



ART-DECOR

for Software Developers/Implementers

ART-DECOR Developer Day @ IHIC 2015
9th February 2015, Prague, Czech Republic

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Maarten Ligtoet (NL)

Marc de Graauw (NL)

Abderrazek Boufahja (BE)



Agenda

ART-DECOR for Software Developers



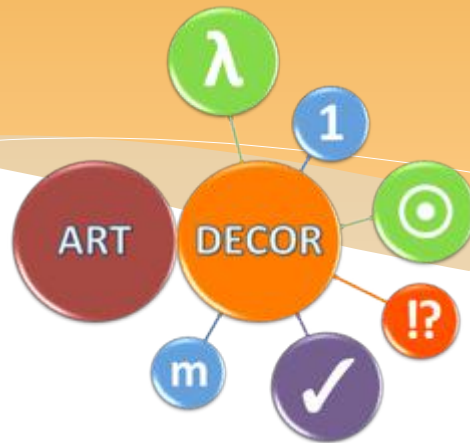
- Schematron and other artefacts
- FHIR with ART-DECOR
- Publications
- Testing with ART-DECOR
- ART-DECOR Application (ADA)
- IHE Gazelle ObjectsChecker: Concepts, Benefits, Demonstration and Access

Agenda



- Maarten Ligtvoet (NL)
 - Nictiz, Product Manager ART-DECOR
 - ART-DECOR Expert
- Marc de Graauw (NL)
 - ART-DECOR Expert
- Dr Kai U. Heitmann (DE)
 - ART-DECOR Expert, HL7 Germany / Netherlands
- Abderrazek Boufahja (BE)
 - IHE Europe

Schematron – Validation of CDA Instances



CDA Standard and Specifications



CDA-Standard



Use Case + Business model .

Implementation Guide

Business Rules

Constraints

Implementation Guides



- CDA Implementation Guides and Profiles
 - Discharge Letter
 - Patient Summary
 - Operation Note
 - EKG Report
 - Lab Results
 - Medication List
 - Prescription



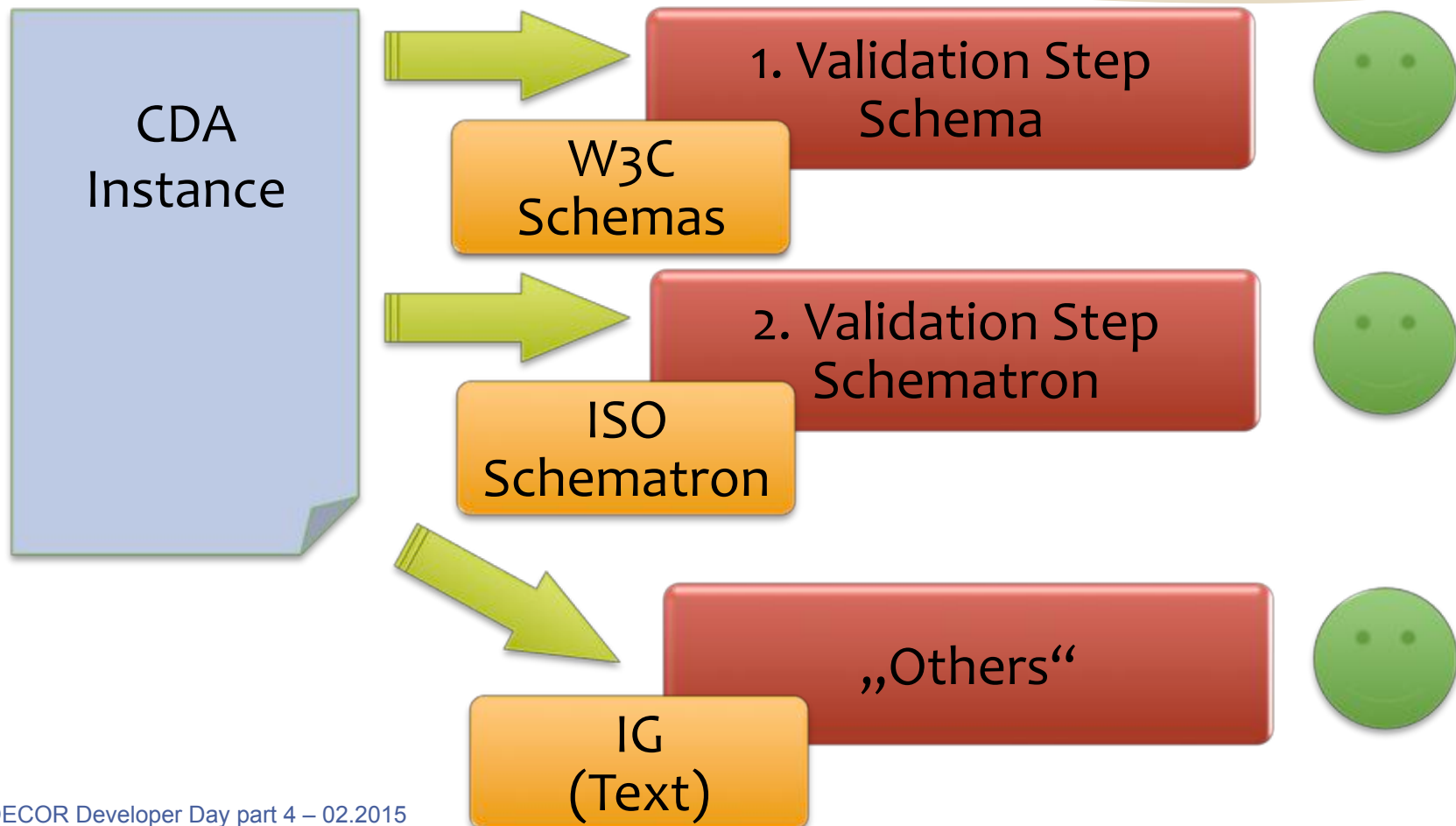
„Valid“ CDA Documents...



