

# ISO 15926 Geometry Templates using OWL

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(Chair: PCA Geometry SIG)

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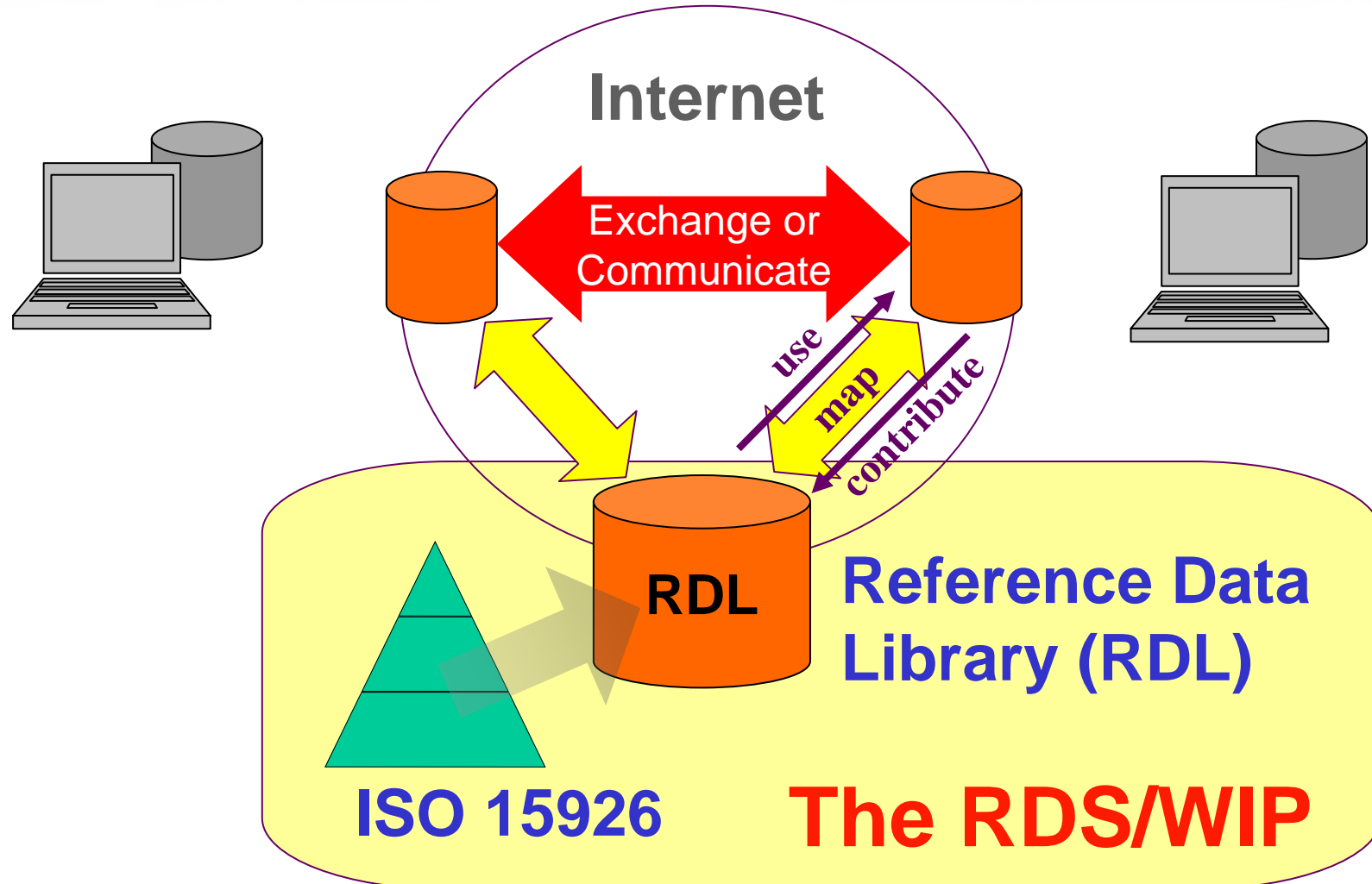
# Content

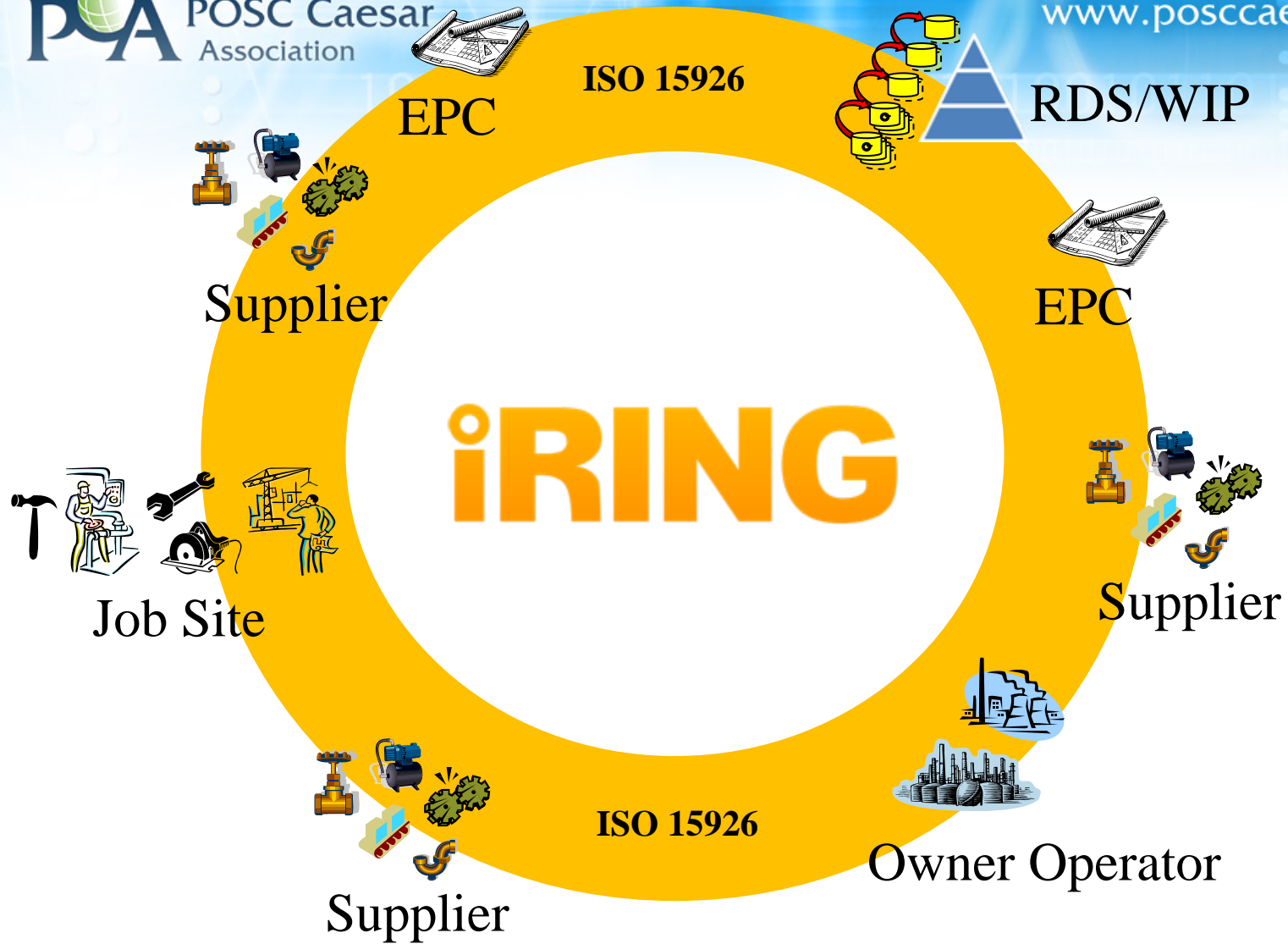
- ISO 15926 and Reference data
- Use of Semantic Web
- Templates Methodology
- Challenges and Need for Geometry Templates
- Geometry Special Interest Group (SIG)
- Geometry Scope
- Geometry Templates Examples

# What is ISO 15926?

- **Integration of life-cycle data for process plants, including oil and gas production facilities**
  - Standard for interoperability and the integration of lifecycle information
- **Standardizes:**
  - Dictionary and Taxonomy
  - Ontology (Using Template Methodology)
  - How computer systems connect, exchange and share information
- **Implemented using Semantic Web Standards**

