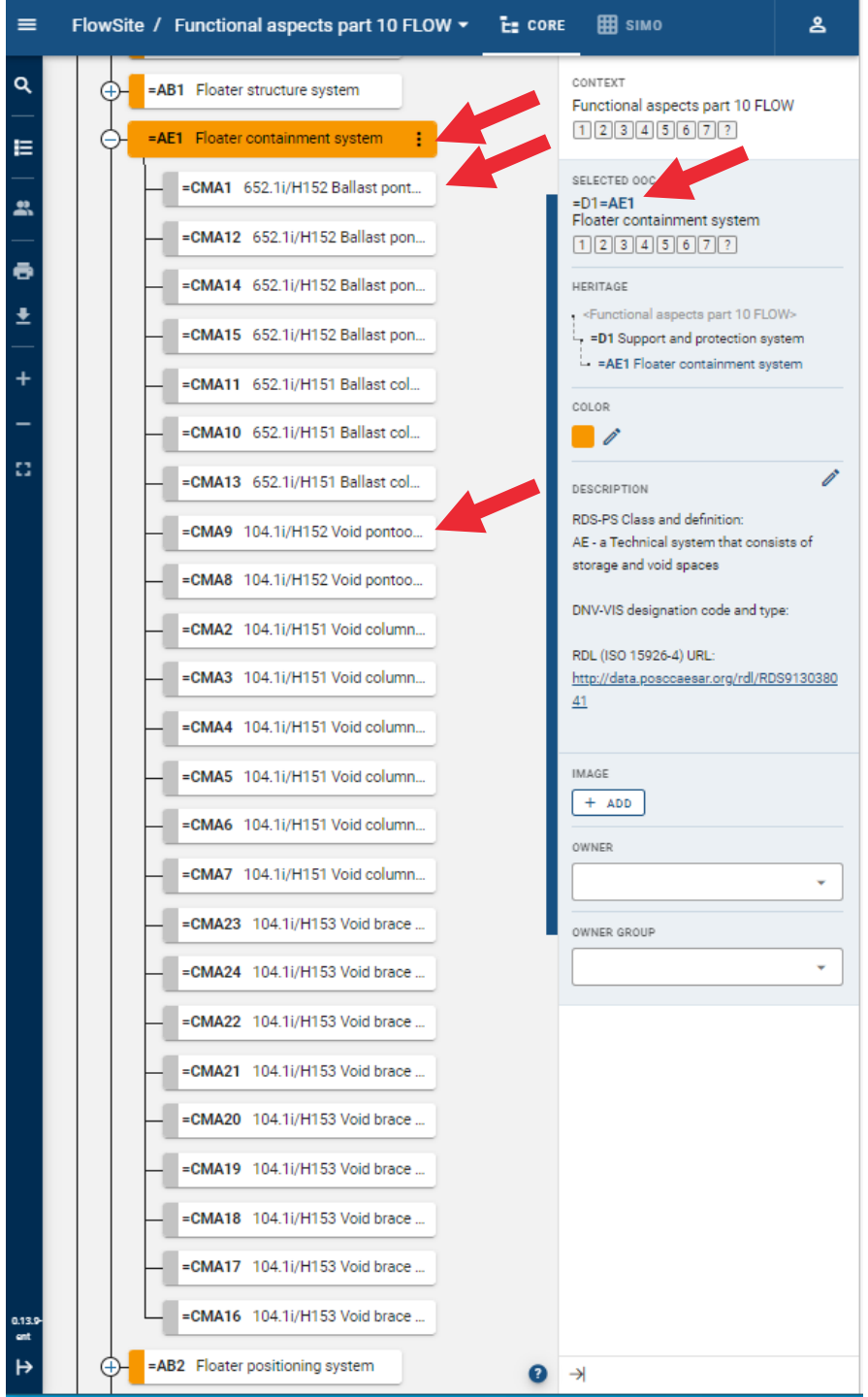
RDS for Technical systems in a Wind Turbine