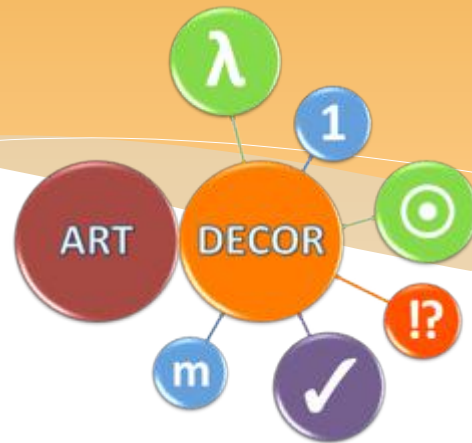
- validate against the published W3C XML Schema
→ XML Schema
- validate against the generic CDA Model
→ MIF (model interchange format)
- validate against the requirements mentioned in the implementation guide → ISO Schematron
- validate against Template Definitions
→ Schematron, MIF, W3C Schema, ...

Multi Phase Validation

Sender Side



W3C Schema



CDA XML W3C Schema for "Person"



Patient

classCode*: <= *PSN*
determinerCode*: <= *INSTANCE*
id: II [0..1] (Deprecated)
name: SET<PN> [0..*]
administrativeGenderCode: CE CWE [0..1] <= *AdministrativeGender*
birthTime: TS [0..1]
maritalStatusCode: CE CWE [0..1] <= *MaritalStatus*
religiousAffiliationCode: CE CWE [0..1] <= *ReligiousAffiliation*
raceCode: CE CWE [0..1] <= *Race*
ethnicGroupCode: CE CWE [0..1] <= *Ethnicity*

```
<xs:complexType name="POCD_MT000040.Patient">  
  <xs:sequence>  
    <xs:element name="templateId" type="POCD_MT000040.InfrastructureRoot.templateId"  
      minOccurs="0" maxOccurs="unbounded"/>  
    <xs:element name="id" type="II" minOccurs="0"/>  
    <xs:element name="name" type="PN" minOccurs="0" maxOccurs="unbounded"/>  
    <xs:element name="administrativeGenderCode" type="CE" minOccurs="0"/>  
    <xs:element name="birthTime" type="TS" minOccurs="0"/>  
    <xs:element name="maritalStatusCode" type="CE" minOccurs="0"/>  
  </xs:sequence>  
  <xs:attribute name="nullFlavor" type="NullFlavor" use="optional"/>  
  <xs:attribute name="classCode" type="EntityClass" use="optional" fixed="PSN"/>  
  <xs:attribute name="determinerCode" type="EntityDeterminer" use="optional" fixed="INSTANCE"/>  
</xs:complexType>
```

