POSC Caesar Association

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PCA ISO 15926 Modelling & Mapping Methodology for ISO 15926 2/3/4/7 + PCA RDL Information Representation

2010-08-19

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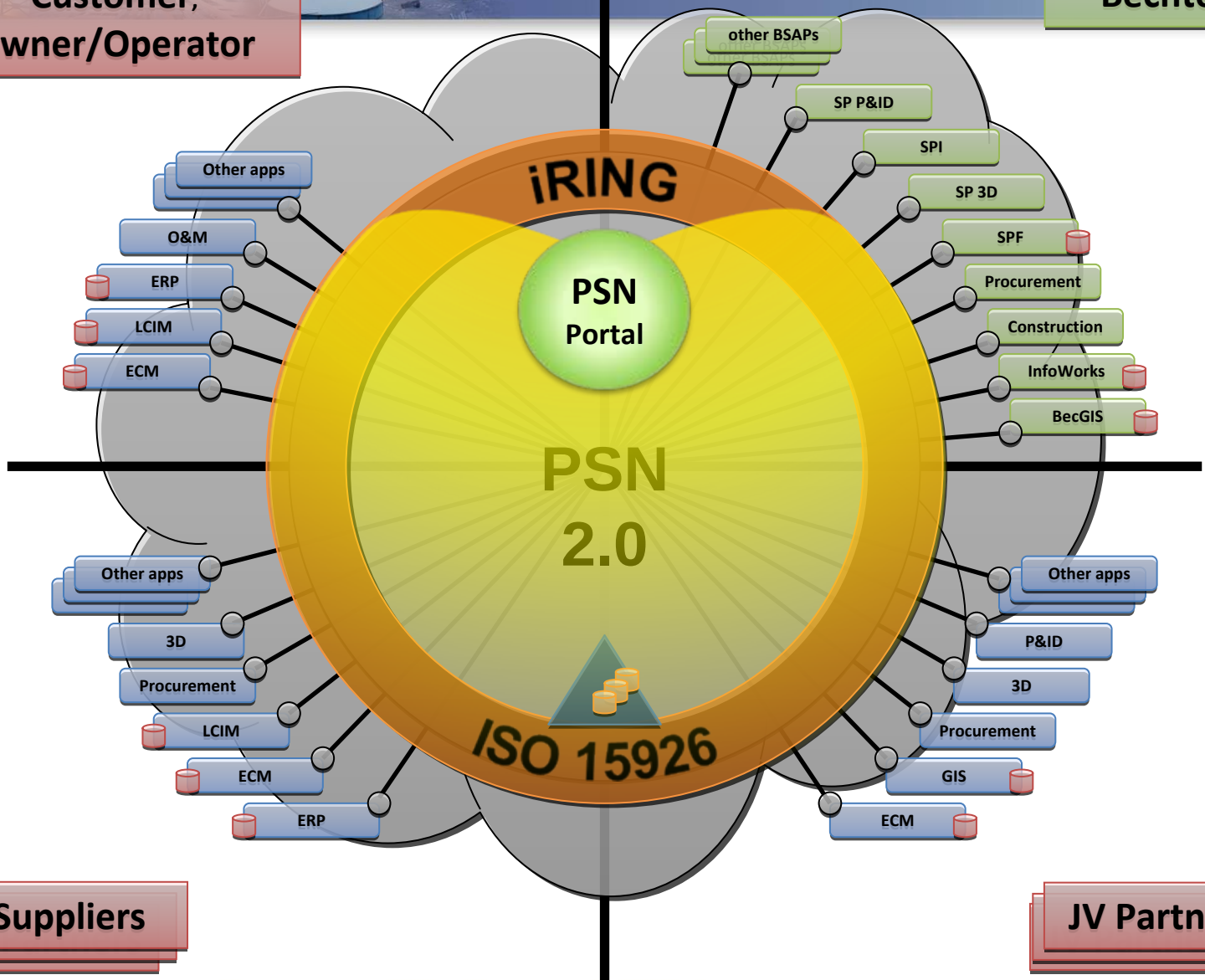
My expectations

- **This is a workshop, not a course**
  - This means that your input is welcomed (?)
- **It is important that we capture your questions as they provide vital input to the written methodology that will follow from this**
  - Luckily I have forgotten what I struggled with during my first years a long time ago
- **I will guide you through a set of typical patterns identified during the EqHub project and we will use that as a basis for discussions and clarifications**

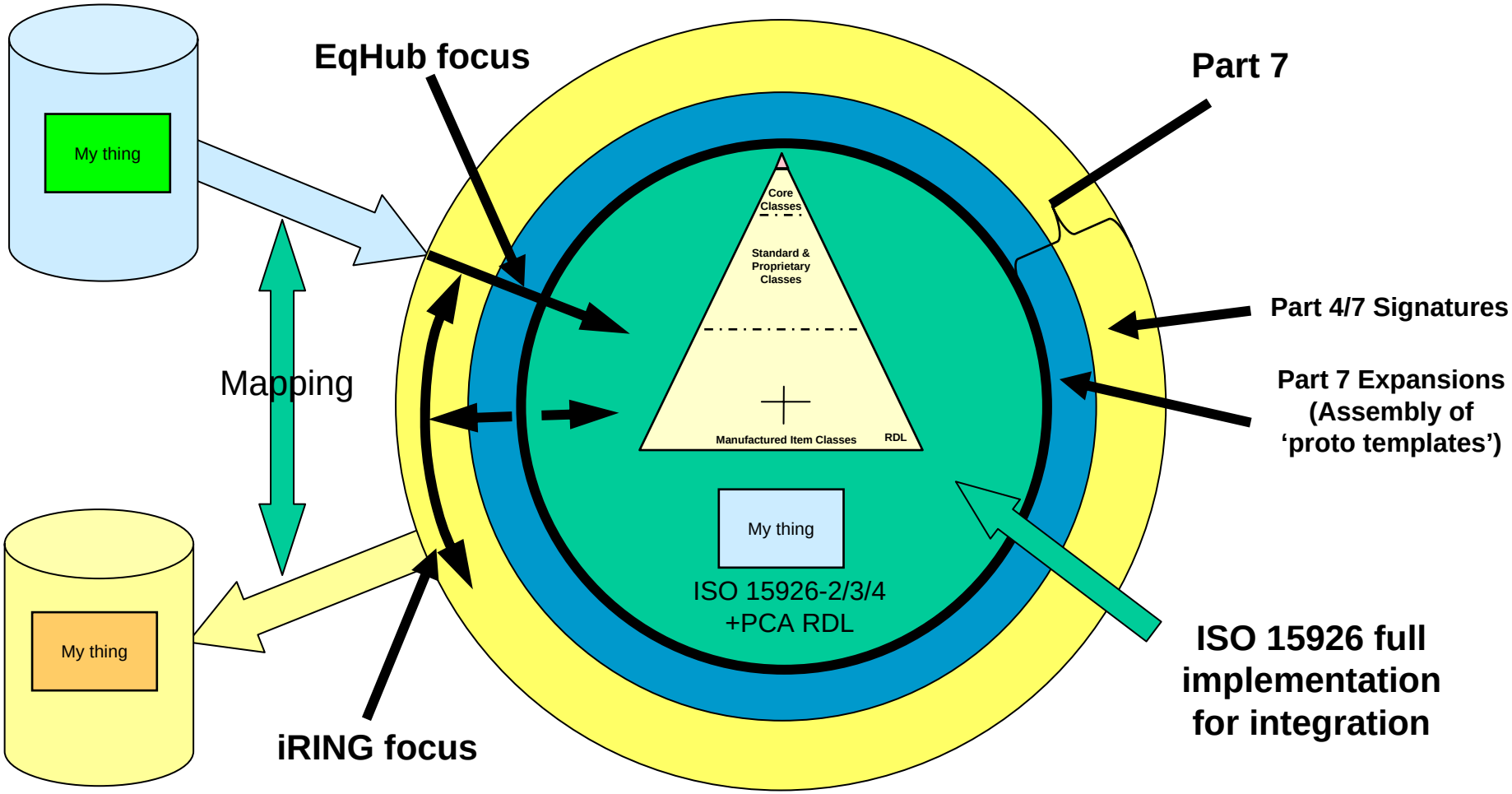
Clarifications on Methodology

- **Need "Methodology" for the following**
  - RD modelling (Ontology (Object information models +++))
    - As we have seen over the last couple of days, if we don't get this right the rest will not be correct
  - Mapping
  - Implementation
- **Resources**
  - RD modelling
    - Responsible for creating and maintaining the shared RD
      - Skills required
        - ISO 15926-2 + domain expertise
        - Familiar with the current RDL
        - Not necessarily one person, but needs to be available in the group responsible for a domain
  - Mapping
    - Responsible for mapping a particular "set of data" (application, DB etc) to a set of template signatures
      - Skills required
        - Basic understanding of the ISO 15926 concepts
        - Basic understanding of the 3 and 4 level architectures and the consequences for the mapping (e.g. which template signatures to use)
  - Implementation
    - Template expansion etc. Anything else not in scope for our current focus (as a group)

iRING Deployment



ISO 15926 for exchange and integration



Important Principles

(Including EPISTLE principles useful for our purpose)

(I think)

EPISTLE Principles

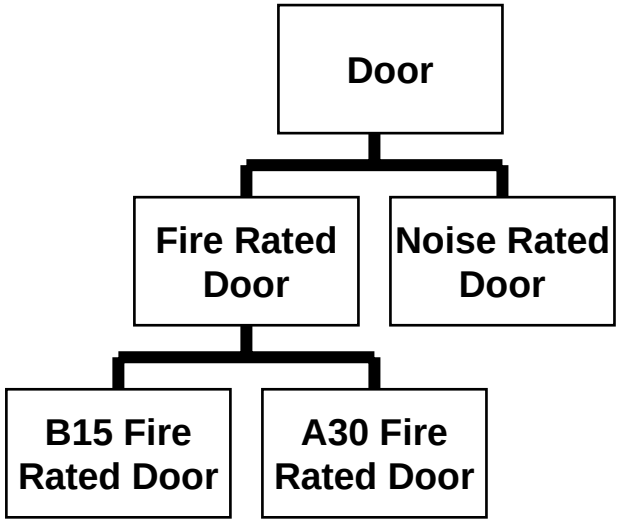
- Artificial system identifiers
- **Attributes should be entities**
- Activities and **relationships should be defined as entities**
- Relationships should define involvement with activities and associations
- **Entities should represent underlying nature**
- **Entities should be part a universal context** (read ontology)

EPISTLE Principles - Attributes

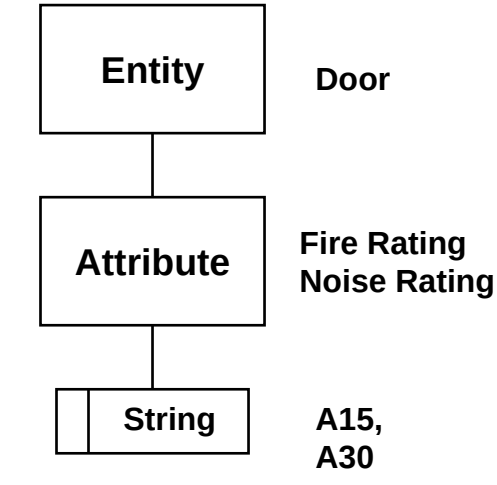
- **Attributes should be defined as entities referred to by relationships**
- **Attributes cannot be referred to and are very inflexible to change**
  - attributes do not allow history
  - information about attributes cannot be held
    - e.g. Units of a number
    - e.g. language of a description
  - attributes do not allow different values
    - many descriptions
    - many names
    - changing values
  - attribution cannot be described
- **What is an entity in one model is an attribute in another models**
  - what is an entity and what is an attribute depend on your start point
  - does not support integration very well