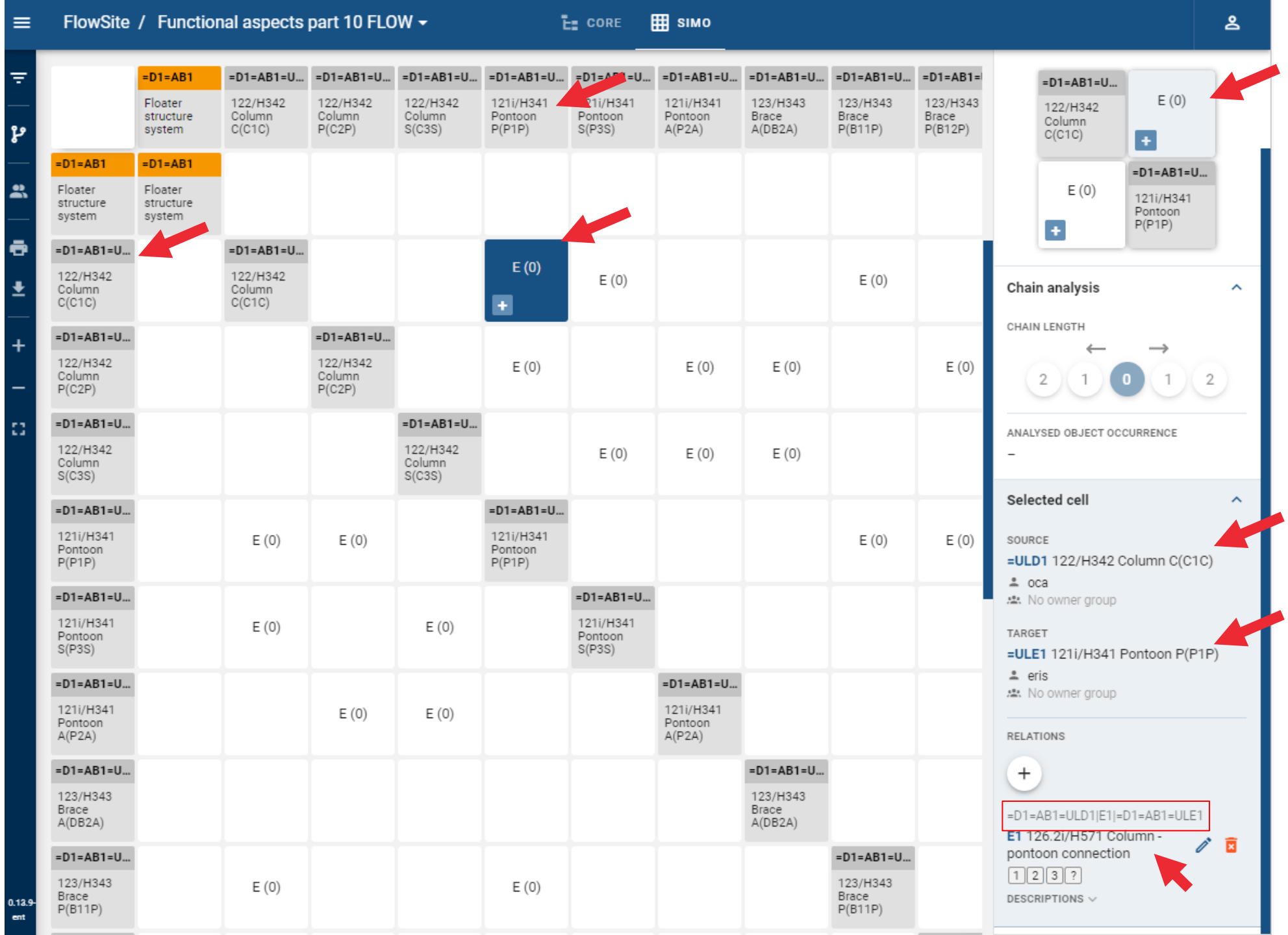


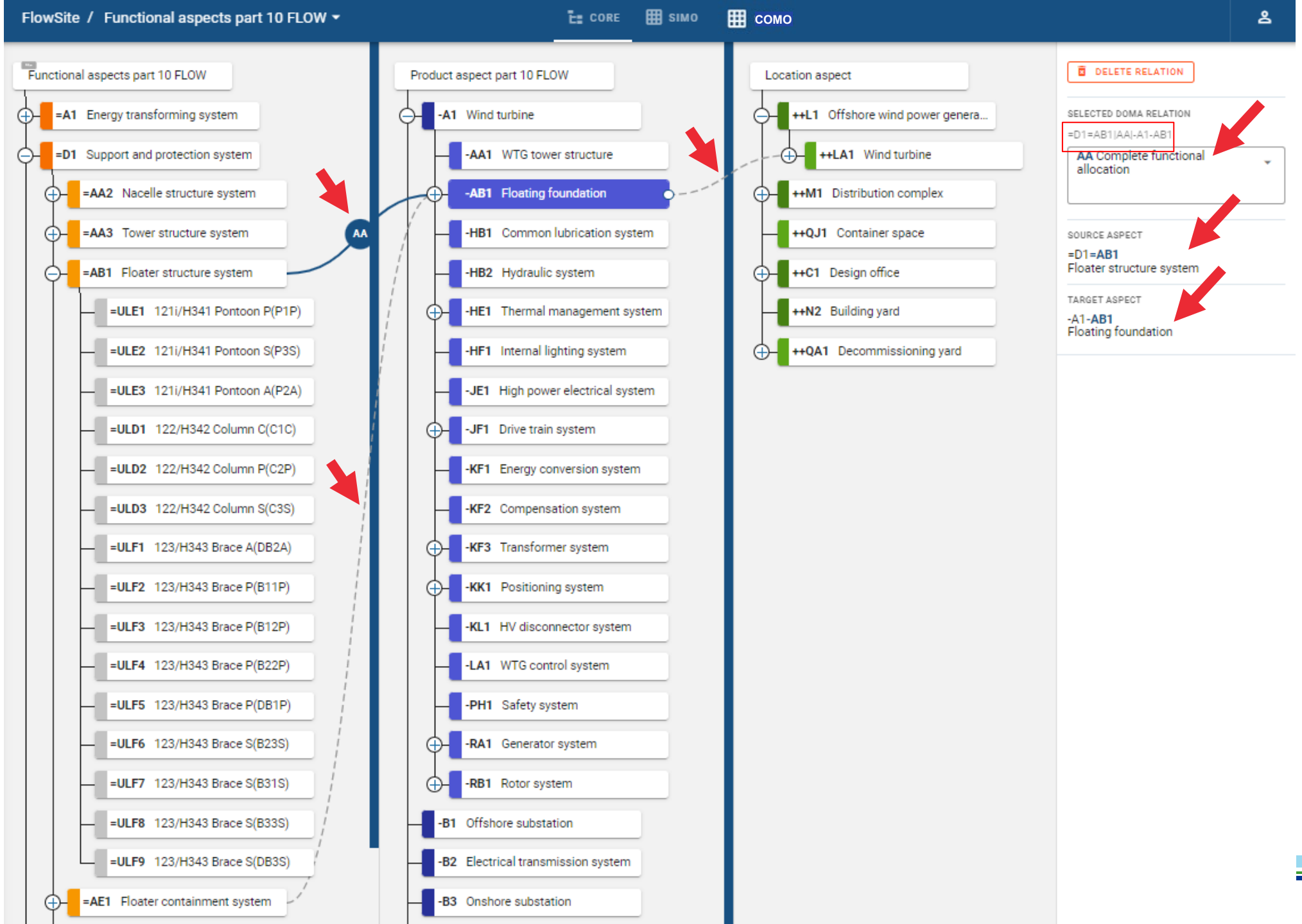


DNV


FlowSite / Functional aspects part 10 FLOW
CORE
SIMO
Functional aspects part 10 FLOW
=A1 Energy transforming system
=D1 Support and protection system
=AA2 Nacelle structure system
=AA3 Tower structure system
=AB1 Floater structure system
=ULE1 121i/H341 Pontoon P(P1P)
=ULE2 121i/H341 Pontoon S(P3S)
=ULE3 121i/H341 Pontoon A(P2A)
=ULD1 122/H342 Column C(C1C)
=ULD2 122/H342 Column P(C2P)
=ULD3 122/H342 Column S(C3S)
=ULF1 123/H343 Brace A(DB2A)
=ULF2 123/H343 Brace P(B11P)
=ULF3 123/H343 Brace P(B12P)
=ULF4 123/H343 Brace P(B22P)
=ULF5 123/H343 Brace P(DB1P)
=ULF6 123/H343 Brace S(B23S)
=ULF7 123/H343 Brace S(B31S)
=ULF8 123/H343 Brace S(B33S)
=ULF9 123/H343 Brace S(DB3S)
=AE1 Floater containment system
=AB2 Floater positioning system
=AD1 Access support system
=PA1 Fire protection system
=PD1 Lightning protection system
CONTEXT
Functional aspects part 10 FLOW
SELECTED OOC
=D1=AB1
Floater structure system
HERITAGE
<Functional aspects part 10 FLOW>
=D1 Support and protection system
=AB1 Floater structure system
COLOR
DESCRIPTION
RDS-PS Class definition:
A Technical system that provides a structural foundation for supporting loads.
DNV-VIS code and type:
120 Column stabilised unit structure
PCA-RDL URL and type:
http://data.posccaesar.org/rdl/RDS282194
PONTOON
OCX model:
https://dev.sesam.dnv.com/explore/assets/202128d7-dc61-4af1-b73b-9d3651a5e6e3/534c62a3-c696-4fa0-b614-559b5dfa3373/model
IMAGE
DELETE IMAGE
OWNER
OWNER GROUP

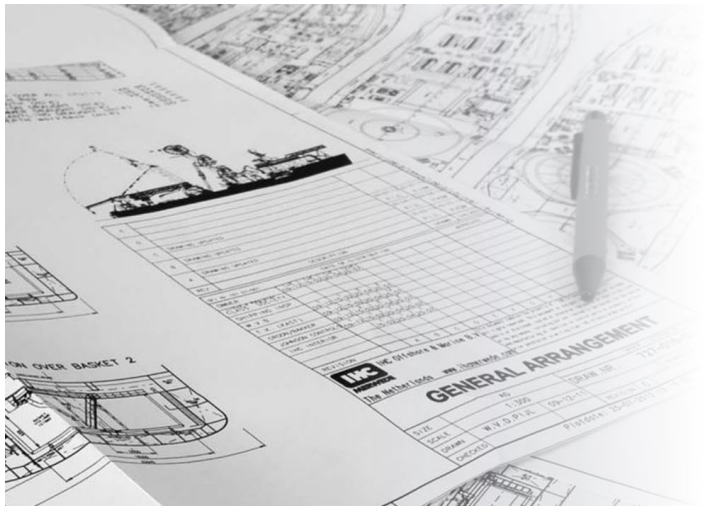

FlowSite / Functional aspects part 10 FLOW
CORE
SIMO
=AB1 Floater structure system
=AE1 Floater containment system
=CMA1 652.1i/H152 Ballast pont...
=CMA12 652.1i/H152 Ballast pon...
=CMA14 652.1i/H152 Ballast pon...
=CMA15 652.1i/H152 Ballast pon...