W3C-Schema for “Observation”



```
<xs:complexType name="POCD_MT000040.Observation">
  <xs:sequence>
    <xs:element name="realmCode" type="CS" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="typeId" type="POCD_MT000040.InfrastructureRoot.typeId" minOccurs="0"/>
    <xs:element name="templateId" type="POCD_MT000040.InfrastructureRoot.templateId"
      minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="id" type="II" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="code" type="CD" />
    <xs:element name="text" type="ED" minOccurs="0"/>
    <xs:element name="statusCode" type="CS" minOccurs="0"/>
    <xs:element name="effectiveTime" type="IVL_TS" minOccurs="0"/>
    <xs:element name="value" type="ANY" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="interpretationCode" type="CE" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="methodCode" type="CE" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="targetSiteCode" type="CD" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="subject" type="POCD_MT000040.Subject" minOccurs="0"/>
    <xs:element name="performer" type="POCD_MT000040.Performer2"
      minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="nullFlavor" type="NullFlavor" use="optional"/>
  <xs:attribute name="classCode" type="ActClassObservation" use="required"/>
  <xs:attribute name="moodCode" type="x_ActMoodDocumentObservation" use="required"/>
  <xs:attribute name="negationInd" type="bl" use="optional"/>
</xs:complexType>
```

Using HL7 v3 Schemas (XML ITS)



- HL7: *informative* XML Schema Definitions (XSD) for v3/CDA
- There are no **normative Schemas**
- Get the message here:

An XML Document, that validates against the W3C Schema, is **not necessarily a valid HL7 CDA-Document**

Schema Validator Example: Oxygen



The screenshot displays the Oxygen XML Editor interface. The main window shows an XML document titled "CDA_example_with_errors.xml" with the following structure:

```
<representedOrganization>
  51 </assignedAuthor>
  52 </author>
  53
  54 <custodian>
  55 <assignedCustodian>
  56 <representedCustodianOrganization>
  57 <!-- Introduced error: element sequence -->
  58 <name>Beth Israel Deaconess Medical Center</name>
  59 <id root="2.16.840.1.113883.2.126"/>
  60 </represent...
  61 </assigne...
  62 </custodian>
  63
  64 <information>
  65 <intended...
  66 <id extension="0000" root="2.16.840.1.113883.4.1"/>
  67 <addr>
  68 <streetAddressLine>6401 Security Blvd</streetAddressLine>
  69 <city>Woodlawn</city>
  70 <state>MD</state>
```

A tooltip is visible over the error message, providing details about the validation failure:

E cvc-complex-type.2.4.a: Invalid content was found starting with element 'name'. One of '{urn:hl7-org:v3}:realmCode, {urn:hl7-org:v3}:typeId, {urn:hl7-org:v3}:templateId, {urn:hl7-org:v3}:id}' is expected.

The bottom of the editor shows a list of 4 errors:

- E cvc-complex-type.2.4.a: Invalid content was found starting with element 'name'. One of '{urn:hl7-org:v3}:realmCode, {urn:hl7-org:v3}:typeId, {urn:hl7-org:v3}:templateId, {urn:hl7-org:v3}:id}' is expected.
- E cvc-enumeration-valid: Value 'PUB' is not facet-valid with respect to enumeration [H, HP, HV, WP, AS, EC, PG, MC]. It must be a value from the enumeration.
- E cvc-attribute.3: The value 'PUB' of attribute 'use' on element 'telecom' is not valid with respect to its type, 'set_cs_TelecommunicationAddressUse'.
- E cvc-complex-type.2.4.a: Invalid content was found starting with element 'blue'. One of '{urn:hl7-org:v3}:content, {urn:hl7-org:v3}:linkHtml, {urn:hl7-org:v3}:sub, {urn:hl7-org:v3}:sup, {urn:hl7-org:v3}:br, {urn:hl7-org:v3}:footnote, {urn:hl7-org:v3}:'

The status bar at the bottom indicates "Validation failed. errors: 4". The Windows taskbar at the very bottom shows the system tray with the time 10:20 and several open applications including Mozilla Firefox, UV_generic..., Internet..., Microsoft Po..., Skype, IHIC_CDA_a..., Java - org.h..., and the Oxygen XML Editor.

