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Study on the ISO 15926 based data modeling methodology for nuclear power industry

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Agenda

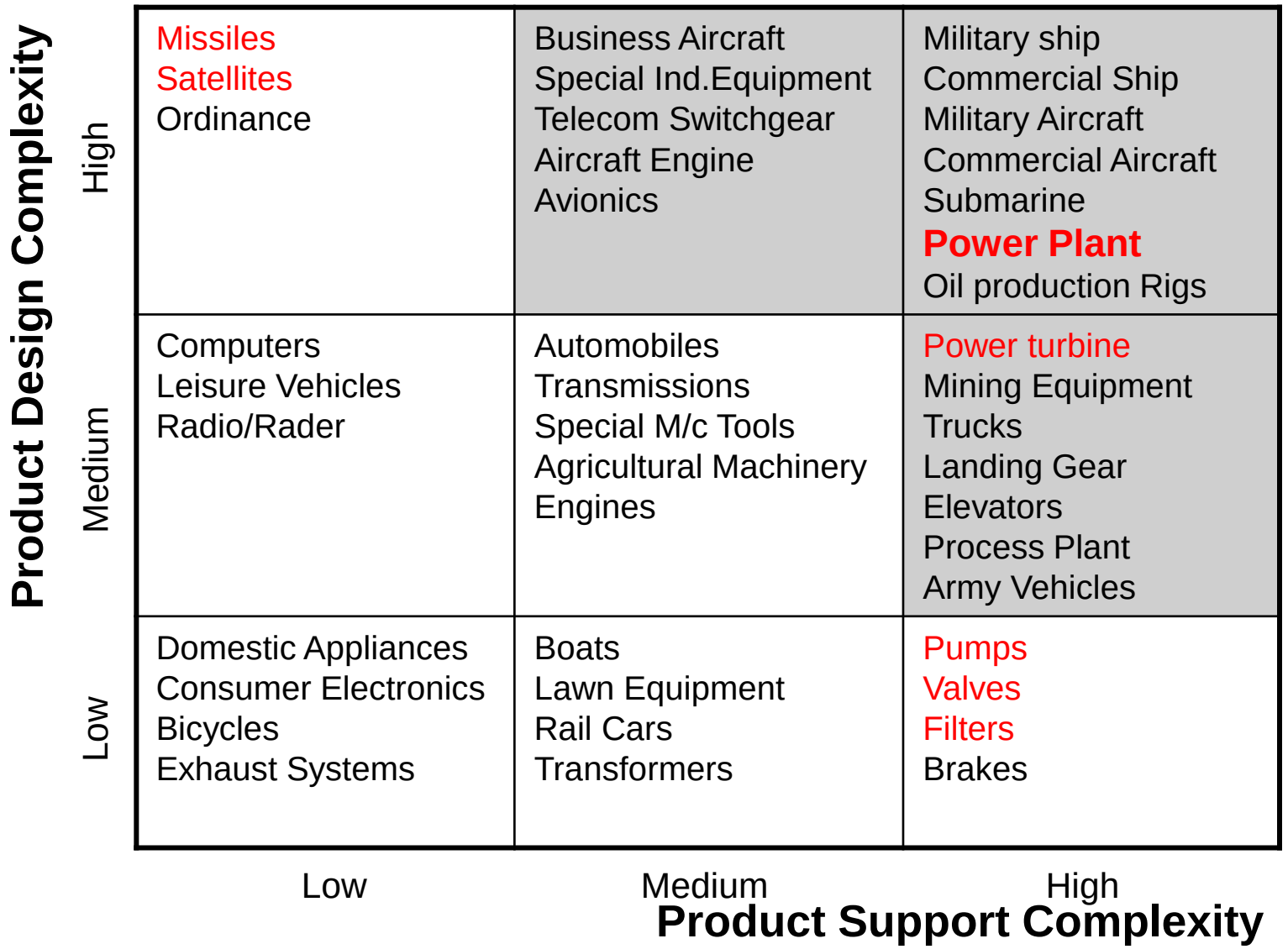
- Introduction
- Technology Intro
- NPP Class Extension
- Conclusion
- Reference

Introduction

- ISO15926 is an international standard for the representation of process plant life-cycle information. The scope is data integration and data to support the whole life of a plant. This representation is specified by a generic, conceptual Data Model (DM) that is independent of any particular application, but that is able to record data from the applications used in plant design, fabrication and operation. The data model is designed to be used in conjunction with Reference Data (RD): standard instances of the DM that represent information common to a number of users, plants, or both.
- This paper introduces a high level description of the structure of ISO 15926 and how this can be adapted to the nuclear power plant industry in particular.

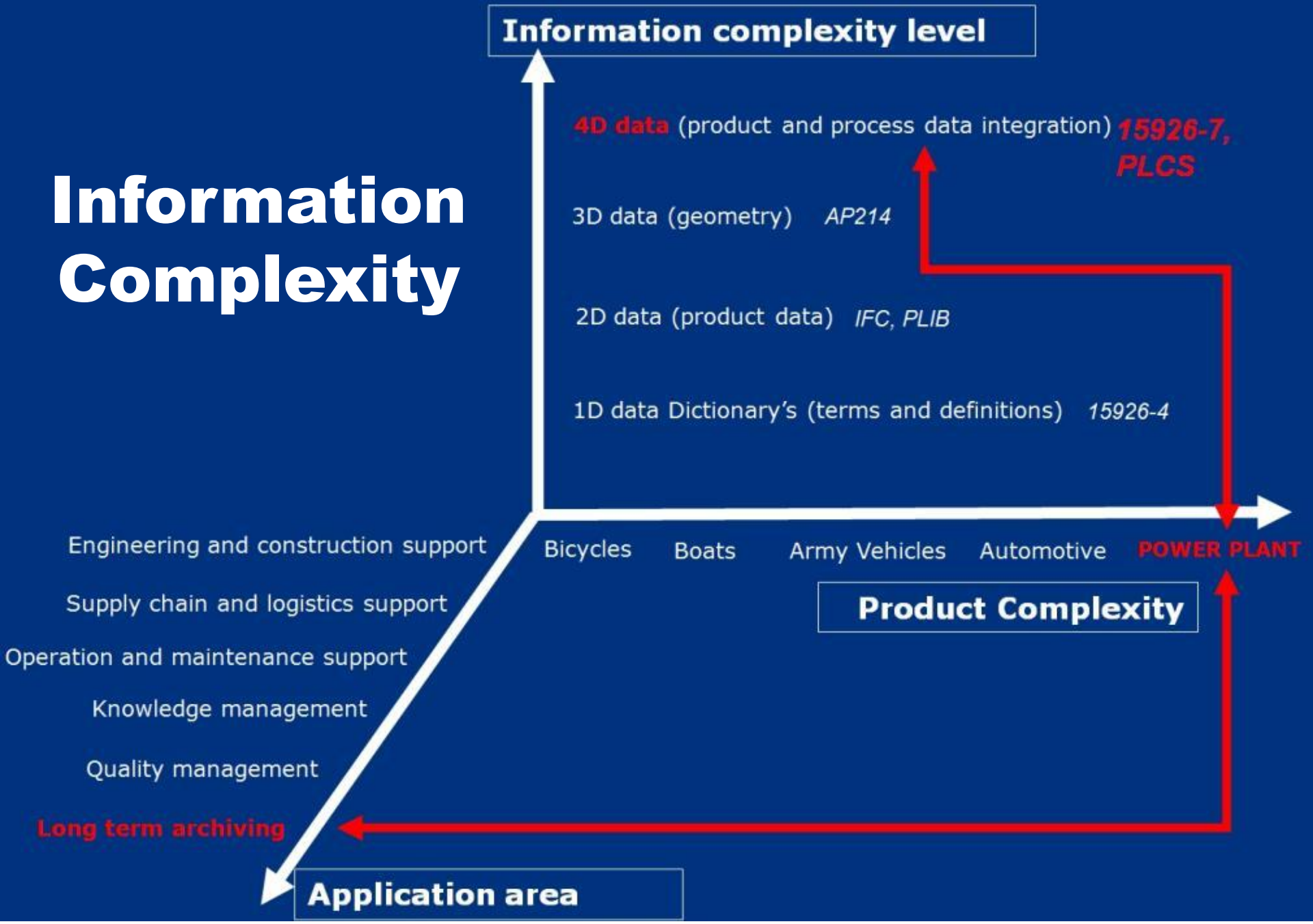
✓ ISO15926: Integration of life-cycle data for process plants including oil and gas production facilities

