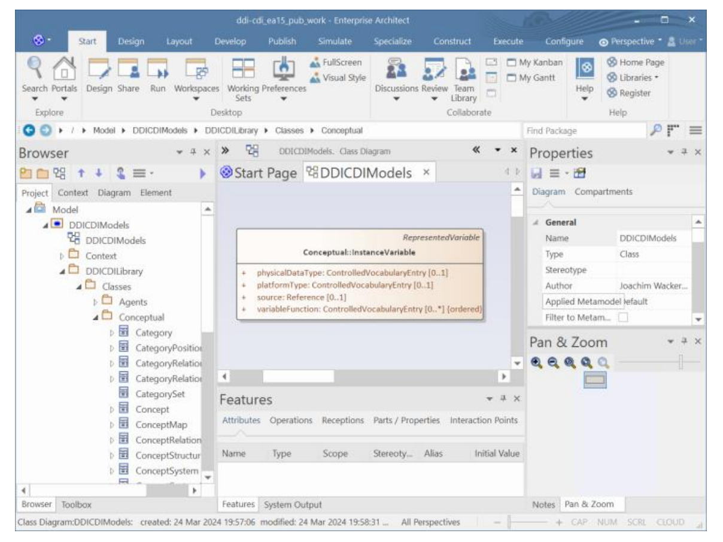
Model-Driven Approach for Metadata Specifications

DATA DOCUMENTATION INITIATIVE

UML Model Creation

- Model editing in a UML tool like Enterprise Architect
- Using only items of UCMIS
- Exporting to XMI (often proprietary flavour)

Includes …
- the conceptual structure of a metadata specification,
- the documentation of all individual elements such as classes, data types, and class relationships.



UML Class Model Interoperable Subset (UCMIS)

The **objectives** are to have a UML class model …
- which is the **single source of truth** for class-level documentation and derived target languages (syntax representations/encodings),
- which provides consistency over time,
- can be further processed in UML tools,
- which ensures the consistency across the target languages, resulting in interoperability on this level,
- which can be used for future target languages.

- UCMIS, a **subset of UML class diagram items**, is intended for data modeling
- It focuses on core items that are familiar from object-oriented programming
- The subset focuses on items that describe classes, describe their relationships to each other, and their attributes
- The subset ensures structural interoperability between UML tools

Git repository: https://bitbucket.org/ddi-alliance/ucmis/

Interoperability

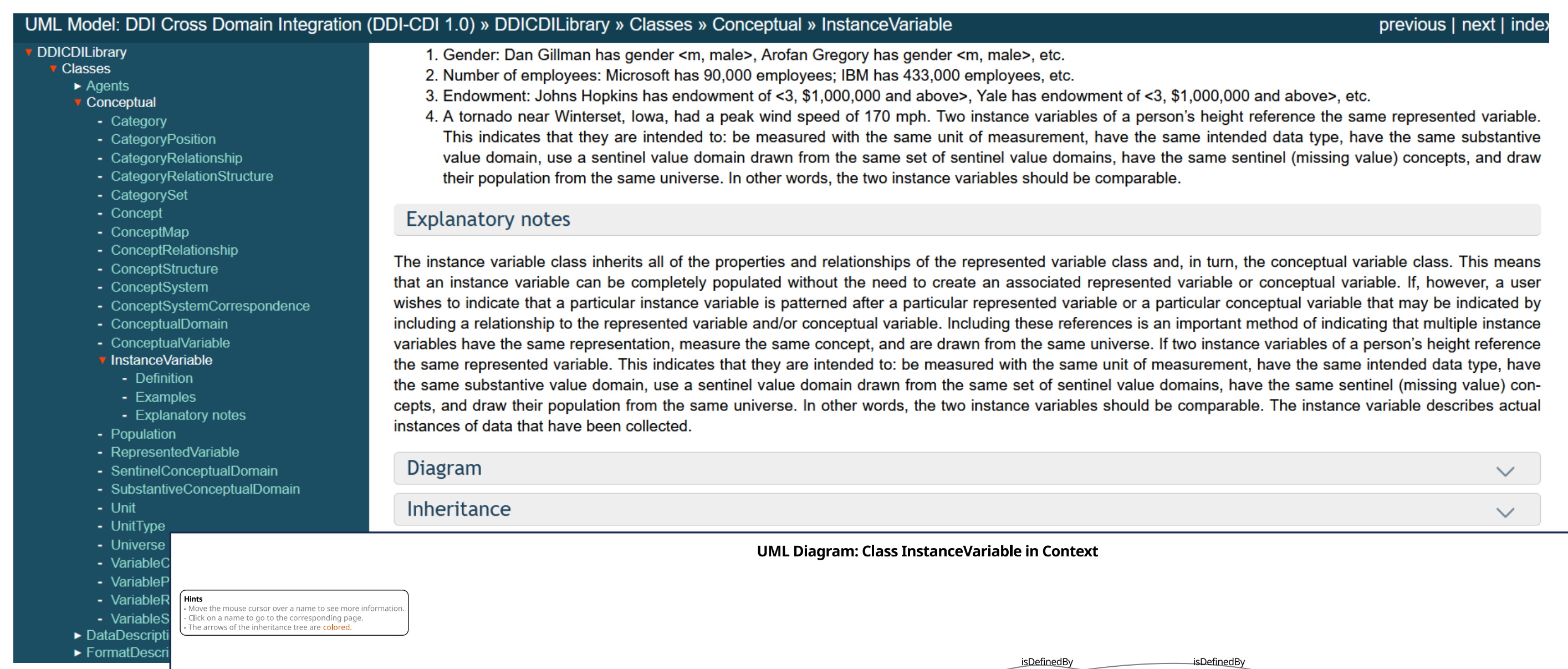
UCMIS models as Canonical XMI ensure interoperability on the structural and syntactic level between UML tools.

