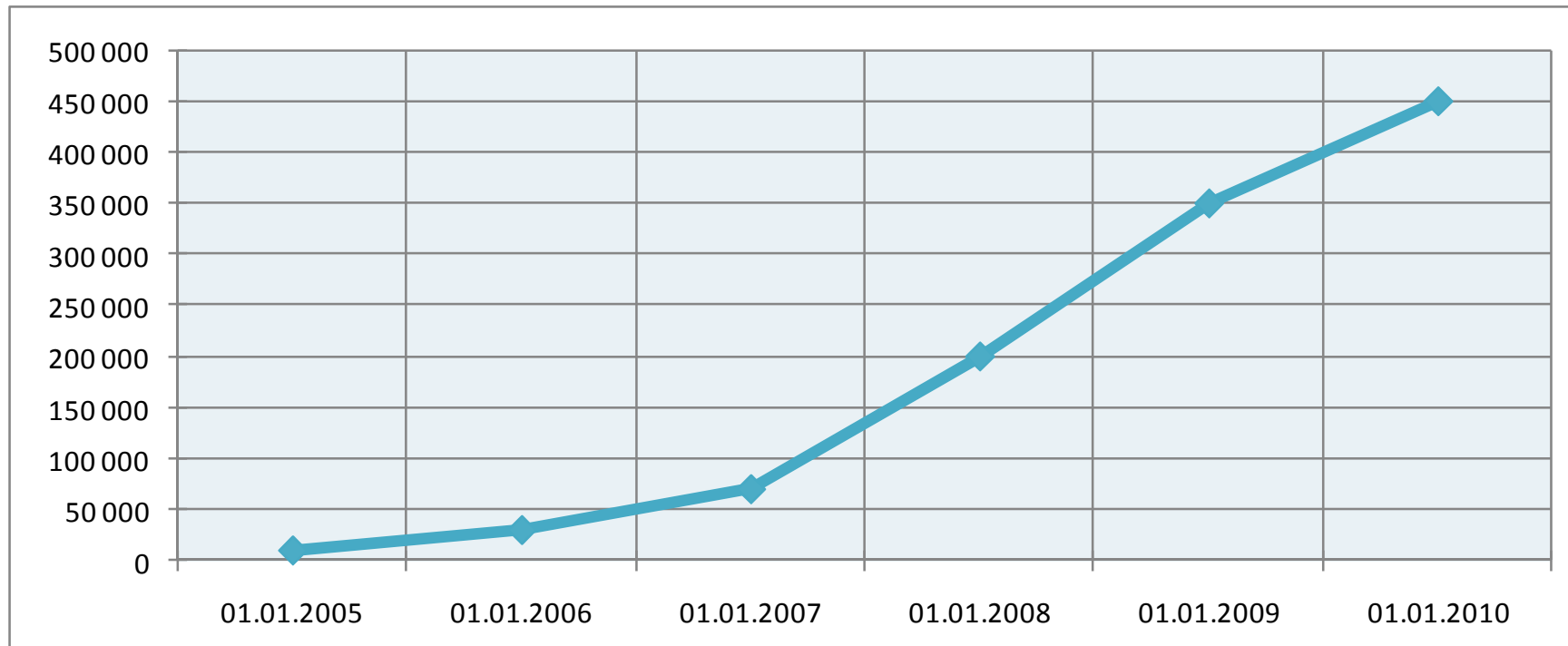


Towards Semantic Interoperability of Information Systems

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University of Tartu

Public Data Services Growth



Source: SOA Trader, Ltd.

Industry Problems

- Detection of integration points **is too expensive**
 - Is based largely on written human-readable documentation
- **Difficult to integrate** selected data services
 - Poor documentation
 - Different semantics and structure of data objects
- **Difficult to find** suitable data services
 - Too many data services available for manual search
 - The amount of data services increases constantly

Burning Money



“For each dollar spent on applications, roughly \$5-\$9 is spent on **integration**, accounting for roughly **40% of IT budgets**” – *Deutsche Bank Securities (February 2005)*

“**Over 40%** of the cost of **integration** today is spent in **application-specific code** to manually reconcile and validate the inconsistent data exchanged between disparate applications, resulting in a tight coupling of systems” – *Progress (February 2008)*