Product Complexity



*REF: ISO 10303-239 Product Life Cycle Support. 2009

Information Complexity



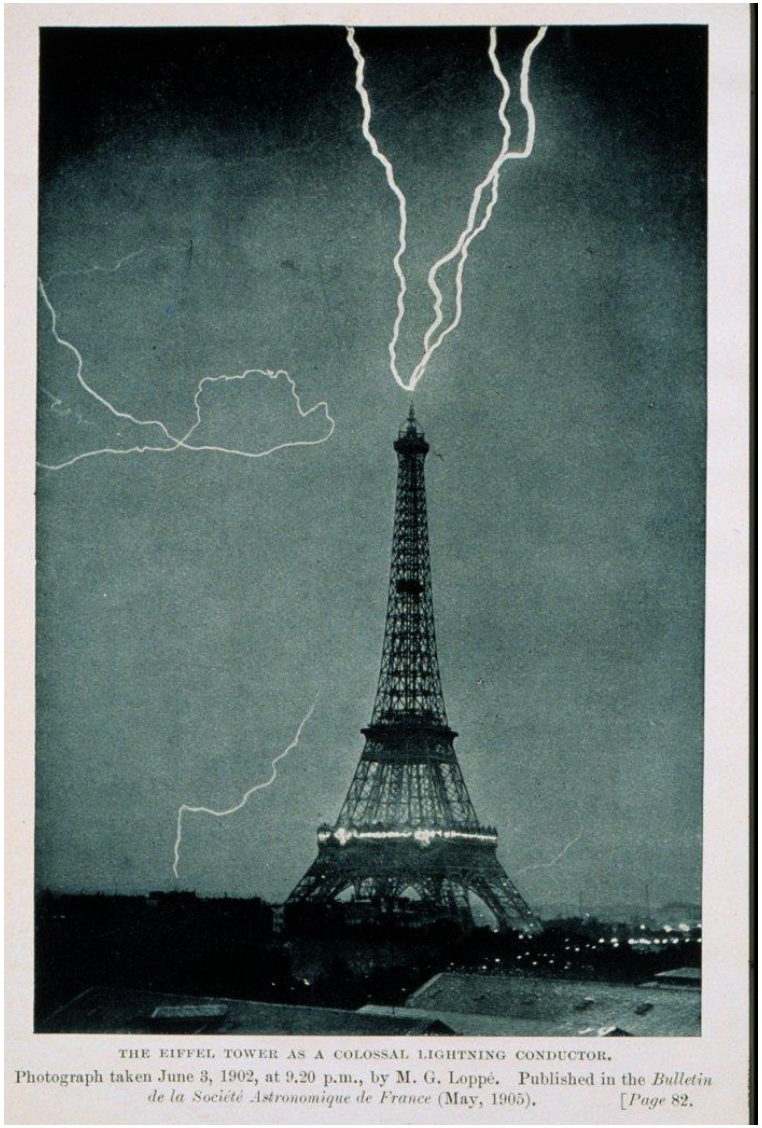
*REF: 57th ISO TC184/SC4 Group Meeting, Parksville, USA. 2009.05

Historian

*REF: Brian McVicar, Historian hopes to boil down huge cache of documents

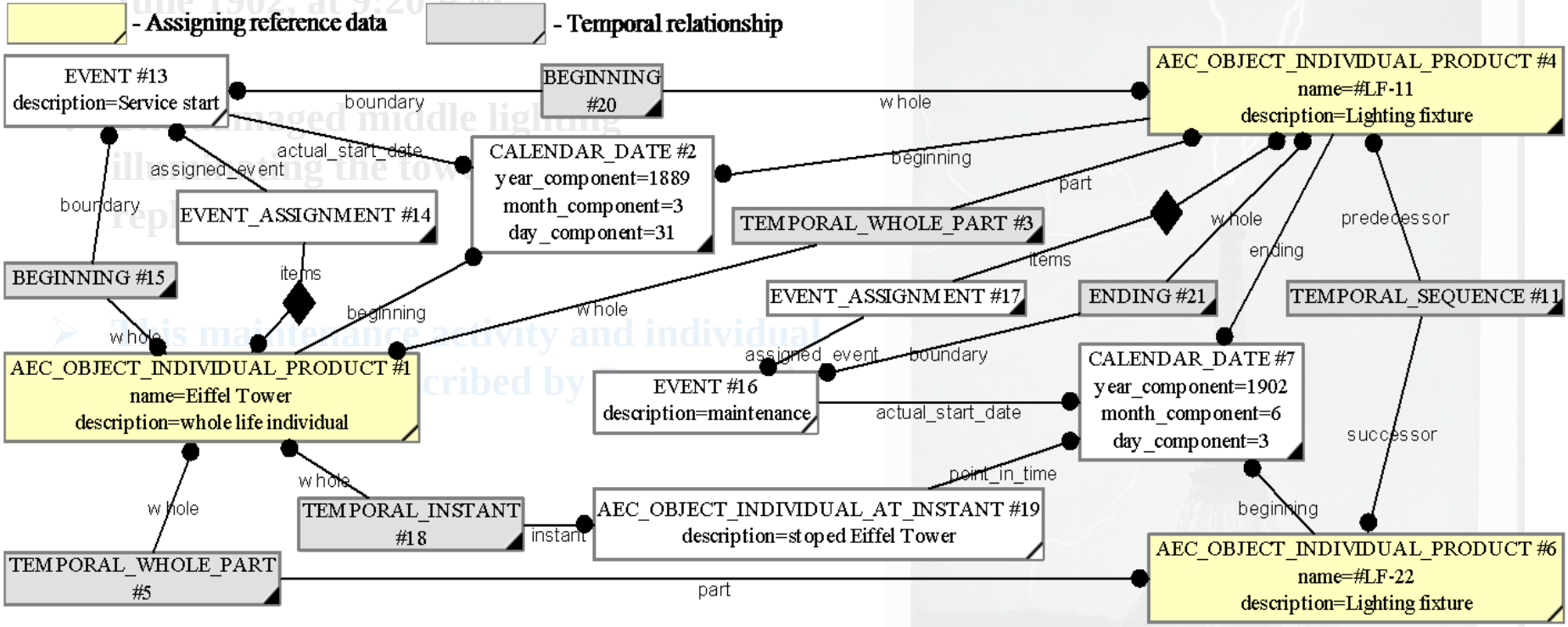
Product Data Model

- **Eiffel Tower was struck by lightning on 3 June 1902, at 9:20 P.M.**
- **The damaged middle lighting illuminating the tower had to be replaced.**
- **This maintenance activity and individual objects can be described by Data model**



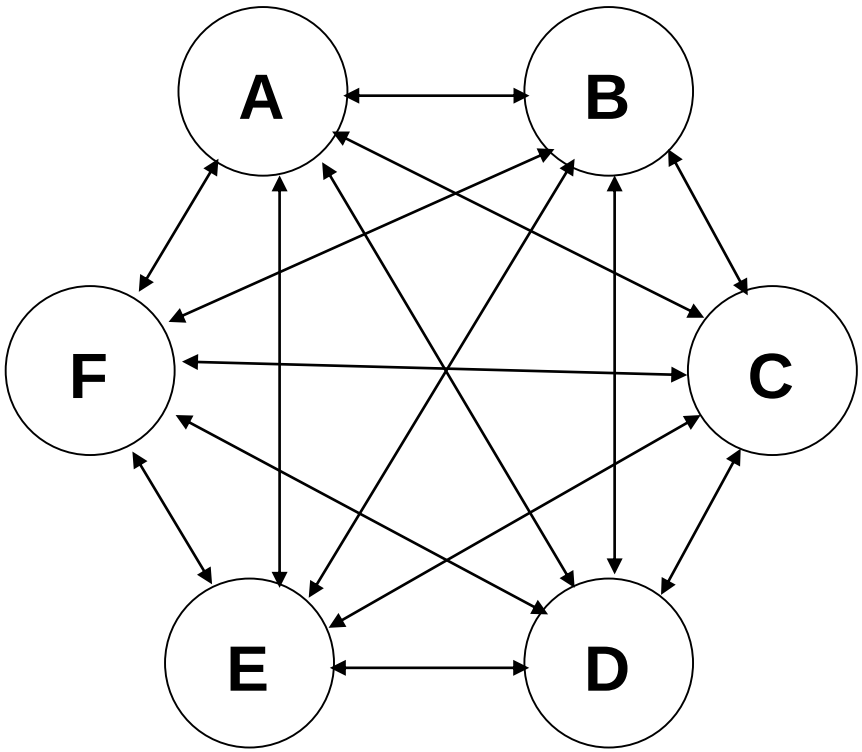
THE EIFFEL TOWER AS A COLOSSAL LIGHTNING CONDUCTOR.
Photograph taken June 3, 1902, at 9.20 p.m., by M. G. Loppé. Published in the *Bulletin de la Société Astronomique de France* (May, 1905). [*Page* 82.