Canonical XMI
- Canonical XMI (see Appendix B of the OMG XMI 2.5.1 specification) constitutes a specific constrained format of XMI that minimizes variability, provides more predictable identification and ordering, and ensures syntactic interoperability
- UCMIS class models as Canonical XMI can be imported into many UML tools (but no tool exports as Canonical XMI)

Model-Driven Products

- Field-level documentation: one page per class and data type
- Syntax representations: XML Schema, RDF (ontology in Turtle, JSON-LD, in the works: SHACL and ShEx)
- Further model processing in UML tools

Example page: https://tinyurl.com/ddicdiexample



UML Model: DDI Cross Domain Integration (DDI-CDI 1.0) » DDICDILibrary » Classes » Conceptual » InstanceVariable — previous | next | index

- DDICDILibrary
  - Classes
    - Agents
    - Conceptual
      - Category
      - CategoryPosition
      - CategoryRelationship
      - CategoryRelationStructure
      - CategorySet
      - Concept
      - ConceptMap
      - ConceptRelationship
      - ConceptStructure
      - ConceptSystem
      - ConceptSystemCorrespondence
      - ConceptualDomain
      - ConceptualVariable
      - InstanceVariable
        - Definition
        - Examples
        - Explanatory notes
      - Population
      - RepresentedVariable
      - SentinelConceptualDomain
      - SubstantiveConceptualDomain
      - Unit
      - UnitType
      - Universe