Schema Validator Example: Oxygen



```
<tr>
  <td>
    <!-- Introduced error: extension -->
    <blue>Blue text</blue>
  </td>
</tr>
<tr>
  <td>MFA["urn:hl7-org:v3":content, "urn:hl7-org:v3":linkHtml,
    MVA, "urn:hl7-org:v3":sub, "urn:hl7-org:v3":sup,
</tr>
  "urn:hl7-org:v3":br, "urn:hl7-org:v3":footnote,
<tr>
  "urn:hl7-org:v3":footnoteRef,
  <td>C1["urn:hl7-org:v3":renderMultiMedia,
</tr>
  "urn:hl7-org:v3":paragraph, "urn:hl7-org:v3":list} is
<!-- Introduced post-publication infrastructural extension (PUB). Not an error. -->
<telecom use="PUB" value="tel:(508)555-4321"/>
<telecom use="WP" value="tel:(781)706-5252"/>
<associatedPerson>
  <name>
    <given>Laura</given>
    <family>Sample</family>
  </name>
</associatedPerson>
```

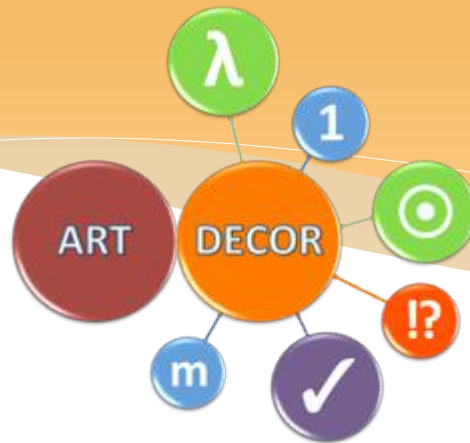
E cvc-complex-type.2.4.a: Invalid content was found starting with element 'blue'. One of [{"urn:hl7-org:v3":content, "urn:hl7-org:v3":linkHtml, MVA, "urn:hl7-org:v3":sub, "urn:hl7-org:v3":sup, "urn:hl7-org:v3":br, "urn:hl7-org:v3":footnote, "urn:hl7-org:v3":footnoteRef, "urn:hl7-org:v3":renderMultiMedia, "urn:hl7-org:v3":paragraph, "urn:hl7-org:v3":list}] is

Press F2 for focus...

E cvc-enumeration-valid: Value 'PUB' is not facet-valid with respect to enumeration '[H, HP, HV, WP, AS, EC, PG, MC]'. It must be a value from the enumeration.

Press F2 for focus...

Schematron Basics with Examples



Business Rules



- Implementation guides quite often define “templates” in the form of textual requirements
 - *The CDA document SHALL contain a ‘discharge diagnosis’ section, which SHALL have the 3645-3 LOINC code.*
 - *A ‘discharge diagnosis’ section SHOULD have an entry with a ICD-10 diagnosis code.*
 - *The section MAY have an author, which if present, should be identified using the national provider identifier.*
- These requirements can be tested using Schematron.

Schematron Use Case



- Rules-based validation language
 - direct checks beyond what schemas can express
 - produce reports for complicated checking by humans
- Find patterns in documents
- Check elements against a controlled vocabulary (from external XML file)

Schematron is



- A rule-based XML validation language
- To validate XML Documents using rules and conditions to test
 - ...content (elements, attributes)
 - ...patterns (structures/context)
 - ...co-constraints (business rules)
- Has a cool Report Generator
- An ISO Standard: ISO/IEC 19757-3

What Schematron Does



- Validate/report on document structure
 - presence/absence of elements
 - sequence of elements
 - presence/absence of attributes
- Validate/report on document content
- Validate/report on attribute content
- Check co-occurrence constraints
 - (If patient is „female“, then ask for „pregnancy“)

A Short Example



- ...in a CDA instance

```
<typeld extension="POCD_HD000040" root="2.16.840.1.113883.1.3"/>
```