Semantic Interoperability

```
<complexType name="RealEstateObject">
```

```
  <sequence>
```

```
    <element name="registryCode" type="string"/>
```

```
    <element name="date" type="datetime"/>
```

```
  </sequence>
```

```
</complexType>
```

...

```
<complexType name="CadastralUnit">
```

```
  <sequence>
```

```
    <element maxOccurs="5" minOccurs="0" name="address" type="tns:Address"/>
```

```
    <element name="area" nillable="true" type="string"/>
```

```
    <element name="areaUnit" nillable="true" type="string"/>
```

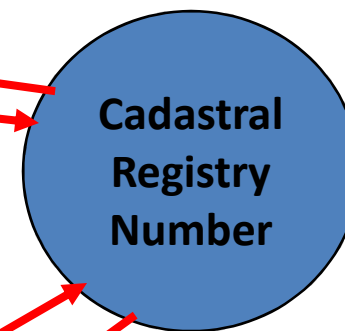
```
    <element name="cadastralRegisterNumber" nillable="true" type="string"/>
```

```
    <element name="createdOnPlanBasis" type="boolean"/>
```

```
  </sequence>
```

```
</complexType>
```

...

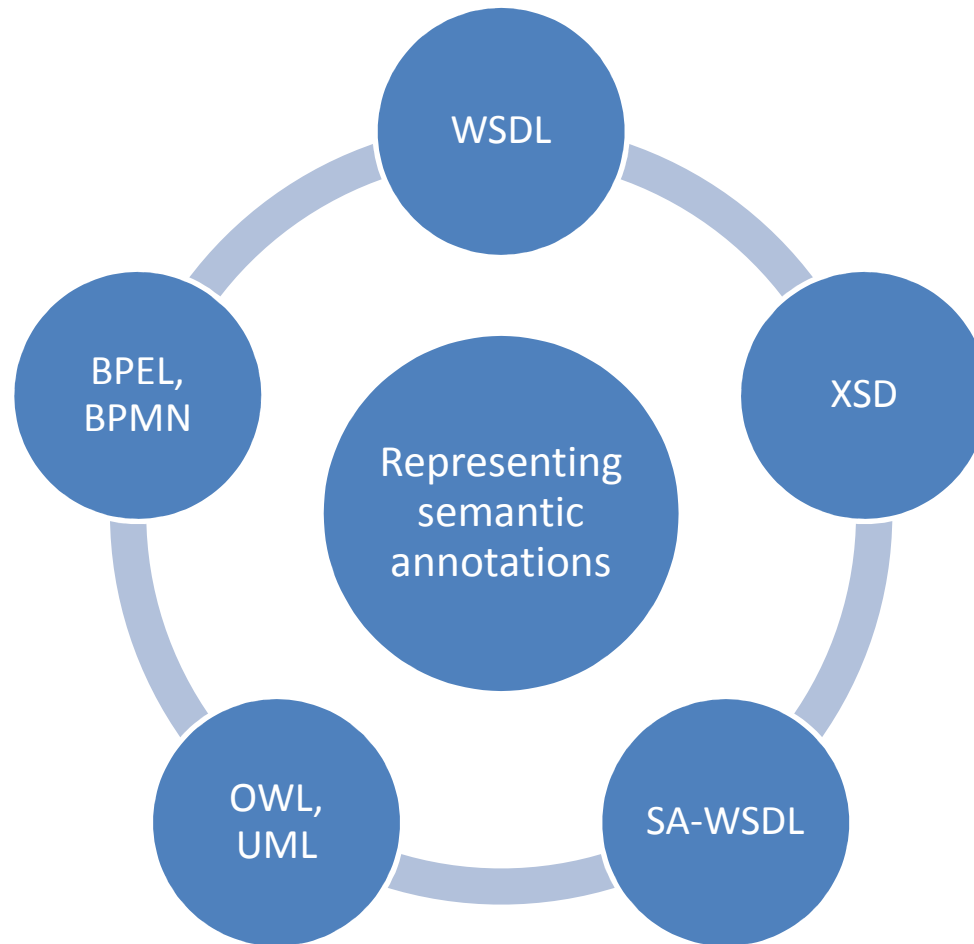


Element Names @ X-Road

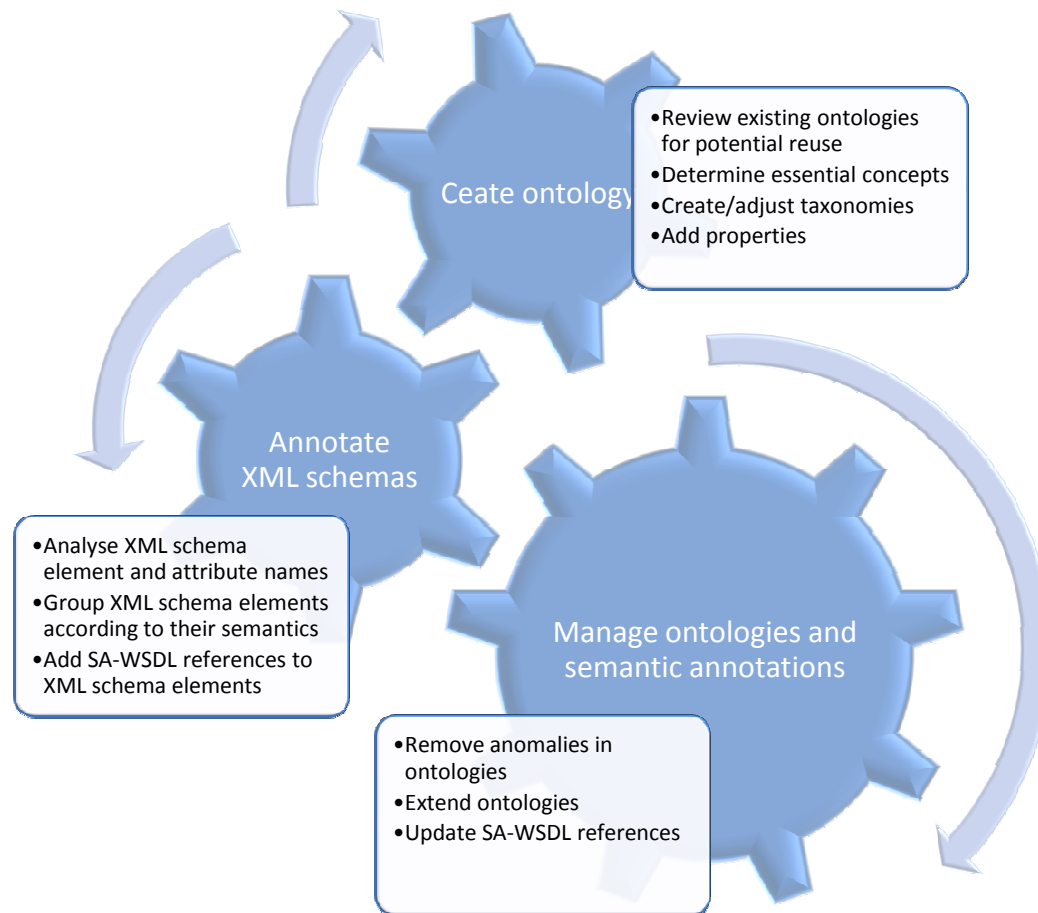
isikukood	National Identifier Code	141
teade	Message	125
eesnimi	First Name	98
perenimi	Last Name	55
nimi	Name	51
kood	Code	47
et_nr	???	44
lopp_kpv	End Date	39
algus_kpv	Start Date	38
id	Identifier	37
perekonnanimi	Last Name	36
synniaeg	Birth Date	35