=CMA11 652.1i/H151 Ballast col...
=CMA10 652.1i/H151 Ballast col...
=CMA13 652.1i/H151 Ballast col...
=CMA9 104.1i/H152 Void pontoo...
=CMA8 104.1i/H152 Void pontoo...
=CMA2 104.1i/H151 Void column...
=CMA3 104.1i/H151 Void column...
=CMA4 104.1i/H151 Void column...
=CMA5 104.1i/H151 Void column...
=CMA6 104.1i/H151 Void column...
=CMA7 104.1i/H151 Void column...
=CMA23 104.1i/H153 Void brace ...
=CMA24 104.1i/H153 Void brace ...
=CMA22 104.1i/H153 Void brace ...
=CMA21 104.1i/H153 Void brace ...
=CMA20 104.1i/H153 Void brace ...
=CMA19 104.1i/H153 Void brace ...
=CMA18 104.1i/H153 Void brace ...
=CMA17 104.1i/H153 Void brace ...
=CMA16 104.1i/H153 Void brace ...
=AB2 Floater positioning system
CONTEXT
Functional aspects part 10 FLOW
SELECTED OOC
=D1=AE1
Floater containment system
HERITAGE
<Functional aspects part 10 FLOW>
=D1 Support and protection system
=AE1 Floater containment system
COLOR
DESCRIPTION
RDS-PS Class and definition:
AE - a Technical system that consists of storage and void spaces
DNV-VIS designation code and type:
RDL (ISO 15926-4) URL:
http://data.posccaesar.org/rdl/RDS913038041
IMAGE
ADD
OWNER
OWNER GROUP

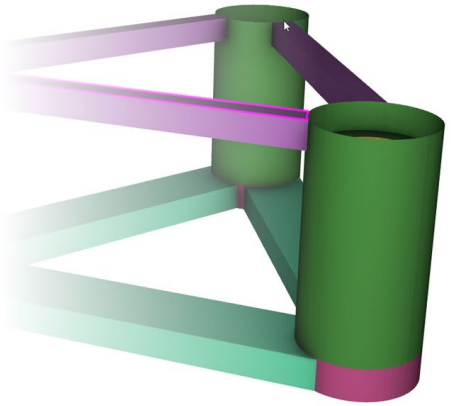

FlowSite / Functional aspects part 10 FLOW
CORE
SIMO
=D1=AB1
Floater structure system
=D1=AB1=U...
122/H342 Column C(C1C)
122/H342 Column P(C2P)
122/H342 Column S(C3S)
121i/H341 Pontoon P(P1P)
121i/H341 Pontoon S(P3S)
121i/H341 Pontoon A(P2A)
123/H343 Brace A(DB2A)
123/H343 Brace P(B11P)
123/H343 Brace P(B12P)
E (0)
Chain analysis
CHAIN LENGTH
2 1 0 1 2
ANALYSED OBJECT OCCURRENCE
–
Selected cell
SOURCE
=ULD1 122/H342 Column C(C1C)
oca
No owner group
TARGET
=ULE1 121i/H341 Pontoon P(P1P)
eris
No owner group
RELATIONS
=D1=AB1=ULD1|E1|=D1=AB1=ULE1
E1 126.2i/H571 Column - pontoon connection
1 2 3 ?
DESCRIPTIONS
0.13.9-ent