# ISO 15926 reference data: At its simplest

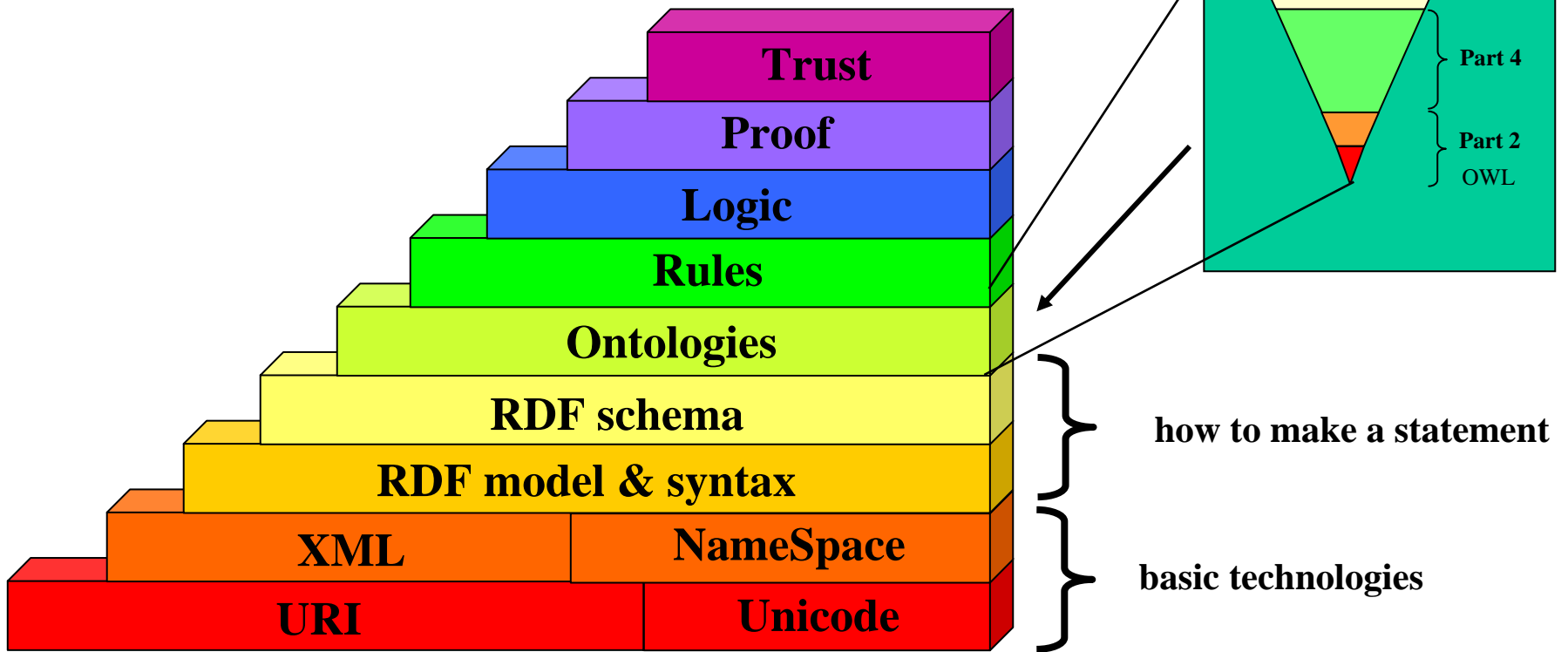




# ISO 15926 Realtime Interoperability Network Grid

## Relation to Semantic Web

# ISO 15926 mapped to the Semantic Web



Reference Data

Library

Plant Owner/  
Operator - HQ

Plant Owner/  
Operator - Plant

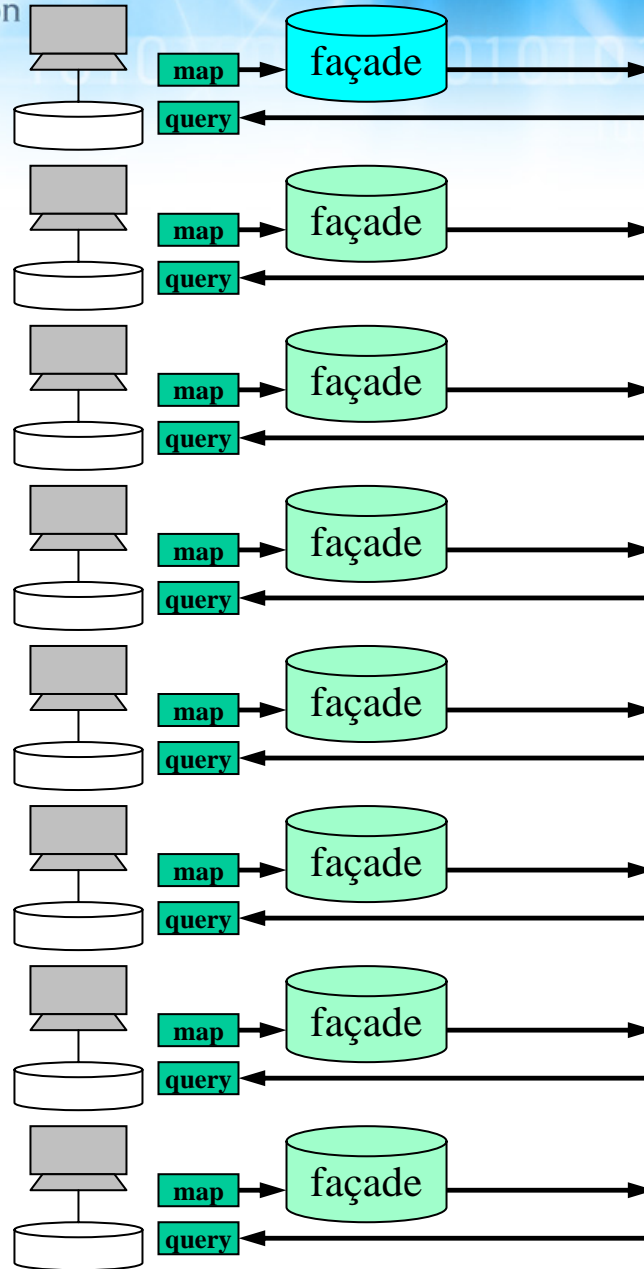
EPC contractor –  
A

EPC contractor –  
B

Supplier Catalog  
–e.g. PLib

Supplier –  
project data

RDL of standards  
organization



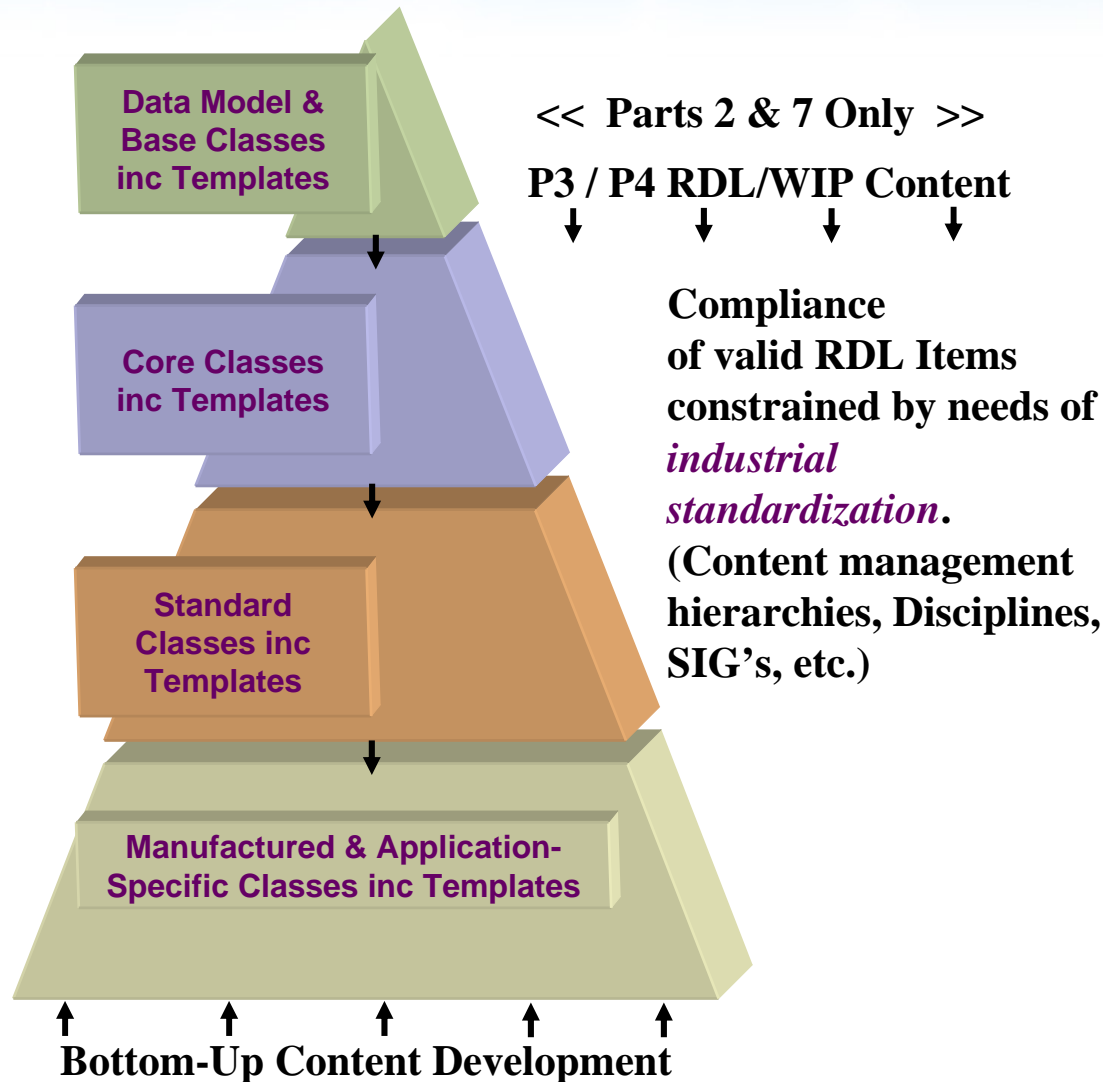
Confederation of  
Participating  
Façades (CPF)