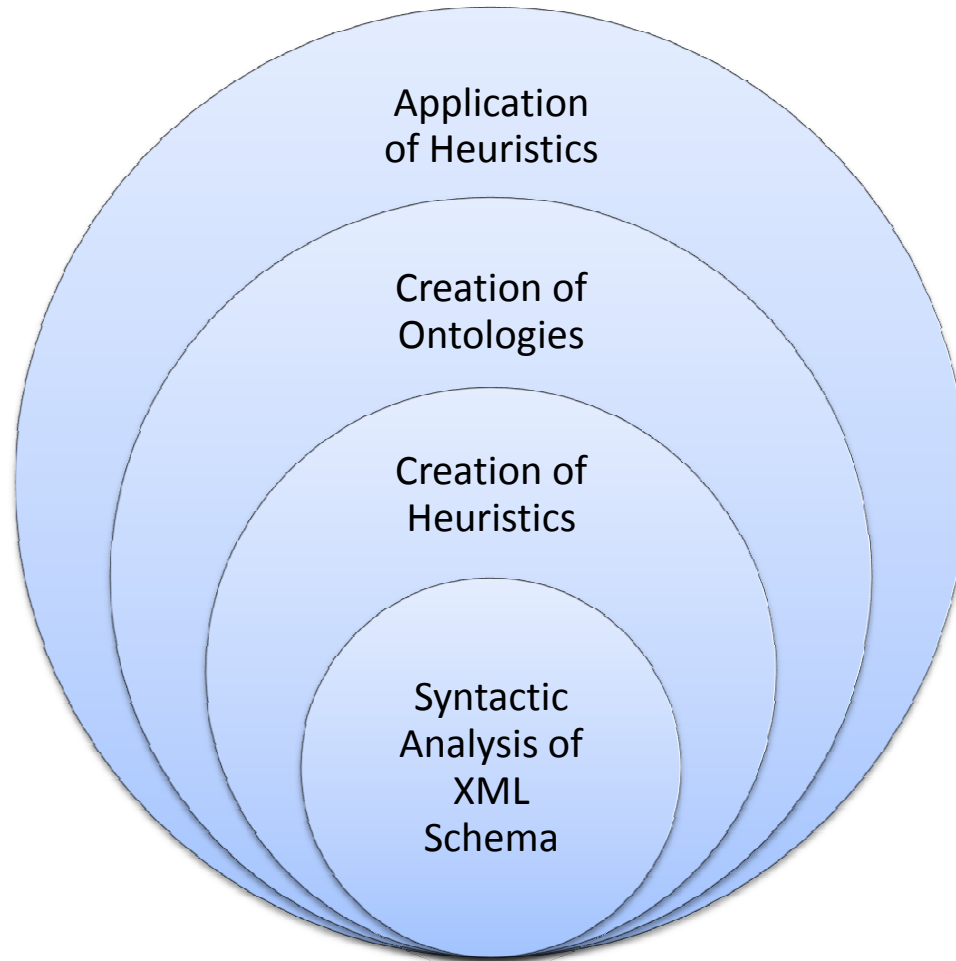
Standards



Creation of Semantic Annotations

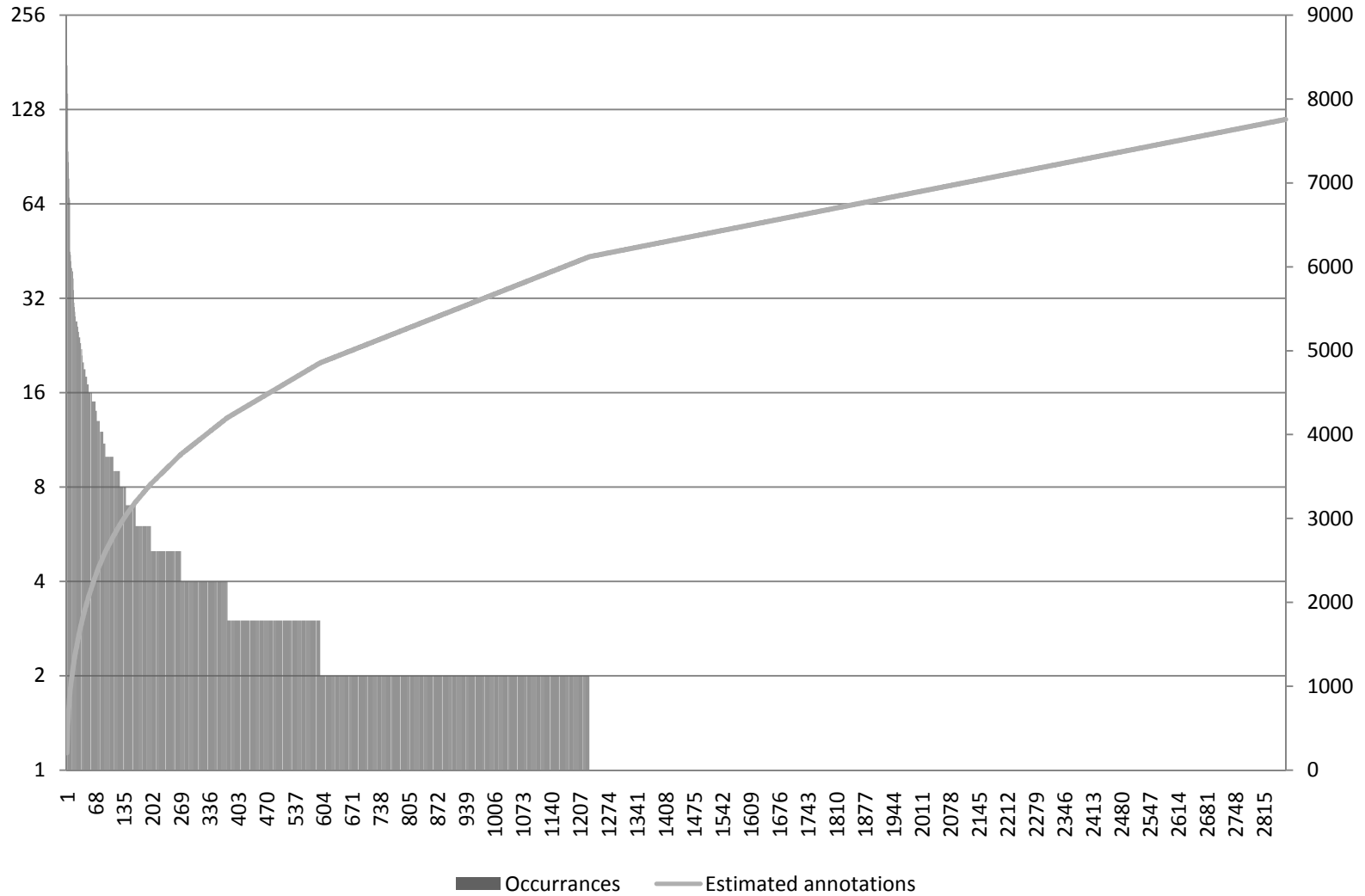


Automation of Semantic Annotation



Id	Elemendi nimi	Elemendi Xpath	Elemendi XSD URL
3152	addr	xsd:complexType[@name=\COCT_MT030202UV01.Place\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT030202UV01.xsd
3162	addr	xsd:complexType[@name=\COCT_MT030200UV04.ContactParty\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT030200UV04.xsd
3169	addr	xsd:complexType[@name=\COCT_MT030200UV04.Employment\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT030200UV04.xsd
3184	addr	xsd:complexType[@name=\COCT_MT030200UV04.Guarantor\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT030200UV04.xsd
3191	addr	xsd:complexType[@name=\COCT_MT030200UV04.Guardian\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT030200UV04.xsd
3239	addr	xsd:complexType[@name=\COCT_MT030200UV04.Student\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT030200UV04.xsd
3246	addr	xsd:complexType[@name=\COCT_MT040200UV01.ResponsibleParty\"]/xsd:sequence/xsd:element[@name=\"addr\"]	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-NORMATIVE/processable/multicacheschemas/COCT_MT040200UV01.xsd
		xsd:complexType[@name=\COCT_MT0	http://pub.e-tervis.ee/standards2/Schema/V3/HL7-ORG-V3-2006-

Annotation Curve



OWL Example

```
<owl:Class rdf:ID="CadastralUnit">  
  <rdfs:label>Cadastral unit</rdfs:label>  
  <rdfs:comment>Registered piece of land in land cadastre.</rdfs:comment>  
</owl:Class>
```

```
<owl:Class rdf:ID="CadastralRegisterNumber">  
  <rdfs:label>Cadastral register number of a cadastral unit</rdfs:label>  
  <rdfs:comment>  
    Numerical code for identifying cadastral units and binding their data to other registers.  
  </rdfs:comment>  
</owl:Class>
```

```
<owl:ObjectProperty rdf:ID="identifies">  
  <rdfs:domain rdf:resource="#CadastralUnit">  
  <rdfs:range rdf:resource="#CadastralRegisterNumber">  
</owl:ObjectProperty>
```