Product Data Model

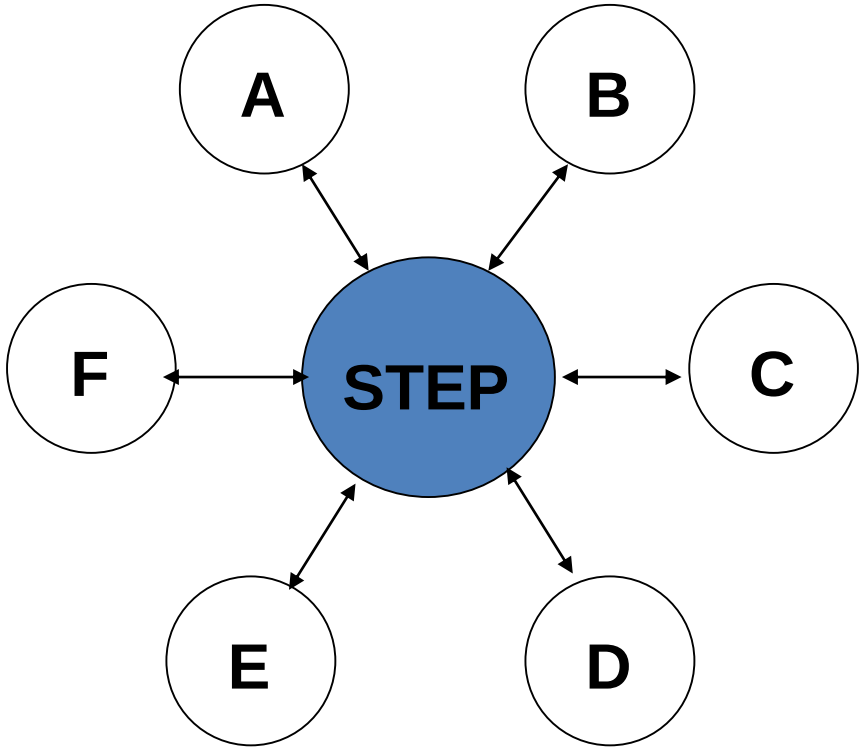


ISO/STEP

STandard for the Exchange of Product model data



Direct translation:
30 translators for 6 systems
(what do we archive?)



Neutral file method:
12 translators for 6 systems
(STEP suitable for archiving)

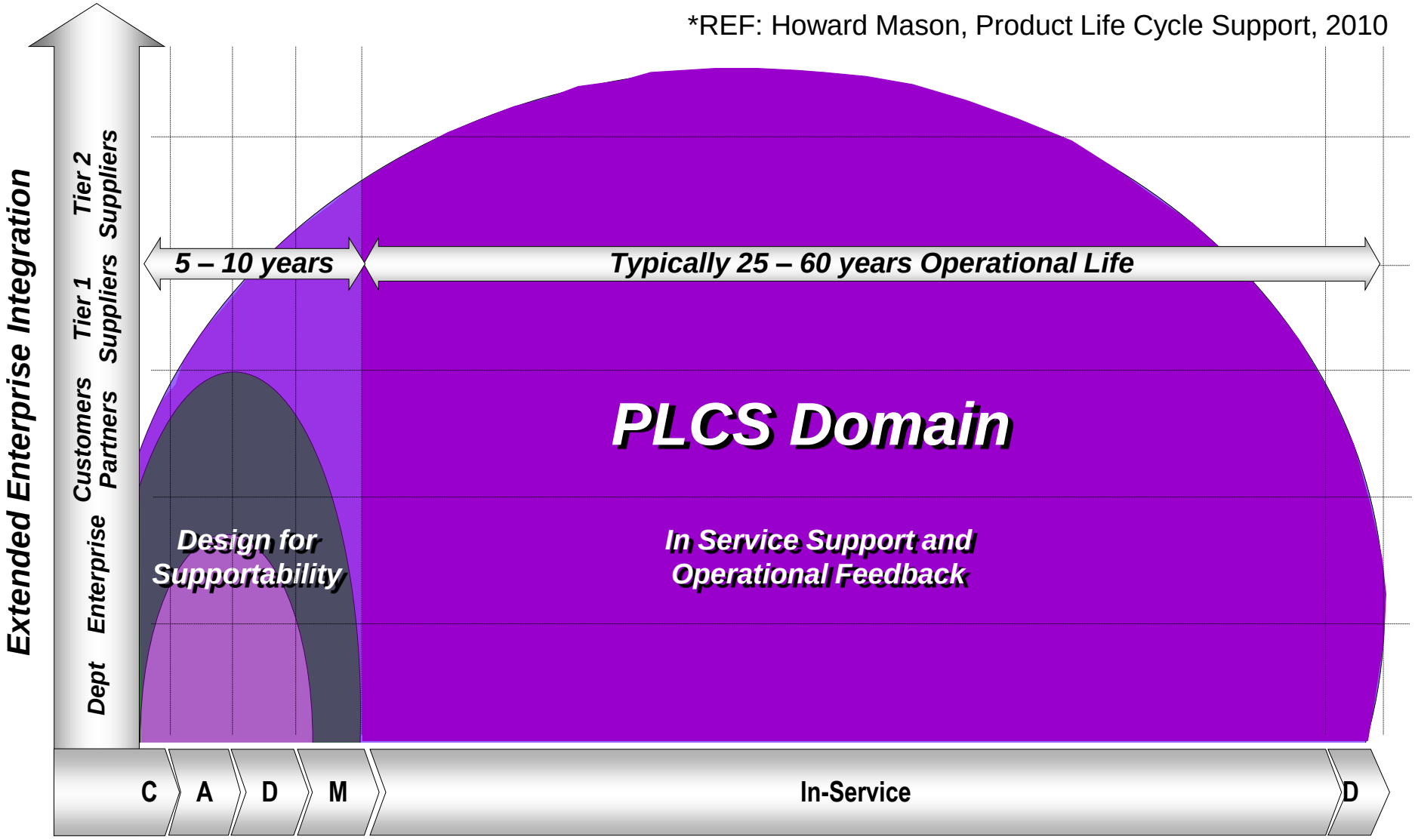
Data exchange issue During the Life Cycle

between partners & suppliers	❖Data exchange between consortium partners, architect engineers, key engineering contractors ❖Data exchange between equipment suppliers (component data, operation & maintenance)
between projects	❖Modularization of plant and Engineering „re-use“ ❖Information/ Configuration Management across plants
between EPC & O/O	❖Handover of „virtual plant“ into Owners system ❖Consider Owner/ Operators need for operation and maintenance ❖Consider plant life time (80 years) data maintainability
between tools	❖Data management & configuration management between the modules of the IMS ❖Interfacing ERP, EDM, PMS, and design tools of specific disciplines

ISO 10303-239 PLCS

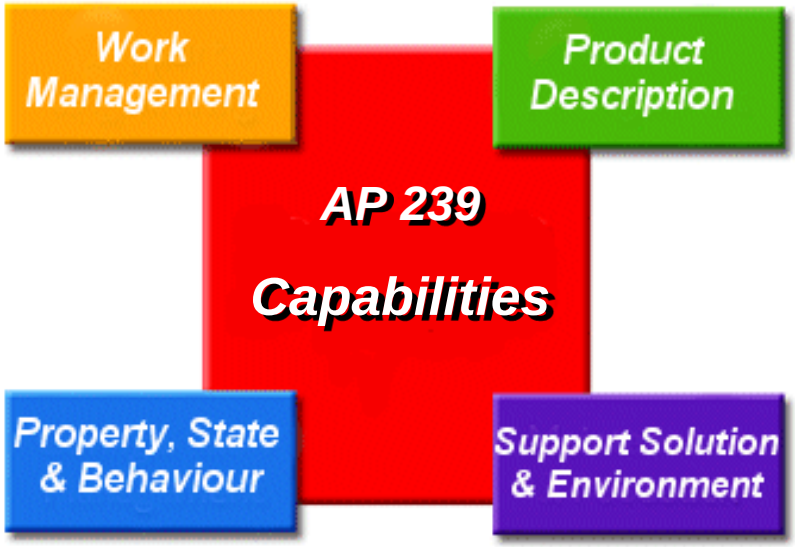
Product Life Cycle Support

*REF: Howard Mason, Product Life Cycle Support, 2010



ISO 10303-239 PLCS

Product Life Cycle Support



Product Description

Capability to define product requirements and configuration, including relationships between parts and assemblies in multiple product structures (as-designed, as-built, as-maintained)

Work Management

Capability to request, define, justify, approve, schedule and capture feedback on work (activities) and related resources.

