

# **INTEROPERABILITY + SEMANTICS = CHECK!**

## **Smart and Cost Effective Data Modelling and Tools of the Future**

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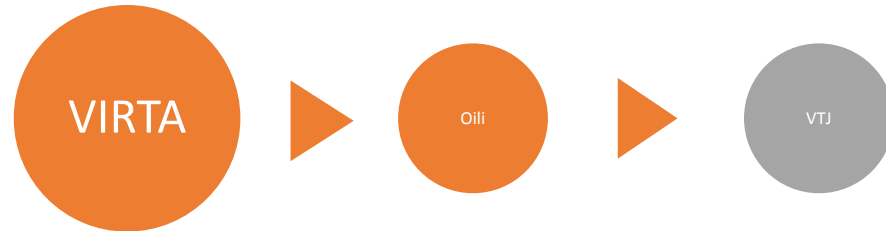
Mikael af Hällström, Finnish Tax Administration

# Summary

- Interoperability challenges
- Interoperability case: Student Transcript
- Framework for Semantic Interoperability
- Implementing the Framework:
  - Interoperability workbench

# Present – Information chaos

Organisation and application specific documentation



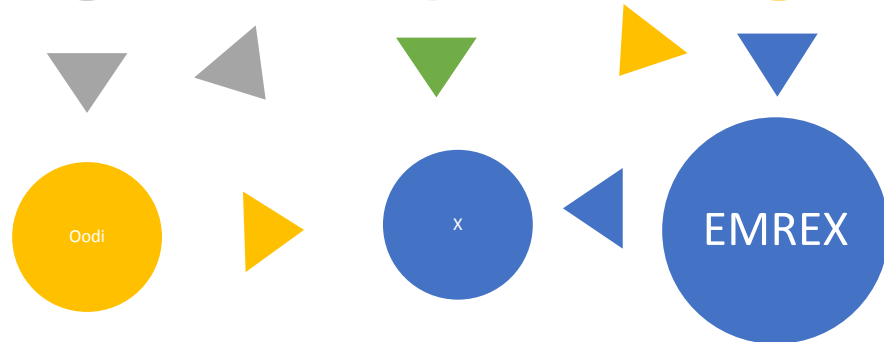
Redefining data models



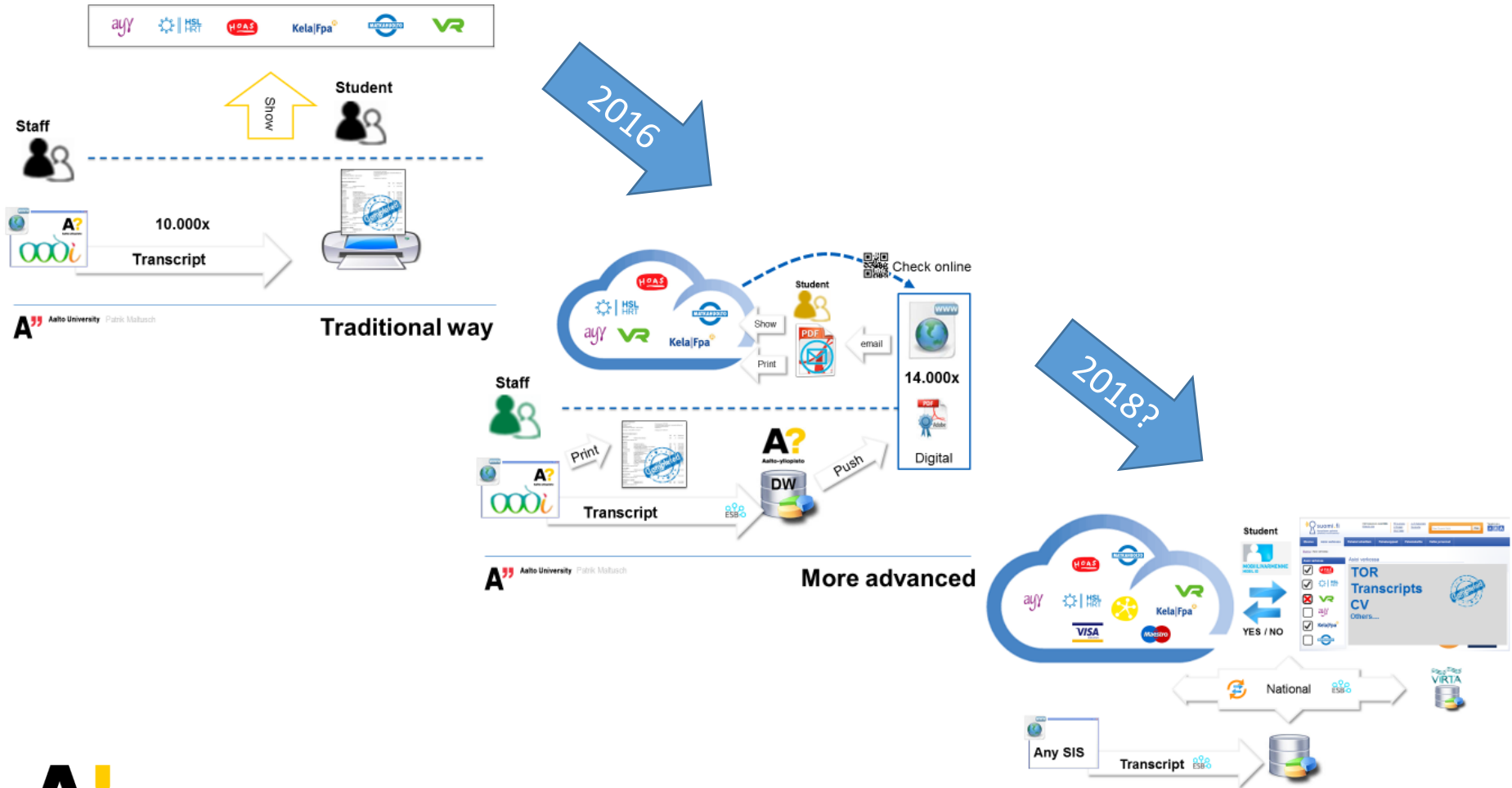
Point to point Integration



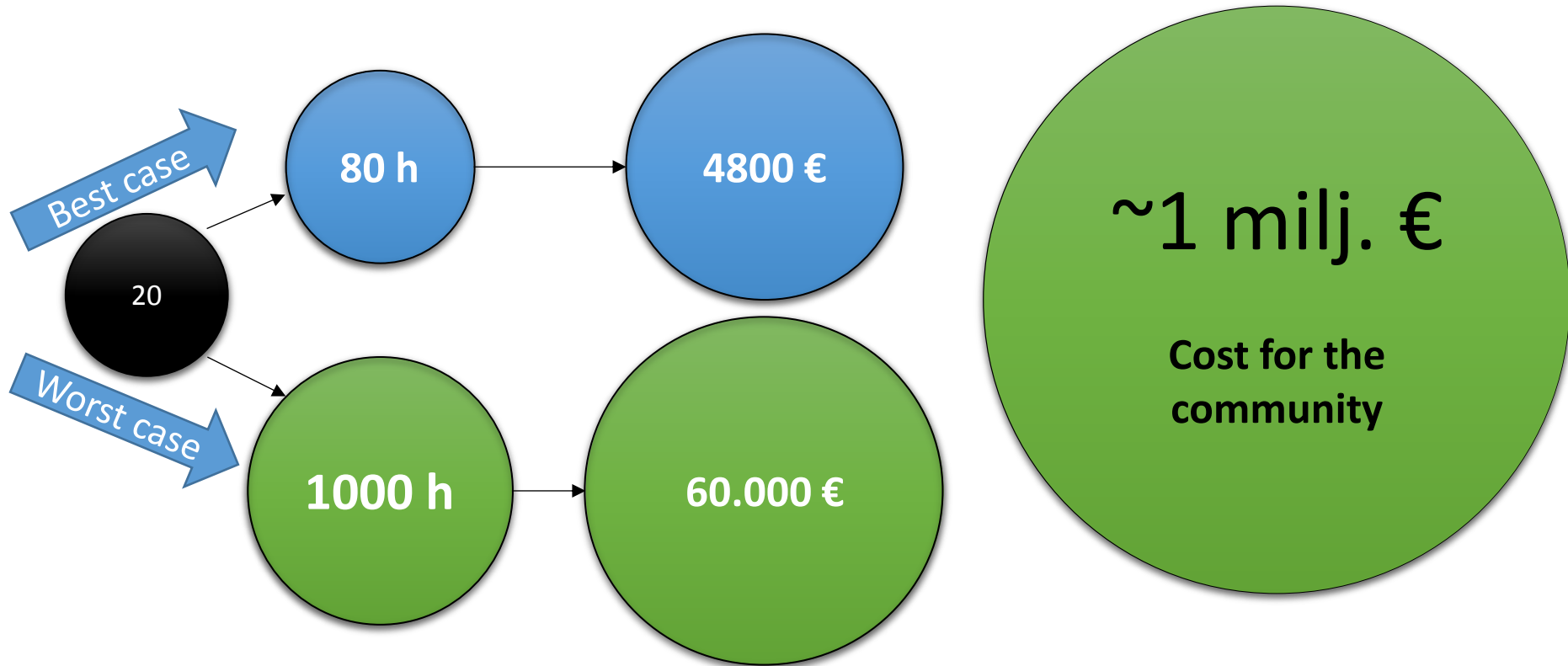
No change management over organisation borders