FlowSite / Functional aspects part 10 FLOW
CORE
SIMO
COMO
Functional aspects part 10 FLOW
=A1 Energy transforming system
=D1 Support and protection system
=AA2 Nacelle structure system
=AA3 Tower structure system
=AB1 Floater structure system
=ULE1 121i/H341 Pontoon P(P1P)
=ULE2 121i/H341 Pontoon S(P3S)
=ULE3 121i/H341 Pontoon A(P2A)
=ULD1 122/H342 Column C(C1C)
=ULD2 122/H342 Column P(C2P)
=ULD3 122/H342 Column S(C3S)
=ULF1 123/H343 Brace A(DB2A)
=ULF2 123/H343 Brace P(B11P)
=ULF3 123/H343 Brace P(B12P)
=ULF4 123/H343 Brace P(B22P)
=ULF5 123/H343 Brace P(DB1P)
=ULF6 123/H343 Brace S(B23S)
=ULF7 123/H343 Brace S(B31S)
=ULF8 123/H343 Brace S(B33S)
=ULF9 123/H343 Brace S(DB3S)
=AE1 Floater containment system
AA
Product aspect part 10 FLOW
-A1 Wind turbine
-AA1 WTG tower structure
-AB1 Floating foundation
-HB1 Common lubrication system
-HB2 Hydraulic system
-HE1 Thermal management system
-HF1 Internal lighting system
-JE1 High power electrical system
-JF1 Drive train system
-KF1 Energy conversion system
-KF2 Compensation system
-KF3 Transformer system
-KK1 Positioning system
-KL1 HV disconnector system
-LA1 WTG control system
-PH1 Safety system
-RA1 Generator system
-RB1 Rotor system
-B1 Offshore substation
-B2 Electrical transmission system
-B3 Onshore substation
Location aspect
++L1 Offshore wind power genera...
++LA1 Wind turbine
++M1 Distribution complex
++QJ1 Container space
++C1 Design office
++N2 Building yard
++QA1 Decommissioning yard
DELETE RELATION
SELECTED DOMA RELATION
=D1=AB1|AA|-A1-AB1
AA Complete functional allocation
SOURCE ASPECT
=D1=AB1
Floater structure system
TARGET ASPECT
-A1-AB1
Floating foundation

THE COMMON LANGUAGE

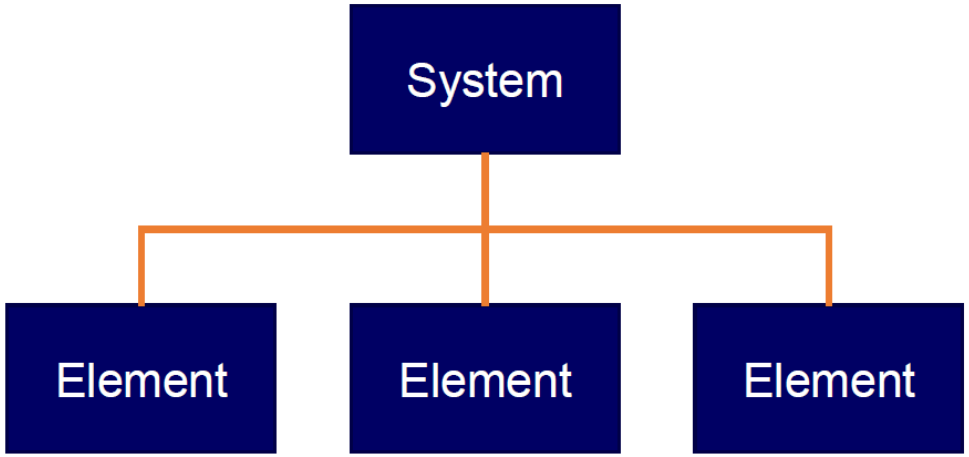
OCX





ISO 81346

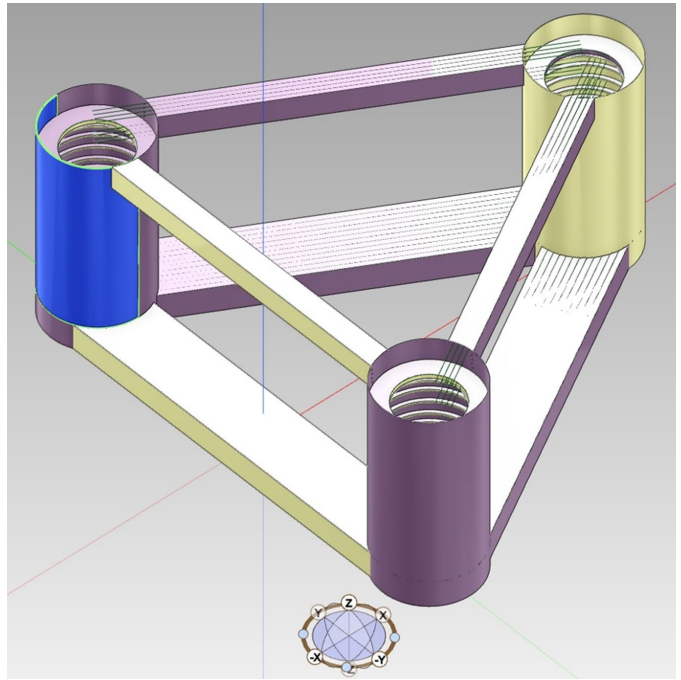
=	Functional aspect
-	Product aspect
+	Location asepct
%	Type aspect