internet

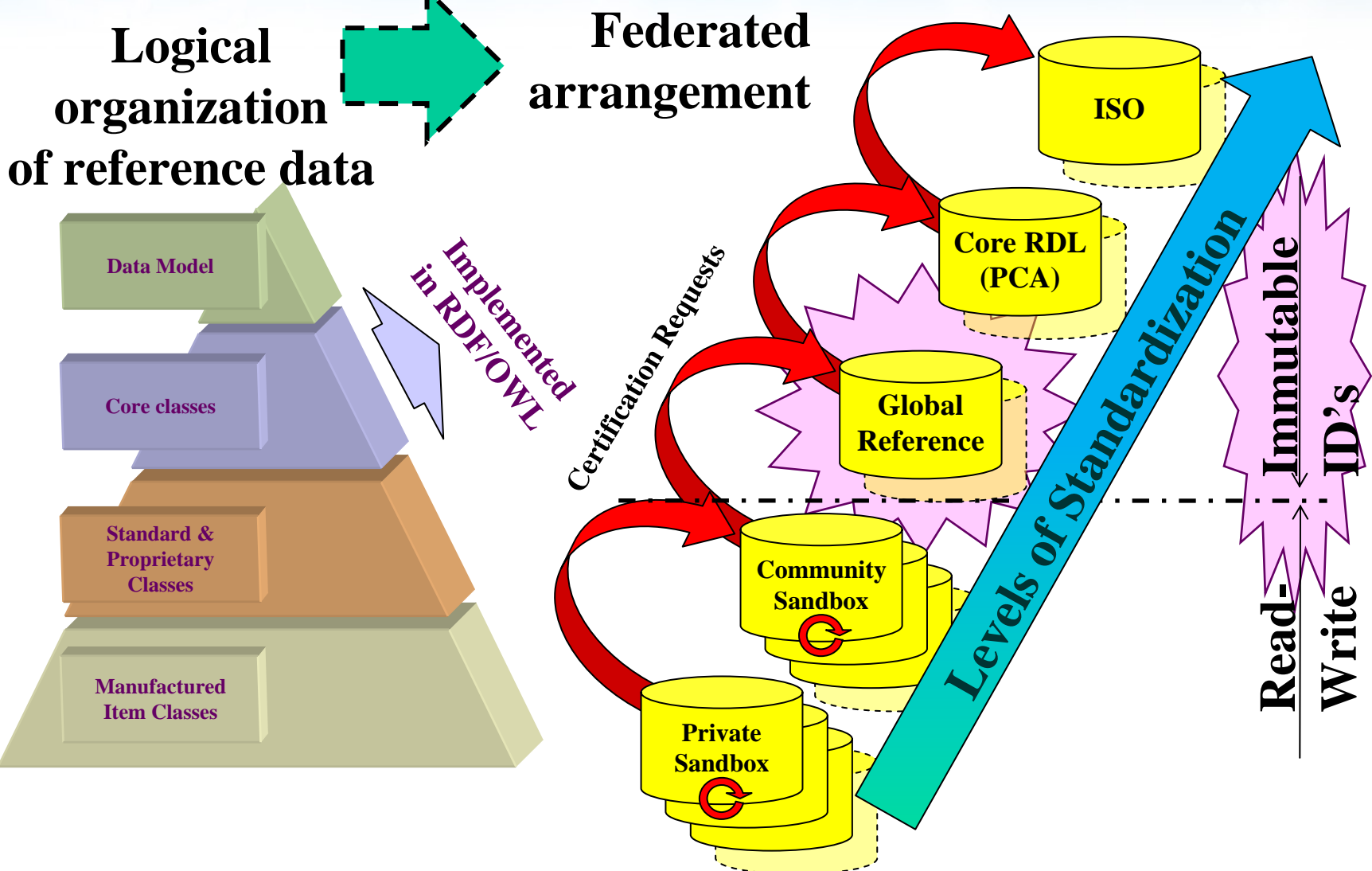
Your laptop  
with façade  
browser



# ISO 15926 Architecture



# 15926 & Federated Reference Data



## Templates Methodology

- **Templates are n-ary relationships**
- **Complex to build but Easy to Use**
- **Template Signatures –  
Specifications for Ontologies**

## A template is a pattern for stating facts

- A Template for ISO 15926 is a *predicate*, a *statement form*, a *pattern for facts*
- A template has a *signature* defining the form of a statement
  - Arguments and Types
- Each template has an *interpretation rule* that interprets facts that fit the pattern
  - Reducing a complex statement into simpler ones
  - Yielding an expression of the fact in the ontology language
- Methodology is rigorously defined in ISO 15926-7

# Template example

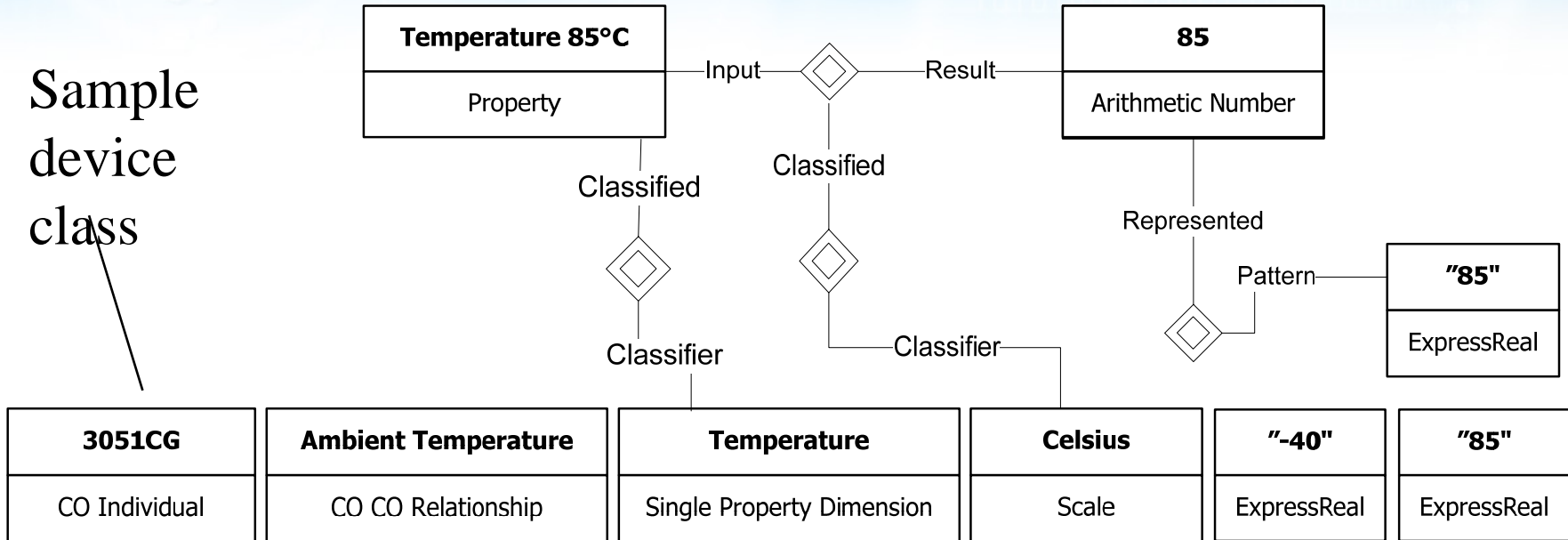
A fairly complex claim

**“The ambient temperature during operation of a 3051CG pressure transmitter should be within -40 and 85 degrees Celsius.”**