# Interoperability CASE: Student Transcript

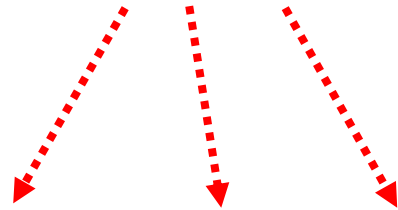


# Making data sources semantic interoperable for a DW



# Equation for Interoperability

SEMANTIC IMPACT

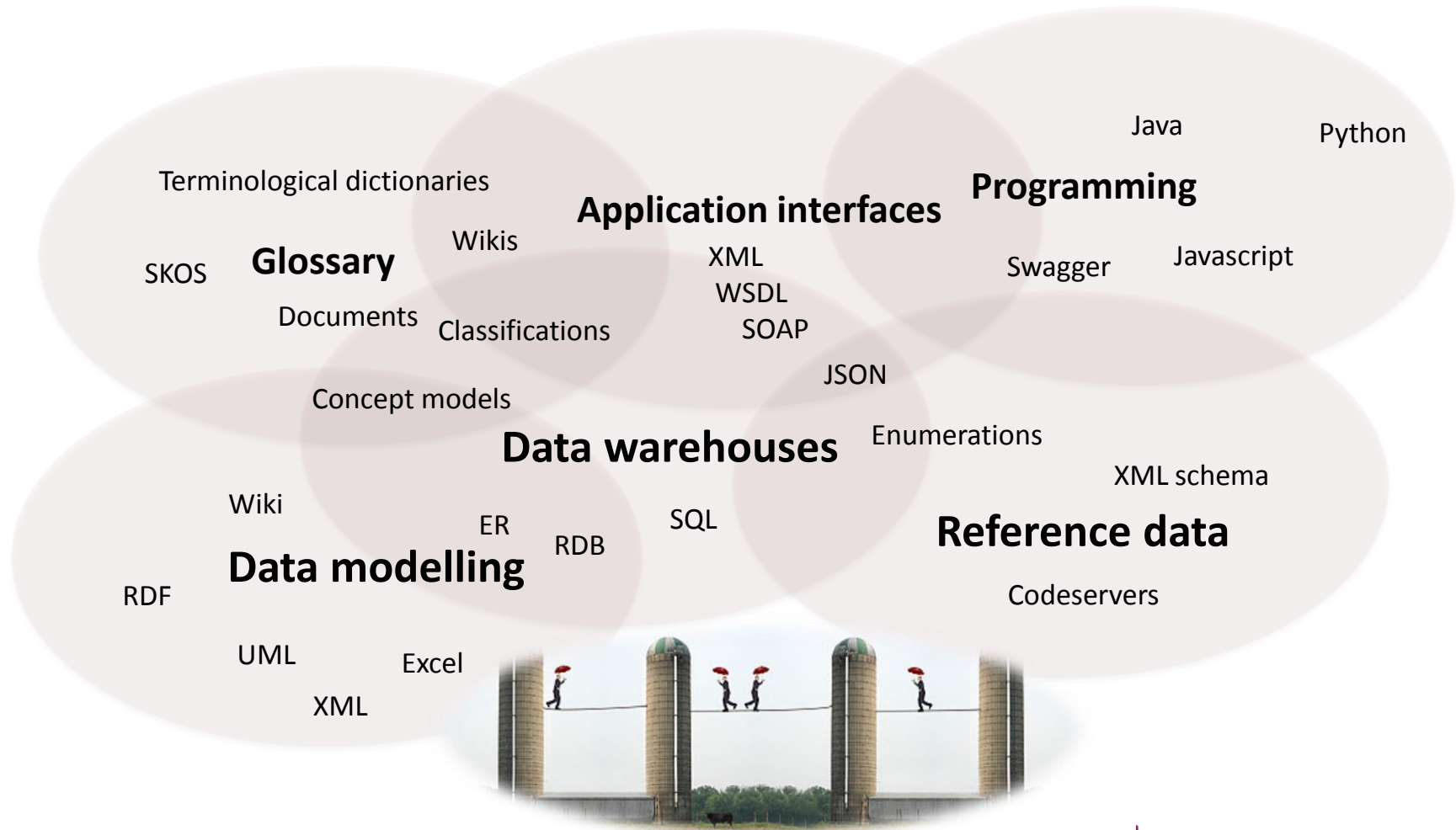


$$ICC * ESB * EIM * DW = \frac{\sum \text{benefits}}{\sum \text{cost}} > 1$$

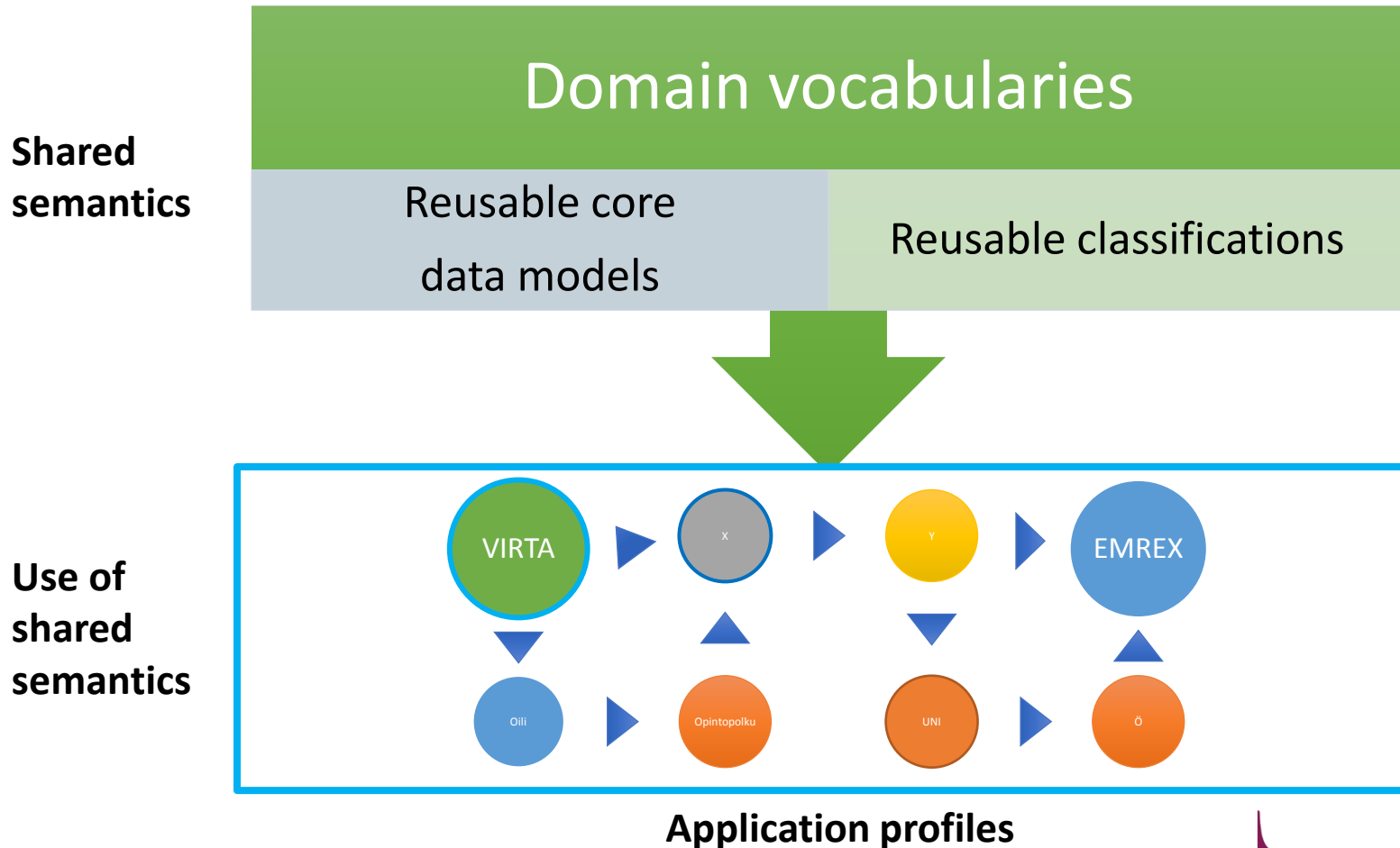
by Patrik Maltusch @aalto.fi



# Used methods for documenting APIs?



# Vision – Data model reuse and uniform documentation





# Application profiles

An Application profile seeks to address the interoperability requirements between systems by:

- retaining conformance with a base standard
- defining new requirements in an open and interoperable manner

## Examples of standard Application profiles:

**CEN/CWA 15903:** Metadata for Learning Opportunities

**CEN/CWA 16132:** European Learner Mobility Achievement Information

**EMREX AP (2016):** Report for the recognition of external studies

**2000** - Idea of Application Profiles evolved from DESIRE Registry project: “mixing and