Source: https://81346.com/english/

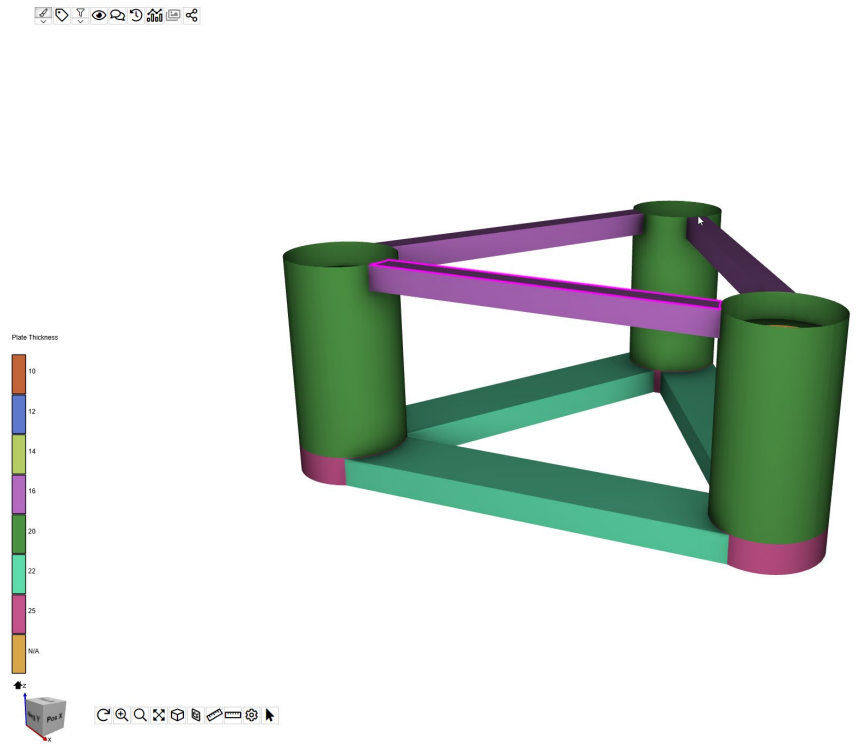
The OCX format can represent the load bearing structure of floating assets

INO12 Modelled in Aveva Everything 3D (E3D)