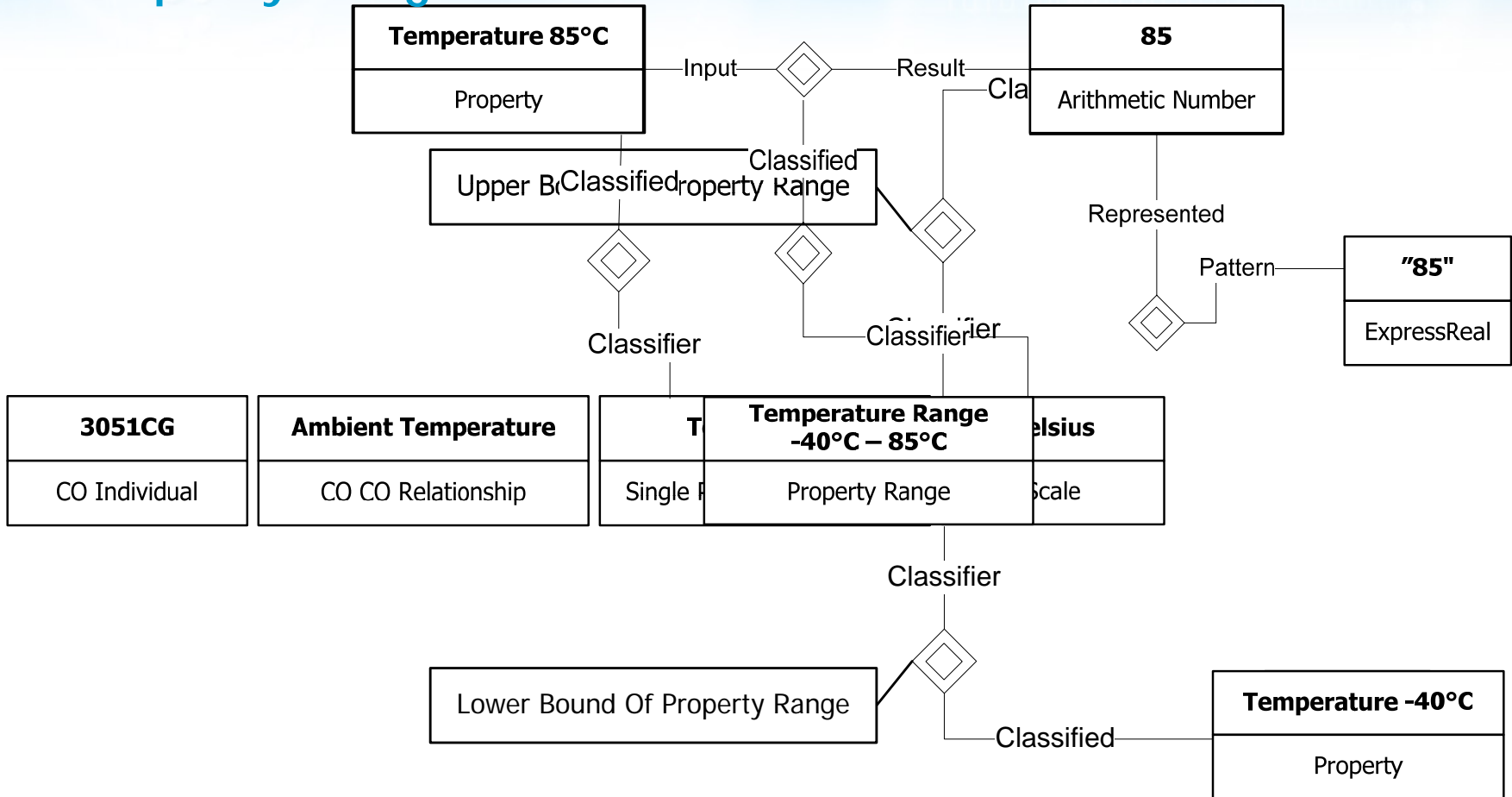
## Property with Scale and Quantification

Sample  
device  
class

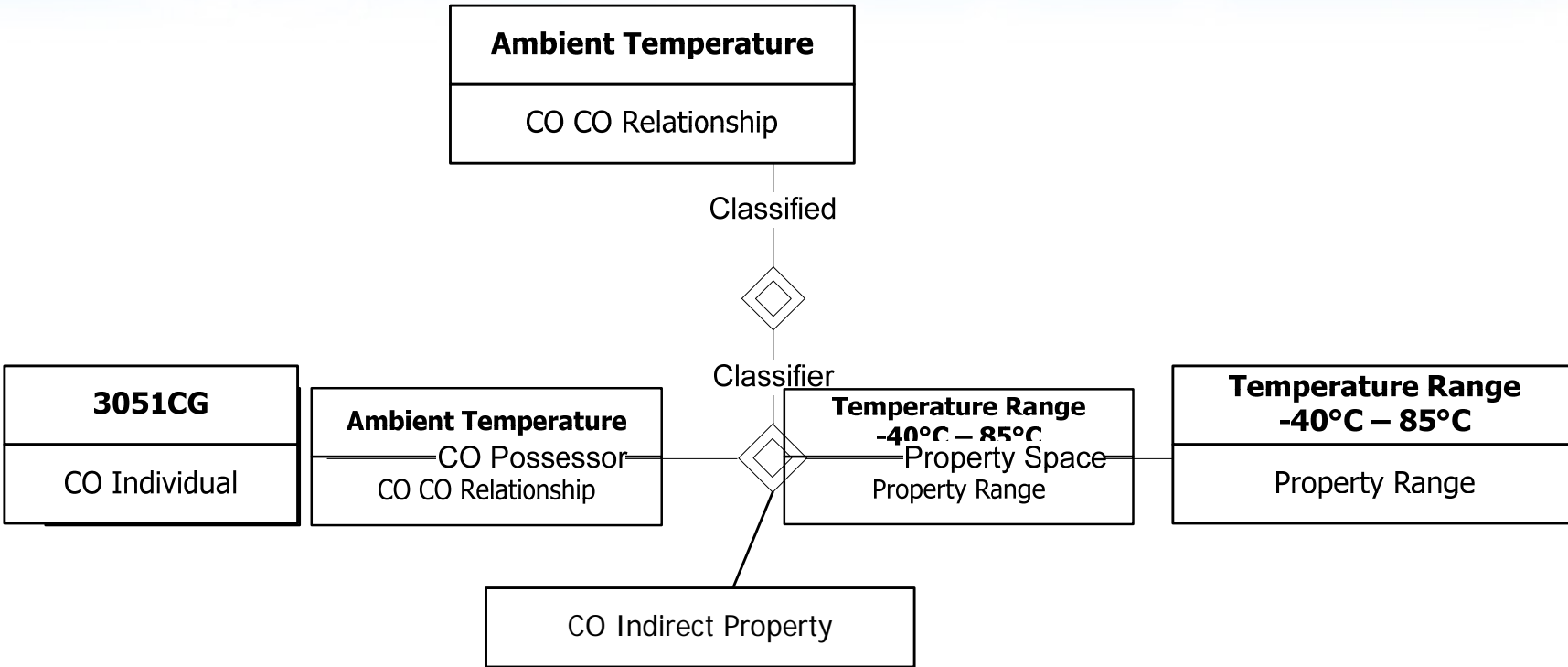


“The ambient temperature during operation of a 3051CG pressure transmitter should be within -40 and 85 degrees Celsius.”

