Tooling and MDA for Detailed Clinical Models

UML Modeling in Enterprise Architect and export to XMI
Model Driven Application Development

Michael van der Zel
Me

Michael van der Zel
Personality (MBTI) INFJ – Idealist, Perfectionist, Chaotic

“INFJs prefer the future and the pathway along which they aspire for profundity.”

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HIT Architect, Information Systems (EHR-S)

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Detailed Clinical Models (ISO), HL7 v3

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Tag Cloud

OASIS
Advancing open standards for the information society

HL7
Electronic Health Record

ISO

Nictiz
Betere zorg door betere informatie

CEN

W3C
World Wide Web consortium

LOINC
Logical Observation Identifiers Names and Codes

THE Open Group
Making standards work®

Common User Interface overview

NHS

IHE
changing the way healthcare connects
How do we exchange specs?

1. Face 2 face
2. Text narrative
3. Structured narrative with headers & sections
4. Ad hoc diagrams & pictures
5. Use a formalism

Source: Principles of Health Interoperability HL7 and SNOMED, Tim Benson, 2009
Topic

- The main focus of this presentation will be the Modeling aspect of a DCM and especially the transformations to system configuration or development and were in the “complete” development process DCM fits in. And the place of DCM with some other related healthcare standards.
Modeling Maturity

- No specifications
- Textual
- Text with models
- Models with text
- Precise models
- Models only

Source: *Principles of Health Interoperability HL7 and SNOMED*, Tim Benson, 2009
Gartner Hype Cycle
OMG's Model Driven Architecture (MDA) provides an open, vendor-neutral approach to the challenge of business and technology change. Based on OMG's established standards, the MDA separates business and application logic from underlying platform-specific technology. This platform-independent modeling and application of integrated system's business and technology and behavior of the other associated modeling standards, can be transparent to the MDA compliant platform, open or proprietary, including Web Services, .NET, CORBA®, J2EE, and others. These platform-independent models document the functionality and behavior of an application separate from the technology-specific code that implements it, insulating the core of the application from technology and its relentless churn cycle while enabling interoperability both within and across platform boundaries. No longer tied to each other, the business and technical aspects of an application or integrated system can each evolve at its own pace - business logic responding to business need, and technology taking advantage of new developments - as the business requires.
Where are we today?

What's beneath the surface?

User Request

Functional
- Meaningful use
- EHR-S FM
- EHR-S FM
- DCM
- IHE
- ADL
- CCR/CCD
- SNOMED CT
- LOINC
- etc...

Traceability

Technology
- HL7 v3
- CDA
- XML
- etc...
- etc...

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Where to put DCM

- Iceberg, DCM's are at the water level
- SAIF / ODP-RM / MDA
- EHR-S Functional Model and related Interoperability Model and Lifecycle Model
- Payload via DCM > HL7 v3 > XML
# DCM and SAIF Matrix

## The SAIF Matrix

<table>
<thead>
<tr>
<th>Topic</th>
<th>Enterprise / Business Viewpoint</th>
<th>Information Viewpoint</th>
<th>Computational Viewpoint</th>
<th>Engineering Viewpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conceptual</strong></td>
<td>DCM Purpose, Evidence Base, etc.</td>
<td>DCM Concepts, Terminology</td>
<td>DCM Care Process</td>
<td></td>
</tr>
<tr>
<td><strong>Platform-Independent</strong></td>
<td>DCM Info Model, Term Binding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Platform-Specific</strong></td>
<td>DCM Artifacts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


SAIF contains number of Frameworks and there is/should be a strong relation with the **SAIF Information Framework** and DCM.

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Model Viewpoints

Conceptual (CIM)
– sketch

Logical (PIM – Platform Independent)
– with reference model

Physical (PSM – Platform Specific)
– with serialization “file” format

Source: http://www.theregister.co.uk/2007/06/14/data_modelling_layers/
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EHR Lifecycle Model

Real-World to EHR System to EHR Record

Use Case > Function > Event

Use Case (Real-world) Action

Invokes one or more...

EHR System (EHRS FM) Function(s)

Invokes one or more...