Property, State and Behaviour

Capability that describes and captures feedback on product properties, operating states, behaviour and usage

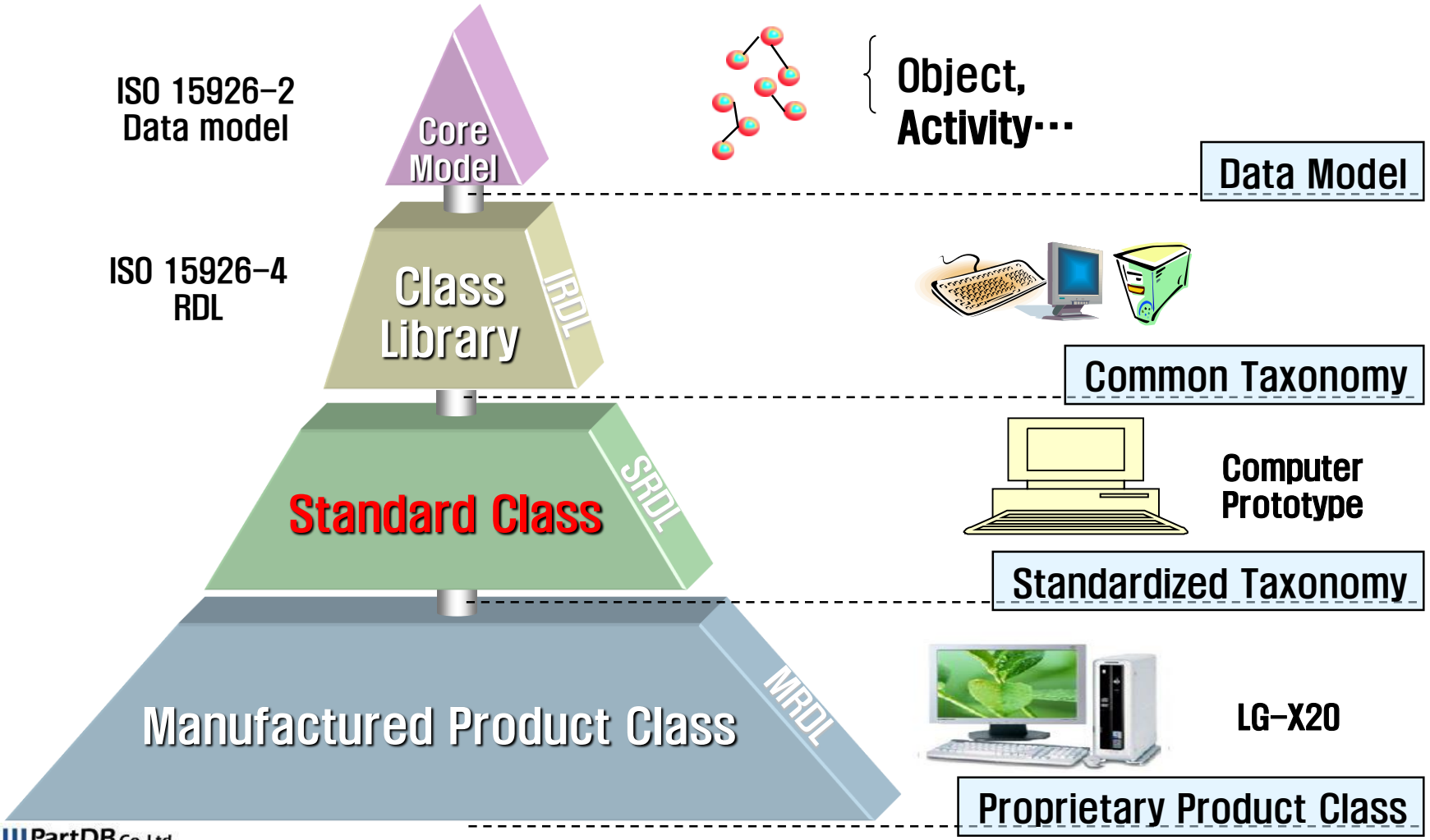
Support Solution and Environment

Capability to define the necessary support for a given set of products in a specified environment and to define support opportunity, facilities, personnel and organizations

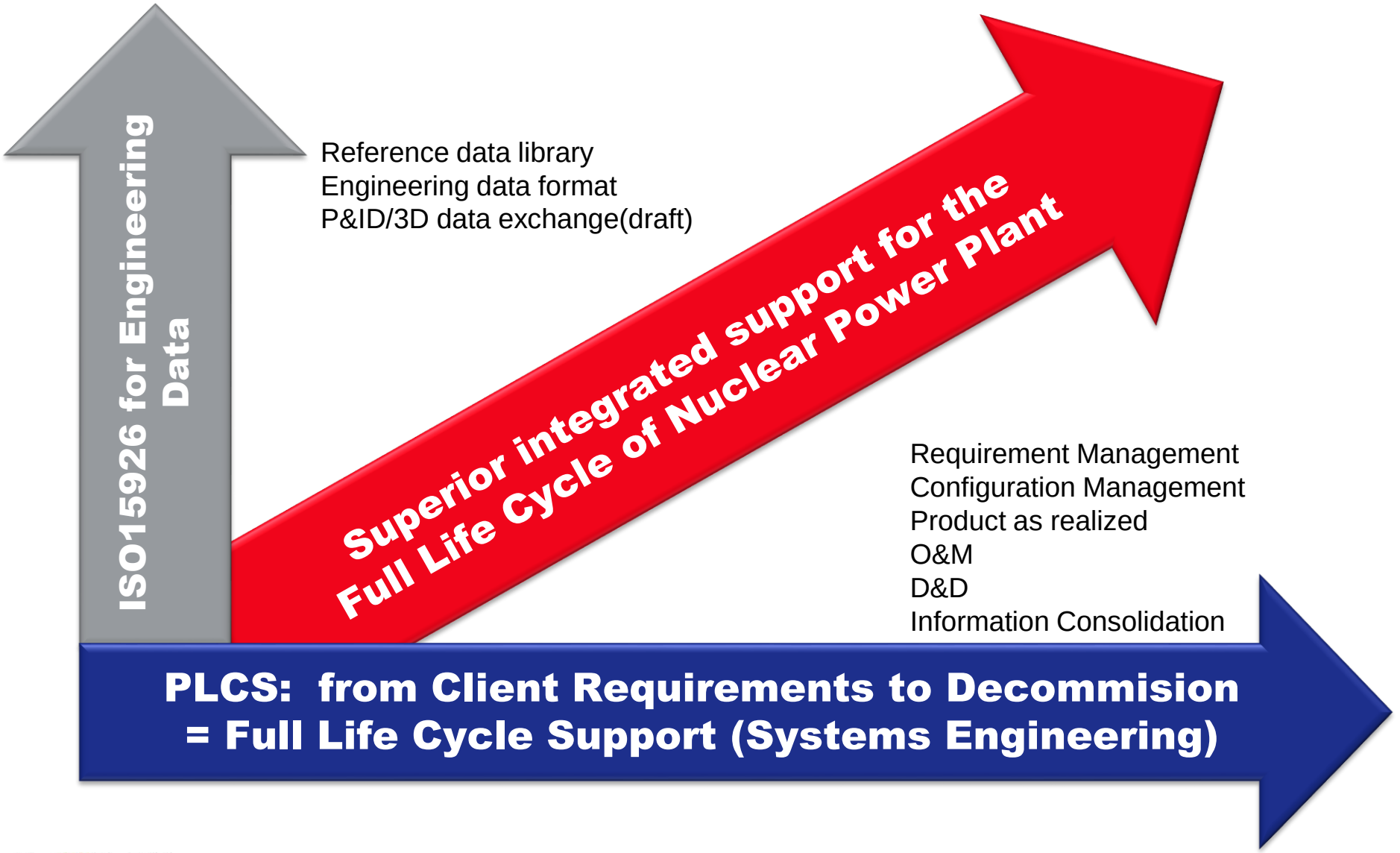
*REF: Howard Mason, Product Life Cycle Support, 2010