matching” metadata elements

**2003** - Guidelines for creating application profiles (CEN/CWA 14855)

**2005** – Guidelines for machine-readable representation .. (CEN/CWA 15248)

**2006** - Guidelines building application profiles in e-learning (CEN/CWA 15555)

**2008** - Guidelines for Dublin Core Application Profiles

**2011 - 2016** – MLR Framework (ISO/IEC 19788-1)

# Need for common framework

## Shared concepts with the business and IT:

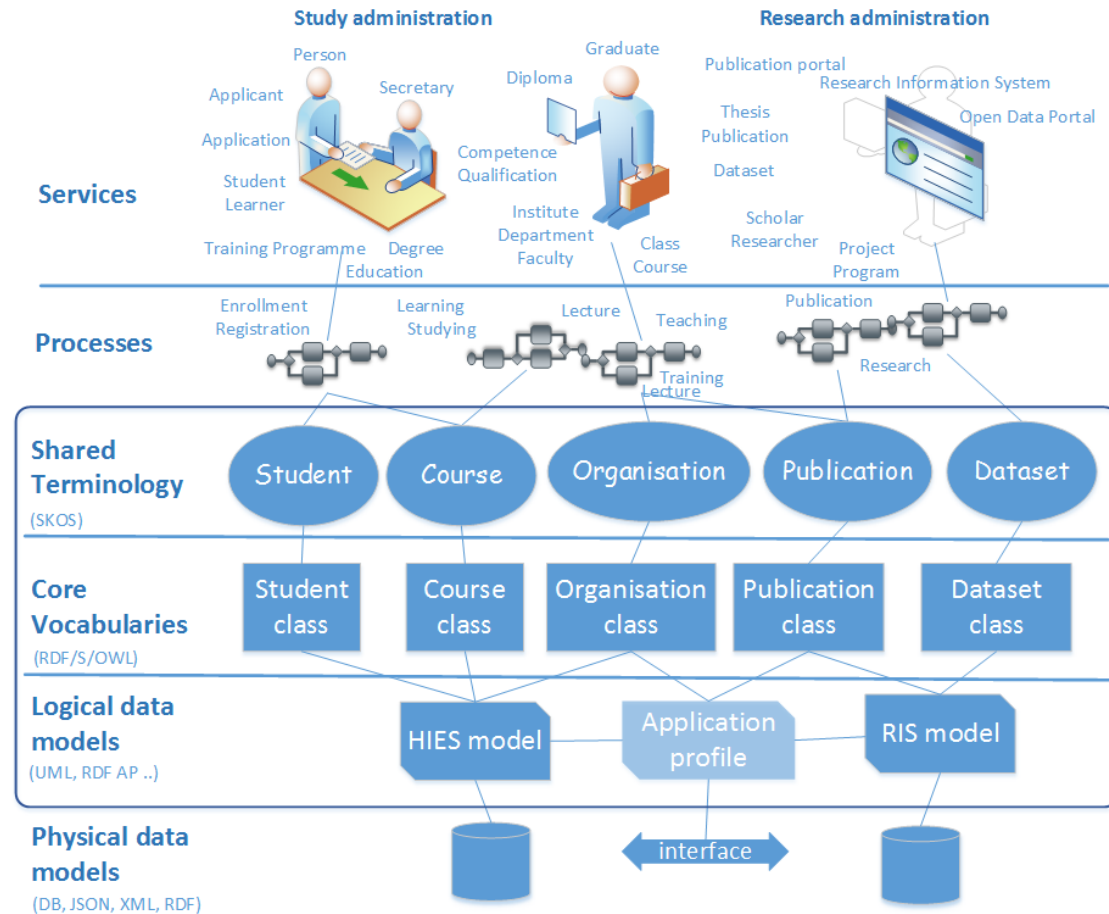
1. Well defined concepts
2. Unique identifiers
3. Machine readable format

## Service innovation and data modeling based on business needs:

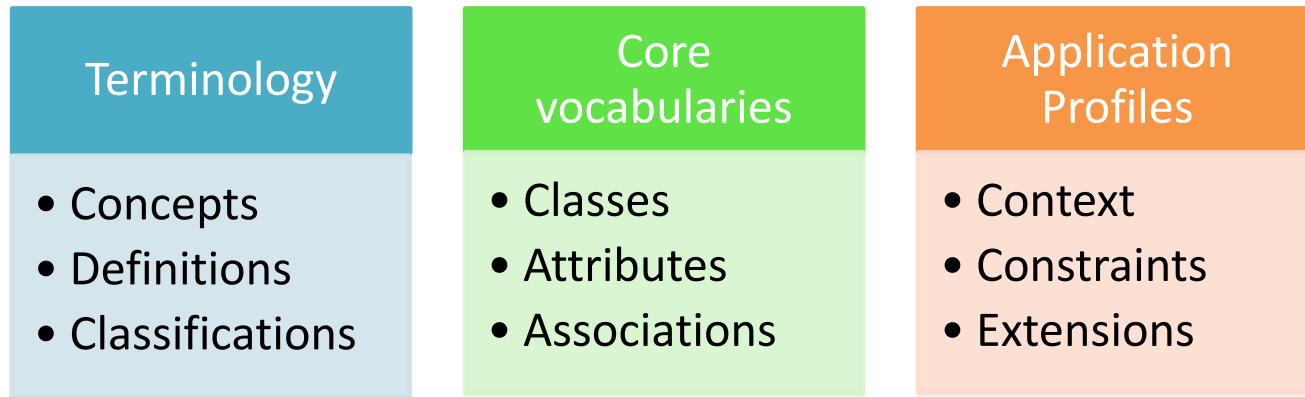
1. Reuse terms and definitions
2. Create reusable components
3. Focus on the interfaces and integration

## Framework for semantic interoperability:

- How to publish core vocabularies and application profiles?
- How to reuse standards?
- How to reuse core vocabularies in the implementations?
- How to document the metadata reuse?
- How to document application interfaces?