Fire Rated Door Class A30

Schema

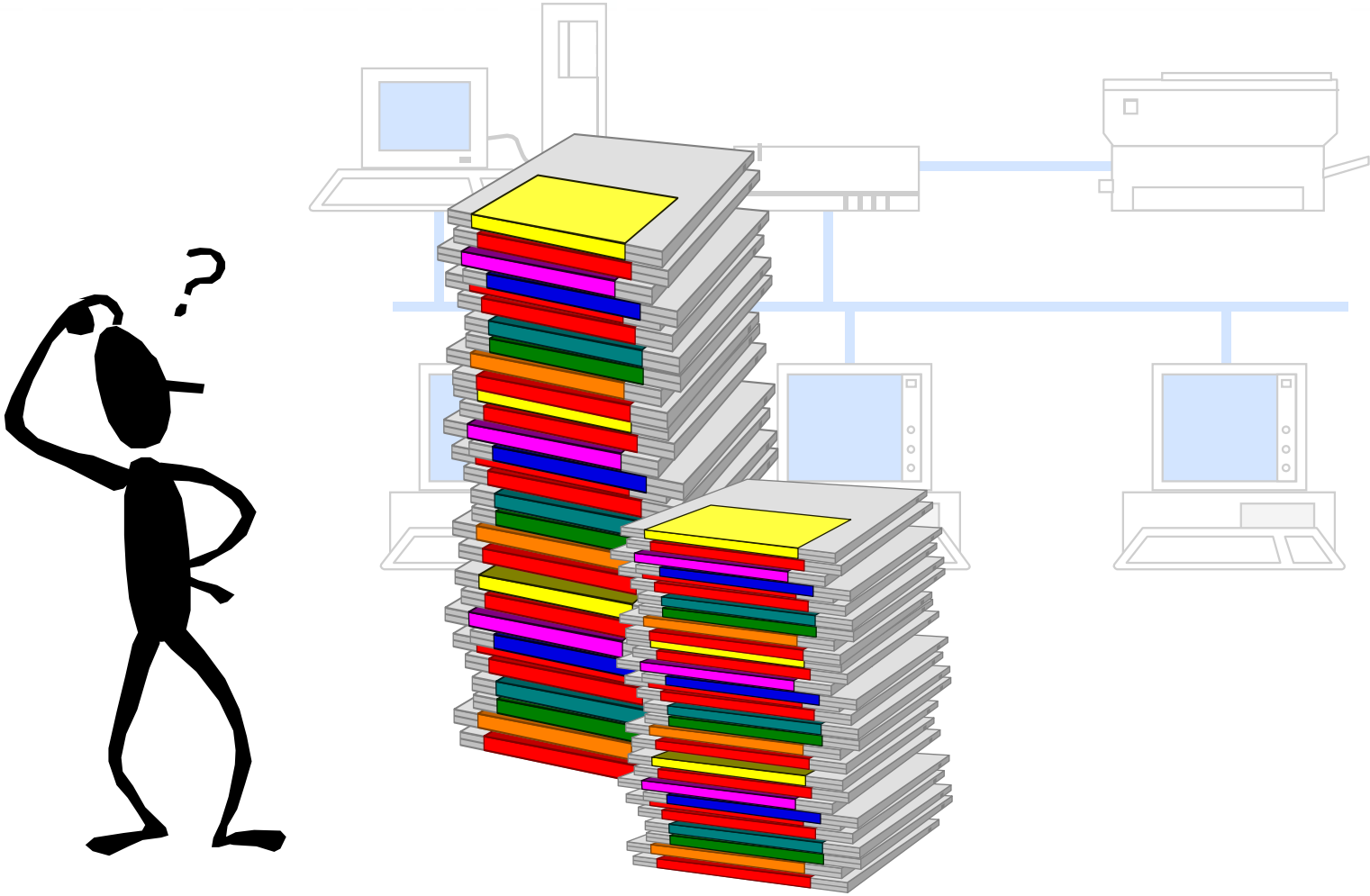


Attributes



RDL

Know what is known



EPISTLE Principles - Underlying Nature

- **What something always is**
- **Roles are transient and not underlying nature**
  - Example
    - Customer and supplier are roles
    - The underlying nature is organisation
    - Enables information about the same thing to be recognised
- **Model underlying nature**
  - composition of organisation, not of customer and of supplier
  - person assignment to organisation, not to customer or supplier
- **Roles identify populations**
  - find all organisations that are my customers

Levels of Precision

Terminology Dictionary

Text

ISO 15926-4 Dictionary

ISO 15926-4 Taxonomy

ISO 15926-4 Ontology

Model (Integration)

1. **Nomenclature (List of names of concepts)**

English	667 447 900	centrifugal pump
English	667 492 900	dynamic pump
English	667 501 900	impulse pump

2. **Dictionary (List of concepts with definitions)**

English	570 200	centrifugal pump	A (dynamic) pump utilizing impellers provided with vanes generating centrifugal force to achieve the required pressure head.

3. **Taxonomy (Structure of like concepts with definitions)**

English	570 200	centrifugal pu	is a specialization of	632 100	dynamic pump
English	632 100	dynamic pump	is a specialization of	570 100	pump

4. **Hybrid (Knowledge models with implicit product structure)**

English	570 200	centrifugal pump	class_of_indirect_property	139999	impeller diameter

5. **Ontology (Knowledge models with explicit product structure)**

English	570 200	centrifugal pump	class_of_assembly_of_individual	130207	pump impeller
English	130207	pump impeller	class_of_indirect_property	139999	impeller diameter

6. **Extended Ontology (Knowledge models including relations between products)**

English	570 200	centrifugal pump	can be performer of a	192512	pumping process
English	400143	batch of liquid	can be subject in a	192512	pumping process

7. **Individual product models**

English	1000001	P-1301	is classified as a	570200	centrifugal pump
English	1000001	P-1301	is part of	1000002	Unit 1300

Domain experts

RDL/Domain experts

Semantic Conformance Levels

Text

Nomenclature Conformance

Dictionary Conformance

Taxonomy Conformance

Template Conformance

Ontology Conformance

Ontology Conformance

Model
(Integration)

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Not Reference Data, Project Data

7. **Individual product models**

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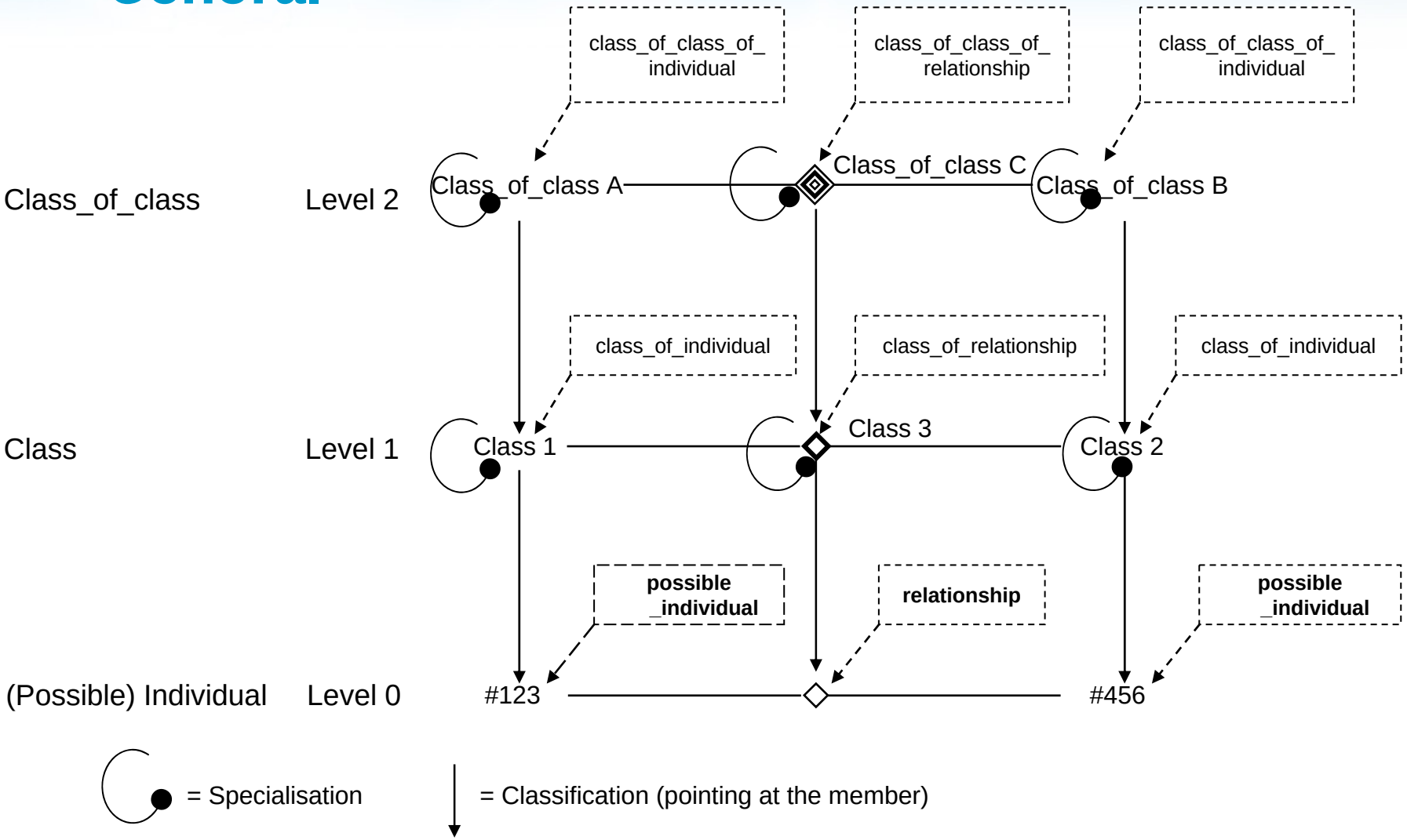
Domain experts