ISO 15926

Integration of life-cycle data for process plants including oil and gas production facilities

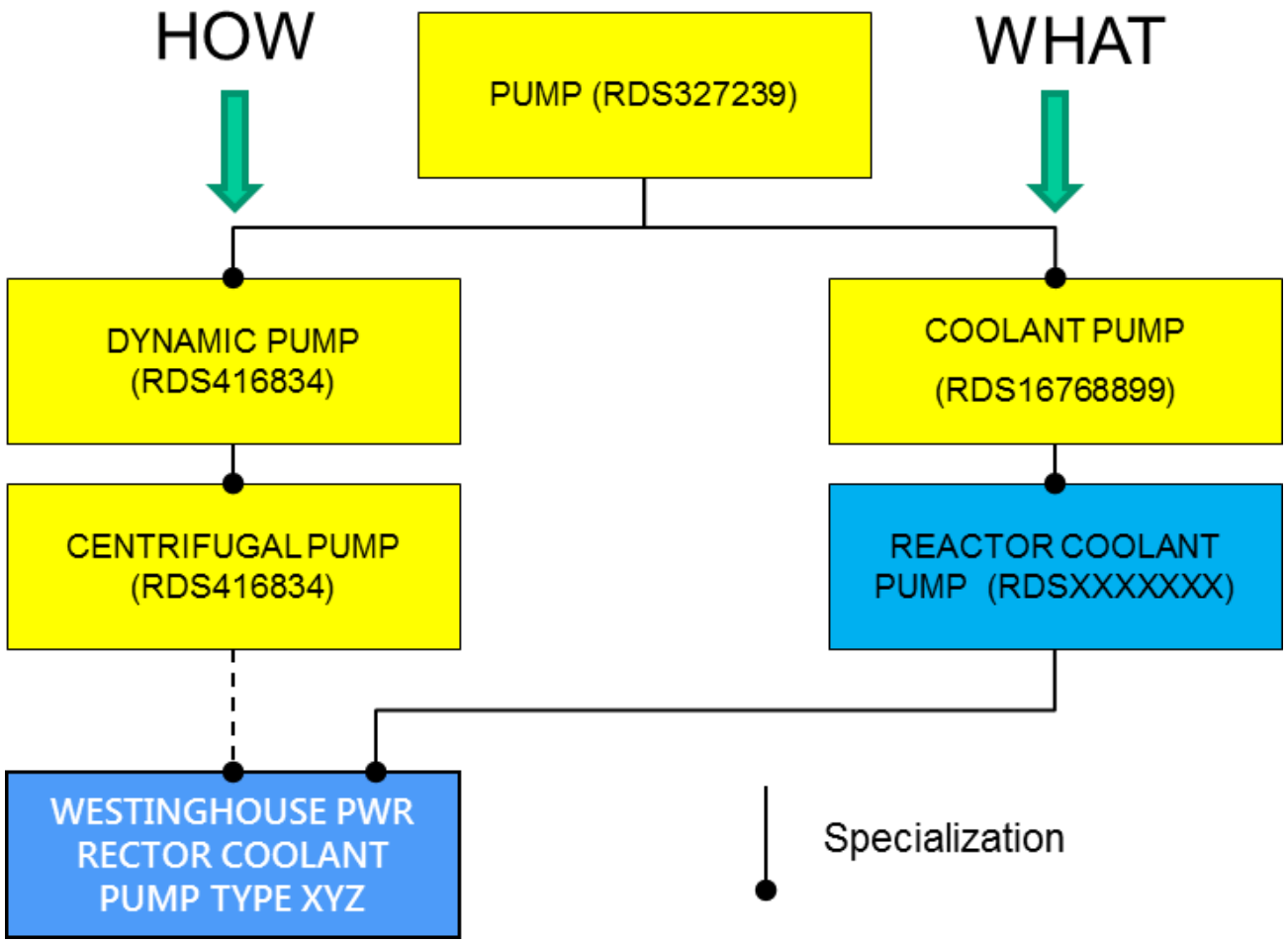


The Best Breed



Extension of ISO 15926 RDL

Reactor Coolant Pump Example

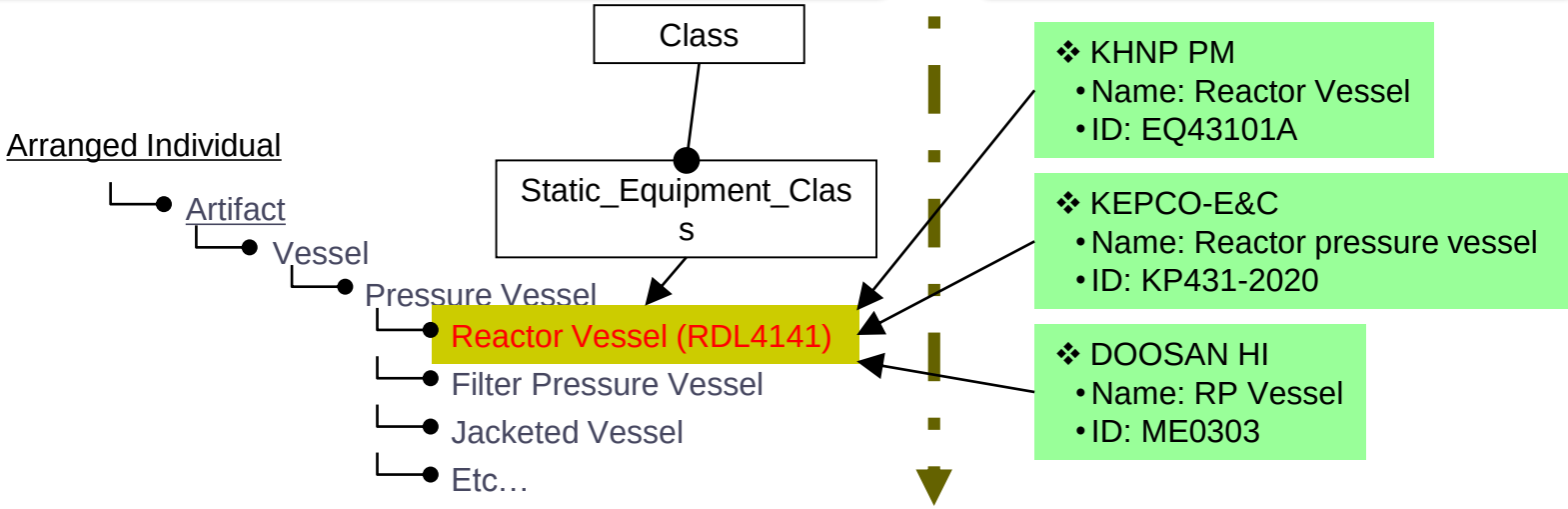


Extension of ISO 15926 RDL

	KHNP RDL	KHNP PM	KEPCO-E&C	DOOSAN HI
Name	Reactor Vessel	Reactor Vessel	Reactor pressure vessel	RP Vessel
ID	RDL4141	EQ43101A	KP431-2020	ME0303
Usage	Mapping standard	O&M data linking	Design data linking	Equipment vendor data linking

ISO 15926 based KHNP RDL

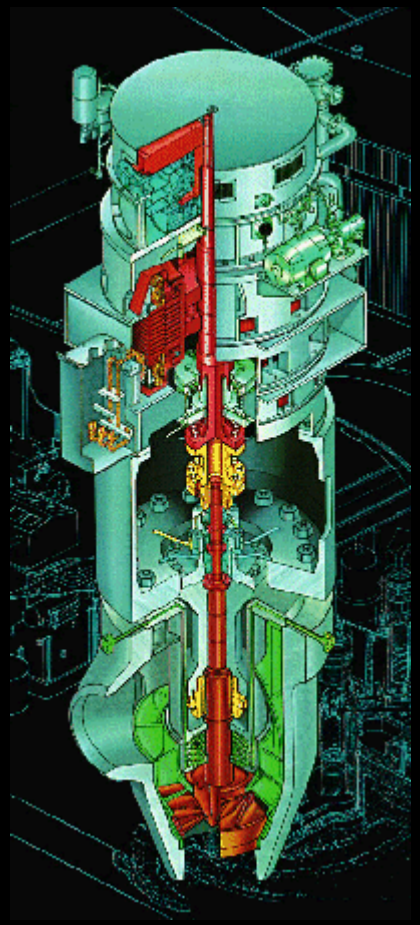
Data mapping target (Field data)