# Property Range

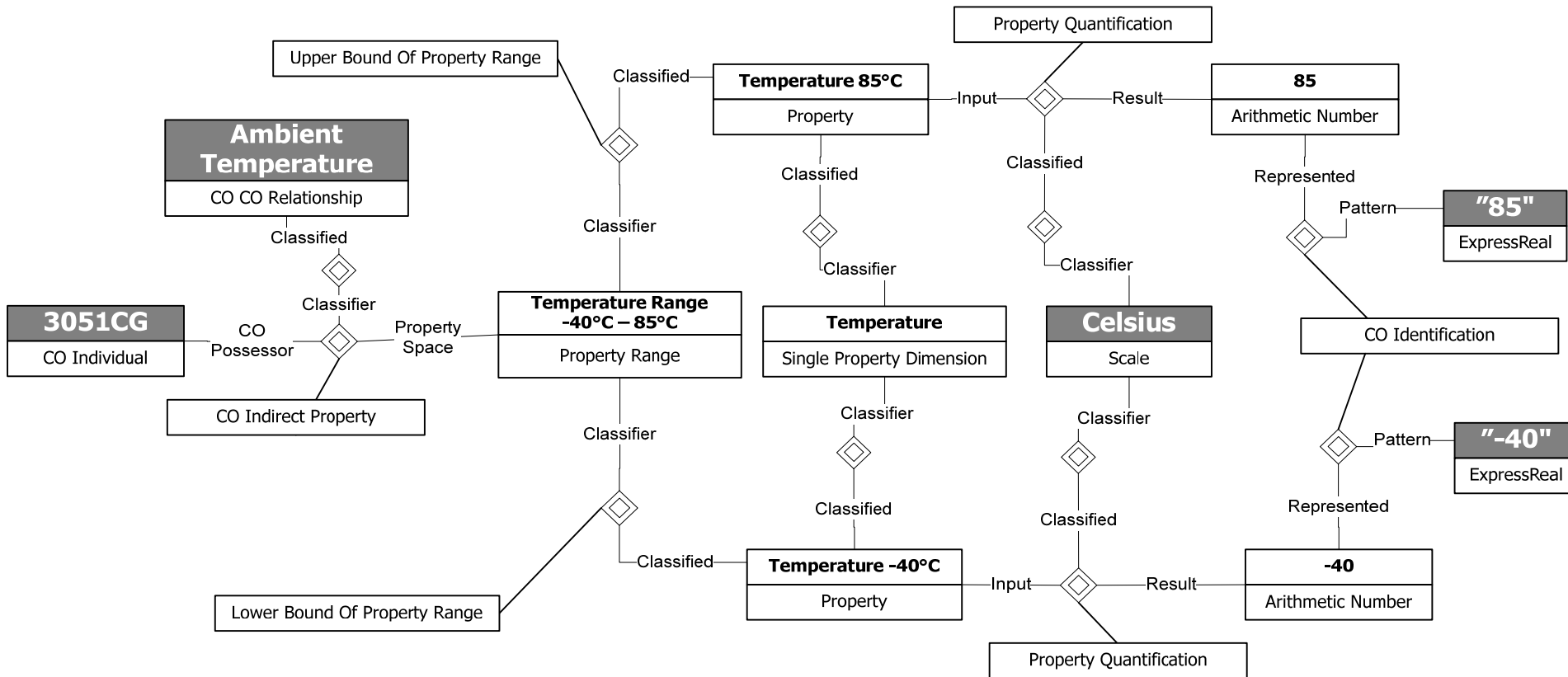


# Property Range Restriction





# Model: Ambient Temperature Range



*3051CG ambient temperature: -40°C – 85°C*

1010101010010101010100101101

101010100101010101010101

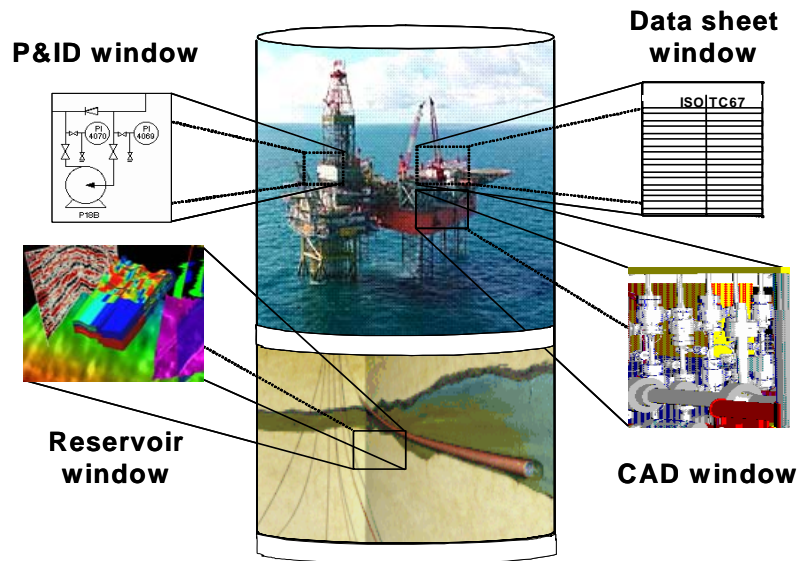
## OWL notation:

### Template instance showing temperature range restriction

```
<rdl:TemperatureRangeRestrictionOfClass rdf:ID="T593292">
  <p7tpl:hasRestrictedClass rdf:resource="#COI-439112"/>
  <p7tpl:hasProperty rdf:resource="http://rdl.rdlfacade.org/data#AmbientTemperature"/>
  <p7tpl:hasScale rdf:resource="http://rdl.rdlfacade.org/data#DegreesCelcius"/>
  <p7tpl:valUpperReal rdf:datatype="http://www.w3.org/2001/XMLSchema#real">
    85
  </p7tpl:valUpperReal>
  <p7tpl:valLowerReal rdf:datatype="http://www.w3.org/2001/XMLSchema#real">
    -45
  </p7tpl:valLowerReal>
</rdl:TemperatureRangeRestrictionOfClass>
```

# Vision of ISO 15926

## Interoperability and Life Cycle



- Started with standards for information handover between EPCs and Owners/Operators
- Last 5-6 years focused on ontology for Integrated Operations
- Last 2-3 years focused on Operation & Maintenance and integration between Engineering and Operation & Maintenance

# Geometry Needs and Challenges

- P&ID Documents and 3D Model representation for Process Plants
- Integration with BIM (IFCs) and Facility Management
- Integration with GIS
- Supply Chain and Design to Construction
- Geometry Reference Data available as Part3 (derived from STEP Part 42) but not represented as Templates

# Geometry Special Interest Group (SIG)

- Collaboration of



**FIATECH**

**iRING**  
— USER GROUP

## ISO 15926 Geometry SIG

**Goal:** Representing ISO 15926 Part 3  
Geometry Reference Data using Part 7  
Template Methodology and advancing  
the usage of Geometry Reference Data