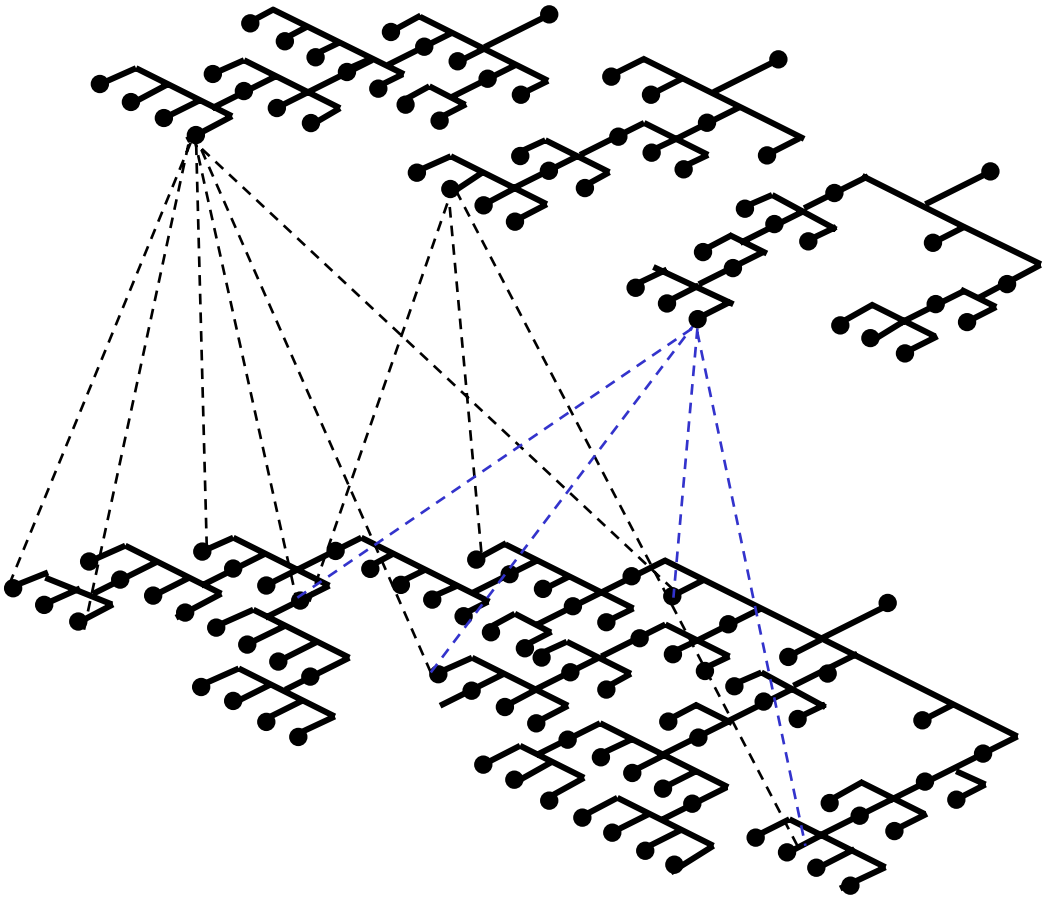
RDL/Domain experts

Levels of Classes

General


class_of_class_of_ individual
class_of_class_of_ relationship
class_of_class_of_ individual
Class_of_class
Level 2
Class_of_class A
Class_of_class C
Class_of_class B
class_of_individual
class_of_relationship
class_of_individual
Class
Level 1
Class 1
Class 3
Class 2
possible _individual
relationship
possible _individual
(Possible) Individual
Level 0
#123
#456
= Specialisation
= Classification (pointing at the member)

ISO 15926 & Classification Systems



Classification systems

- Business dependent views
- Many are in use
- Overlap
- Used for grouping

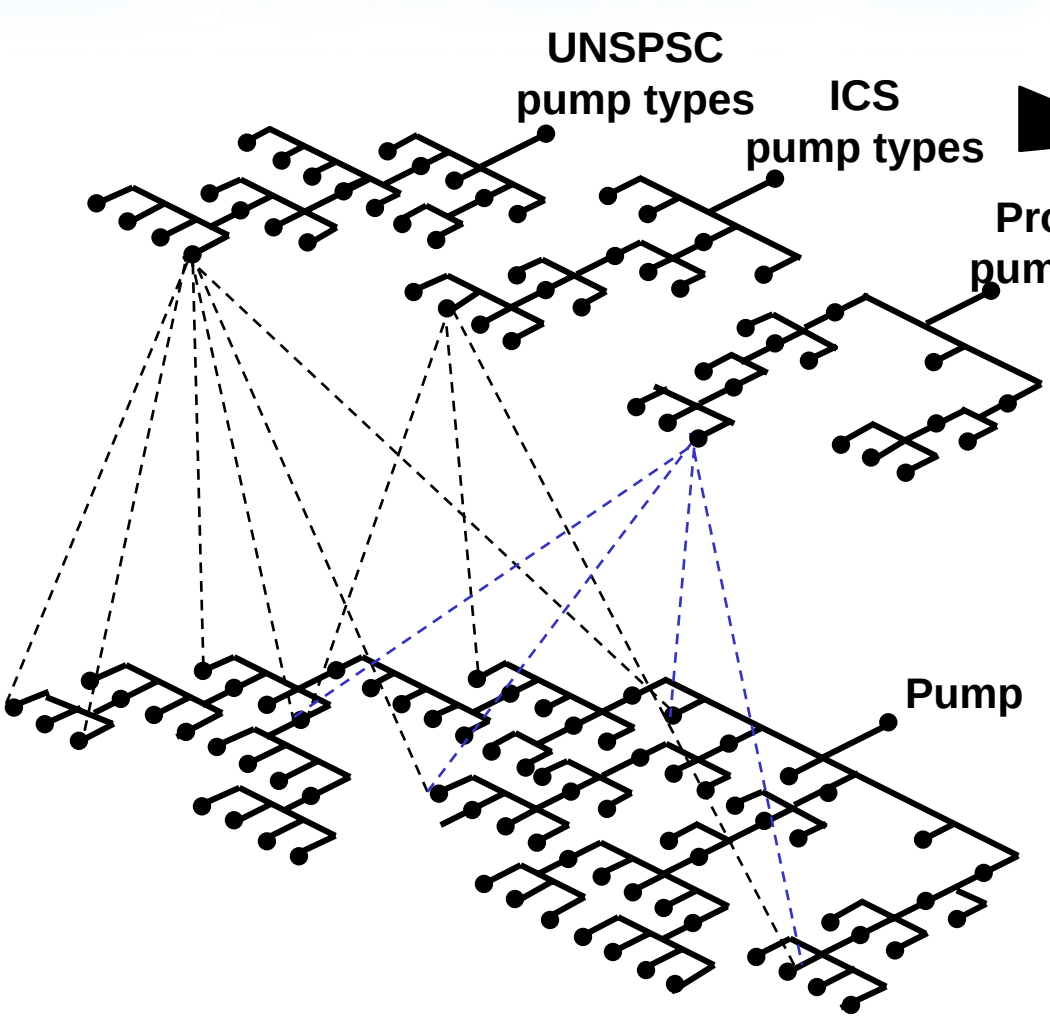
NB!! Implemented as a Level 2 structure

Extensively used to record options and limitations for role fillers

RDL standard structure
- Ontology
- Independent of a particular view
- Supports any views