# Semantic interoperability framework



## Common metadata architecture for data modelling:

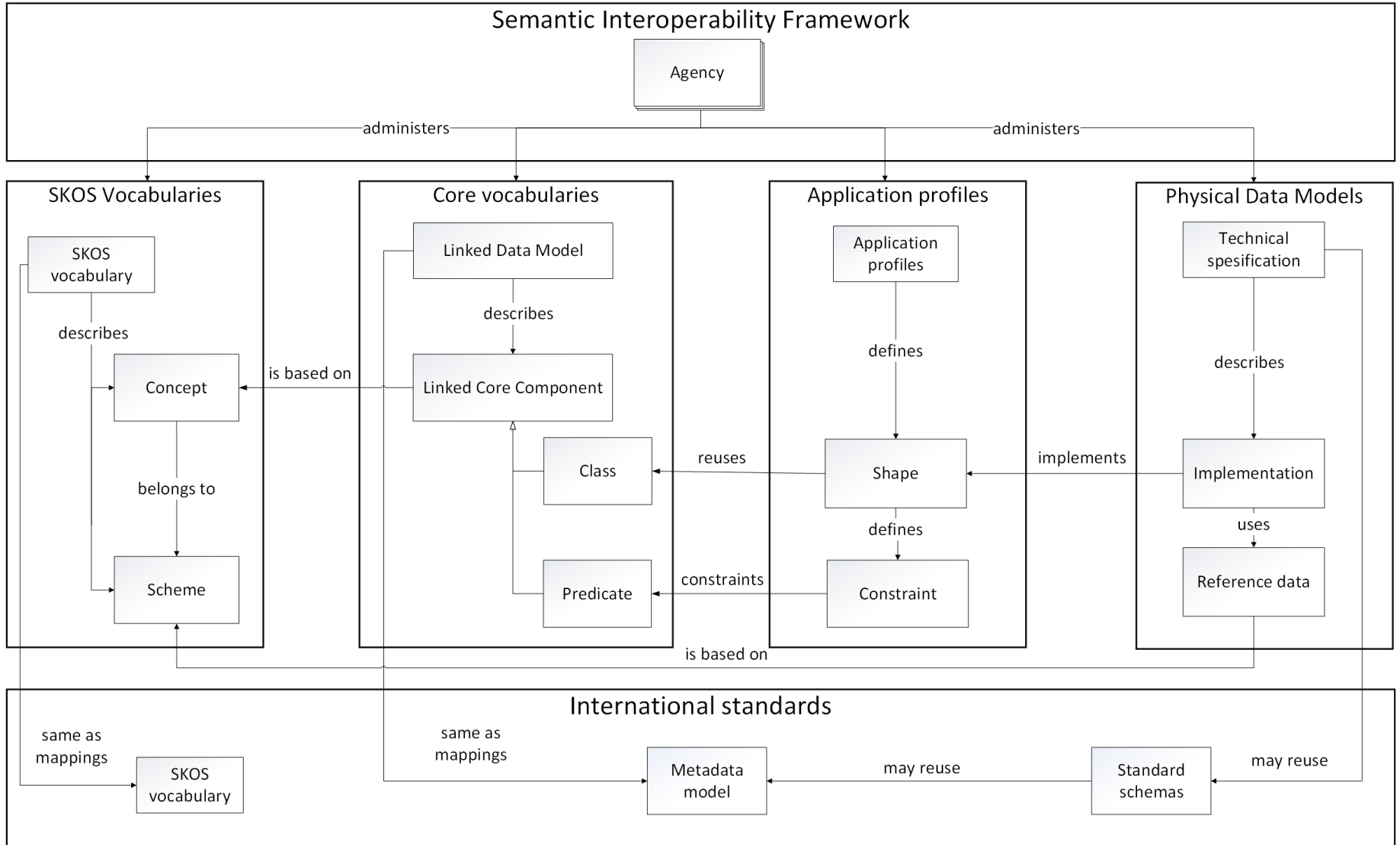
- Machine readable terminology
- Reusable core vocabularies and core components
- Documented reuse of core components

# Interoperability objectives

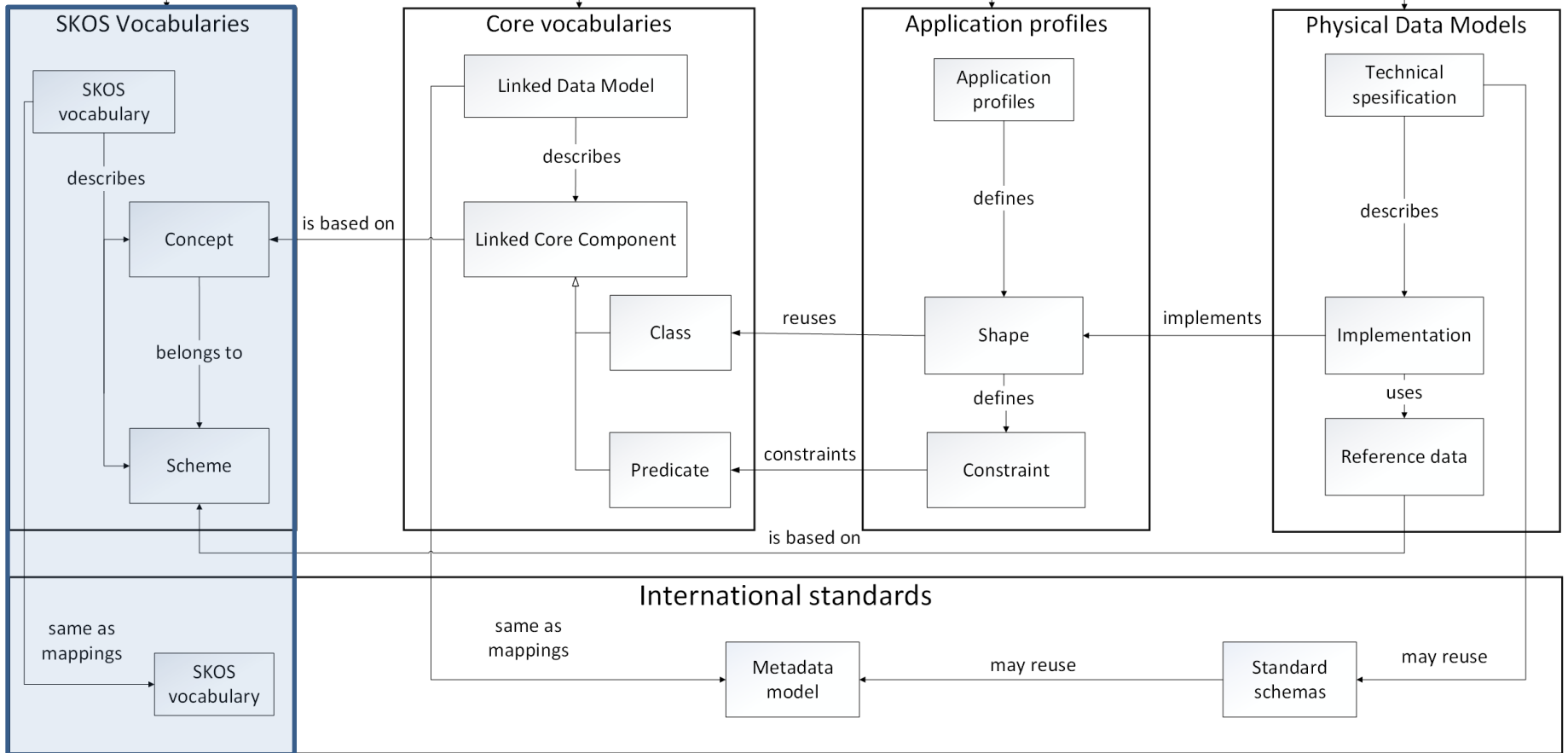
- Shared metadata models for education and research
- Modular and reusable metadata definitions
- Improve readability and understandability of data models
- Interoperability with international standards
- Promote standard reuse
- Formal and semantic mappings to CEN and ISO standards