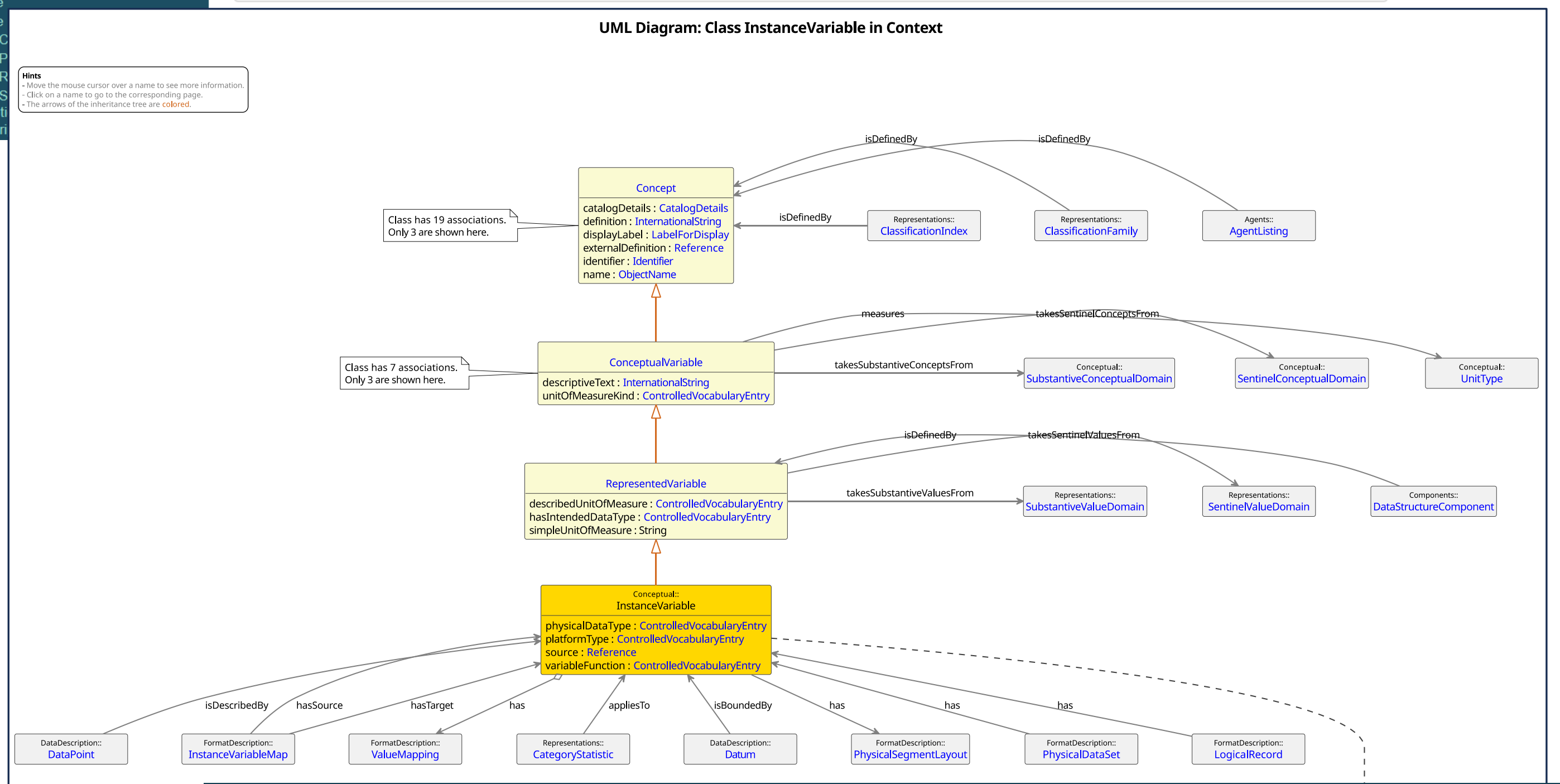
1. Gender: Dan Gillman has gender <m, male>, Arofan Gregory has gender <m, male>, etc.
2. Number of employees: Microsoft has 90,000 employees; IBM has 433,000 employees, etc.
3. Endowment: Johns Hopkins has endowment of <3, $1,000,000 and above>, Yale has endowment of <3, $1,000,000 and above>, etc.
4. A tornado near Winterset, Iowa, had a peak wind speed of 170 mph. Two instance variables of a person's height reference the same represented variable. This indicates that they are intended to: be measured with the same unit of measurement, have the same intended data type, have the same substantive value domain, use a sentinel value domain drawn from the same set of sentinel value domains, have the same sentinel (missing value) concepts, and draw their population from the same universe. In other words, the two instance variables should be comparable.