Business Benefits

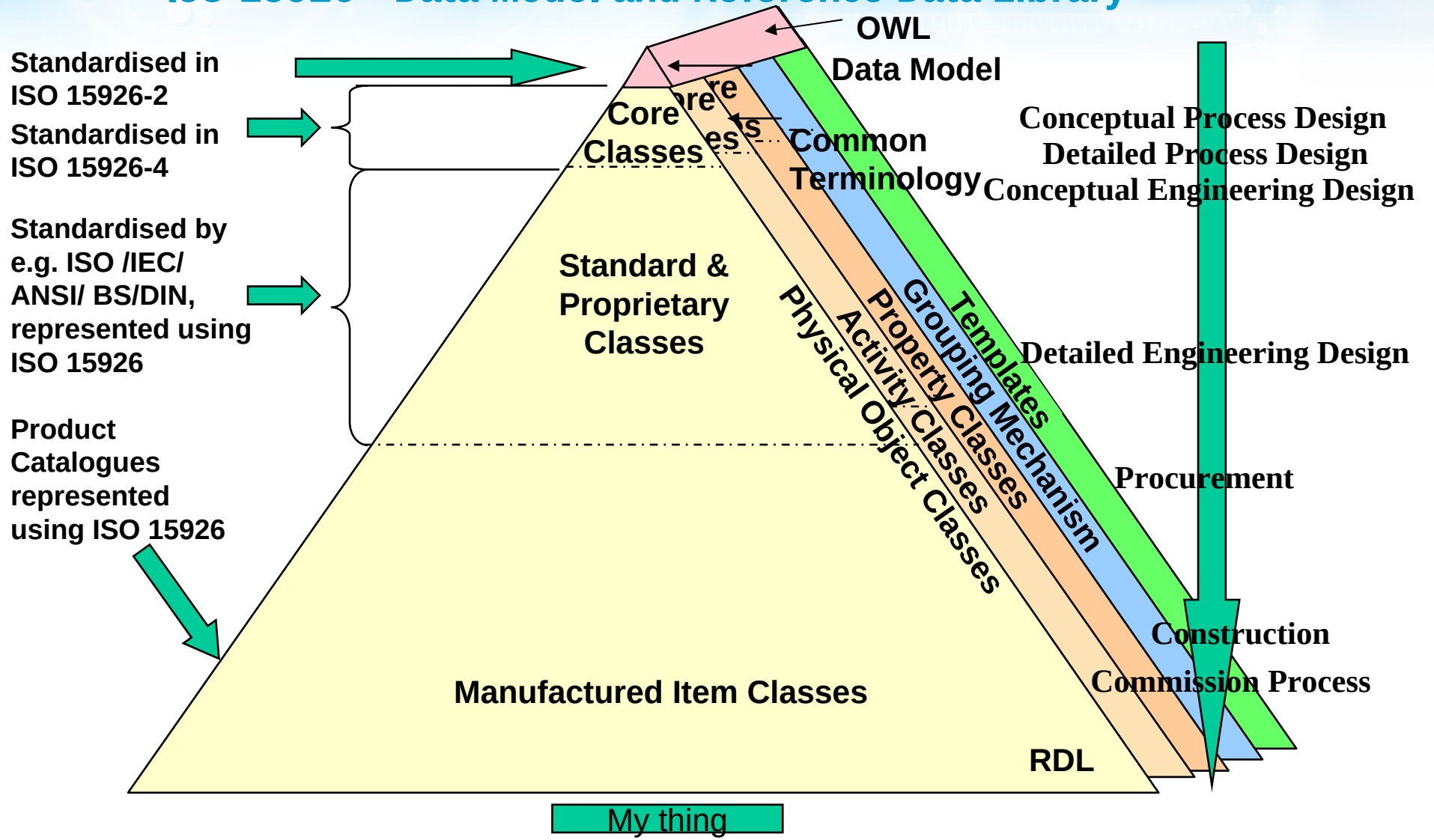
ERP/ Business Access



Technical Access
/
Specifications

Both can be held
within the same RDL

ISO 15926 - Data Model and Reference Data Library



ISO 15926-2/4 + PCA RDL Representations Modelling Principles

RDL Representations & Mapping Patterns

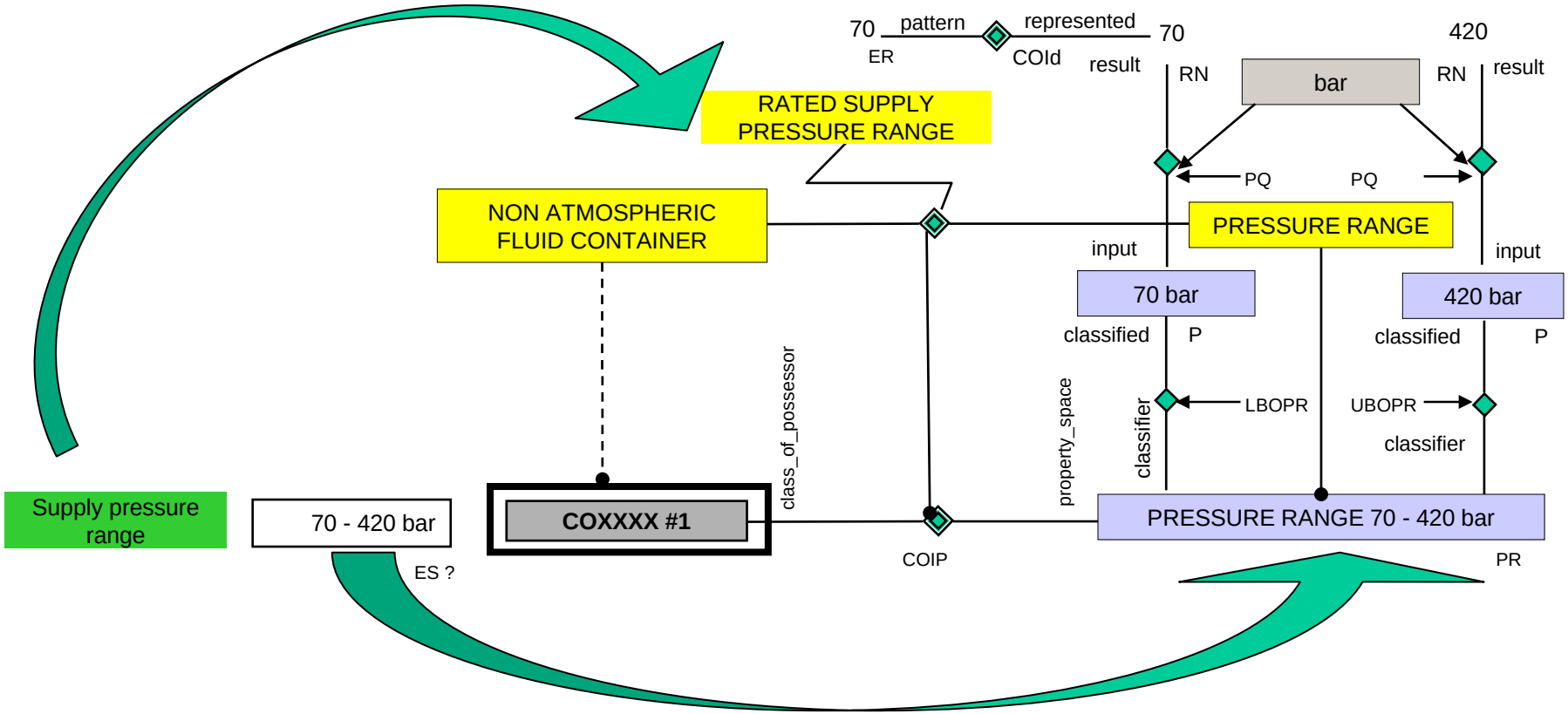
- **External Objects**
  - See “Life Of An Electric Motor” for placement
  - Also class levels
- **External Attributes**
  - Descriptions
  - Properties (Real +UoM)
  - Validation Tables/ “Text” attributes
  - References
  - Containment
  - Assemblies
  - “Properties” of assemblies

Shortcut to EqHub Stage 1 and 2 Mapping.xls.lnk

Shortcut to EqHub Stage 2 mapping.ppt.lnk

Note: For data in external system it is irrelevant to use 15926 terminology.

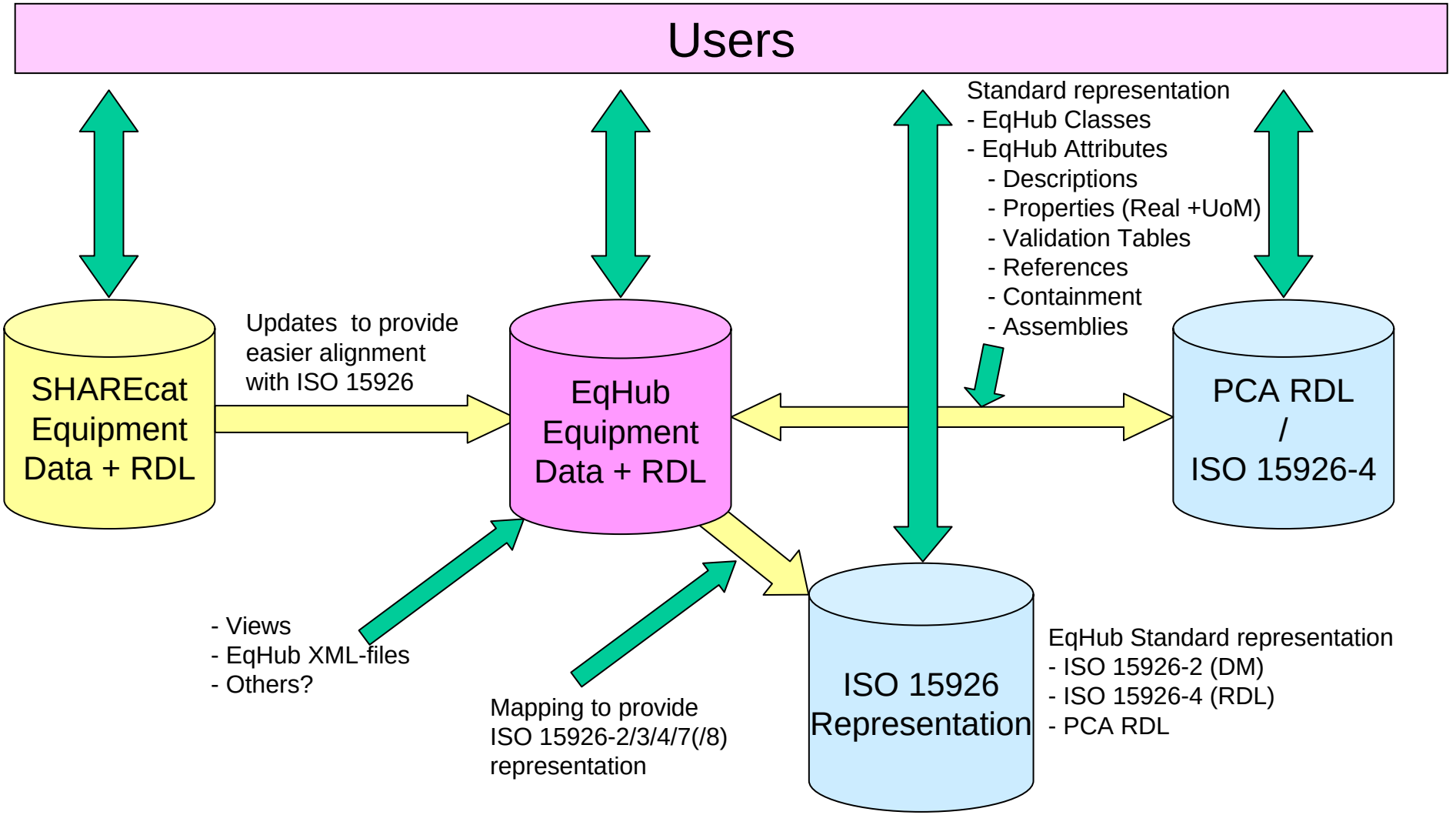
Properties (Real +UoM)
11 “Supply pressure range”



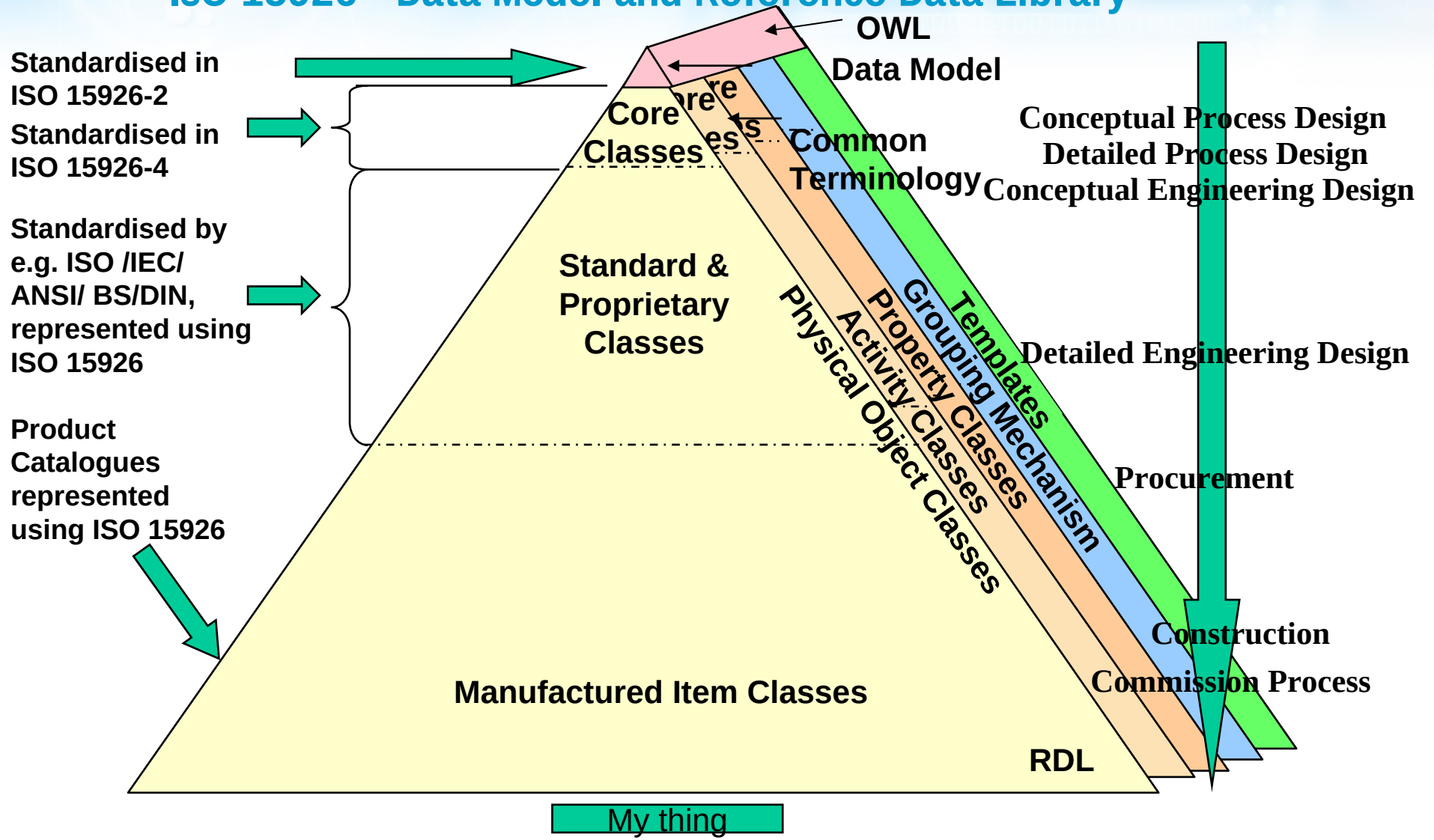
NB! Note the more precise property class, and the level at which the property applies