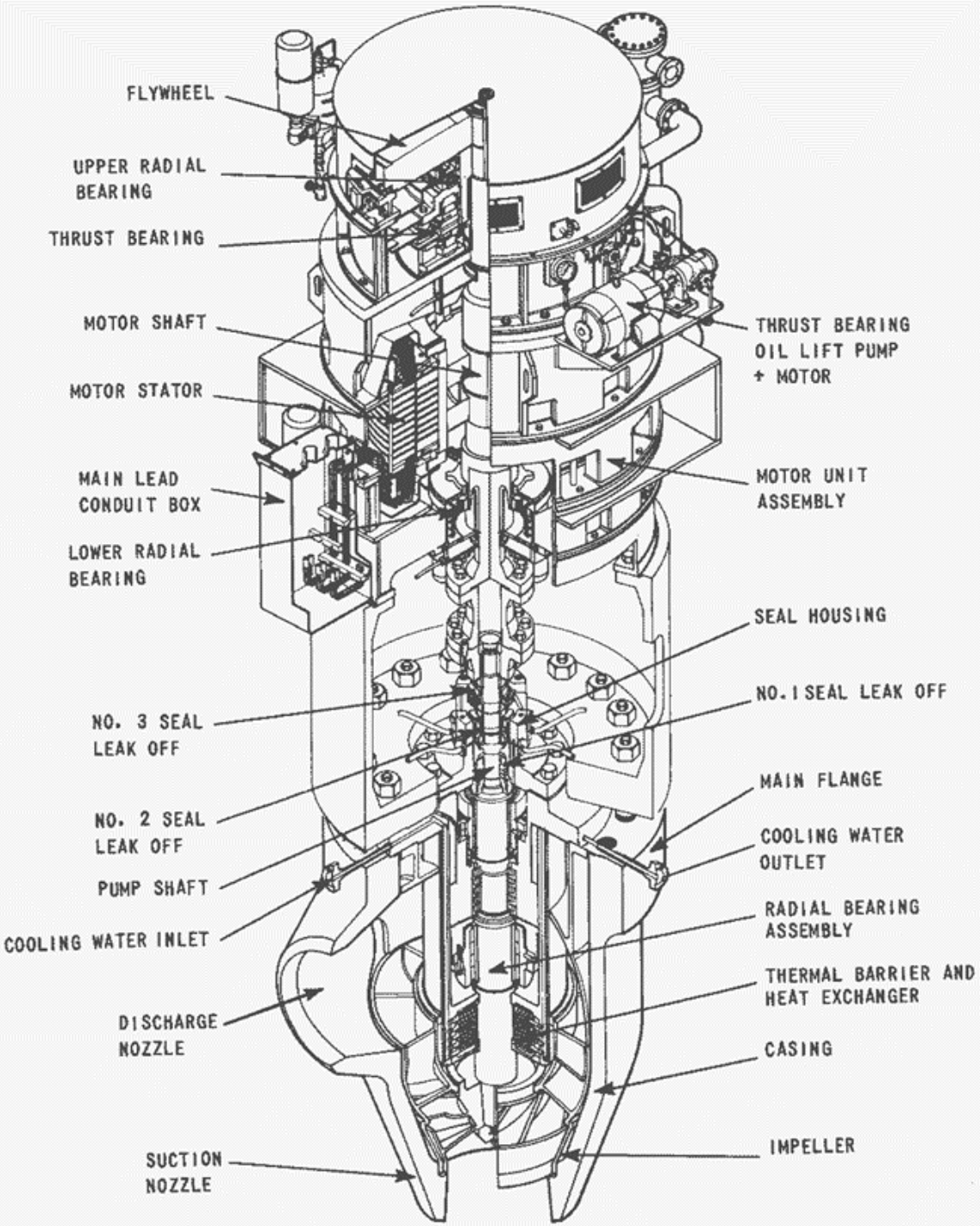


- EQ43101A in KHNP PM is a Reactor Vessel.
- KP431-2020 in KEPCO-E&C is a Reactor Vessel.
- ME0303 in DOOSAN HI is a Reactor Vessel.

➔ All data related with Reactor Vessel(RDL4141) can be integrated using ISO 15926 based information system

Westinghous RCP MB3596





*REF: http://www.nucleartourist.com/systems/rcs1.htm

Classes that represent main parts of a RCP

Item	Description	Class	URI
1	Impeller	PUMP IMPELLER	http://data.posccaesar.org/rdl/RDS816299
2	Suction nozzle	INLET NOZZLE	http://data.posccaesar.org/rdl/RDS43167562153
3	Discharge nozzle	DISCHARGE NOZZLE	http://data.posccaesar.org/rdl/RDS402642231
4	Casing	SINGLE TYPE CASING	http://data.posccaesar.org/rdl/RDS881459
5	Thermal barrier	No	
6	Heat exchanger	HEAT EXCHANGER	http://data.posccaesar.org/rdl/RDS304199
7	Radial bearing assembly	RADIAL BEARING BEARING ASSEMBLY	http://data.posccaesar.org/rdl/RDS6810280 http://data.posccaesar.org/rdl/RDS12956450
8	Cooling water inlet		
9	Cooling water outlet		
10	Pump shaft	PUMP SHAFT	http://data.posccaesar.org/rdl/RDS869714
11	Main flange		
12	No. 1 seal leak off		
13	No. 2 seal leak off		
14	No. 3 seal leak off		
15	Seal housing		
16	Lower radial bearing		
17	Main lead conduit box		
18	Motor unit assembly		
19	Motor stator	ELECTRICAL STATOR	http://data.posccaesar.org/rdl/RDS891449
20	Motor shaft		
21	Thrust bearing	THRUST BEARING	http://data.posccaesar.org/rdl/RDS6810235
22	Thrust bearing oil lift pu mp and motor		
23	Upper radial bearing		
24	Flywheel	FLYWHEEL	http://data.posccaesar.org/rdl/RDS13662164

Definition of Pump Impeller

PUMP IMPELLER

rdl:defaultRdsId	"R15904148988"
rdl:hasCreationDate	"1999.10.26"
rdl:hasCreator	"u20683"
rdl:hasDefinition	"An impeller that forms part of a rotating assembly of a pump imparting kinetic energy to the liquid being pumped."
rdl:hasDesignation	"PUMP IMPELLER"
rdl:hasIdPCA	"RDS816299"
rdl:hasStatus	"Incomplete"
rdf:type	p2:ClassOfInanimatePhysicalObject
rdfs:label	"PUMP IMPELLER"
owl:sameAs	http://posccaesar.org/rdl/RDS816299

Classification

Classifier
- NORSOK Z-CR-002 EQUIPMENT CLASS
- PUMP COMPONENT CLASS

ClassOfIndirectProperty

PropertySpace
- LOWER LIMIT IMPELLER DIAMETER
- RATED IMPELLER DIAMETER
- UPPER LIMIT IMPELLER DIAMETER
- UPPER LIMIT IMPELLER HEAD AT RATED SPEED

