ISO 15926 for interoperability

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Fluor Corporation
- Combined with “ISO 15926 templates and the Semantic Web” from DnV
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ISO 15926

- Interoperability standard
  - Interoperability: the ability of different types of computers, networks, operating systems, and applications to work together effectively, without prior communication, in order to exchange information in a useful and meaningful manner.

- Neutral layer used for data integration
ISO 15926

- Chosen by FIATECH associated companies as THE interoperability standard

- Many companies worked on this standard
  - Estimated spent more than 50 man-years

- FIATECH ADI (Acceleration Deployment ISO 15926)
  - Total value $3.5 million

- POSC Caesar IDS (Intelligent data Sets)
  - Total value: $2.5 million
20 ISO 15926 projects
RDL: reference data library

ISO 15926

Information

Exchange

The ISO 15926 provides the ability to build common data models
## ISO 15926 part 4 spreadsheets

<table>
<thead>
<tr>
<th>Spreadsheet</th>
<th>count</th>
<th>Spreadsheet</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
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<td>valves.xls</td>
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<tr>
<td>core.xls</td>
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<td>connection_ material.xls</td>
<td>226</td>
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<tr>
<td>uom.xls</td>
<td>1087</td>
<td>mathematical_objects.xls</td>
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<td>information.xls</td>
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<td>rotating_equipment</td>
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<td>1667</td>
<td>activities.xls</td>
<td>1829</td>
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<tr>
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<td>488</td>
<td>functions.xls</td>
<td>80</td>
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<tr>
<td>heat_transfer.xls</td>
<td>268</td>
<td>solid_handling.xls</td>
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<td>encoded_information.xls</td>
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<td>protection.xls</td>
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<td>static_equipment.xls</td>
<td>637</td>
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<tr>
<td>instrumentation.xls</td>
<td>724</td>
<td>transport.xls</td>
<td>100</td>
</tr>
<tr>
<td>piping.xls</td>
<td>704</td>
<td>Total</td>
<td>11624</td>
</tr>
</tbody>
</table>

Total: 11624
Façades

System A → map → Façade (Semantic Web Triple Store)

query & map

Other’s Façades
Confederation of Participating Façades (CPF)

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

internet

Your laptop with façade browser
Reference Data Libraries

- ISO-defined classes & reference individuals in OWL format
- ERDL façade in ISO 15926-7 format
- Mapping of end-user classes & individuals
- Specialization of standard classes in other formats
- Specialization of catalogs in other formats
- Specialization of product & service classes
- Specialization of supplier façades
- Façades of government and industry standardization bodies
Wanted: A simple, compliant interface

• Standardized modelling practice
• Tools that are familiar to domain experts
  – Protégé, Reference Data Editor are out
• Tools that support the user and check correctness
  – Excel is out
• Tools that provide for working at a suitable level of abstraction
  – Most ontology editors expose the user to too much ‘assembly code’
Building domain ontologies with *templates*

- An ontology is used to record *statements*. That’s semantics.
- To build the RDL, we need to represent facts about a given domain using the language of ISO 15926
- Ideally, a domain expert states the facts, and the machine interprets the facts automatically
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
  - What arguments need to be given
  - What are their types
- Each template has an *interpretation rule* that interprets facts that fit the pattern
  - Reducing a complex statement into simpler ones
  - Eventually, to atomic statements in ISO 15926
  - Yielding an expression of the fact in the ontology language
- Logical methodology is rigorously defined in ISO 15926-7
Template example I

• Constraint: A car has 3 or more wheels
• Express the constraint with a suitable template
  \[\text{Parts-at-least} \ ( \text{Car}, \text{Wheel}, 3 \ ) \]
• Rules generate a set of ISO 15926 statements

“ The statement
  \[\text{Parts-at-least} \ ( C, D, i \ )\]

means that
  Any \( C \) has at least \( i \) \( D \)'s as parts ”
Template example I

- Assume that any car has 3 or more wheels
- Expressed with a suitable template $Parts\_\text{Parts-at-least}(\text{Car}, \text{Wheel}, 3) \neq 0$
- Rules generate a set of ISO 15926 statements

- … as illustrated by this figure
A car has at least three wheels.
A familiar interface

- Making the statement 
  \[ \text{Parts-at-least ( Car, Wheel, 3 )} \]
  requires no detailed knowledge about modelling
- A list of arguments can easily be stored in a table (Excel!)

<table>
<thead>
<tr>
<th>Equipment type</th>
<th>Part type</th>
<th>Min. number of parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>Wheel</td>
<td>3</td>
</tr>
<tr>
<td>Bicycle</td>
<td>Wheel</td>
<td>1</td>
</tr>
</tbody>
</table>

- Correctness of the generated ontology structure can be checked using generic ontology tools
Translation by means of templates

A simple mapping into template statements

And back again
Template example II

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

• Five arguments are required for a precise statement
  “The *body height* of a *human* is a property which varies from *50* to *250 cm*”
“The ambient temperature during operation of a 3051CG pressure transmitter should be within -40 and 85 degrees Celsius.”
Property Range Restriction

Ambient Temperature
- CO CO Relationship

Classified

3051CG
- CO Individual

Ambient Temperature
- CO Possessor
- CO CO Relationship

Temperature Range
-40°C – 85°C
- Property Space
- Property Range

Classifier

CO Indirect Property

Temperature Range
-40°C – 85°C
- Property Range
Model: Ambient Temperature Range

3051CG ambient temperature: -40°C – 85°C
Template showing temperature range

```xml
<part2:MultidimensionalObject rdf:ID="ST-593292">
  <rdf:type rdf:resource="http://tpl.rdlfacade.org/data#ST-4790"/>
  <part7:propertyRangeRestrictedClass rdf:resource="#COI-439112"/>
  <part7:propertyRelation rdf:resource="http://rdl.rdlfacade.org/data#AmbientTemperature"/>
  <part7:propertyType rdf:resource="http://rdl.rdlfacade.org/data#Temperature"/>
  <part7:scale rdf:resource="http://rdl.rdlfacade.org/data#DegreesCelsius"/>
  <part7:upperReal>
    <part4:XmlSchemaReal>
      <part2:content rdf:datatype="http://www.w3.org/2001/XMLSchema#real">-40</part2:content>
    </part4:XmlSchemaReal>
  </part7:upperReal>
  <part7:lowerReal>
    <part4:XmlSchemaReal>
      <part2:content rdf:datatype="http://www.w3.org/2001/XMLSchema#real">85</part2:content>
    </part4:XmlSchemaReal>
  </part7:lowerReal>
</part2:MultidimensionalObject>
```
Templates for ontology development

- A flexible and precise language for ontology building
- Let the compiler handle the “assembly language”
- Creating rich semantic structure becomes practical
- Standardization of templates makes standardized modelling patterns possible
Information

http://www.ids-adi.org

http://trac.poscccaesar.org/

http://www.fiatech.org/

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