EHR Record (EHR LM) Lifecycle Event(s)

SOA/SAIF

“Process” Service(s)

SOA/SAIF

“Record” Service(s)


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Traceability to HL7 v3

- DCM is not implementable (- workflow, state, patient, author are common elements)
- I see HL7 v3 as a Logical Model (more detailed implementable model)
- E.g. Assessment Scale Topic is a Logical Model which must have a Conceptual Model at its roots
- That Conceptual Model can/should be a DCM Pattern
- The other way around you can transform a DCM into a Logical model

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Use of the DCM

Building Block

EHR / CR System

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Example Digitize Paper Form

- Form (“please make this form digital”)
- What is the context of the form? > Process (turns out there are multiple forms in 1 form or even more forms, 1 form per step)
- DAM (formal process + identify sections/dissect forms), find DCM's (possible reuse)
- DCM (form sections + full metadata/terminology)
- Generate HL7 Templates
- UI (Generate Forms)
- CDR (Store coded/structured)
- Generate CDA / Letter

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Tools for DCM?

- Tools for DCM can be considered a set of software programs that facilitate one or more steps in the DCM development or use.
- Most important: concept representations in different formats
- Tools should work together, or allow moving smoothly from one step to the other, ending with testing of working systems
Why UML/DSL?

See Architecture Journal Article
Why EA / UML?

Why EA?
- Cheap
- **Use existing tooling**
- Widely used (e.g. HL7, CDISC)
- Feature rich

Why UML?
- **Use existing modeling language**
- Don't reinvent the wheel
- Knowledge wide spread, easy to get
Information vs Terminology

- Information Model vs Terminology Model
- Where to cut
- You could encode all concept in 1 Observation with a post-coordinated SNOMED CT expression or we could split it up in their parts
- You should split all parts that are essential separately in the interpretation of the DCM
- So for example we could split the concept “Left Ear” in 2 parts, Body Part and Location.
Requirements for good Models

1. Accurate – corresponds to the real world
2. Unambiguous – only one meaning
3. Understandable – People recognize the real world referent(s)
4. Reproducible – Different modelers would model in the same way
5. Parsimonious and harmonious use of terminology – Semantics of the model and terminology match
6. Flexible – Evolve gracefully over time
7. Consistent across domains – Specimen Collection and I&O Charting
8. Practical – implementable in real systems
9. Minimally complex – cover only what is needed
10. Common queries are easy
11. Fits with available technology (OO languages)

Source: Stan Huff, Intermountain Health Care (IHC), 2010

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UML Profile for DCM

- Stereotypes (data, state, qualifier)
- Reference Models (ISO 21090 Datatypes)
- Tag names (DCM::Xxx)
- Patterns (Assessment)

UML is generic, UML Profile defines kind of a DSL. Profile adds hints for model transformations.
EA Template

- Packages
- Tags

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<th>Template</th>
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<td>+ Revision History</td>
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Information Model

- Structure
  - Data
  - State
  - Qualifier
- References / Slots
- Terminology Binding
Information Model – Details

**BodyHeight**

- **Definition**
  - **DCM::DefinitionCode** = SCT: 50373000 body height measure
  - **Notes**
    - Height (or Length) of the body is measured from crown of head to sole of foot, and based on either standing height or recumbent length. In general, length measurements are recommended for children under 2 years of age and individuals who cannot stand.
    - Is also used to determine BMI. The BMI itself is not included, every system can make its own calculations based on body height and body weight.

**Constraints**

- **Unit in centimeters**
- **Less than 10 meter**

**BodyPosition**

- **Definition**
  - **DCM::DefinitionCode** = SNOMED-CT: 397155001 body position
  - **Id** = {4395E1-882B-4Tc-8C7A-E800CCE7D257}
  - **Notes**
    - The position of the body during the measurement.

**MeasuringDevice**

- **Definition**
  - **DCM::DefinitionCode** = SNOMED-CT: 363699004 direct device
  - **Notes**
    - Device used to measure body height.

**State**

- **Confounding**
  - **Notes**
    - A factor of confusion which is of influence of the body height, e.g. amputation.

**State, Reference**

- **BodyPosition**
  - **Notes**
    - The position of the body during the measurement.