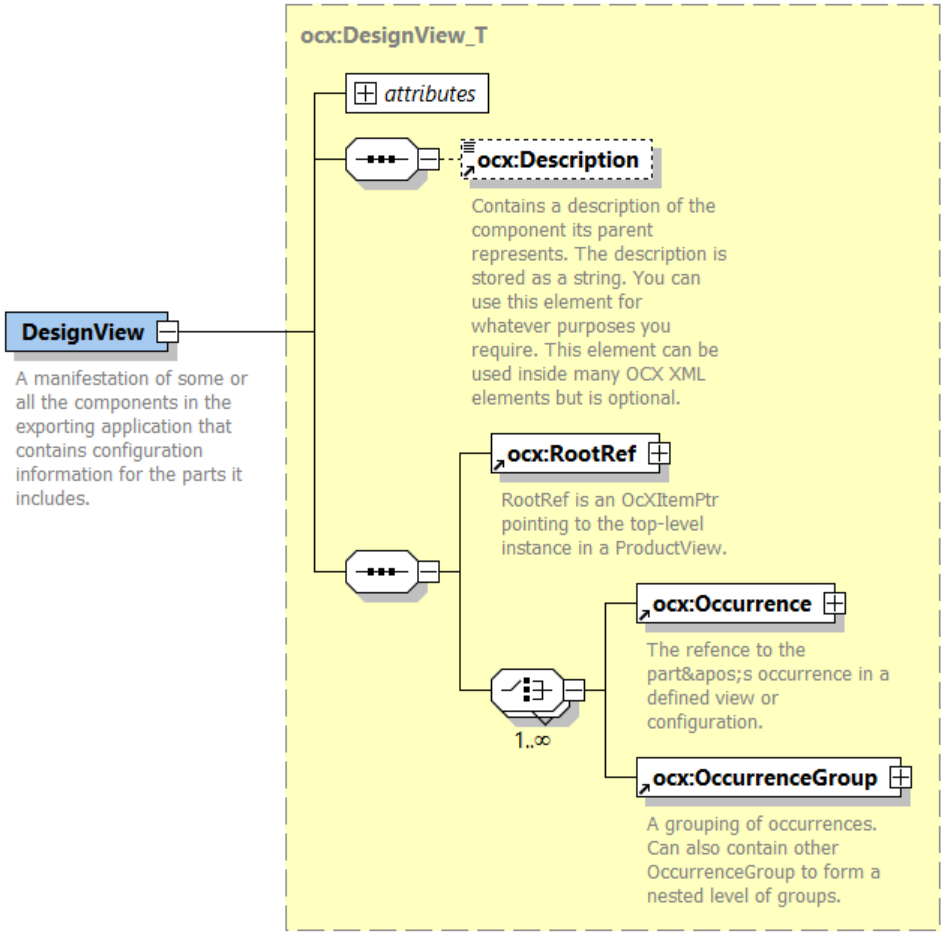
OCX

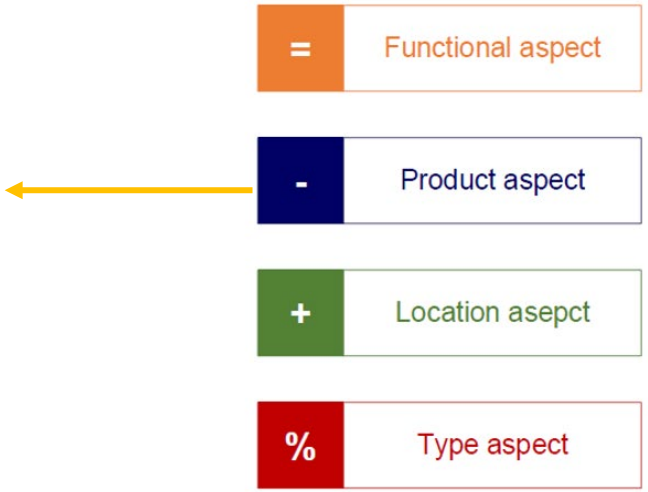
INO12 transferred to Sesam Insight



ISO81346 Product Aspect

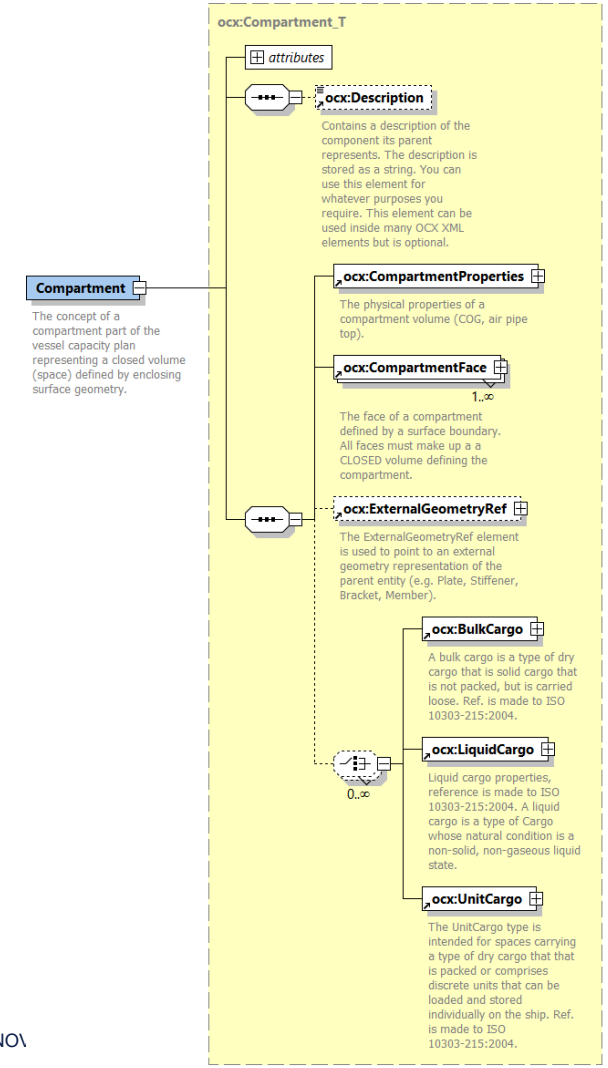
OCX schema type DesignView

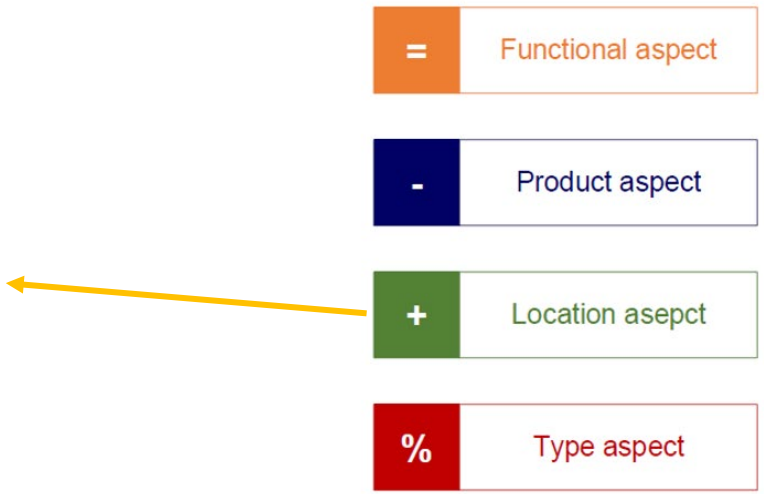




ISO81346 Location Aspect

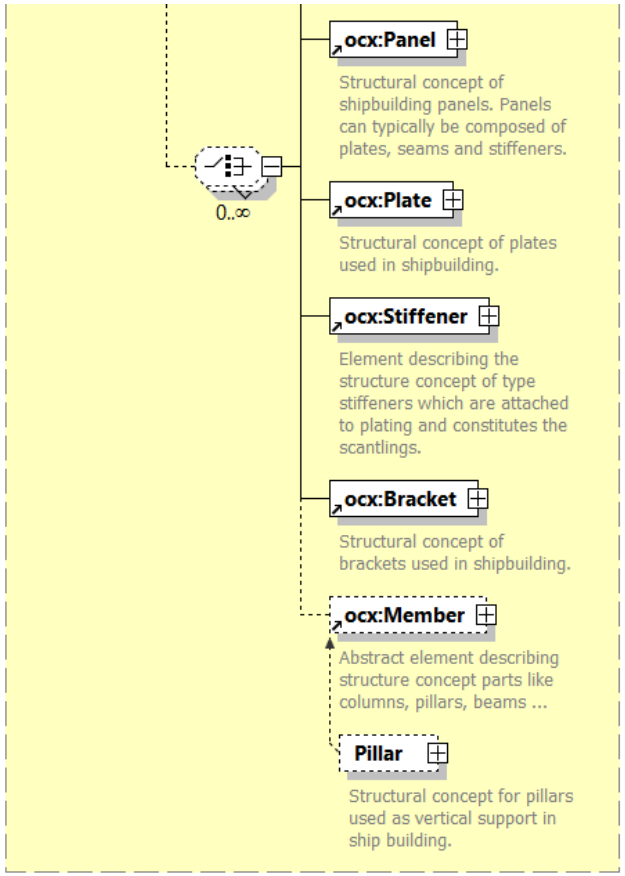
OCX schema type Compartments and subdivisions