End

EqHub RD Development Process



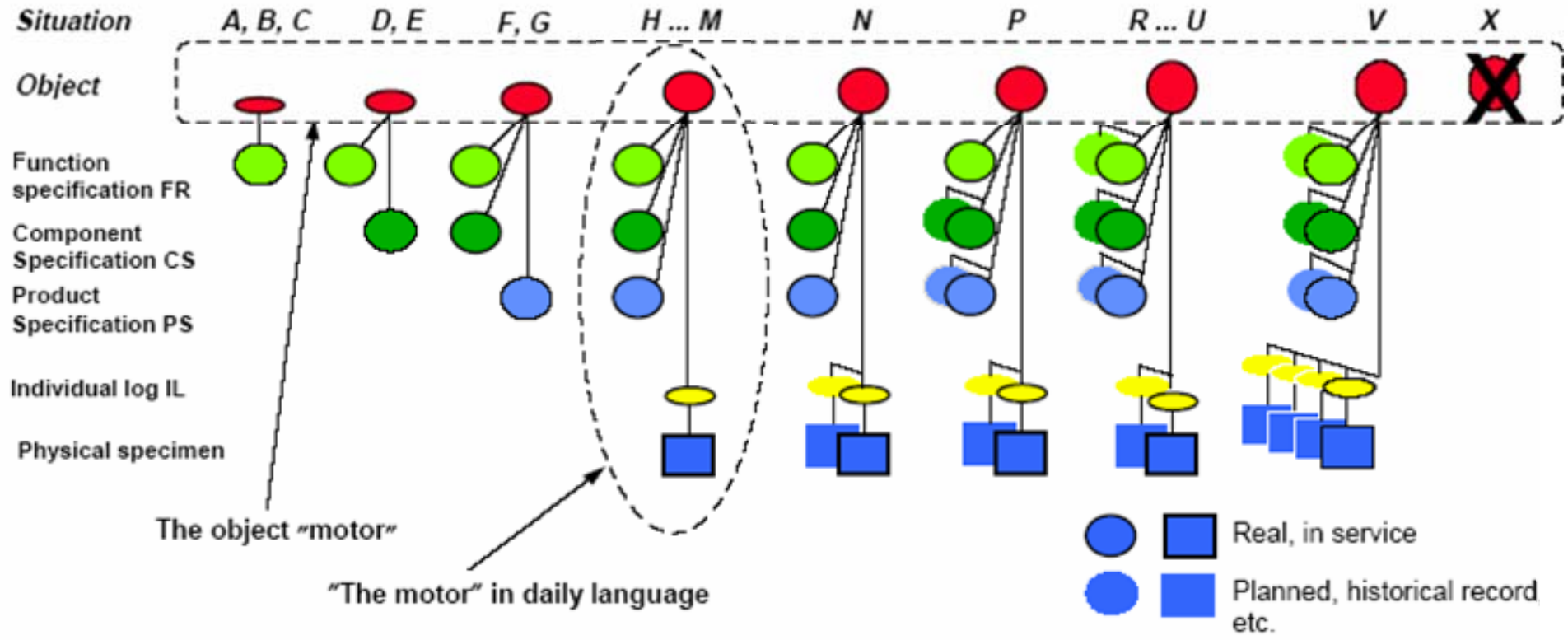
ISO 15926 - Data Model and Reference Data Library



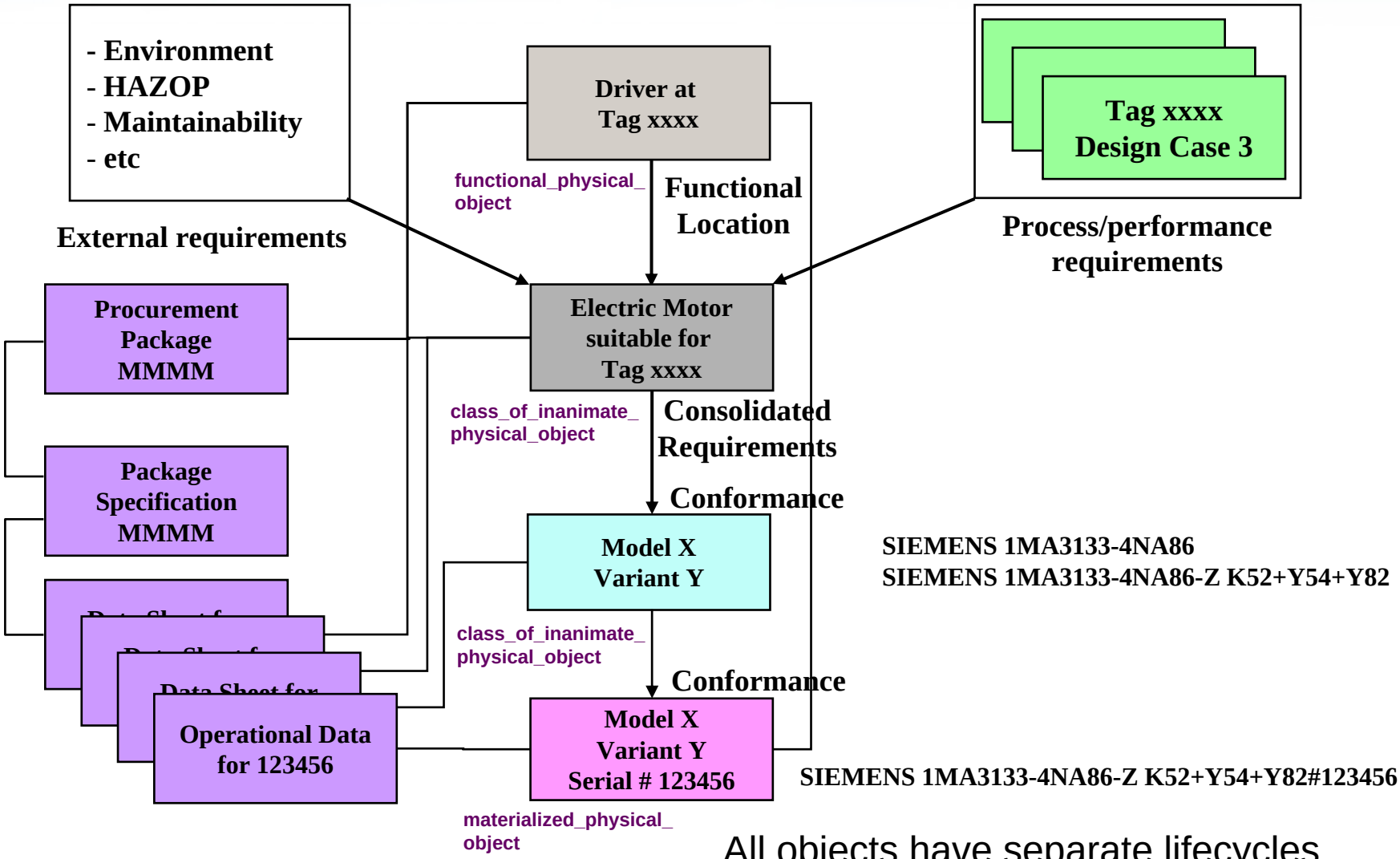
The Life of a Pump

“The Life Of An Electric Motor”

The Life Cycle According to IEC 61346-4



Electric Motor Lifecycle Objects



All objects have separate lifecycles

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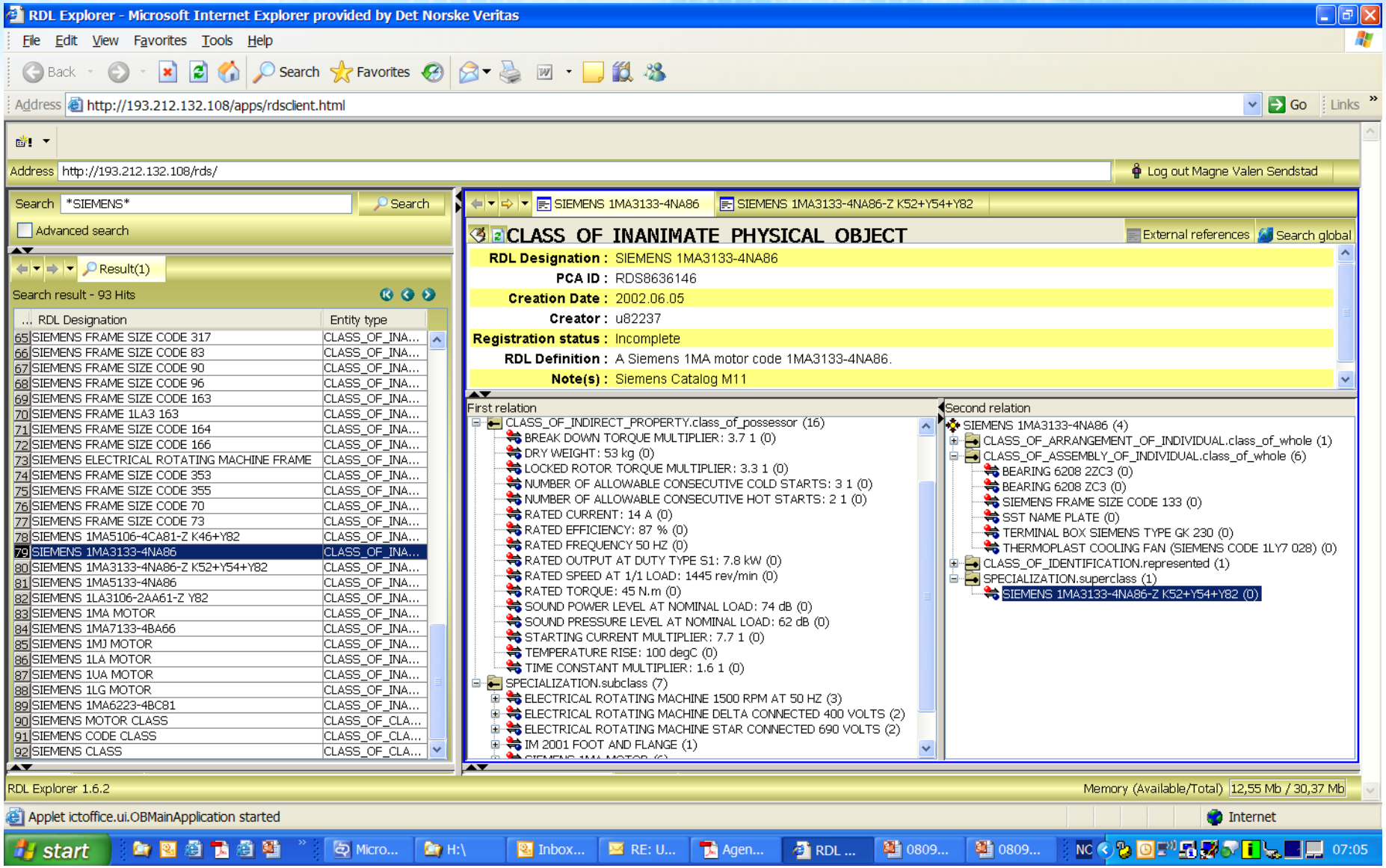