**Qualifier**

- **MeasuringDevice**
  - **Notes**
    - Device used to measure body height.
Demo EA Template
Transformations

Why Eclipse?
- Cheap
- Use existing tooling
- Widely used (e.g. HL7, CDISC)
- Feature rich

XMI > Human Readable
- RTF > PDF
- Narrative of Model
- WikiText for discussion on wiki's

XMI > Computable
- HL7 v3 Example Instance, MIF, ADL
Transformation Tools

- EA Model 2 Model Transformations
- XSLT
- Robert Worden Mapping Tool
- Advanced MDA Tooling
Different contents:
- just the text
- information model
  - full model
  - model narrative
- just concepts + datatypes
  - concepts + dt + terminology binding (all, or 1) matrixes
Payload

EHR-S FM function(s)
Detailed Clinical Model
Convert to Care Record Template
Information Model Narrative

PropensityToAdverseReaction has CausativeAgent
PropensityToAdverseReaction has Reaction
PropensityToAdverseReaction has Certainty
CausativeAgent triggers Reaction
Reaction has Severity
Reaction has ReactionType
Severity is a coded description
CausativeAgent ContactAllergen is a CausativeAgent
Certainty is a coded description
CausativeAgent All is a CausativeAgent
CausativeAgent DrugOrMedicament is a CausativeAgent
CausativeAgent Materials is a CausativeAgent
CausativeAgent is a coded description
CausativeAgent DietarySubstance is a CausativeAgent
ReactionType is a coded description
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            xsi:type="CD" />
    </observation>
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</REPC_MT000100UV01.Organizer>
First Informative HL7 v3 Ballot – example Body Height
Demo of transformations
Traceability

- EHR-S FM
- CCR/CCD
- Archetypes/ADL
- HL7v3 Models
DC.1.4.1 Manage Allergy, Intolerance and Adverse Reaction List

**DC.1.4.1#1** The system **SHALL** provide the ability to capture true allergy, intolerance, and adverse reaction to drug, dietary or environmental triggers as unique, discrete entries.

**DC.1.4.1#2** The system **SHOULD** provide the ability to capture the reason for entry of the allergy, intolerance or adverse reaction.

**DC.1.4.1#3** The system **SHALL** provide the ability to capture the reaction type.

**DC.1.4.1#4:** The system **SHOULD** provide the ability to capture the severity of a reaction.

**DC.1.4.1#7** The system **SHOULD** provide the ability to capture the source of allergy, intolerance, and adverse reaction information.

**DC.1.4.1#8** The system **SHALL** provide the ability to deactivate an item on the list.

**DC.1.4.1#9** The system **SHALL** provide the ability to capture the reason for deactivation of an item on the list.

**DC.1.4.1#10** The system **MAY** present allergies, intolerances and adverse reactions that have been deactivated.

**DC.1.4.1#11** The system **MAY NOT** provide the ability to display user defined sort order of list.

**DC.1.4.1#12** The system **SHOULD** provide the ability to indicate that the list of medications and other agents has been reviewed.

**Functionally and mostly about Content**

+ **CUI Guidance for Recording Adverse Drug Reactions**

DC.1.4.1#11 The system **MAY NOT** provide the ability to display user defined sort order of list.
More info

- Stan Huff – Complex Issues in Modeling
- HITE Summer 2010 Article

MODEL DRIVEN ARCHITECTURE

Bridging the gap between software developers and healthcare professionals

Model-Driven Application Development (OMG MDA, 3) is at the Peak of Inflated Expectations on the Gartner Hype Cycle and in 2009, it was expected to be mainstream and adopted within 2 to 5 years. Now in 2010 we are still at the beginning of adopting the technique, especially in Healthcare.

We need to use Model Driven Architecture (MDA) thinking as a fundamental principle in our work and standards development owing to the growing complexity of Healthcare IT and the information sharing across healthcare. Data need to become semantically interoperable to understand each other, where the Healthcare connected. Hospitals, especially academic hospitals, have many applications to work with patient data. Each of which will have its own internal model. Each mapping can contain mismatches because different models never fit perfectly. Some will even be one-way. This kind of combinatorial explosions are well known in the field of health IT standards.
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