SIG Kicked-Off – Mid April 2010

## Current SIG Members

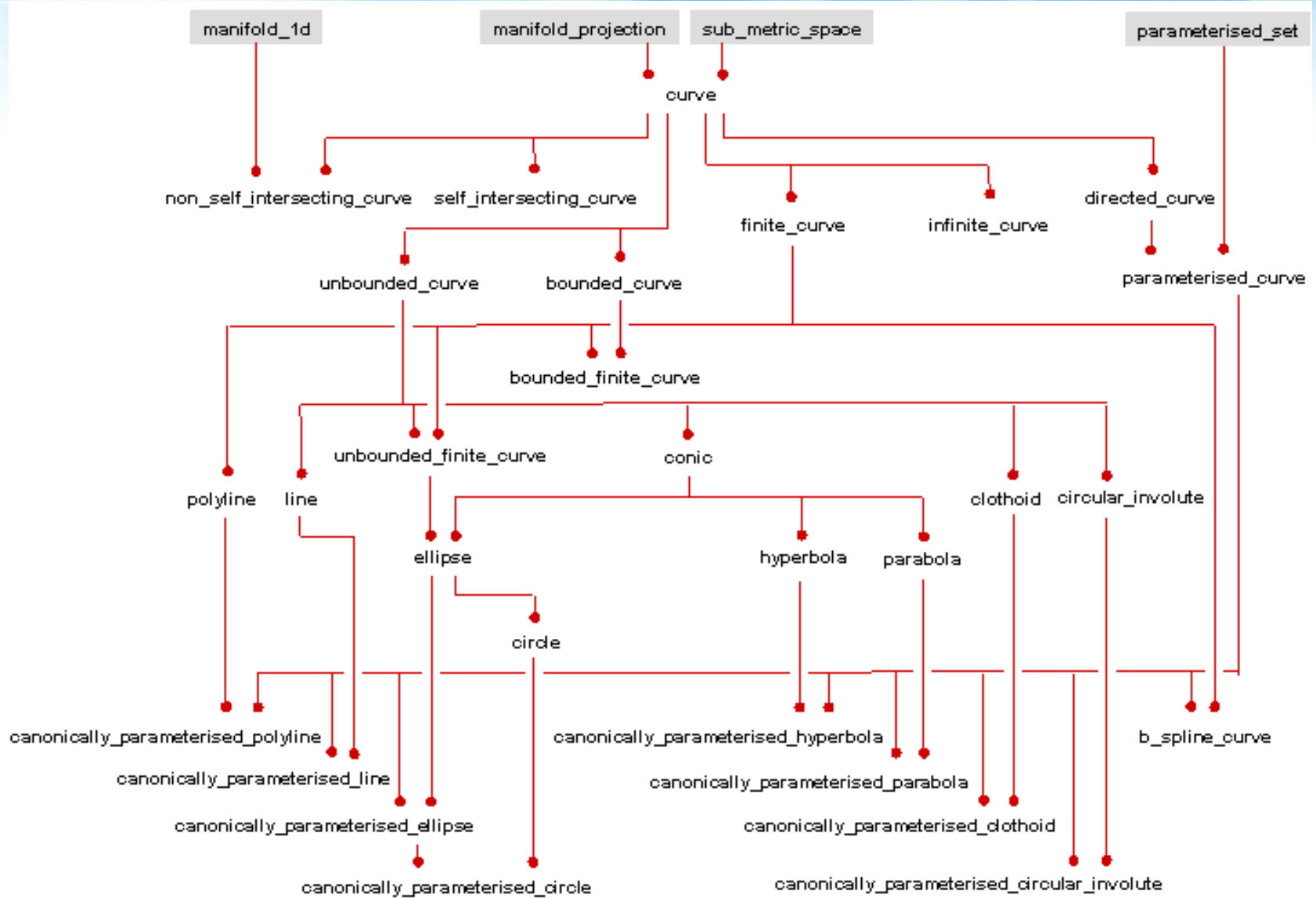
- **AVEVA, Bechtel, Bentley, CCC, Noumenon, Siemens, Tecgraf**
- **Active Contributors:**
  - Darius Kanga – Bechtel, USA
  - Mohammed Moubarak – CCC, Beirut
  - Adrian Laud – Noumenon, UK
  - Gabriel Lopes – TecGraf/PUC-Rio
  - Geiza Maria – TecGraf/PUC-Rio

# ISO 15926 Geometry SIG

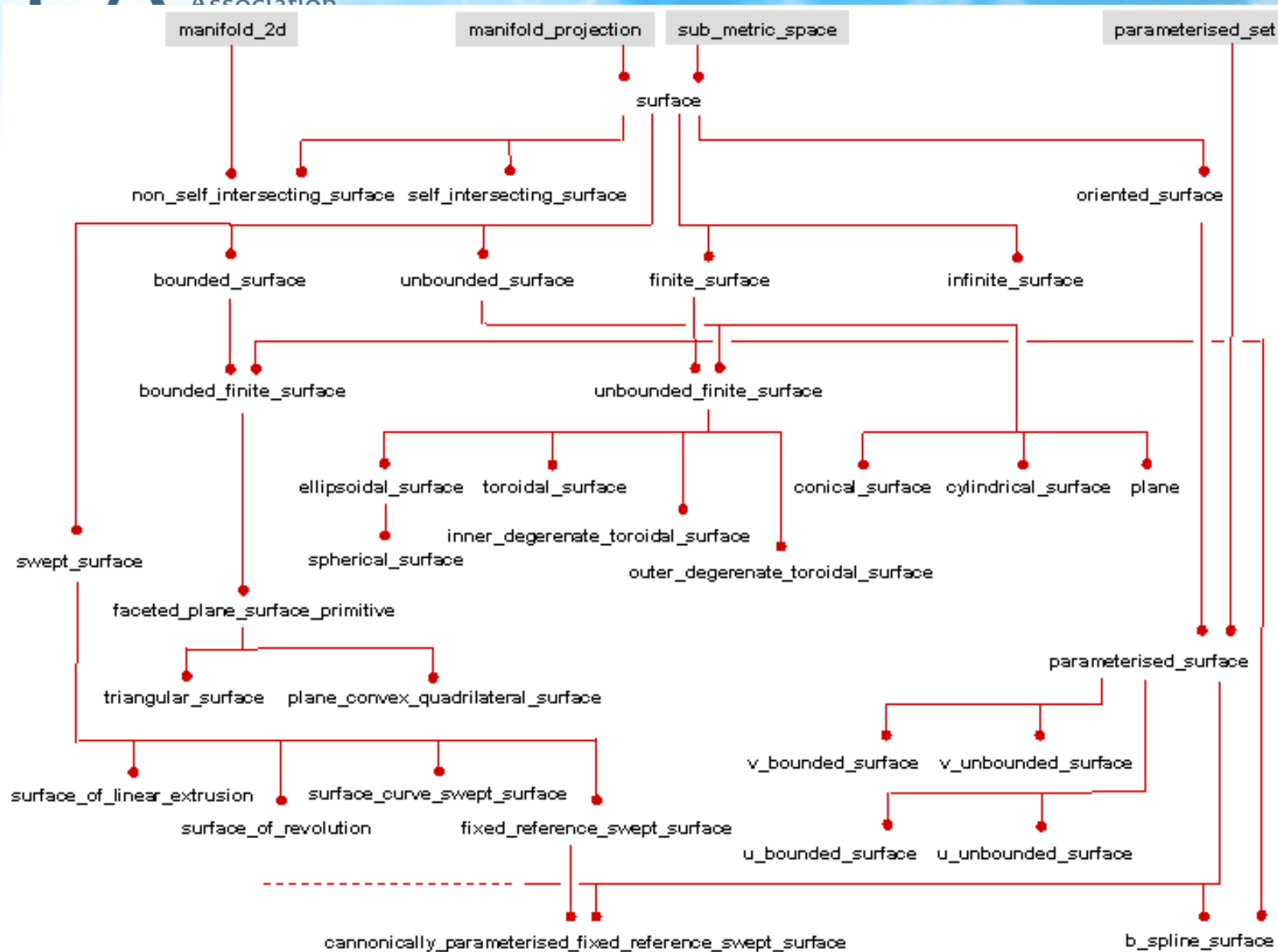
Initial deliverables are:

- Geometry Template Signatures in Spreadsheet format
- Documentation of Geometry Reference Data to assist implementers and users
- Example usages of Geometry Reference Data
- Geometry Templates and Classes as Part 8 OWL representation
- Geometry Reference Data hosted in a PCA/FIATECH Sandbox exposed through a SPARQL endpoint