End

Requirements for new classes

RDL Designations And Definitions I

- **Level 0 (Possible_Individual/Relationship)**
  - As a general individuals will not have designations or definitions, except from Reference Individuals (e.g. Paris, London, DNV, ISO TC184/SC4), that at least will have Designation.
  - Relationships will not have Designations, only PCA Identifiers and classifications stating the class membership.
- **Level 1 (Class_of_Individual/Class_of_relationship)**
  - Designation in singular form
  - Definition in singular form, i.e. as if we are describing a member of the class.
  - See ISO TS 15926-6, Section 5.3, Reference data item designation, and
  - See ISO TS 15926-6, Section 6, Reference data item definition by explanatory text
- **Level 2 (Class_of_class/Class_of_class_of_relationship)**
  - Designation in singular form, reflecting that the member is a class. Hence the designation shall end with the word ‘class’.
  - Definition in singular form, i.e. as if we are describing a member of the class.
  - See ISO TS 15926-6, Section 5.3, Reference data item designation, and
  - See ISO TS 15926-6, Section 6, Reference data item definition by explanatory text

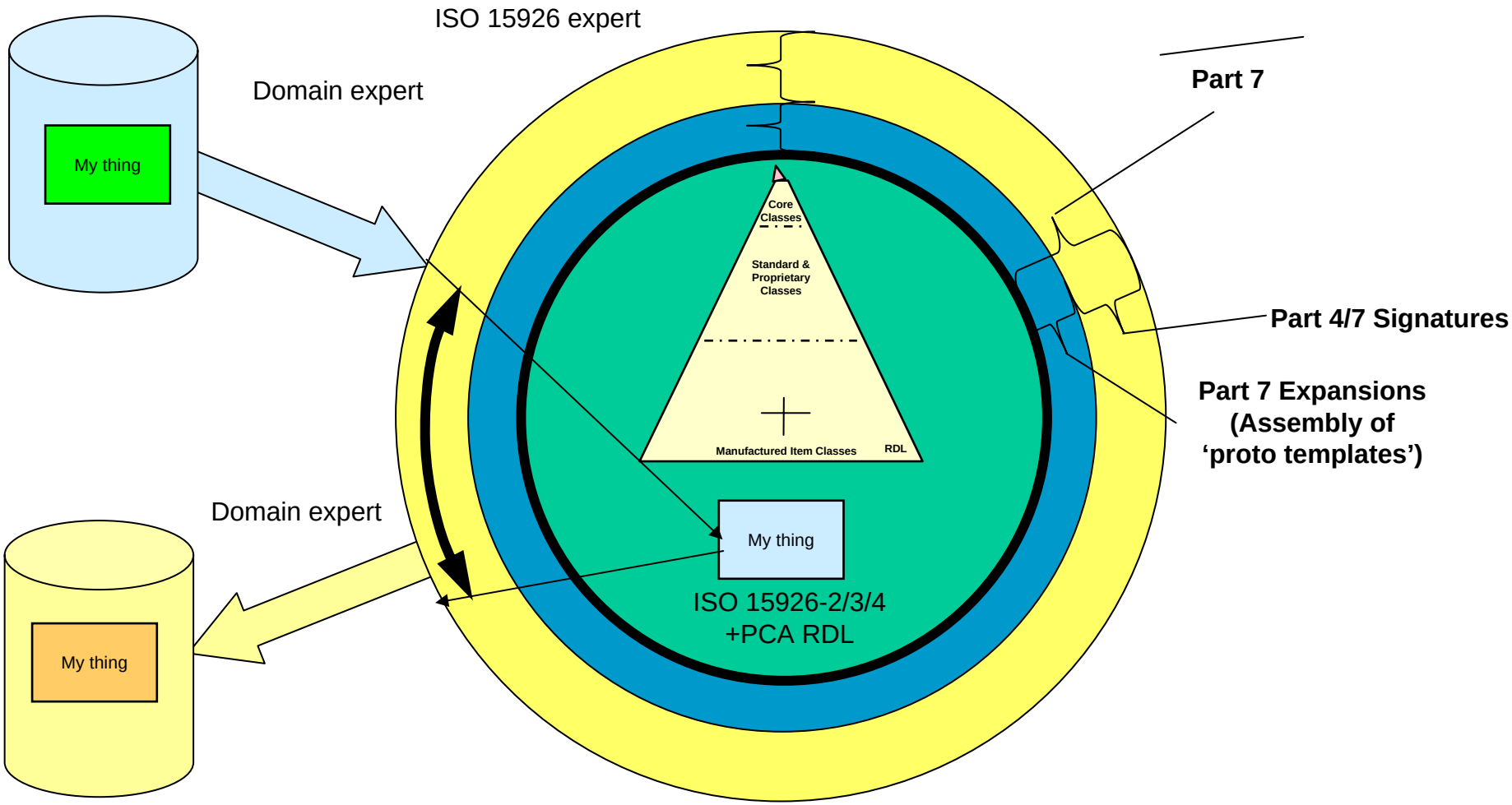
RDL Designations And Definitions II

- **For each entity type in ISO 15926-2 there is a corresponding RDL class (the universal class).**
- **These classes shall have a designation starting with 'ISO 15926-4 ' (for now) followed by a string derived from their entity type as follows:**
  - Level 1 (class)
    - Name of entity type excluding 'class_of', e.g. the universal class of 'class_of_arranged_individual' is 'ISO 15926-4 ARRANGED INDIVIDUAL', instance of 'class_of_arranged_individual'.
  - Level 2 (class_of_class)
    - Name of entity type excluding 'class_of_class_of', and appended by 'class', e.g. the universal class of 'class_of_class_of_individual' is 'ISO 15926-4 INDIVIDUAL CLASS', instance of 'class_of_class_of_individual'.

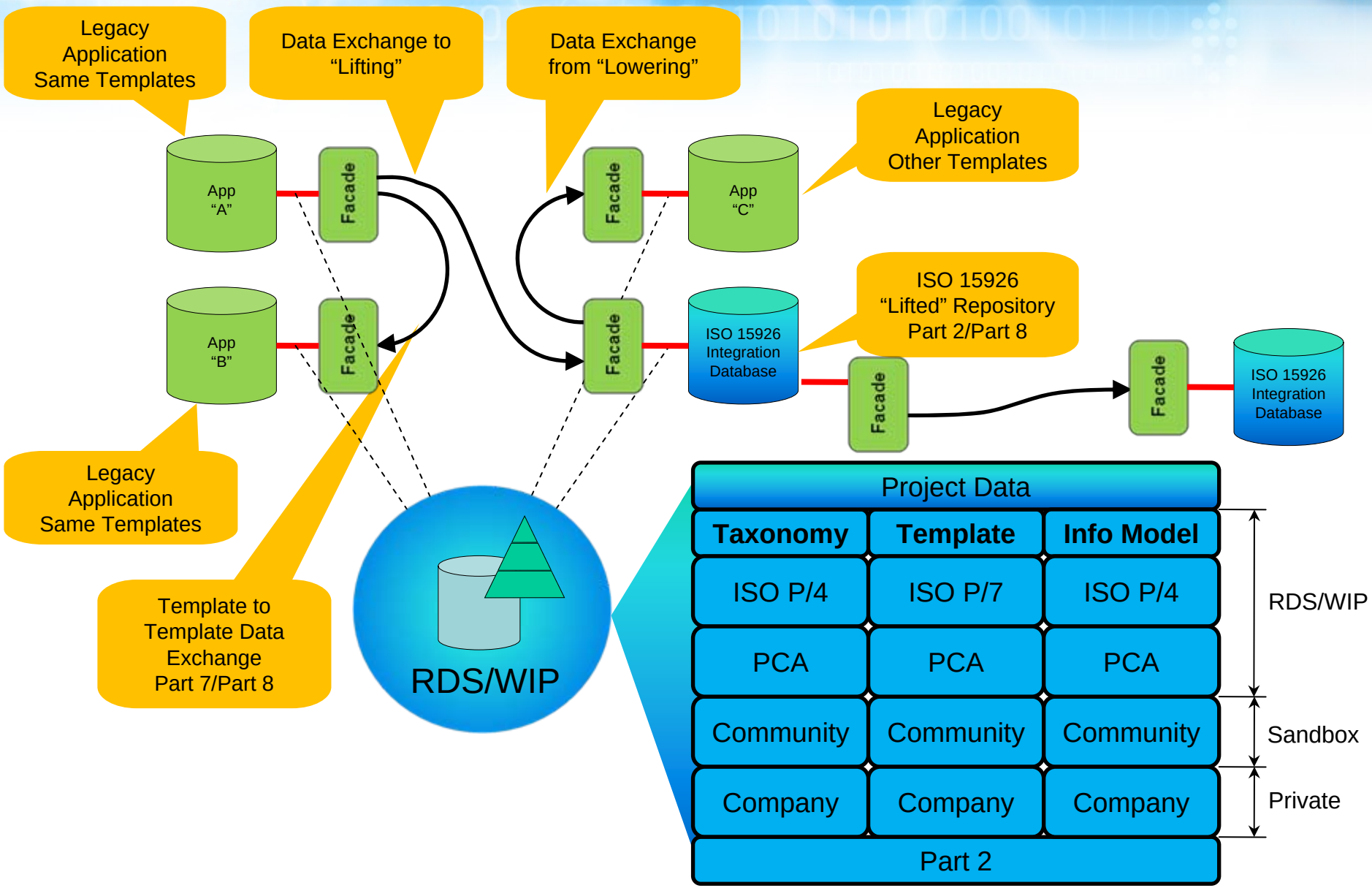
Additional PCA conventions (additions to the ISO 15926 conventions)

- **“Reference individuals” vs. “project individuals”**
- **Individuals shall only be assigned a UID.**
  - i.e. Not a designation
- **Designations (and definitions) shall be in the singular form (as if we are describing a member of the class) (ISO 15926-6 Item 3.4.2 and 5.3.2, Recommendations for a reference data item name identifier)**
  - This holds for Level 1 classes

End


ISO 15926 expert
Domain expert
My thing
Part 7
Core Classes
Standard & Proprietary Classes
Manufactured Item Classes
RDL
Part 4/7 Signatures
Part 7 Expansions (Assembly of 'proto templates')
Domain expert
My thing
My thing
ISO 15926-2/3/4 +PCA RDL

Data Exchange Scenarios



What RDL usage rules do we need ?

When to use levels 0, 1 & 2 (Individual, Class and Class of Class)
- **when mapping (pointing) to an RDL Item from a business domain.**
- **when proposing and linking a new RDL Item to existing content.**

What level of ”specialization” is appropriate when doing this.
- **(Appropriate covers usual questions of efficiency, economy, manageability, ... normalization, referential integrity, versioning, etc ... What to persist where, when.)**
- **(Appropriate applies to both RDL content management *and* project content.)**

The discussion thread is addressing these issues
- **https://www.posccaesar.org/wiki/TemplateImplementationModelling**

Then we need agreement on how (say) native OWL constructs are used to represent these. But we can’t agree these (say in part 8) until we have agreed the intended usage, and many rules will actually end up in the content. We can work real content examples, and continue to use spreadsheets to capture the mappings / definitions as we agree them. (*The ”methodology” describes ”HOW” to relate business content to these resources*.)