# Interoperability benefits

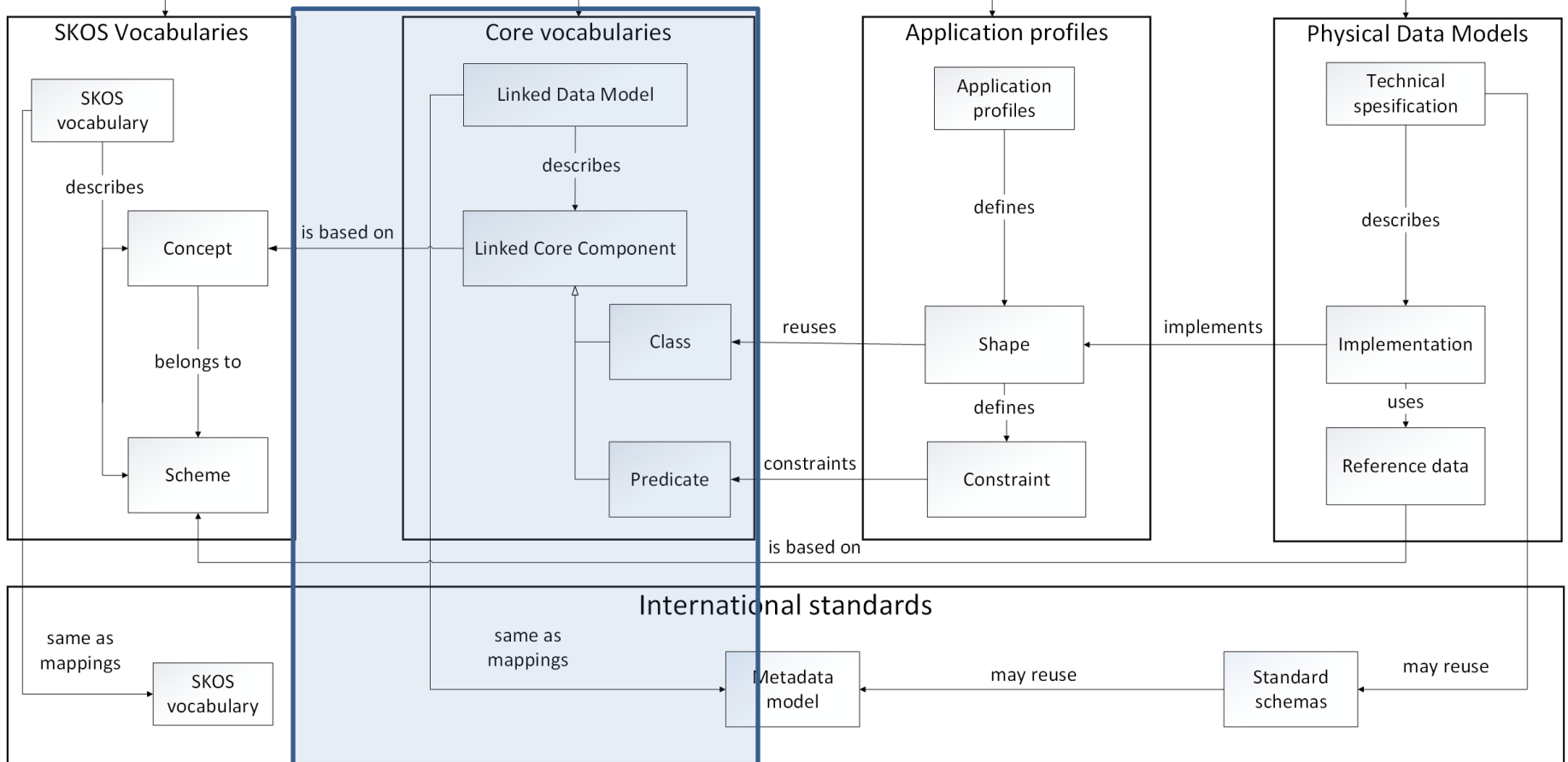
- Collaborative tool for metadata publishing
  - Benefit from external expertise
- Avoid redefinition of data models
  - Lower integration costs
- Shared terminology
  - Less confusion
- Same terms for many communications needs
  - Study administration
  - User interfaces



# Domain specific vocabularies are administered by different agencies and published in the standard SKOS model in the Finnish Thesaurus and Ontology Service

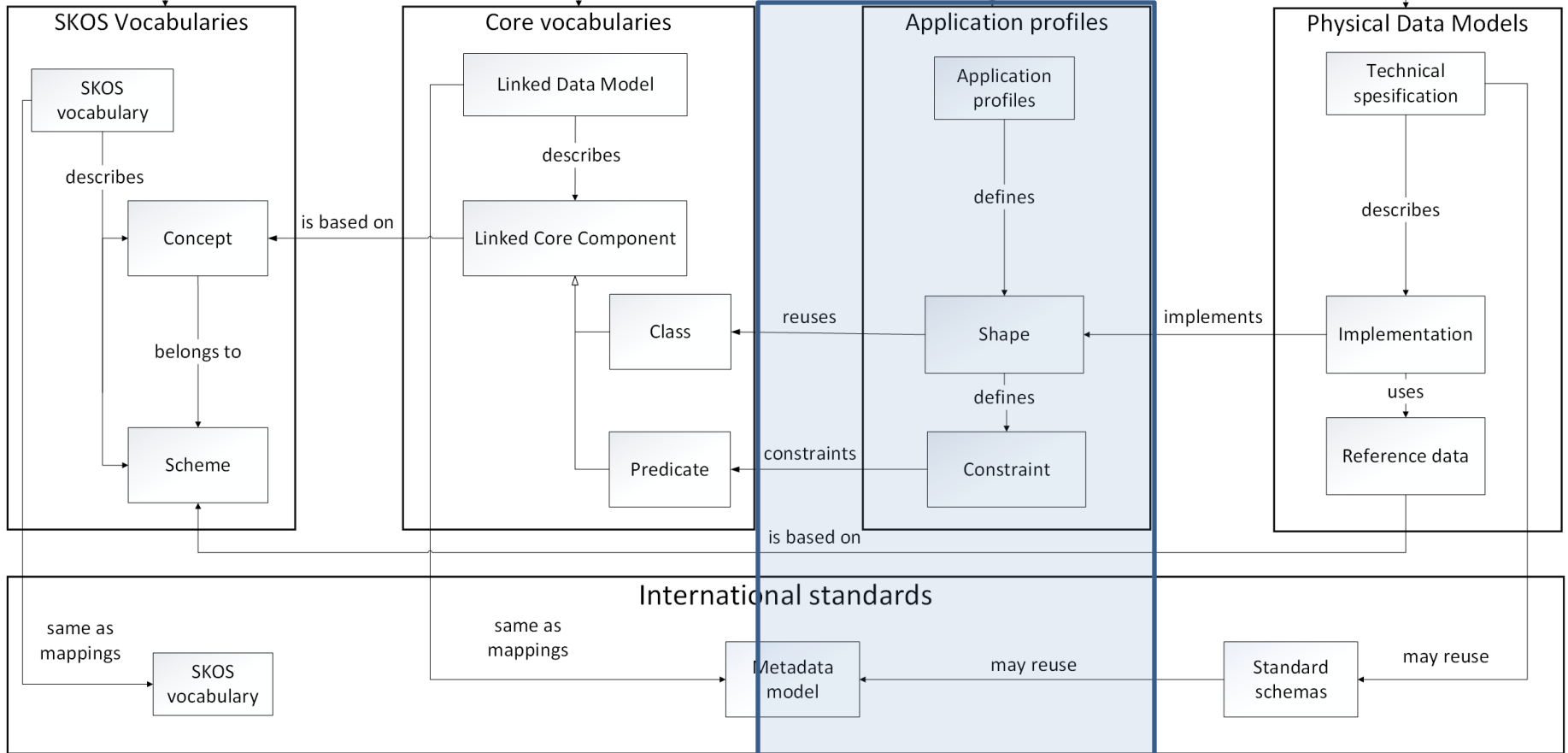


Core vocabularies are published as Linked Data that defines re-usable classes and properties based on shared concepts and links to standards and best practices.