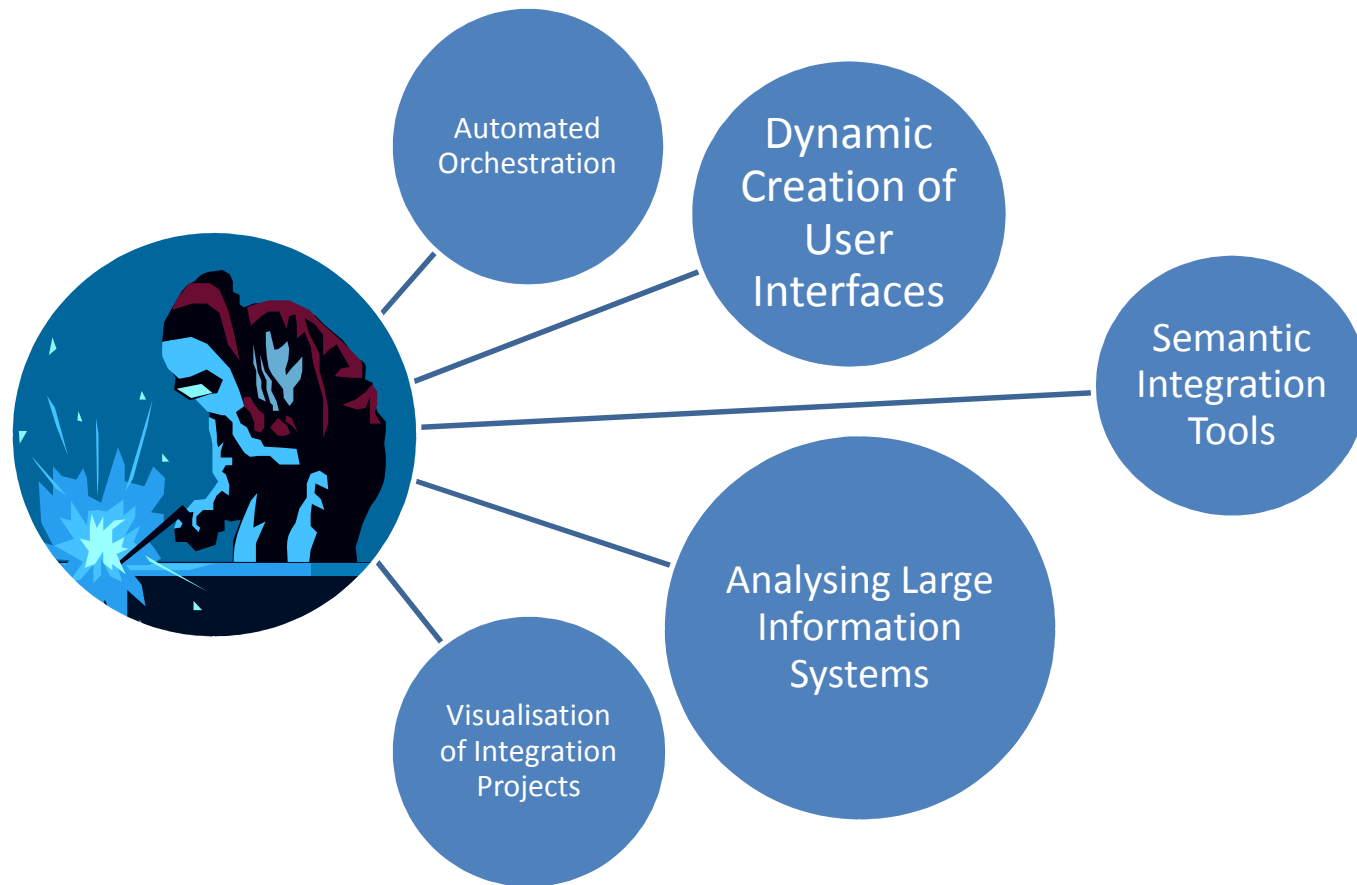
XSD Example

```
<complexType name="RealEstateObject">  
  <sequence>  
    <element name="registryCode" type="string"/>  
    <element name="date" type="datetime"/>  
  </sequence>  
</complexType>
```