Recent Partial Update

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Brown – Part 2 Entity Types (Co = Class_of)
Heavy Blue = Classification of Members
Black Dot = Specialization of Class
RED = Name of ISO15926-4 RDL ITEM CLASS *standing for* the Part2 entity
GREEN = P7 Proto Templates in RDL ?

Work in Progress

CoCo_Individual aka INDIVIDUAL CLASS

CoCo_Relationship aka RELATIONSHIP CLASS

CoCo_Individual aka INDIVIDUAL CLASS

CoCo_individual

CoCo_relationship

CoCo_individual

Level 2
Class_of_class

Class_of_class A

Class_of_class C

Class_of_class B

Co_Individual aka INDIVIDUAL

Co_Relationship aka RELATIONSHIP

Co_Individual aka INDIVIDUAL

Co_individual

Co_relationship

Co_individual

Level 1
Class

Class 1

Class 2

??

??

??

possible _individual

relationship

possible _individual

Level 0
(Possible) Individual

#123

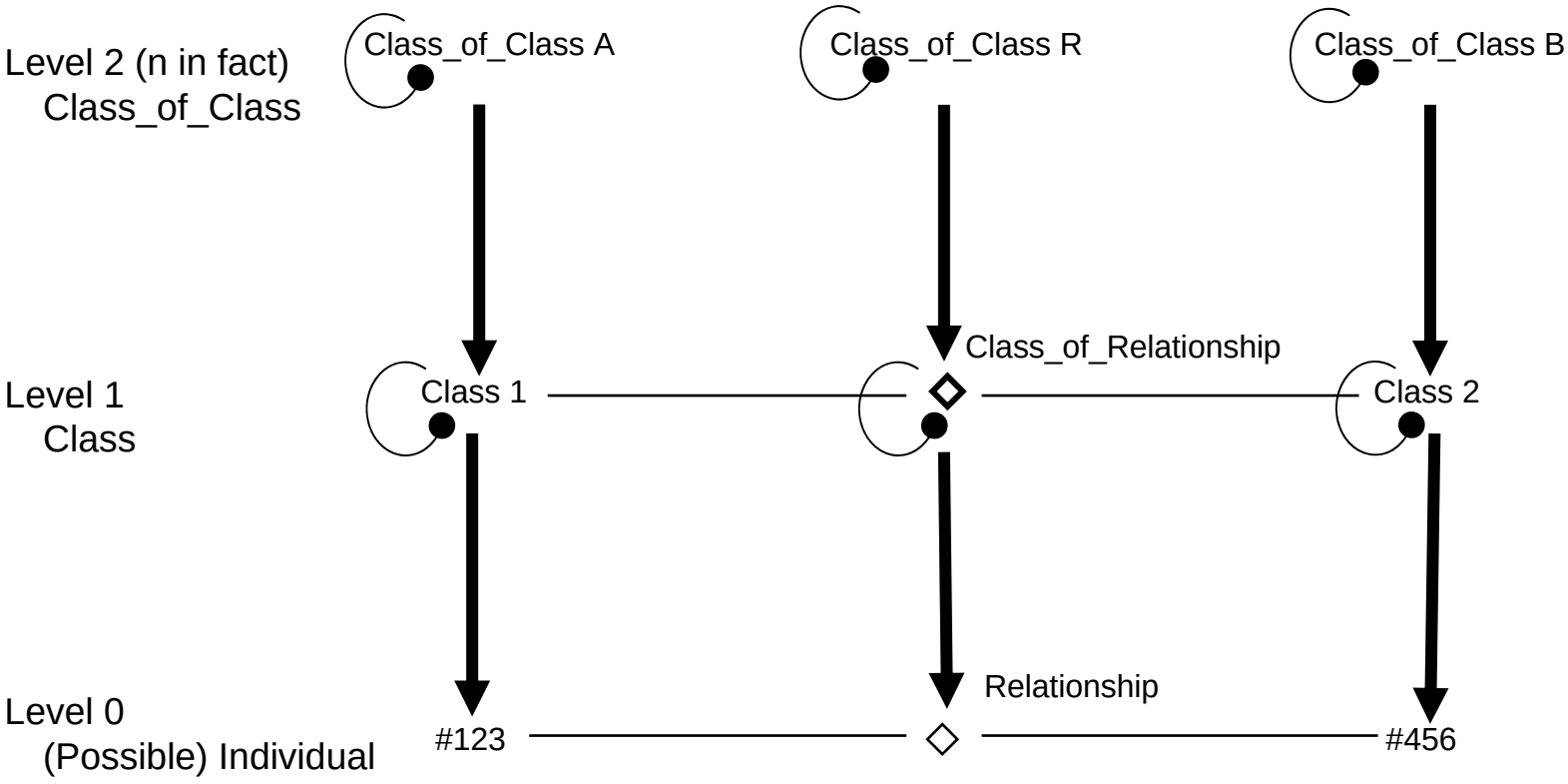
#456

See Notes.

Recognizing the need for “Class of Class”

NOTE - Language and notation here is non-normative – Illustration of the evolution of the issues and their partial solutions.

Whether we are talking about relationships & templates and/or about the entities that fulfil their roles – we need to recognise (at least) 2 levels of class as well as individuals. We would like to ”hide” as much of this as possible eventually but the issue will not go away.



NB – Dropping the self-referential "specialization"

Class_of_class xxx

Class xxx

?????

This confusing notation is dropped.

So remember .... NOTE :

NOTE

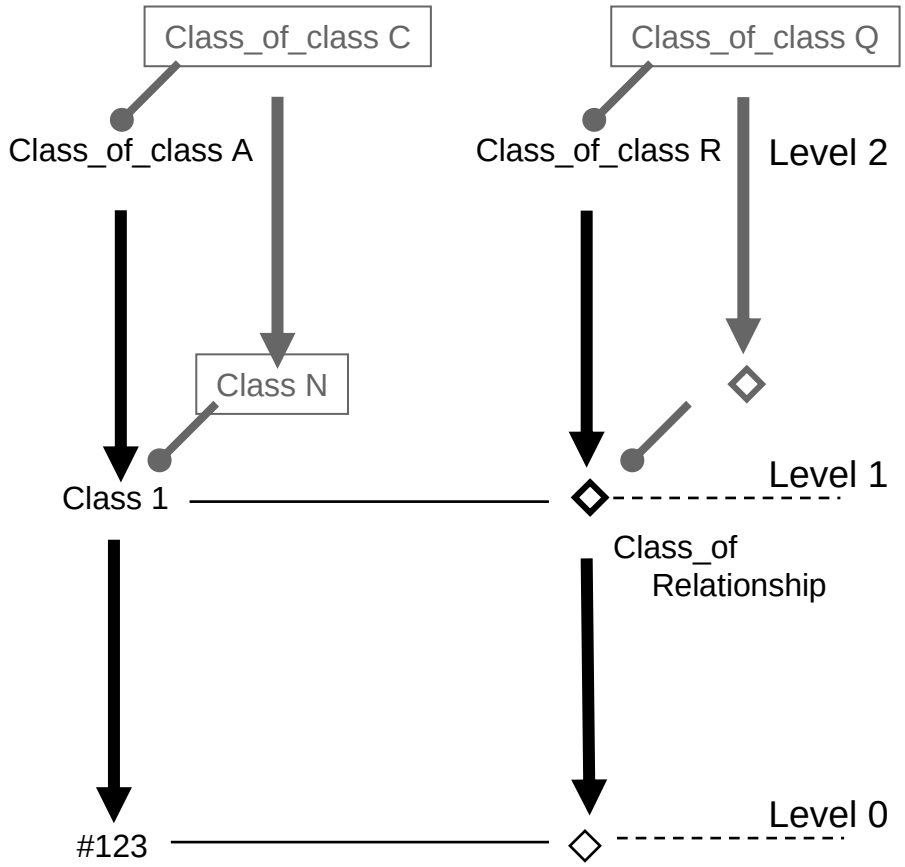
Classes of Class always "Specialise" other Classes of Class

AND

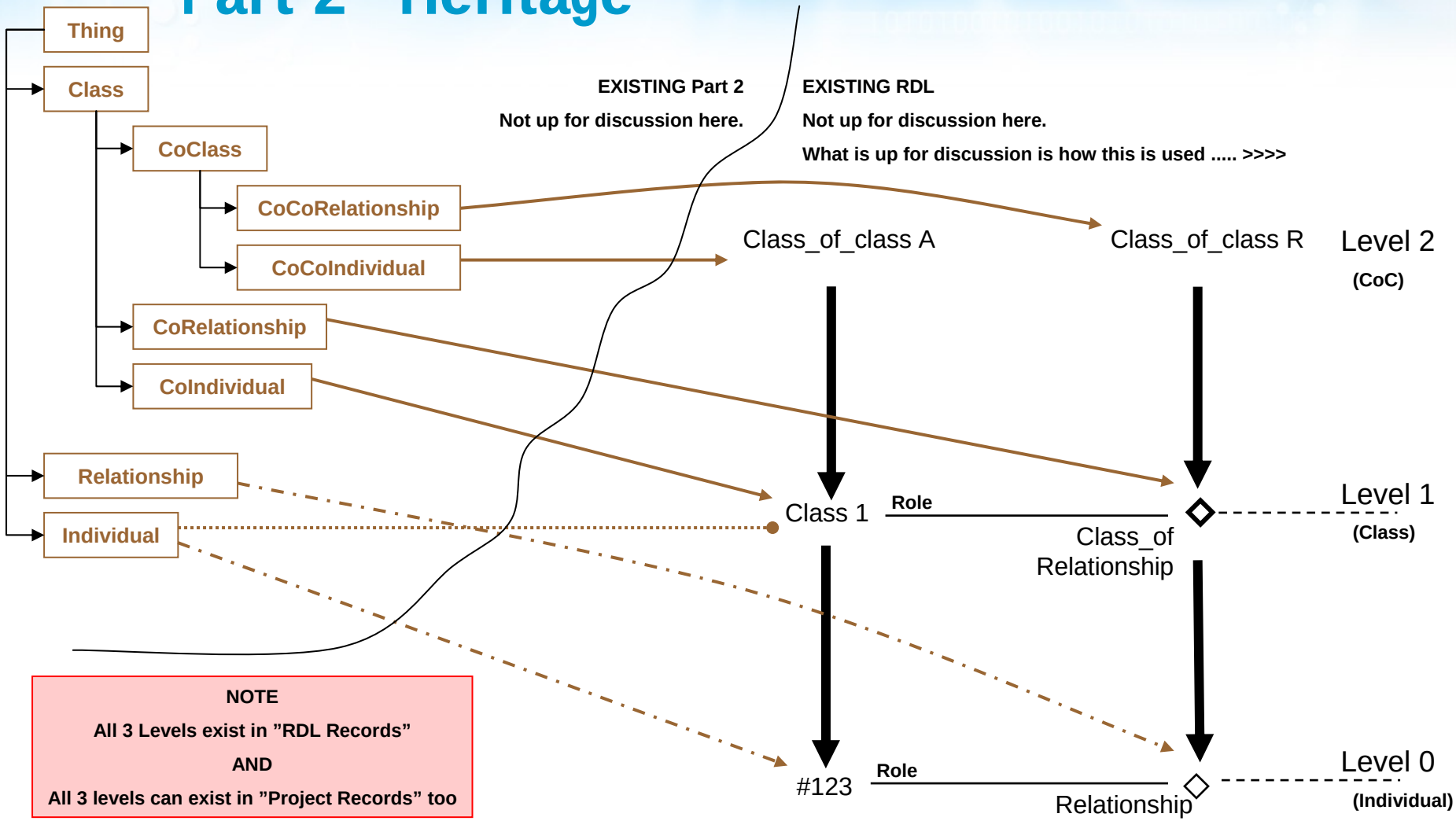
Classes always "Specialize" other Classes

AND

These specialization hierarchies will in general *always* interpose between the Class (or Class of Class) used and any RDL Item standing for the most generic entity types.