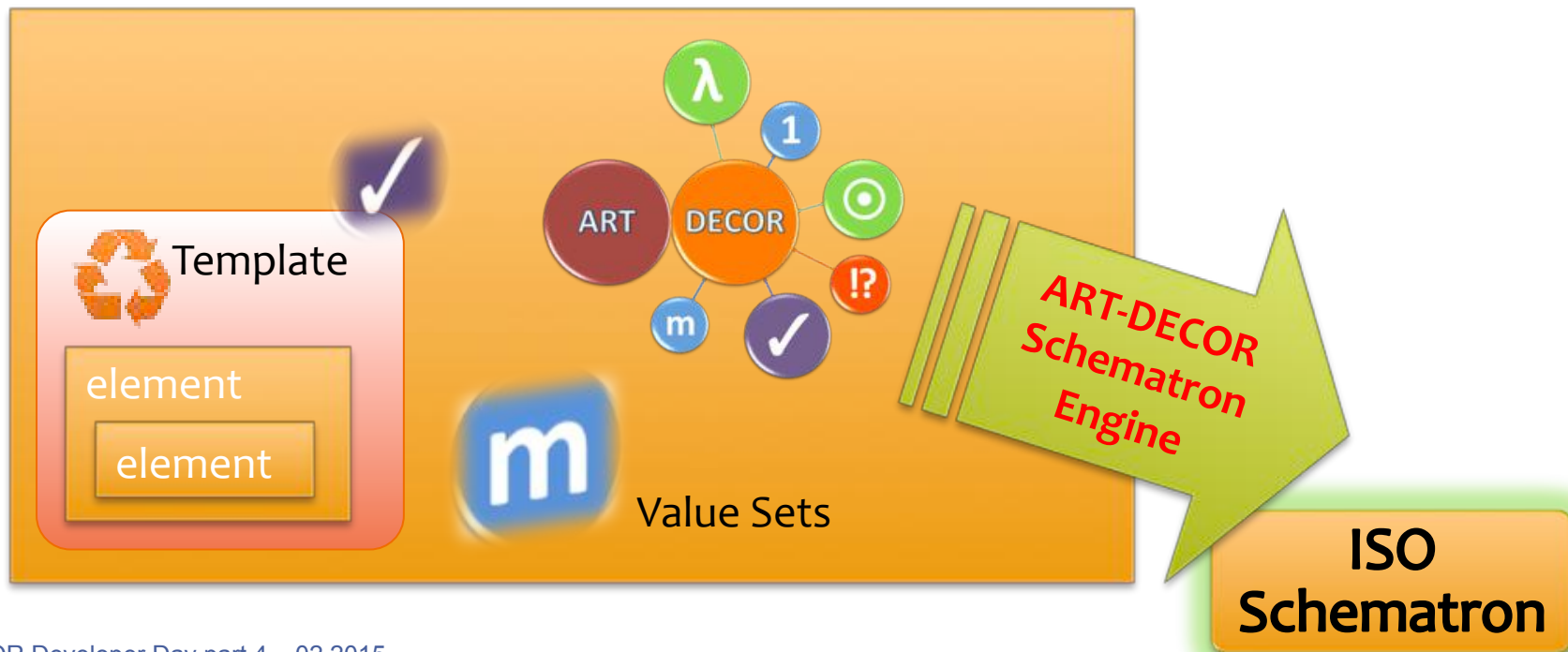
- Schematron

```
<rule context="hl7:typeld">  
  <assert role="error"  
    test="@extension='POCD_HD000040'">  
    ClinicalDocument.typeld (2.16.840.1.113883.2.4.6.10.35.3)  
    @extension SHALL have value POCD_HD000040 static </assert>  
  
  <assert role="error" test="@root='2.16.840.1.113883.1.3'">  
    ClinicalDocument.typeld (2.16.840.1.113883.2.4.6.10.35.3)  
    @root SHALL have value 2.16.840.1.113883.1.3 static </assert>  
</rule>
```