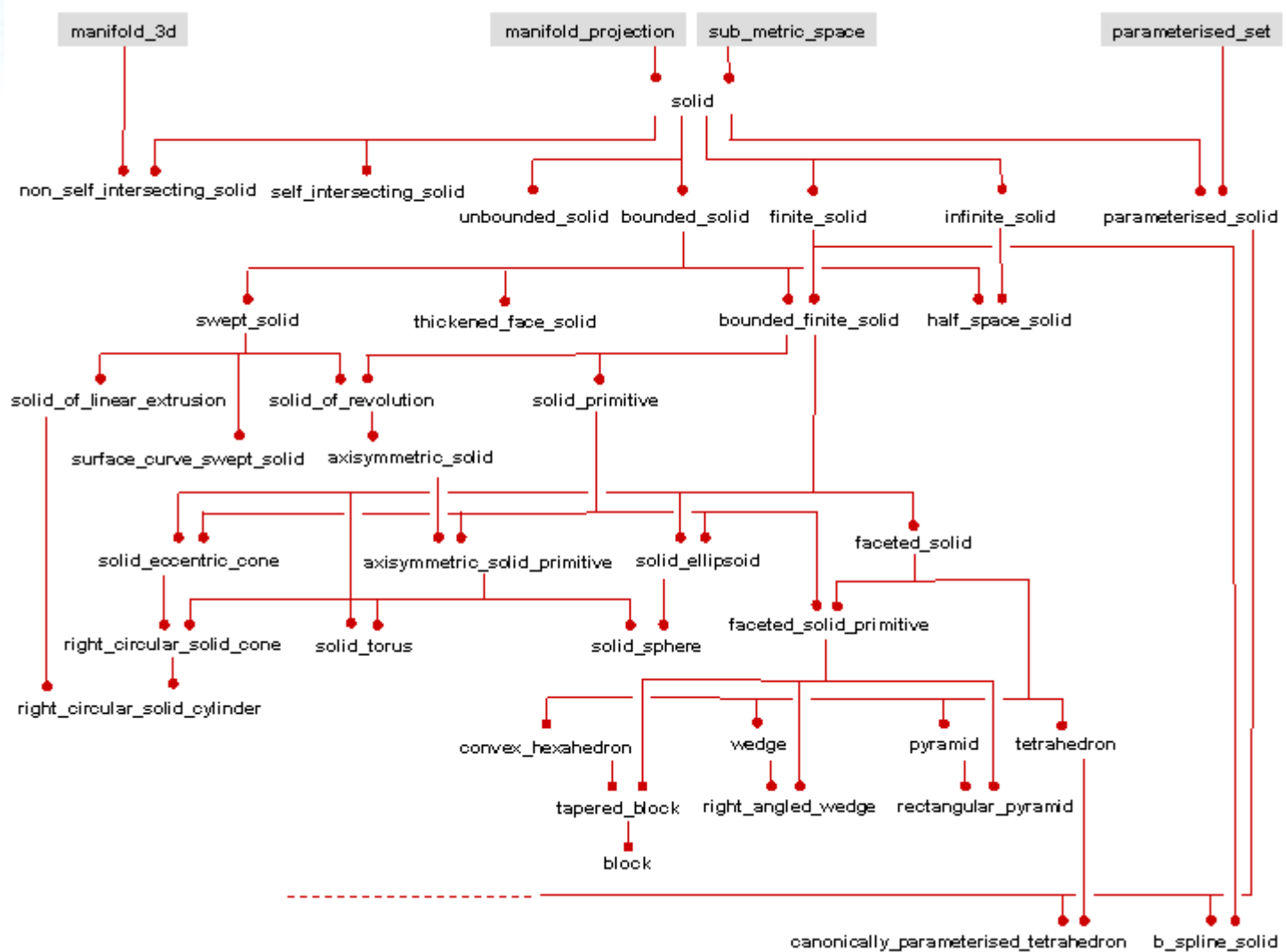




## Principal subclasses of curve



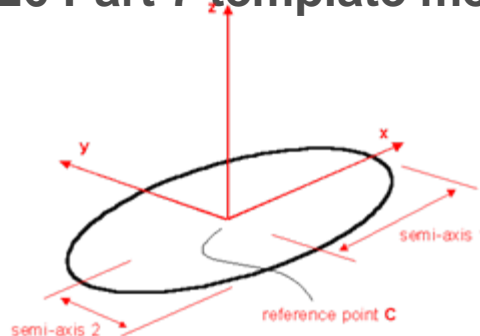
## Principal subclasses of surface



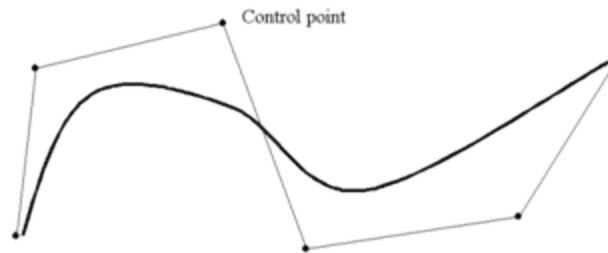
## Principal subclasses of solid

# Templates for Geometry

- Detailed analysis of ISO15926 Part 3 geometry primitives aiming conformance to ISO15926 Part 7 template methodology



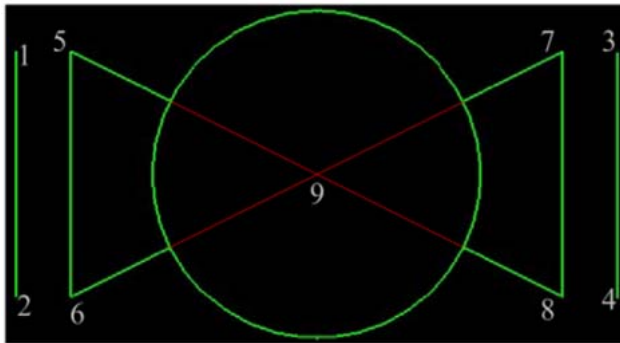
| Template Name  | Parent Template | Role1 Name | Role1 Type                      | Role1 Value | Role2 Name        |
|----------------|-----------------|------------|---------------------------------|-------------|-------------------|
| <b>Ellipse</b> |                 |            |                                 |             |                   |
| PrimaryAxis    |                 | hasObject  | OBJECT_WITH_SEMI_AXIS1          |             | hasPrimaryAxis    |
| SecondaryAxis  |                 | hasObject  | OBJECT_WITH_SEMI_AXIS2          |             | hasSecondaryAxis  |
| Position       |                 | hasObject  | OBJECT_WITH_REFERENCE_PLACEMENT |             | hasReferencePoint |



| Template Name             | Parent Template                       | Role1 Name | Role1 Type     | Role1 Value | Role2 Name               |
|---------------------------|---------------------------------------|------------|----------------|-------------|--------------------------|
| <b>BsplineCurve</b>       |                                       |            |                |             |                          |
| ControlPoints             | control_points_of_b_spline_curve      | hasObject  | B_SPLINE_CURVE |             | hasTableMetricSpacePoi   |
| BsplineDegree             | degree_of_b_spline_curve              | hasObject  | B_SPLINE_CURVE |             | hasDegreeOfBsplineCurv   |
| BsplineKnots              | distinct_knots_of_b_spline_curve      | hasObject  | B_SPLINE_CURVE |             | hasDistinctKnotsOfBsplin |
| BsplineKnotMultiplicities | knot_multiplicities_of_b_spline_curve | hasObject  | B_SPLINE_CURVE |             | hasKnotMultiplicitiesOfB |