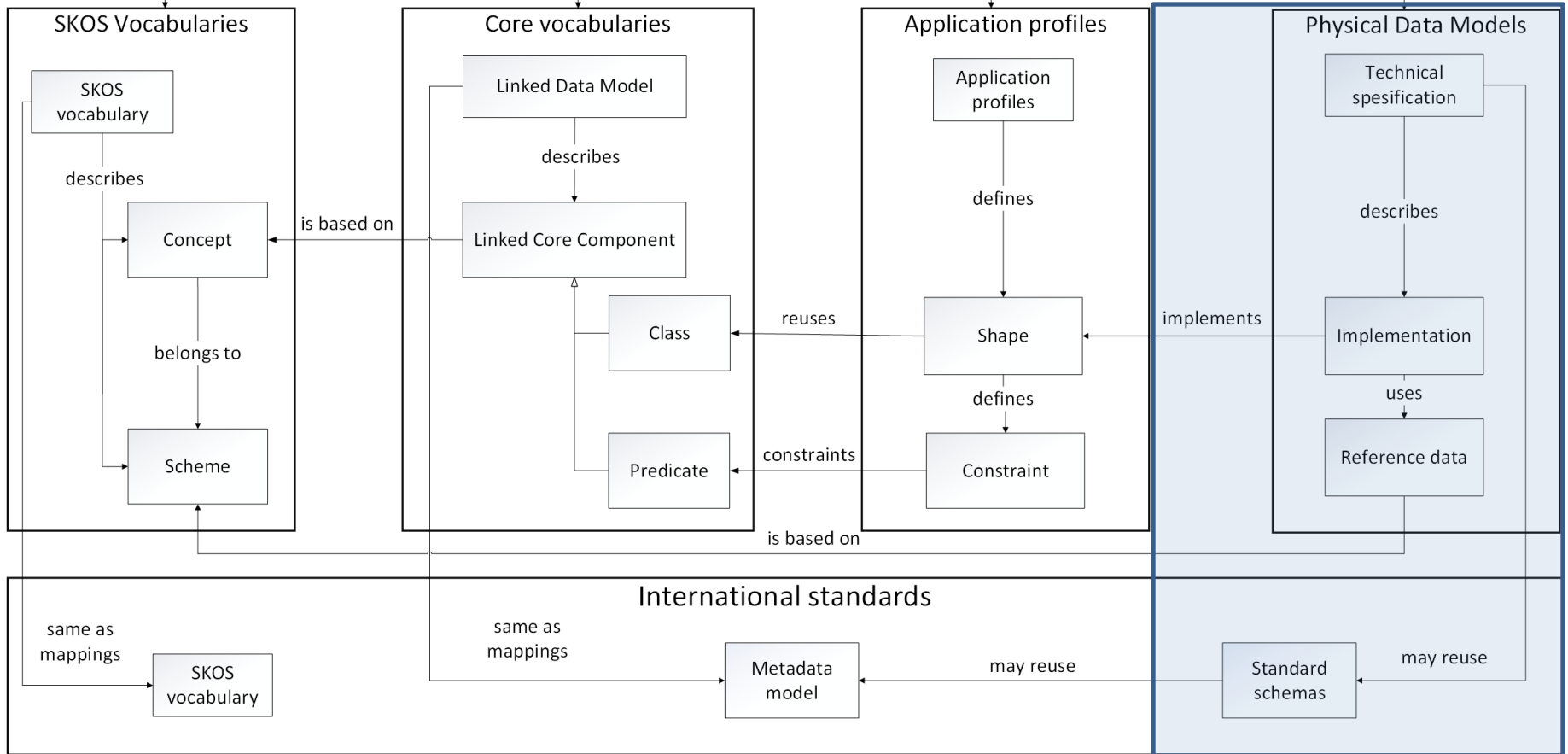




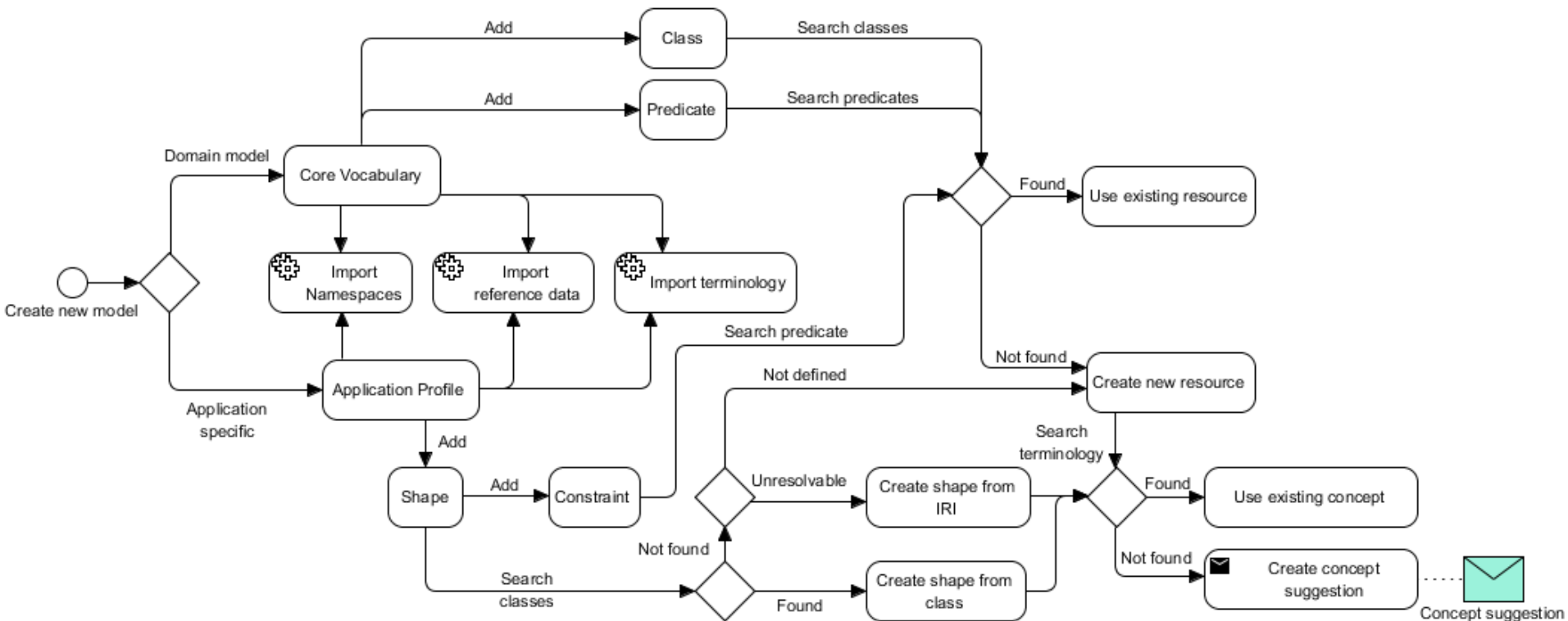
Domain specific data models and interfaces are documented as Application profiles that re-use the classes and properties from the Core Vocabularies



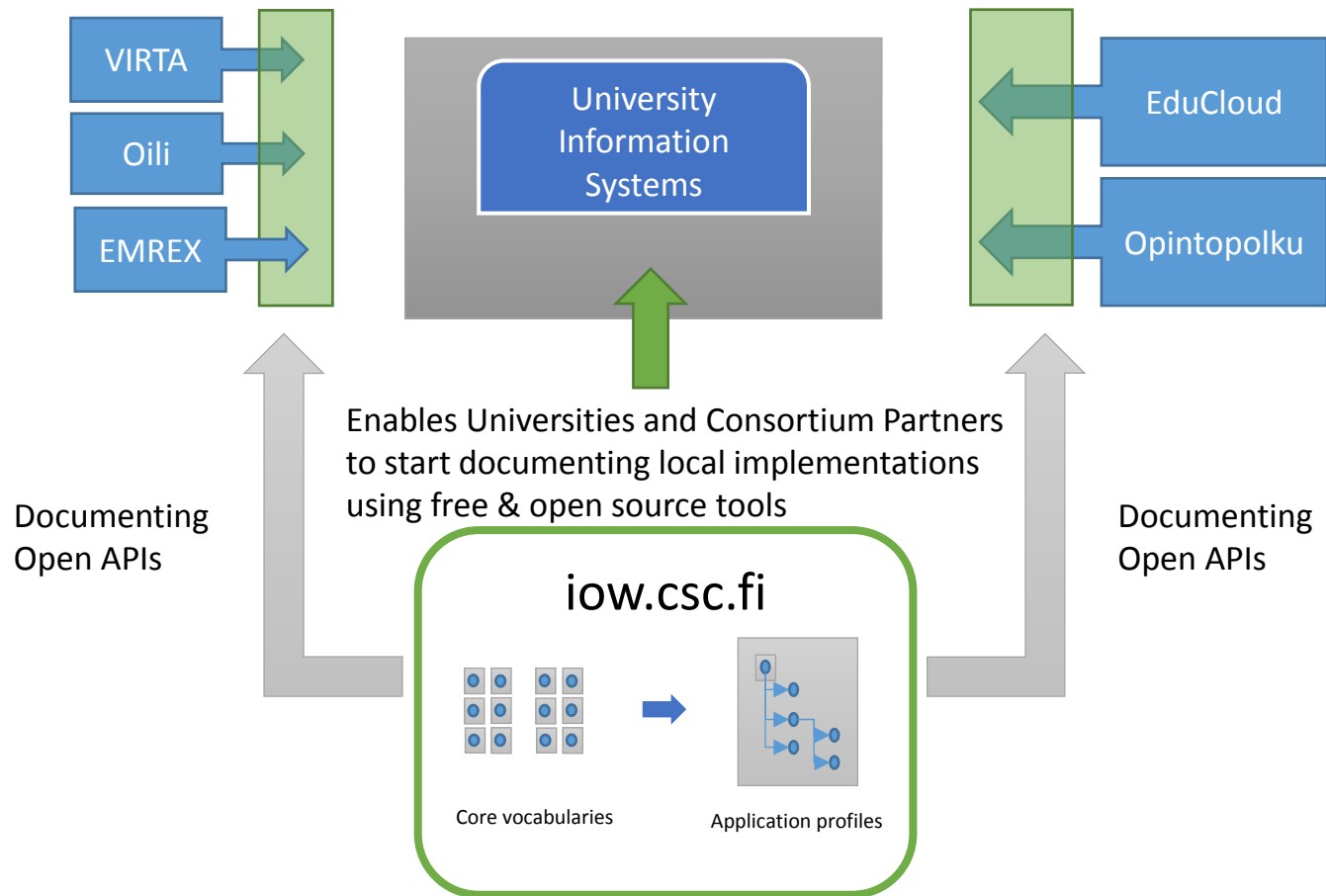
Data models are implemented with languages that best suit the given architecture by implementing the application profile.