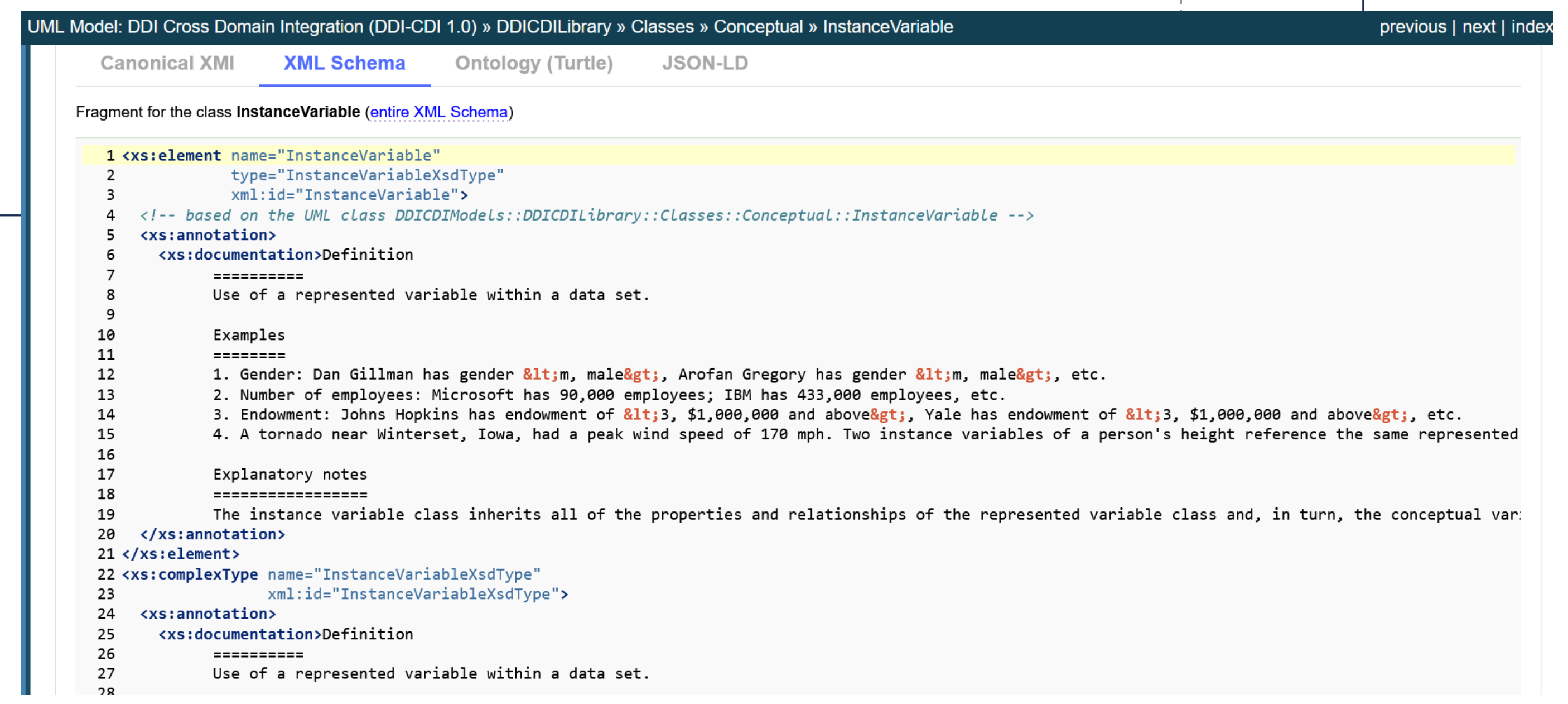
Explanatory notes

The instance variable class inherits all of the properties and relationships of the represented variable class and, in turn, the conceptual variable class. This means that an instance variable can be completely populated without the need to create an associated represented variable or conceptual variable. If, however, a user wishes to indicate that a particular instance variable is patterned after a particular represented variable or a particular conceptual variable that may be indicated by including a relationship to the represented variable and/or conceptual variable. Including these references is an important method of indicating that multiple instance variables have the same representation, measure the same concept, and are drawn from the same universe. If two instance variables of a person's height reference the same represented variable. This indicates that they are intended to: be measured with the same unit of measurement, have the same intended data type, have the same substantive value domain, use a sentinel value domain drawn from the same set of sentinel value domains, have the same sentinel (missing value) concepts, and draw their population from the same universe. In other words, the two instance variables should be comparable. The instance variable describes actual instances of data that have been collected.

Diagram

Inheritance


UML Diagram: Class InstanceVariable in Context
Hints
- Move the mouse cursor over a name to see more information.
- Click on a name to go to the corresponding page.
- The arrows of the inheritance tree are colored.
Class has 19 associations. Only 3 are shown here.
Concept
catalogDetails : CatalogDetails
definition : InternationalString
displayLabel : LabelForDisplay
externalDefinition : Reference
identifier : Identifier
name : ObjectName
isDefinedBy
Representations:: ClassificationIndex
Representations:: ClassificationFamily
Agents:: AgentListing
measures
takesSentinelConceptsFrom
Conceptual:: InstanceVariable
physicalDataType : ControlledVocabularyEntry
platformType : ControlledVocabularyEntry
source : Reference
variableFunction : ControlledVocabularyEntry
isDescribedBy
hasSource
hasTarget
has
appliesTo
isBoundedBy
FormatDescription:: InstanceVariableMap
FormatDescription:: ValueMapping
Representations:: CategoryStatistic
DataDescription:: Datum
FormatDescription:: PhysicalSegmentLayout
FormatDescription:: PhysicalDataSet
FormatDescription:: LogicalRecord



UML Model: DDI Cross Domain Integration (DDI-CDI 1.0) » DDICDILibrary » Classes » Conceptual » InstanceVariable — previous | next | index

Canonical XMI | XML Schema | Ontology (Turtle) | JSON-LD

Fragment for the class **InstanceVariable** (entire XML Schema)