Part 2 “Heritage”



What is actually represented in the RDL ?

RDL Items *standing for* "non-relationshp" entities exist as "ISO 15926-4 *ENTITY NAME*" of Entity Type "ENTITY TYPE"

RDL Items *standing for* "relationship" entities exist as "ISO 15926-7 *PROTOTEMPLATE NAME*" of Entity Type "*Class of MDO*"

See the discussion thread ...

All our implementations (using OWL, or Part-8 precursor versions, or any "15926" compliant implementation)

Will use endpoints that refer to these RDL Item instances.

ISO 15926-4 *CLASS OF CLASS (and appropriate Specializations of this)*

ISO 15926-7 *CLASS OF CLASS OF xxxx Template (Initial Set and Specializations)*

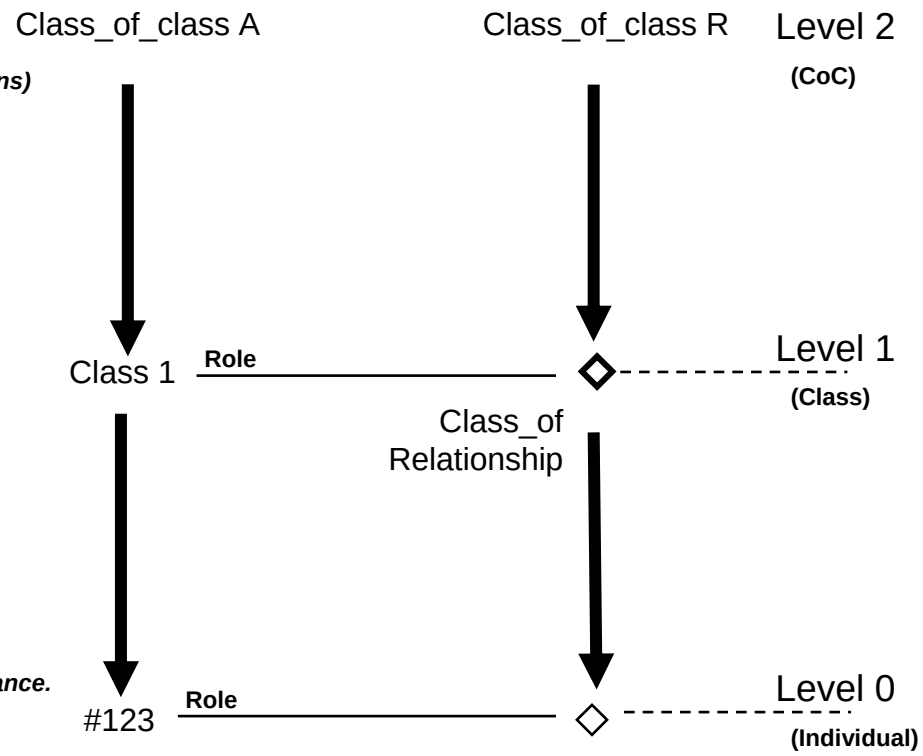
ISO 15926-4 *CLASS (and appropriate Specializations of this)*

ISO 15926-7 *CLASS OF xxxx Template (Initial Set and Specializations)*

Specializations of ISO 15926-4 *INDIVIDUAL*

Specializations of ISO 15926-7 *RELATION BETWEEN INDIVIDUALS*

(Remember these specializations may be in both the RDL and the Project instance. Those in the project instance may be persisted or on the fly.)



Translation in practice

IDS converter

Data in Template Format

SWRL

lifting

ISO 15926 in OWL

SPARQL

lowering

Data in Template Format

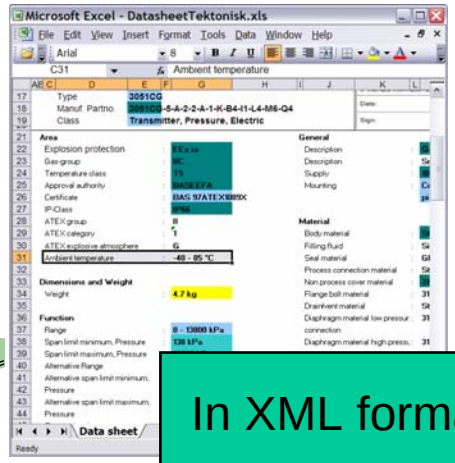
XQuery

Mapping into template statements

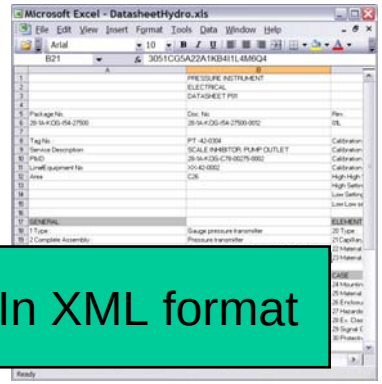
OWL DL reasoner:
- consistency
- type inference

Mapping into target format

XQuery



In XML format

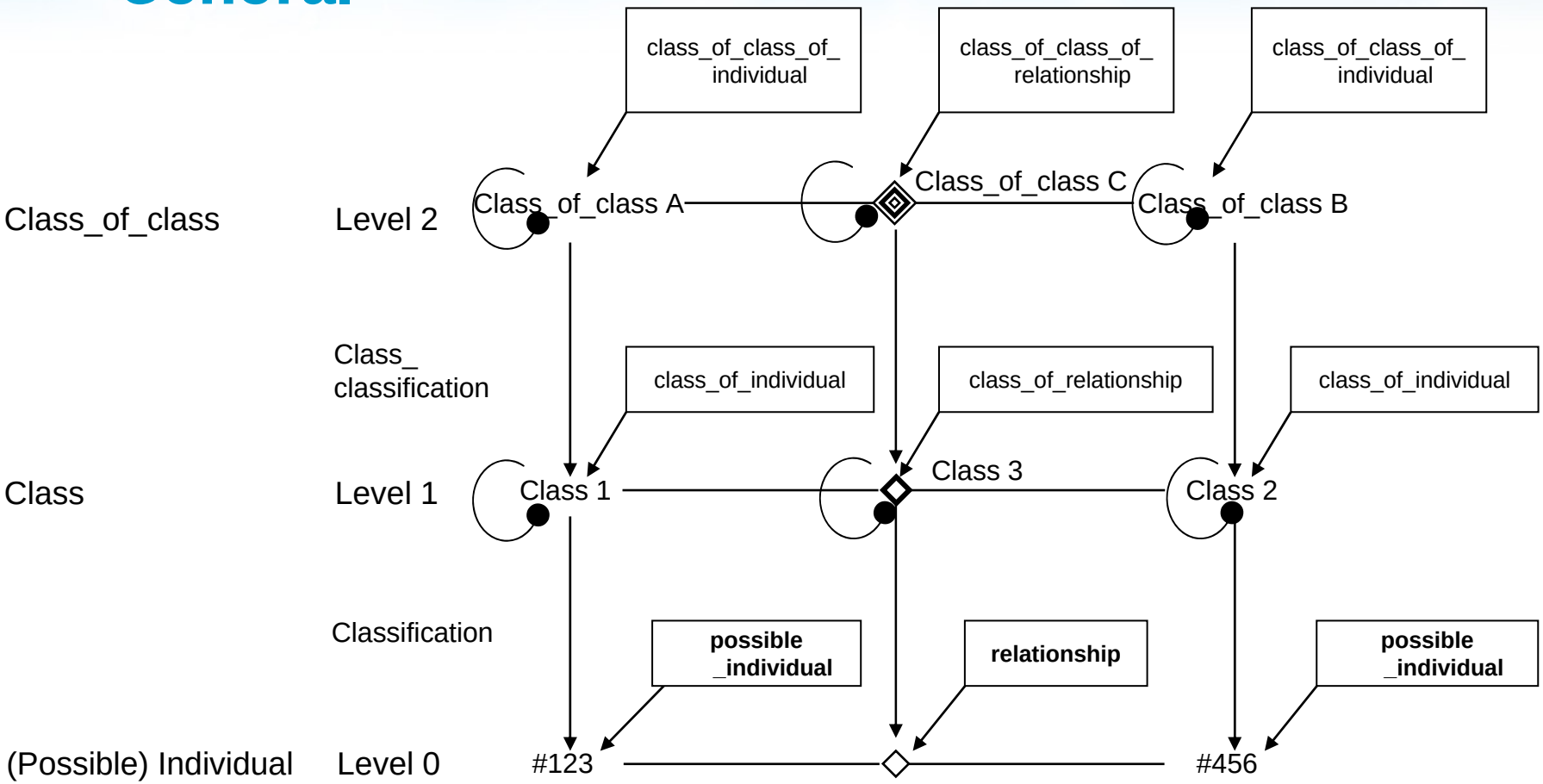


In XML format

Proposed Future Conformance Level

- Dictionary Conformance (Adding RDL identifiers to your data)
- Signature Conformance (Part 7)
  - Signatures as defined in RDL
  - Camelot (IDS3) - iRING
- Lifting/lowering Conformance
  - Signatures as defined in RDL
  - + Full Part 7
- Part 8 as the data carrier format
- Part 9 for the API
- This does not prevent other solutions, but these will be the standardised
- Dictionary conformance level will still provide substantial business benefits

General


class_of_class_of_ individual
class_of_class_of_ relationship
class_of_class_of_ individual
Class_of_class
Level 2
Class_of_class A
Class_of_class C
Class_of_class B
Class_ classification
class_of_individual
class_of_relationship
class_of_individual
Class
Level 1
Class 1
Class 3
Class 2
Classification
possible _individual
relationship
possible _individual
(Possible) Individual
Level 0
#123
#456

What RDL usage rules have we discovered so far ?

There are some already proposed in the discussion thread.

(Many of the rules are also already in the methodology.)

A MANDATORY relation for an individual is to *classify* it.
(To say using a Classification relation which Class it is a member of.)
(That Class should be as specialized as possible / appropriate)

A MANDATORY relation for a Class is to *specialize* it.
(To say using a Specialization relation which Class it is a subtype of.)

A MANDATORY relation for a Class of Class is to *specialize* it.
(To say using a Specialization relation which Class of Class it is a subtype of.)

An OPTIONAL relation for a Class is to *classify* it.
(To say using classification which Class or Class it is a member of.)

A MANDATORY relation for any object is to *identify* it ... Etc ...

When we get to the OWL/RDF (general ontological) world –
***Classify* corresponds to** Type **(transfers entity type and entity-type-related rules & behaviour to the members.)**
***Specialize* corresponds to** SubClassOf **(inherits all aspects of the parent class except for specialization of the constraining aspect.)**