# Simplified process for describing Core vocabularies and Application profiles



# Piloting Interoperability Framework



# Interoperability workbench

- Collaborative online tool for creating Core Vocabularies and Application Profiles:

The screenshot shows the website for 'Interoperability descriptions'. The header is blue with the site name on the left and language options ('Suomeksi', 'In English') and a 'Login' link on the right. Below the header, there's a 'FRONT PAGE' label. The main content area is divided into two columns. The left column has a section titled 'Interoperability method' with a refresh icon. It contains three paragraphs: 'What are the descriptions for interoperability?', 'What is the interoperability method?', and 'What can the interoperability workbench do?'. The right column has a 'Search' section with a search box containing 'Studen' and a magnifying glass icon. Below the search box is an 'Advanced search' section with a list of results: 'Electronic Mobility Report', 'Learner', 'Learning Opportunity Instance', and 'Report'. Below the search section is a 'Browse' section with two links: 'Common vocabularies' and 'Learning, Education and Culture'. At the bottom of the page, there is a footer with contact information for CSC - IT Center for Science Ltd and a version string: 'Version 17.05.2016 12:22 Source code: Frontend, Backend, Database licensed under the European Union Public Licence'.



# Integration to controlled vocabularies

- Link controlled vocabularies to created model
- Create classes and properties based on existing concepts



## Controlled vocabularies

🔍 Browse concepts [+ Add vocabulary](#)

Identifier	Vocabulary name	
eos	Elinikäisen oppimisen sanasto (fi)	
jhsmeta	JHSmeta (fi)	

## Reference data

None added

## Imported namespaces

Prefix	Namespace label
adms	adms
cm	Educational Credit Information Model

[+ Add reference data](#)

Määrittele käsite uudelle luokalle

Hae ensin tarvitsemaasi käsitettä sanastoista. Jos et löydä tarpeisiisi sopivaa, voit luoda uuden käsite-ehdotuksen.

opisk

RAJAA HAKUTULOKSIA

Sanasto

Kaikki sanastot

+ ehdota 'opisk' sanastoon

opiskelija  
Elinikäisen oppimisen sanasto

opiskelija  
JHSmeta

opiskelijaksi ilmoittautuminen  
Elinikäisen oppimisen sanasto

opiskeluoikeuden tila  
JHSmeta

opiskeluoikeus  
JHSmeta

**Käsitteen nimi**  
opiskelija

**Käsitteen tunniste**  
<http://low.csc.fi/skos/eos#tmpOKSAID227>

**Määritelmä**  
henkilö, joka opiskelee muun kuin esi- tai perusopetuksen piirissä

Peruuta Luo uusi luokka

# Integration to classification schemes

- Link to existing reference data from code service
- Restrict allowed values by using existing reference data

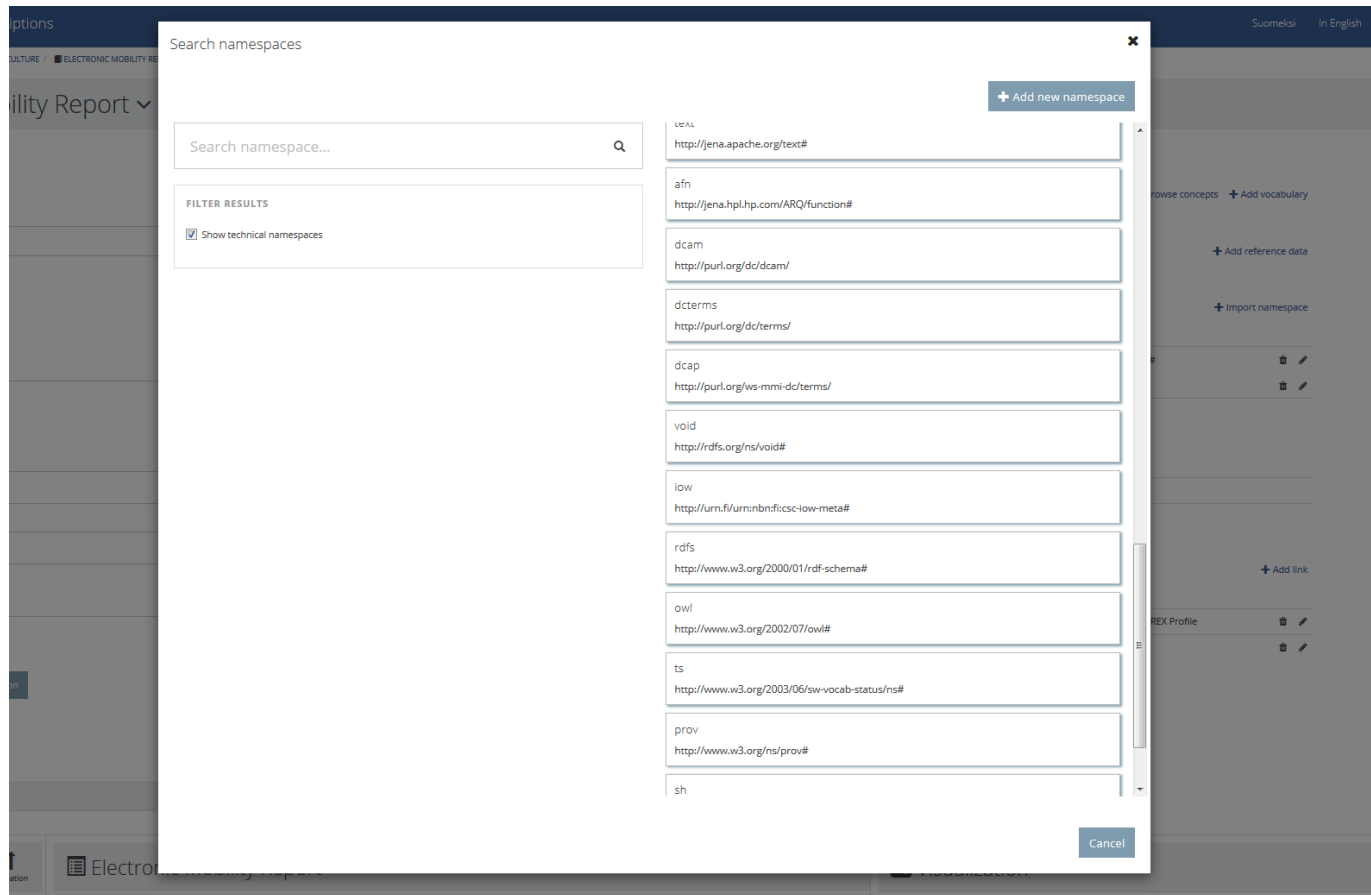
The screenshot displays a software interface for managing classification schemes. On the left, there is a search bar and a list of classes. The central workspace shows a table with columns for a numeric value and a text label. The right-hand pane is titled 'Data in english - Shape properties' and shows the configuration for a class property labeled 'Citizenship (fi)'. This property has a description, a range of 'xsd:string', and a status of 'Unstable'. Below this, there is a section for 'Reference data' with a table listing reference data names and their descriptions.