## Representing 2D Geometry in OWL

- A globe valve symbol is broken down into a *circle* and a few *polylines*



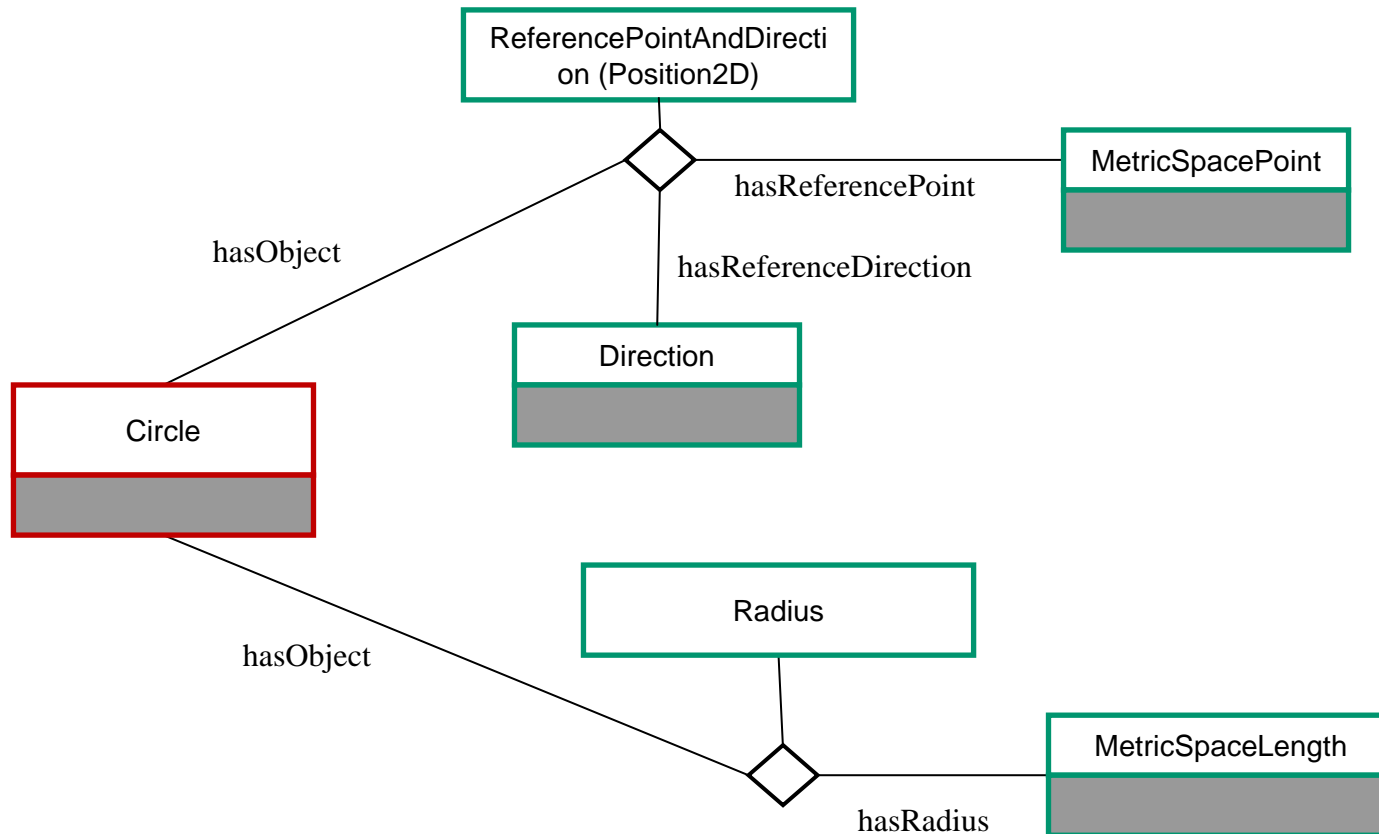
|            |         | X     | Y     |               |
|------------|---------|-------|-------|---------------|
| Polyline 1 | Point 1 | 0,034 | 0,686 |               |
|            | Point 2 | 0,034 | 0,302 |               |
| Polyline 2 | Point 3 | 0,97  | 0,686 |               |
|            | Point 4 | 0,97  | 0,302 |               |
| Polyline 3 | Point 5 | 0,119 | 0,686 |               |
|            | Point 6 | 0,119 | 0,302 |               |
|            | Point 7 | 0,884 | 0,686 |               |
|            | Point 8 | 0,884 | 0,302 |               |
| Circle     | Point 9 | 0,5   | 0,5   | Radius : 0.25 |

- Taken from ISO15926 Part 3, all concepts necessary to define a geometry primitive are tied together in a template signature
- Classes and relationships are modeled and instantiated using Protegé

# Representing 2D Geometry in OWL

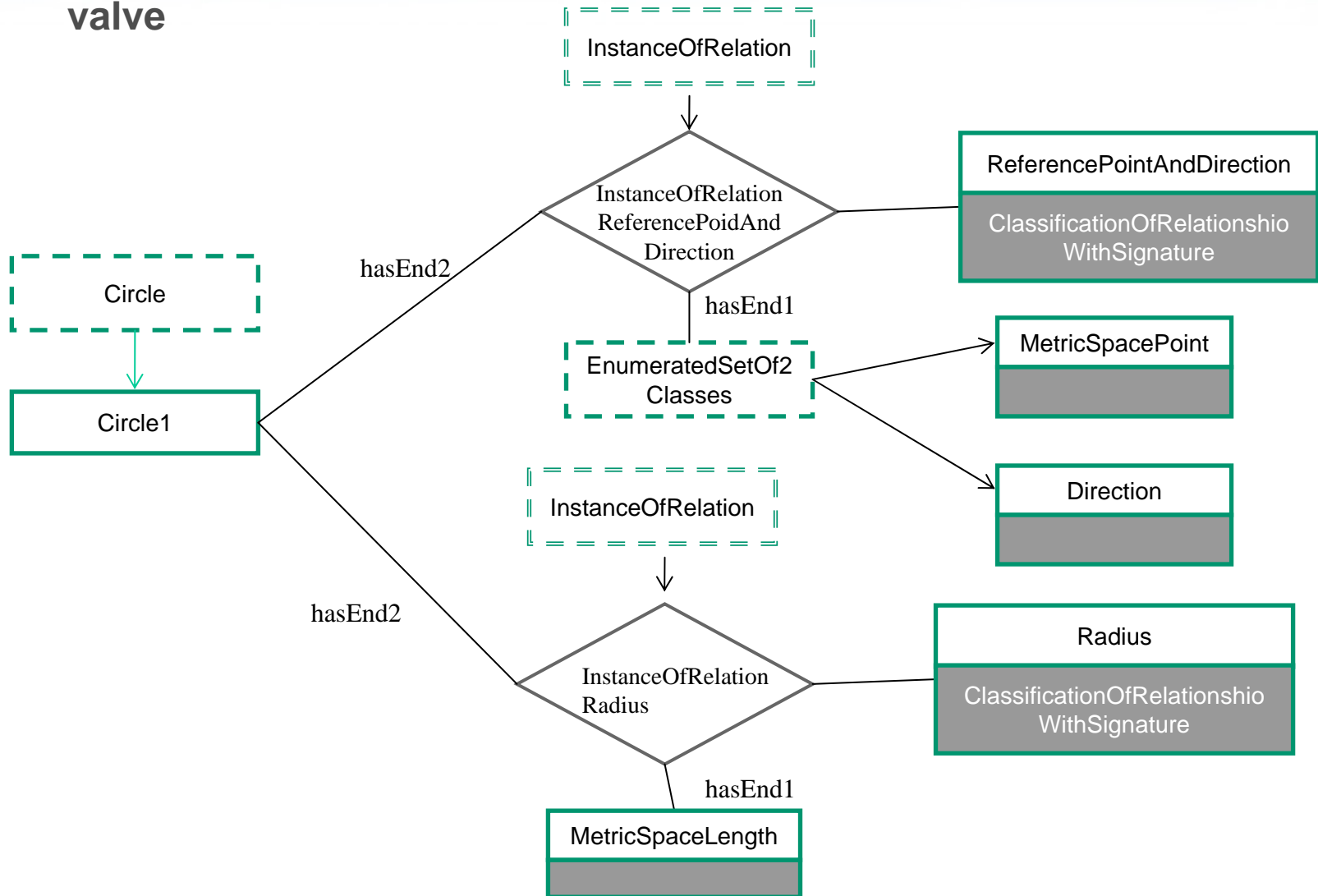
- Example: A template is used to describe a given object as a *circle*

| Template Name                           | Role1 Name | Role1 Type                            | Role2 Name        | Role2 Type          | Role3 Name            | Role3 Type |
|---|------------|---------------------------------------|-------------------|---------------------|-----------------------|------------|
| Circle                                  |            |                                       |                   |                     |                       |            |
| Radius                                  | hasObject  | object_with_radius                    | hasRadius         | metric_space_length |                       |            |
| ReferencePointAndDirection (Position2D) | hasObject  | object_with_axial_reference_placement | hasReferencePoint | metric_space_point  | hasReferenceDirection | DIRECTION  |



# Representing 2D Geometry in OWL

- An instance of a circle needs to be created in order to “draw” the globe valve



## Representing 2D Geometry in OWL

- The end result is Part 7 & 8 compliant OWL that can be used to interoperate P&ID geometry using Iso 15926 Templates

```
<!-- http://www.tecgraf.puc-  
rio.br/ISO15926/TemplateGeometry/Templates.owl#InstanceOfRelation  
Radius -->  
  
<owl:ObjectProperty rdf:about="#InstanceOfRelationRadius">  
  <rdfs:subPropertyOf rdf:resource="#InstanceOfRelation"/>  
  <rdfs:domain rdf:resource="#Radius"/>  
  <rdfs:domain>  
    <owl:Restriction>  
      <owl:onProperty  
rdf:resource="http://dm.rdlfacade.org/data#hasEnd2"/>  
      <owl:someValuesFrom  
rdf:resource="http://rdl.rdlfacade.org/data#R17180418724"/>  
    </owl:Restriction>  
  </rdfs:domain>  
</owl:ObjectProperty>
```



## Summary

- ISO 15926 Reference data is implemented using Semantic Web Technologies
- Templates Methodology simplifies the Ontology development and is easy to use
- Geometry SIG is formed to advance usage of Geometry Reference Data
- Geometry Templates are being developed using the Templates Methodology

# Questions?

It's Lunch  
Time!!

# Thank You!!

- **Contact Info**

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