ClassOfIdentification

Pattern
- rdl:RDS6192912
- rdl:RDS6713607
- rdl:RDS6714627
- rdl:RDS999707260

ClassOfAssemblyOfIndividual

ClassOfWhole
- CENTRIFUGAL PUMP

Subclass
- AXIAL FLOW PUMP IMPELLER
- CLOSED PUMP IMPELLER
- DOUBLE SUCTION PUMP IMPELLER
- INDIVIDUALLY SECURED PUMP IMPELLER
- MIXED FLOW PUMP IMPELLER
- OPEN PUMP IMPELLER
- RADIAL FLOW PUMP IMPELLER
- SEMI-OPEN PUMP IMPELLER
- SINGLE SUCTION PUMP IMPELLER

http://data.posccaesar.org/rdl/RDS816299

Definition of Operating Weight

OPERATING WEIGHT

rdl:defaultRdsId	"RDS1661800301"
rdl:hasDesignation	"OPERATING WEIGHT"
rdl:hasIdPCA	"RDS1661800301"
p2:hasClassOfPosse...	ARTEFACT
p2:hasPropertySpace	WEIGHT RANGE
rdf:type	p2:ClassOfIndirectProperty
rdfs:label	"OPERATING WEIGHT"
owl:sameAs	http://posccaesar.org/rdl/RDS1661800301

http://data.posccaesar.org/rdl/RDS1661800301

Specialization

Superclass • ISO 15926-4 INDIRECT PROPERTY

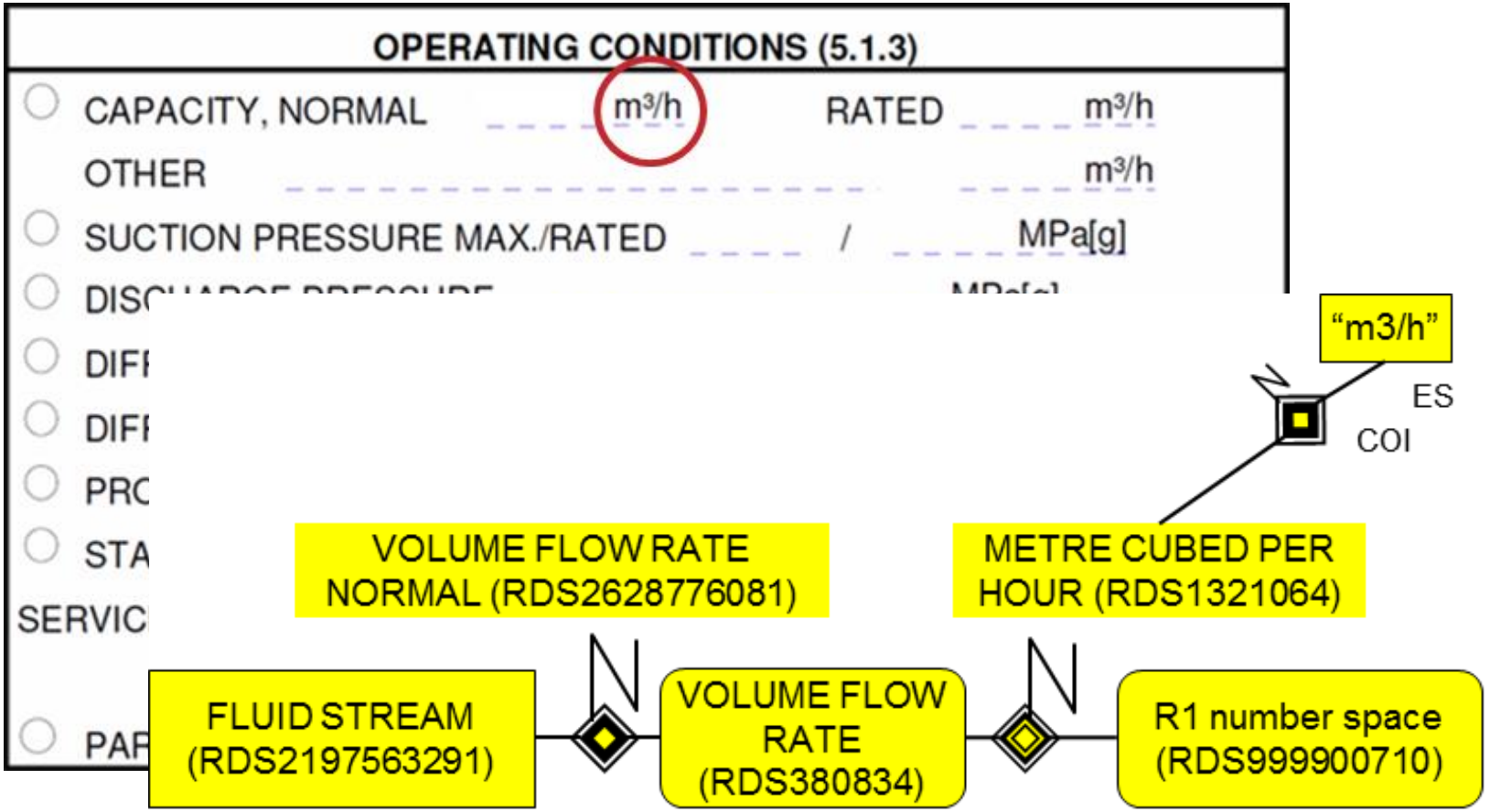
Classification

Classifier • ISO TS 15926-4 (2007) PROPERTY CLASS

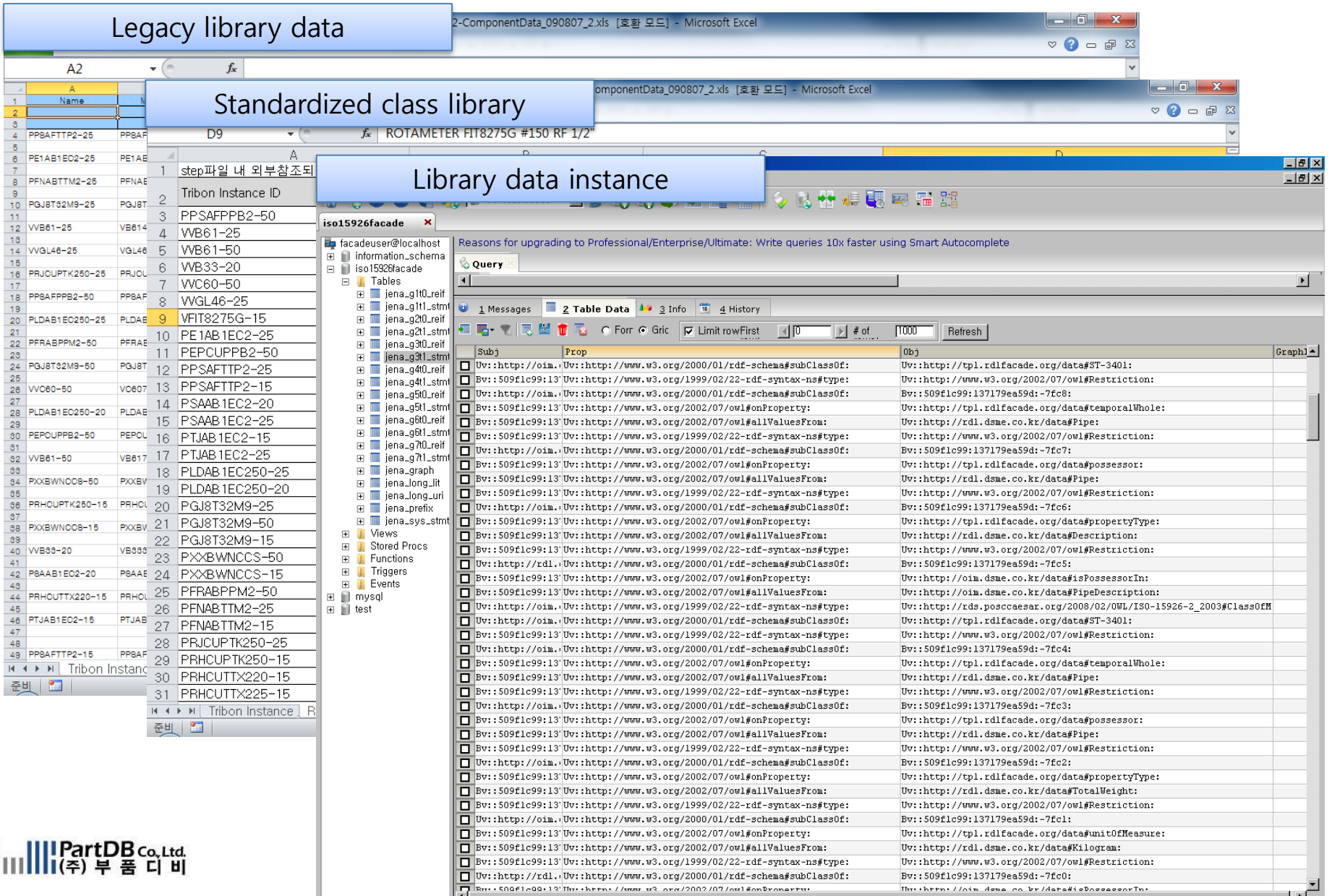
Subclass • CALCULATED OPERATING WEIGHT
- CATALOGUE DATA OPERATING WEIGHT
- ESTIMATED OPERATING WEIGHT
- WEIGHED OPERATING WEIGHT

Usage of ISO 15926 RDL

API 610 data sheet for Centrifugal Pumps has a section called “OPERATING CONDITIONS”