Reference data name	Description
Valtiot ja maat 2 (fi)	Valtiot ja maat -luokitusta käytetään mm. väestötilastoissa henkilöiden kansallisuuden luokittamiseen. Valtioiden ja maiden tunnuksat perustuvat kansainväliseen ISO 3166 -standardiin (International Standard ISO 3166-1, Codes



# Interoperability workbench

- Import existing models from local models and external namespaces



# Interoperability workbench

- Include and search metadata from imported standards
- Create new domain models as highly reusable metadata

The screenshot displays the 'Add class' dialog in the Interoperability workbench. The search bar contains the text 'Co'. The filter results are set to 'All models'. The search results are as follows:

Class Name	Category
+ Create new class 'Co'	
+ Create new shape by referencing external uri	
Collection	skos
Concept	skos
Concept Scheme	skos
Online Account	foaf
Online Chat Account	foaf
Online E-commerce Account	foaf
Online Gaming Account	foaf
Ordered Collection	skos

Buttons at the bottom right: Cancel, Specialize class.

# Interoperability workbench

- Map new classes and class usage to relevant standards

The screenshot displays the 'Class information' interface for the class 'Electronic Mobility Report'. The interface is divided into several sections:

- Left sidebar:** A list of class types including 'Academic Term', 'Attachment', 'Category', 'Custom extension container', 'Electronic Mobility Report' (highlighted), 'Identifier', 'Issuer', 'Learner', 'Learning Opportunity Instance', 'Learning Opportunity Specification', 'Report', 'Result distribution', and 'Shortened grading table'. Above this list are buttons for 'Class', 'Attribute', and 'Association', and a '+ Add class' button.
- Class information panel:**
  - Data in english:** A text field containing 'Electronic Mobility Report'.
  - Class id:** A text field containing 'Elmo'.
  - Superclass:** A text field with 'Write identifier...' and a 'Choose class' button.
  - Equivalent class:** A text field with 'Write identifier...' and a scrollable list of classes including 'skos:Collection', 'skos:Concept', 'skos:ConceptScheme', 'skos:OrderedCollection', 'adms:Asset' (highlighted), 'adms:AssetDistribution', 'adms:AssetRepository', 'adms:Identifier', 'foaf:Agent', and 'foaf:Document'.
  - Class property label:** A text field containing 'Generation date'.
  - Range:** A dropdown menu set to 'Ajanhetki (xsd:dateTime)'.
- Description panel:**
  - Description:** A text area containing 'Exchange document containing multiple student achievement reports'.
  - Status:** A dropdown menu set to 'Keskenärsäinen (Unstable)'.
  - Definition:** A text area containing 'Report (fi) Exchange document containing multiple student achievement reports (fi)'.
  - Description (bottom):** A text area containing 'The datetime when the file was generated'.

# Interoperability workbench

- Export schemas in multiple formats
- Enforces Naming practices

```

dcterms:modified "2016-04-27T16:05:05.236+03:00"^^xsd:dateTime ;
dcterms:subject <urn:uuid:0497601a-9989-4e6d-8268-e160a88a7bd4> ;
owl:versionInfo "0"^^xsd:string ;
sh:property <urn:uuid:7566d864-032c-43a3-8ea8-123a8785fec9> , <urn:uuid:06af2af6-dc9a-43b8-846f-93e830701e1e> , <urn:uuid:bbd8fa797-ab96-480a-af5f-69aba73ced4e> .

ex:ex1:ShortenedGradingTable
  a rdfs:Class ;
  rdfs:comment "Grading table based on the ECTS Grading Table (EGT)">en ;
  rdfs:label <http://owc.fi/oa/EMXex> ;
  rdfs:label "Shortened grading table">en ;
  dcterms:created "2016-04-27T17:16:02.912+03:00"^^xsd:dateTime ;
  dcterms:identifier <urn:uuid:73b2968e-4e1c-433c-b466-d6e44d3d99fc> ;
  dcterms:modified "2016-04-27T17:16:02.912+03:00"^^xsd:dateTime ;
  dcterms:subject <urn:uuid:33b2968e-4e1c-433c-b466-d6e44d3d99fc> ;
  owl:versionInfo "0"^^xsd:string ;
  sh:property <urn:uuid:f4eb8af-1b57-4e68-9e4f-aca4fe7d0913> , <urn:uuid:0c0e98a-4e4f-4c73-461e-6a2a7d6752ca> , <urn:uuid:87654466-82f9-4c79-93c9-f29b904cbeab> .

<urn:uuid:7684923-132e-6686-9e54-c0f649c013b>
  rdfs:comment "Attachments to the report">en ;
  rdfs:label "Attachments">en ;
  dcterms:created "2016-04-27T18:39:03.889+03:00"^^xsd:dateTime ;
  dcterms:identifier "Attachments" ;
  dcterms:type owl:ObjectProperty ;
  owl:versionInfo "0"^^xsd:string ;
  sh:index 3 ;
  sh:property ex:ex1:Attachment ;
  sh:valueShape ex:ex1:Document .

<urn:uuid:60c4ffe-ef0c-4166-b516-c2b8894780e>
  xsd:definition "Category of results">en ;
  shor:profileLabel "Category">en .

<urn:uuid:38e2321-3a89-674-9afa-1eaf5c64fd0c>
  rdfs:comment "Any value can be used here">en ;
  rdfs:label "Any attribute">en ;
  dcterms:created "2016-04-27T18:00:44.306+03:00"^^xsd:dateTime ;
  dcterms:identifier "anyAttribute" ;
  dcterms:type owl:DatatypeProperty ;
  owl:versionInfo "0"^^xsd:string ;
  sh:datatype rdfs:Literal ;
  sh:index 0 ;
  sh:property ex:ex1:anyAttribute .

ex:ex1:EMXex1Issuer
  a sh:Shape ;
  rdfs:comment "Description of the Higher Education Institution that has issued the results">en ;
  rdfs:label <http://owc.fi/oa/EMXex> ;
  rdfs:label "Issuer">en ;
  dcterms:created "2016-04-29T09:41:54.851+03:00"^^xsd:dateTime ;
  dcterms:identifier <urn:uuid:0aee7b-3883-8ea8-9880-1eaad93a3e3a> ;
  dcterms:modified "2016-04-29T09:41:54.851+03:00"^^xsd:dateTime ;
  owl:versionInfo "0"^^xsd:string ;
  sh:property <urn:uuid:43051705-4ece-4987-8373-bad32d0dfe9> , <urn:uuid:c9e8d83-8ea8-47a2-8ef1-c2998a0119c4> ;
  .
  
```

RDF

```

"items":{
  "type":"array"
},
"required":[
  "label",
  "count"
],
"enum":[
  "title":"Electronic Mobility Report">en,
  "description":"Exchange document containing multiple student achievement reports">en,
  "properties":{
    "attachments":{
      "title":"Attachments",
      "description":"Attachments to the report">en,
      "type":"array",
      "items":{
        "type":"object",
        "id":"#/definitions/document"
      }
    },
    "date":{
      "title":"Generation date">en,
      "description":"The datetime when the file was generated">en,
      "format":"date-time"
    },
    "learner":{
      "title":"Learner">en,
      "description":"A student whose achievements are described in the report">en,
      "type":"object",
      "id":"#/definitions/EMXexLearner"
    },
    "report":{
      "title":"Report">en,
      "description":"Student achievement reports associated with the Learner">en,
      "minItems":1,
      "type":"array",
      "items":{
        "type":"object",
        "id":"#/definitions/report"
      }
    },
    "signature":{
      "title":"Signature">en,
      "description":"Original signature, smd4sig-core2, for demonstrating the authenticity of EMXex documents">en,
      "type":"object",
      "id":"#/definitions/signature"
    }
  },
  "required":[
    "date",
    "report",
    "signature",
    "date",
    "report",
    "signature",
    "date",
    "report",
    "signature",
    "date",
    "report"
  ]
}
  
```

JSON Schema

XML Schema

tbd ...

# Thanks!

- Questions
- Interoperability workbench
- <http://iow.csc.fi>