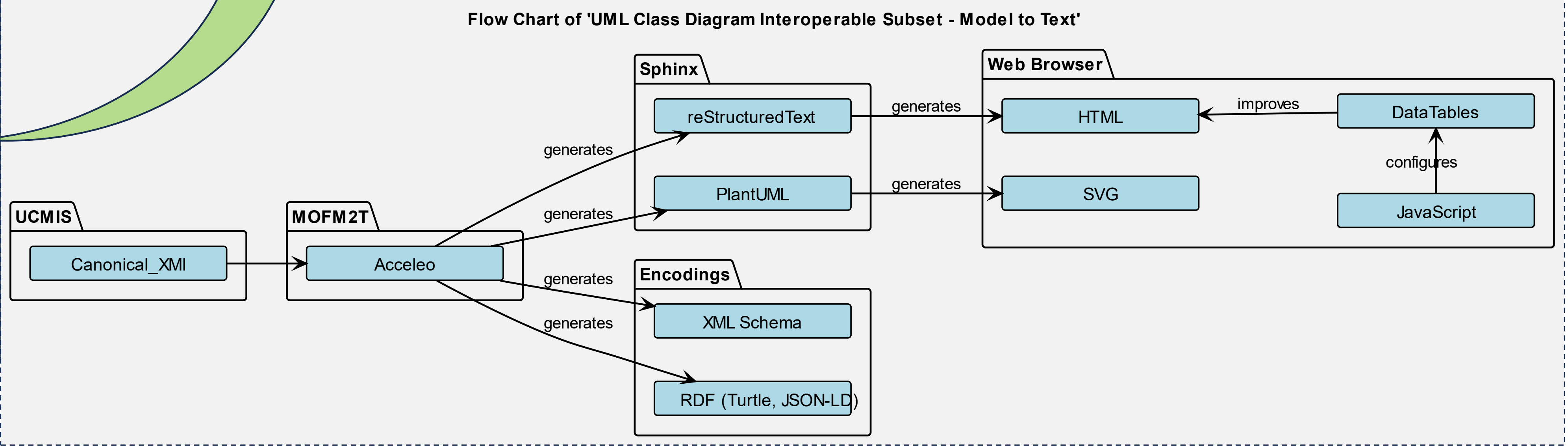
```
<xs:element name="InstanceVariable"
            type="InstanceVariableXsdType"
            xml:id="InstanceVariable">
  <!-- based on the UML class DDICDIModels::DDICDILibrary::Classes::Conceptual::InstanceVariable -->
  <xs:annotation>
    <xs:documentation>Definition
          ==========
          Use of a represented variable within a data set.

          Examples
          ========
          1. Gender: Dan Gillman has gender &lt;m, male&gt;, Arofan Gregory has gender &lt;m, male&gt;, etc.
          2. Number of employees: Microsoft has 90,000 employees; IBM has 433,000 employees, etc.
          3. Endowment: Johns Hopkins has endowment of &lt;3, $1,000,000 and above&gt;, Yale has endowment of &lt;3, $1,000,000 and above&gt;, etc.
          4. A tornado near Winterset, Iowa, had a peak wind speed of 170 mph. Two instance variables of a person's height reference the same represented

          Explanatory notes
          =================
          The instance variable class inherits all of the properties and relationships of the represented variable class and, in turn, the conceptual var
  </xs:annotation>
</xs:element>
<xs:complexType name="InstanceVariableXsdType"
                xml:id="InstanceVariableXsdType">
  <xs:annotation>
    <xs:documentation>Definition
          ==========
          Use of a represented variable within a data set.
```

Transformation from proprietary XMI to Canonical XMI
Software tool: to-canonical-xmi (set of XSLTs)
- Intensively tested for Enterprise Architect XMI flavour
- Basic tests for flavors other major UML editing tools
- Output is Canonical XMI which can be imported into many UML tools

Git repository: https://bitbucket.org/wackerow/to-canonical-xmi/

Transformation from UCMIS model as Canonical XMI to documentation and encodings
Software tool: UCMIS Model to Text (UCMIS.M2T)
- UCMIS.M2T is a tool for the generation of the classifier documentation (including UML diagrams) and syntax representations of a model confirming to UCMIS
- It uses the Eclipse Acceleo implementation of the OMG standard MOF Model to Text Transformation Language (MOFM2T™)

Git repository: https://bitbucket.org/wackerow/ucmis.m2t/


Flow Chart of 'UML Class Diagram Interoperable Subset - Model to Text'

- *The **overall concept** is used for the new specification **DDI Cross Domain Integration (DDI-CDI)** - forthcoming publication in 2024.*
  Git repository: https://bitbucket.org/ddi-cdi-resources/ddi-cdi/
- *UCMIS is developed by the DDI-CDI working group of the DDI Alliance and planned for publication in 2024.*
- *The software tools are developed by Joachim Wackerow and contributors with some support of the DDI Alliance.*
- *Poster author: Joachim Wackerow (joachim.wackerow@posteo.de).*