Class library extension



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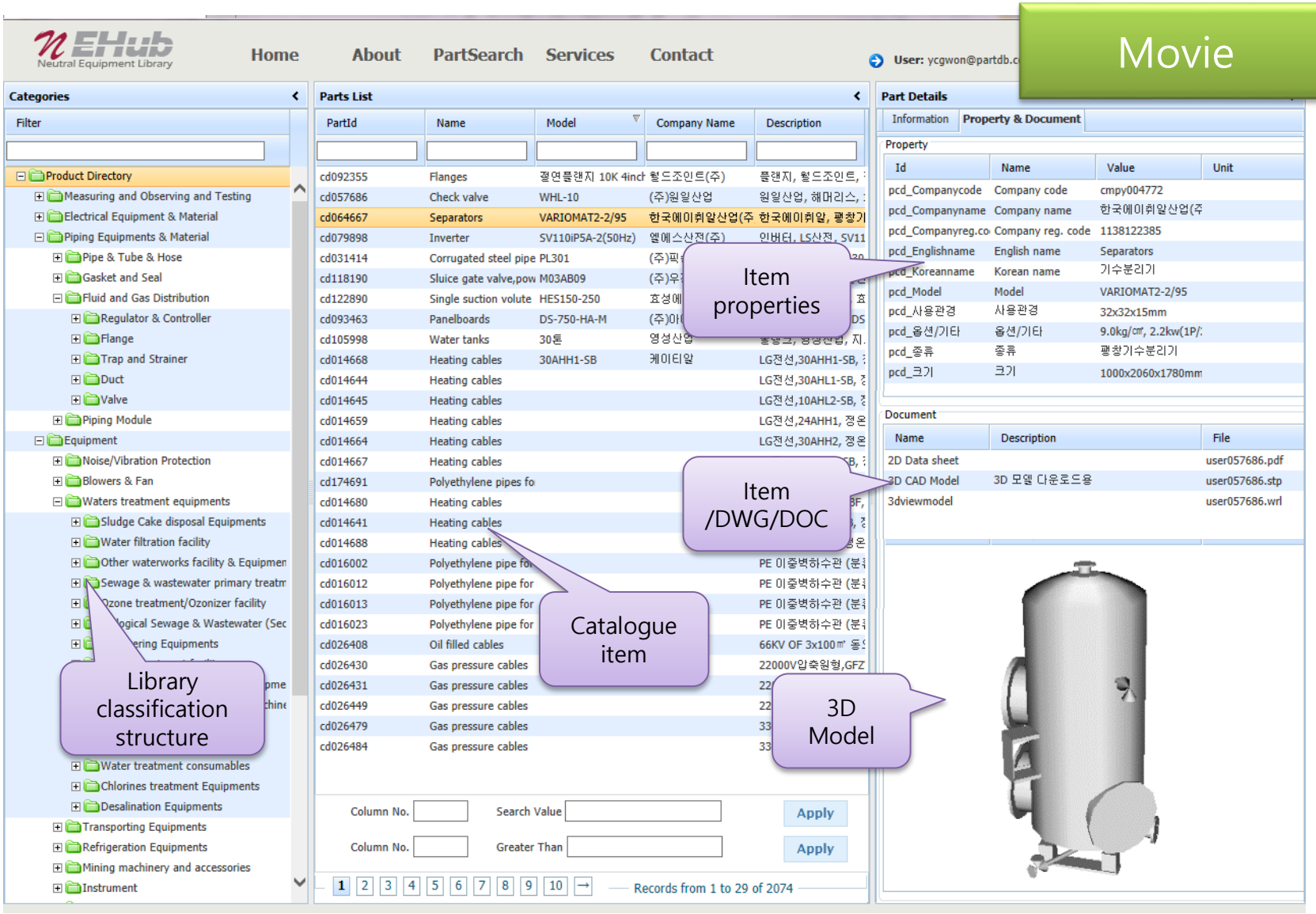
(주) 부 품 디 비

System implementation case

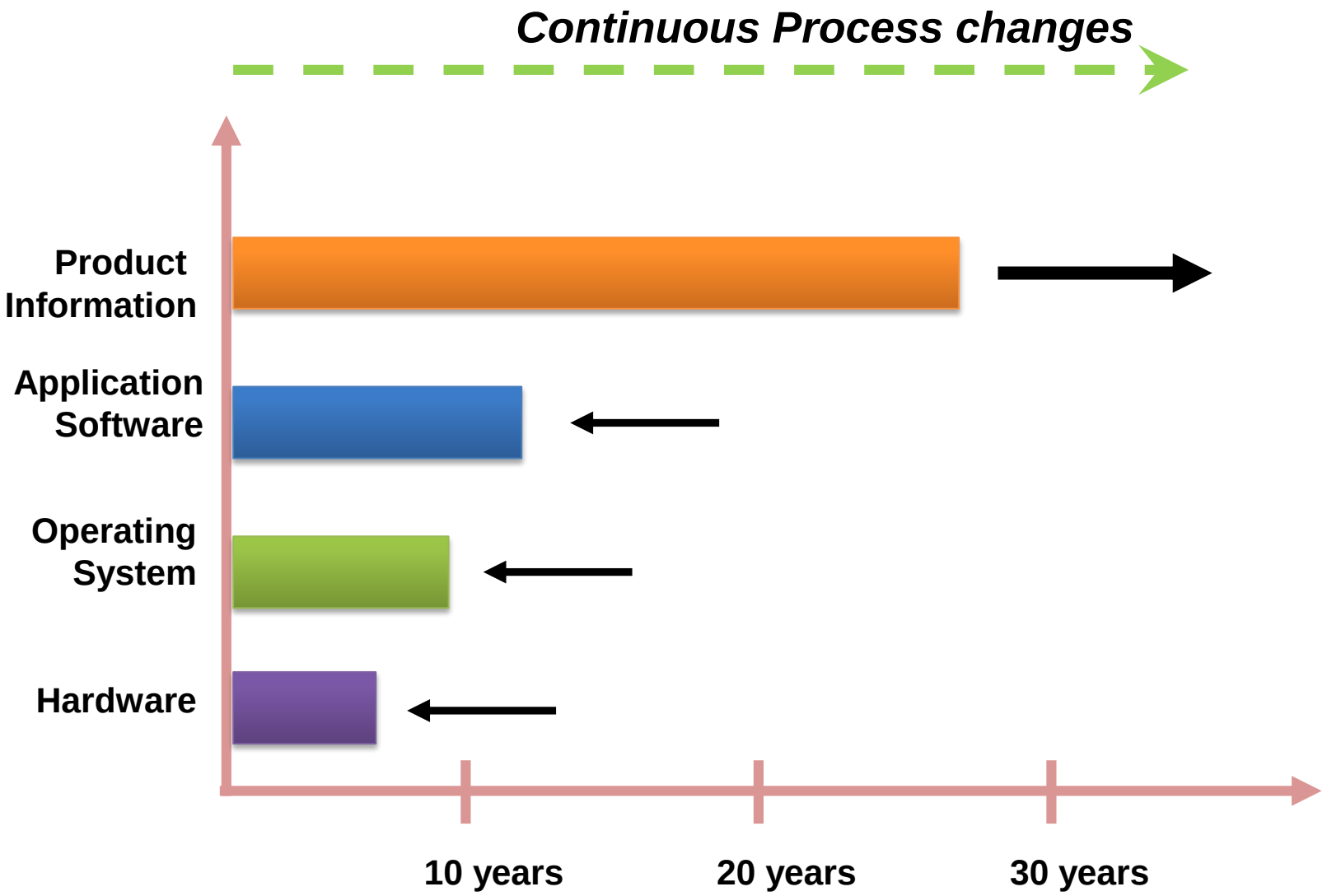
Movie



Conclusions

- This paper introduces ISO 15926 methodology and how to extend the existing RDL for nuclear power industry.
- As the ISO 15926 representation is independent of applications, interfaces to existing or future applications have to be developed. Such interfaces are provided by Templates that takes input from external sources and “lifts” it into an ISO 15926 repository, and/or “lowers” the data into other applications.
- This is a similar process to the process defined by W3C. Data exchange can be done using e.g. XML messages, but the modelling is independent of technology used for the exchange.
- ISO 15926 based RDL is useful for NPP class standardization and lifecycle data integration.

Importance of Product Information



*Ref: Gartner Inc.

Q&A

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