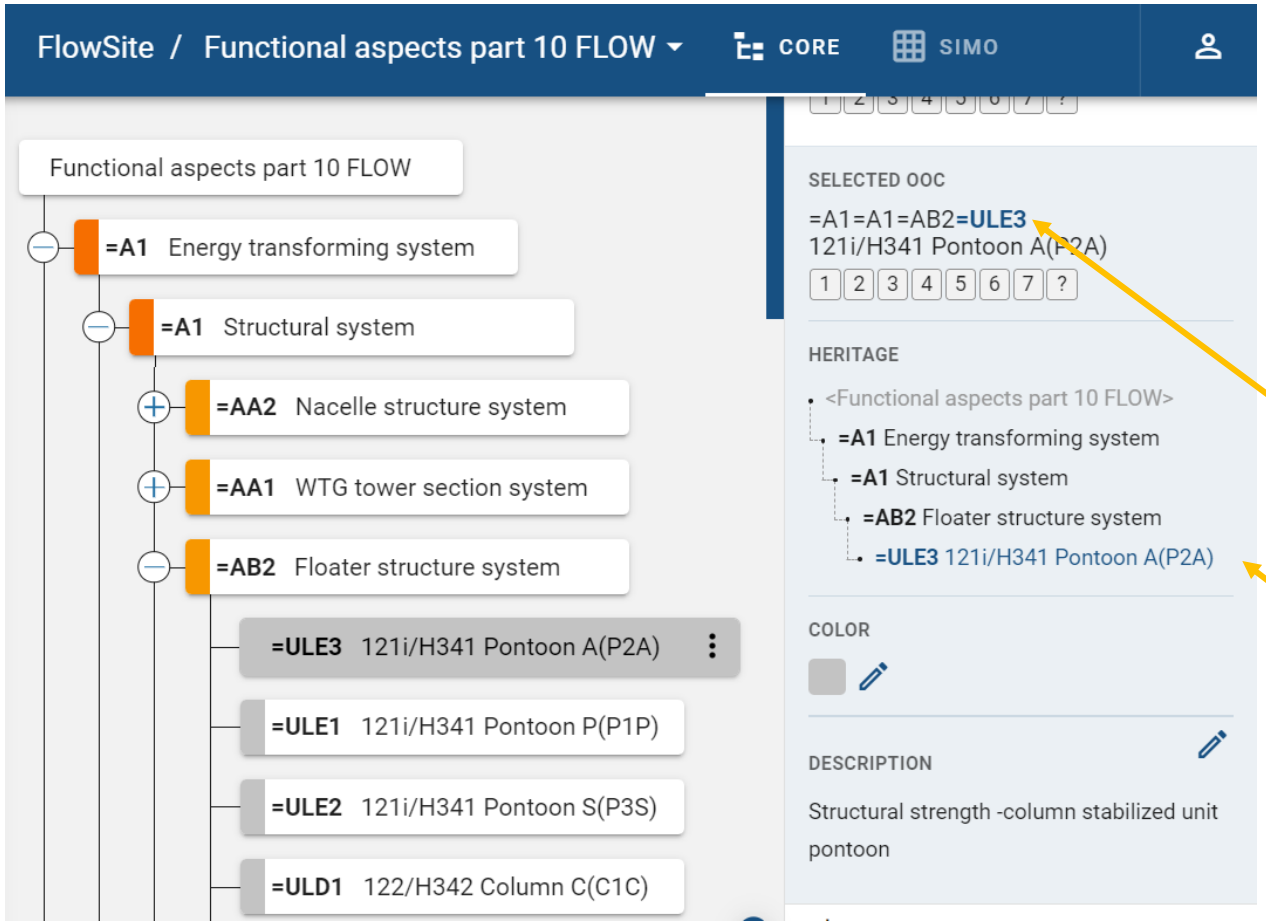


ISO81346 Type Aspect

OCX schema types Plate, Stiffener, Bracket etc



VIS RDS to ISO 81346 mapping

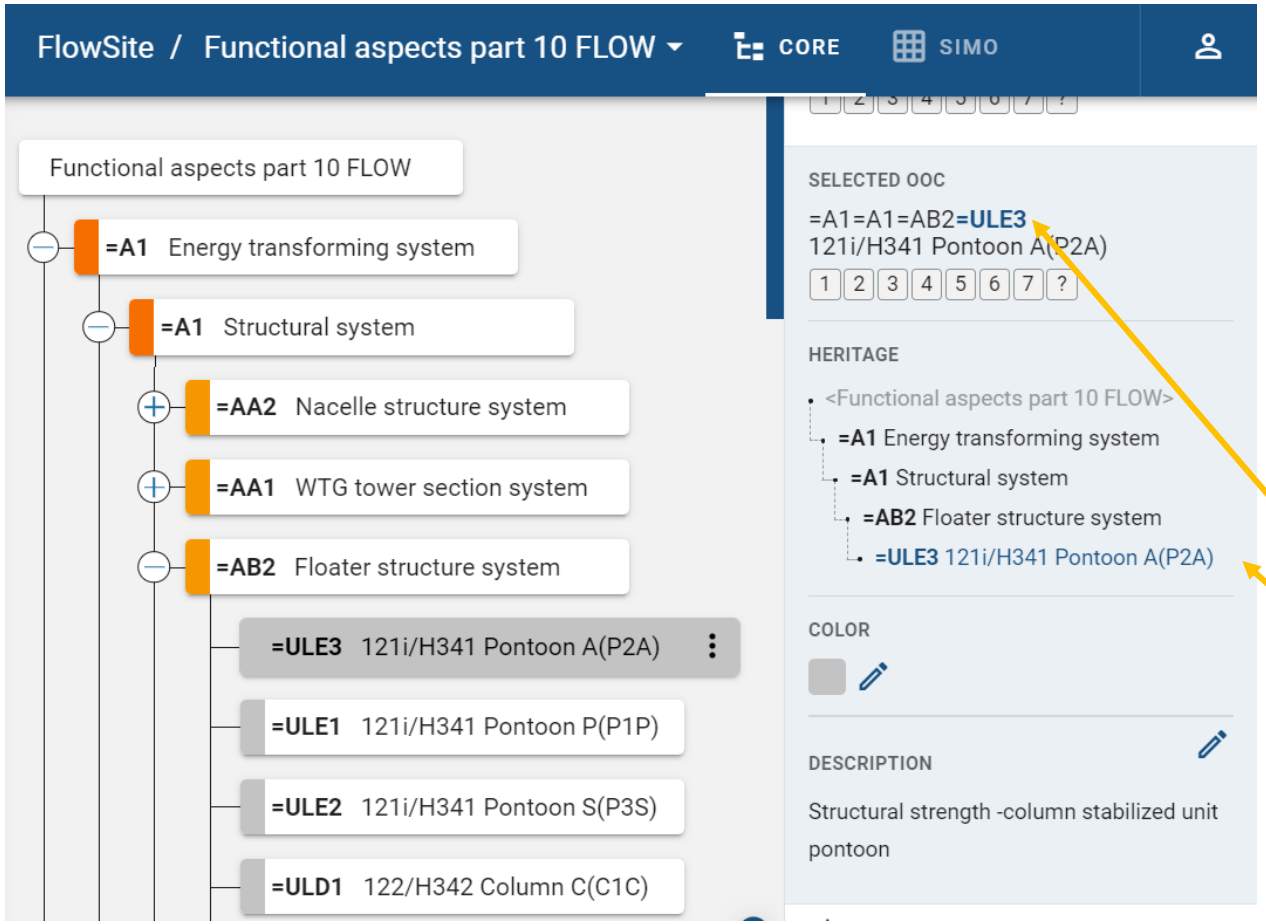


=A1 Energy transforming system	**=A1**
=A1 Structural system	**=A1.A1**
=AB2 Floater structure system	**=A1.A1.AB2**
=ULE3 121i/H341 Pontoon A(P2A)	**=A1.A1.AB2.ULE3**
=ULE1 12iI/H341 Pontoon P(P1P)	**=A1.A1.AB2.ULE1**
=ULE2 121i/H341 Pontoon S(P3S)	**=A1.A1.AB2.UL2**
=ULD1 122/H342 Column C(C1C)	**=A1.A1.AB2.ULD1**
=	

Designation from ISO 81346-10:2022 (RDS-PS)

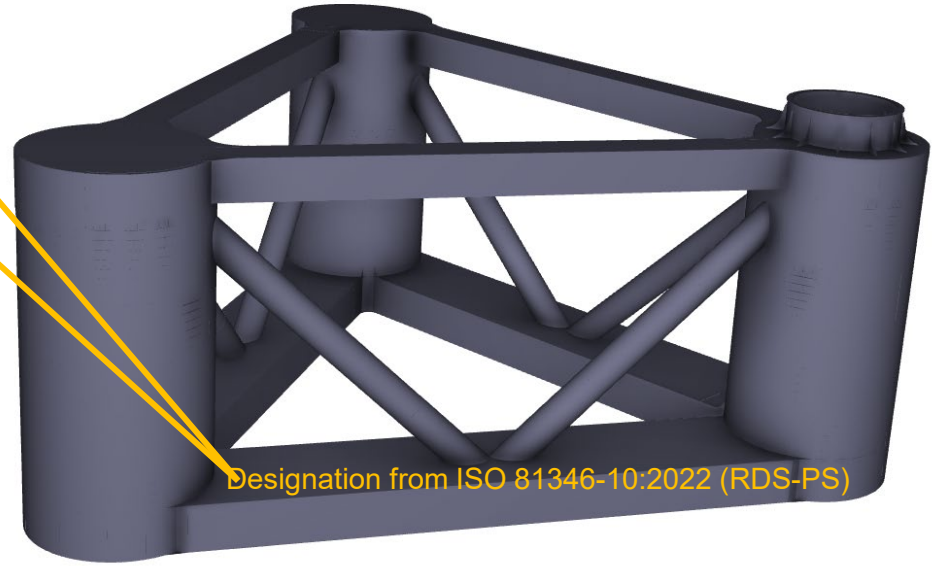
Designation from DNV Maritime execution model

OCX to ISO 81346 mapping



Principle

- Link between the function node and the OCX 3D part
- Link ID can be GUID or an 81346 RDS tag
- The 3D model provides sub-level tags



The INO WINDMOOOR 12MW use case example – **as-is** workflow

User Requirements (the asset model governance domain)	**Domain Description** (the asset model engineering domain)	**Data Representation** (the asset model ontology domain)	**System Deployment** (the asset model implementation domain)
INO-12 specification *DNV RU-OU-512 Offshore wind turbine installations* *DNV ST-0119 Floating wind turbine structure*	*INO-12 model representation* *Geometry model* *Environment model* *Load model* *Capacity model*	*SESAM Interface files*	*SESAM CAE software*

The INO WINDMOOOR 12MW use case example – **to-be** workflow

User Requirements (the asset model governance domain)	**Domain Description** (the asset model engineering domain)	**Data Representation** (the asset model ontology domain)	**System Deployment** (the asset model implementation domain)
INO-12 specification *DNV RU-OU-512 Offshore wind turbine installations* *DNV ST-0119 Floating wind turbine structure*	*INO-12 model representation* *Geometry model* *Environment model* *Load model* *Capacity model*	*SESAM Interface files* *OCX schema* *Vessel Information structures (VIS)* *Operational data and (ISO 19847/8)*	*SESAM CAE software* *Aveva CAD model* *Nauticus Production System (NPS)* *Veracity operational data services*
Documentation (the common asset model classification language and designation system) *ISO 81346-10:2022*			