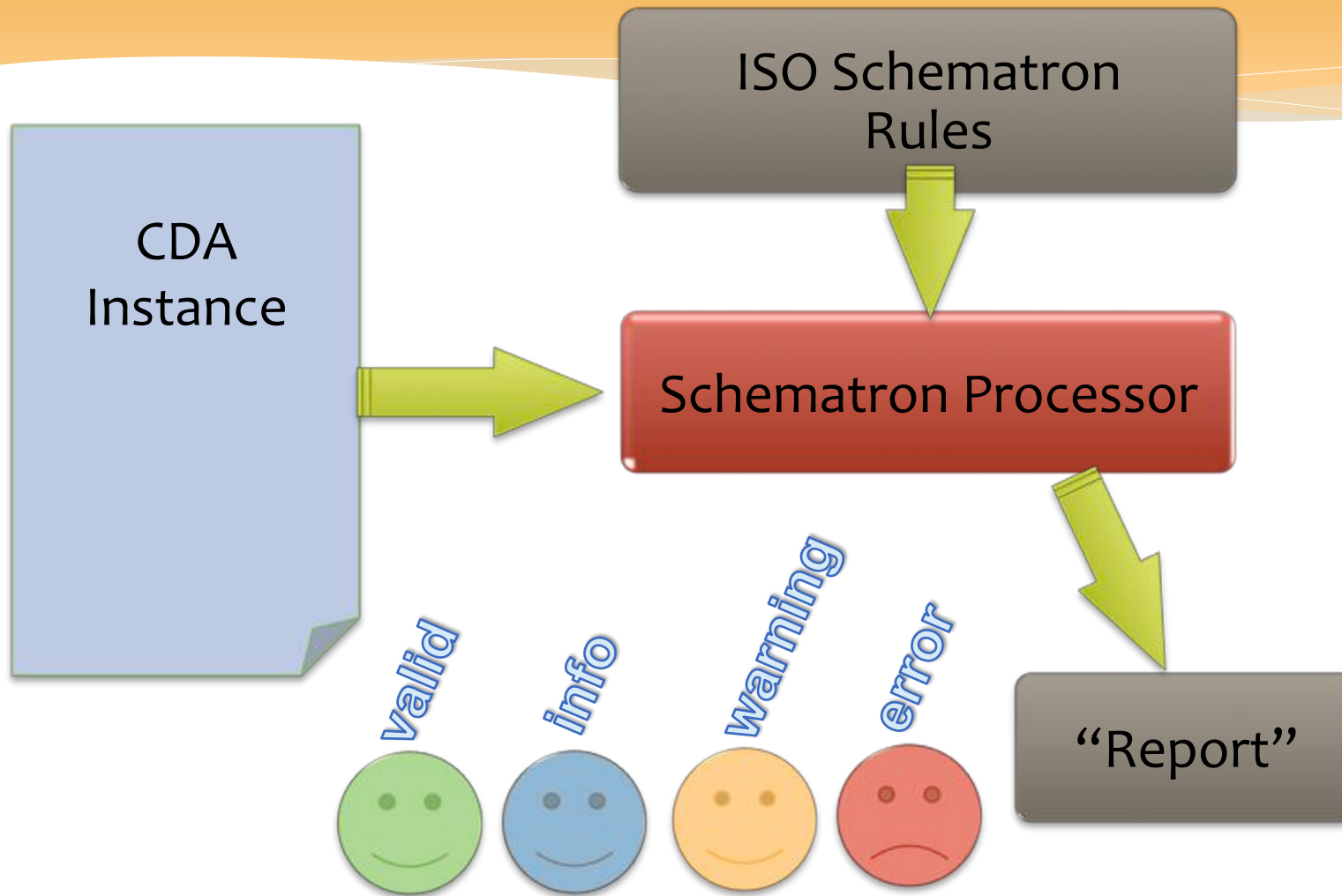
XML Schematron generators



- Schematron files can be generated from Template specifications (\rightarrow Templates DSTU)



No secrets involved



Publications

Testing with ART-DECOR

Maarten Ligvoet



ART-DECOR Application (ADA)

Marc de Graauw

IHE Gazelle ObjectsChecker: Concepts, Benefits, Demonstration and Access

Abderrazek Boufahja



ART-DECOR Benefactors



ART-DECOR is developed with funding by

- Nictiz, Den Haag (NL)
- and
- Heitmann Consulting and Services, Hürth (DE)
- Gerrit Boers, Maastricht (NL)
- HL7 Germany, Köln (DE)



Become a benefactor!



Dr Kai U. Heitmann, MD, FHL7 (DE)
Maarten Ligetvoet (NL)
Marc de Graauw (NL)
Abderrazek Boufahja (BE)

Thank you!
Questions?