SA-WSDL Example

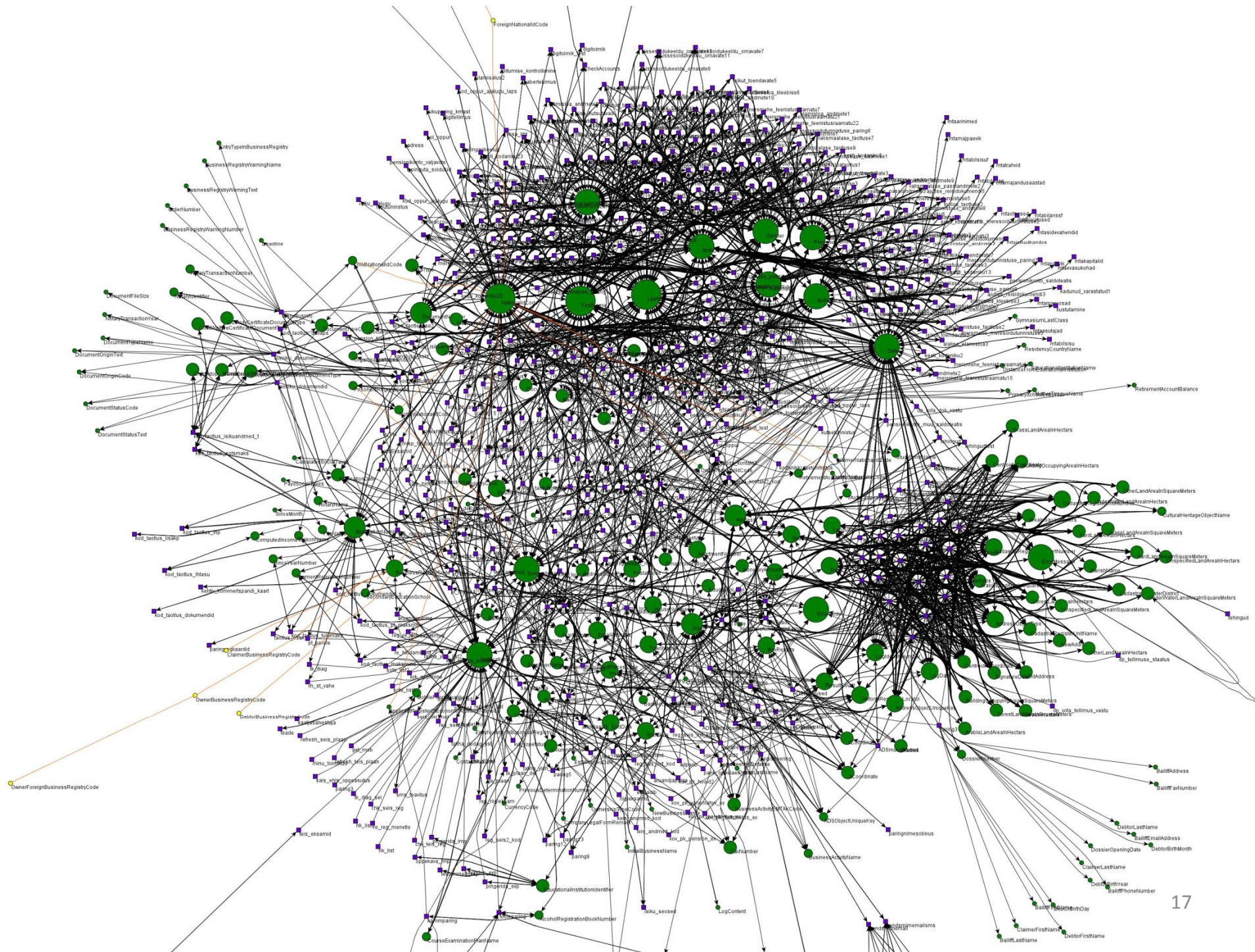
```
<complexType name="RealEstateObject">
  <sequence>
    <element name="registryCode" type="string"
      sawsdl:modelReference="http://onto.soatrader.com/ontology/CadastralRegister.owl#
CadastralRegisterNumber "
      sawsdl:loweringSchemaMapping="http://ws.soatrader.com/sawsdl/CadastralRegister/loweri
ng12.xslt"
      sawsdl:liftingSchemaMapping="http://ws.soatrader.com/sawsdl/CadastralRegister/lifting21.
xslt"
    />
    <element name="date" type="datetime"/>
  </sequence>
</complexType>
```

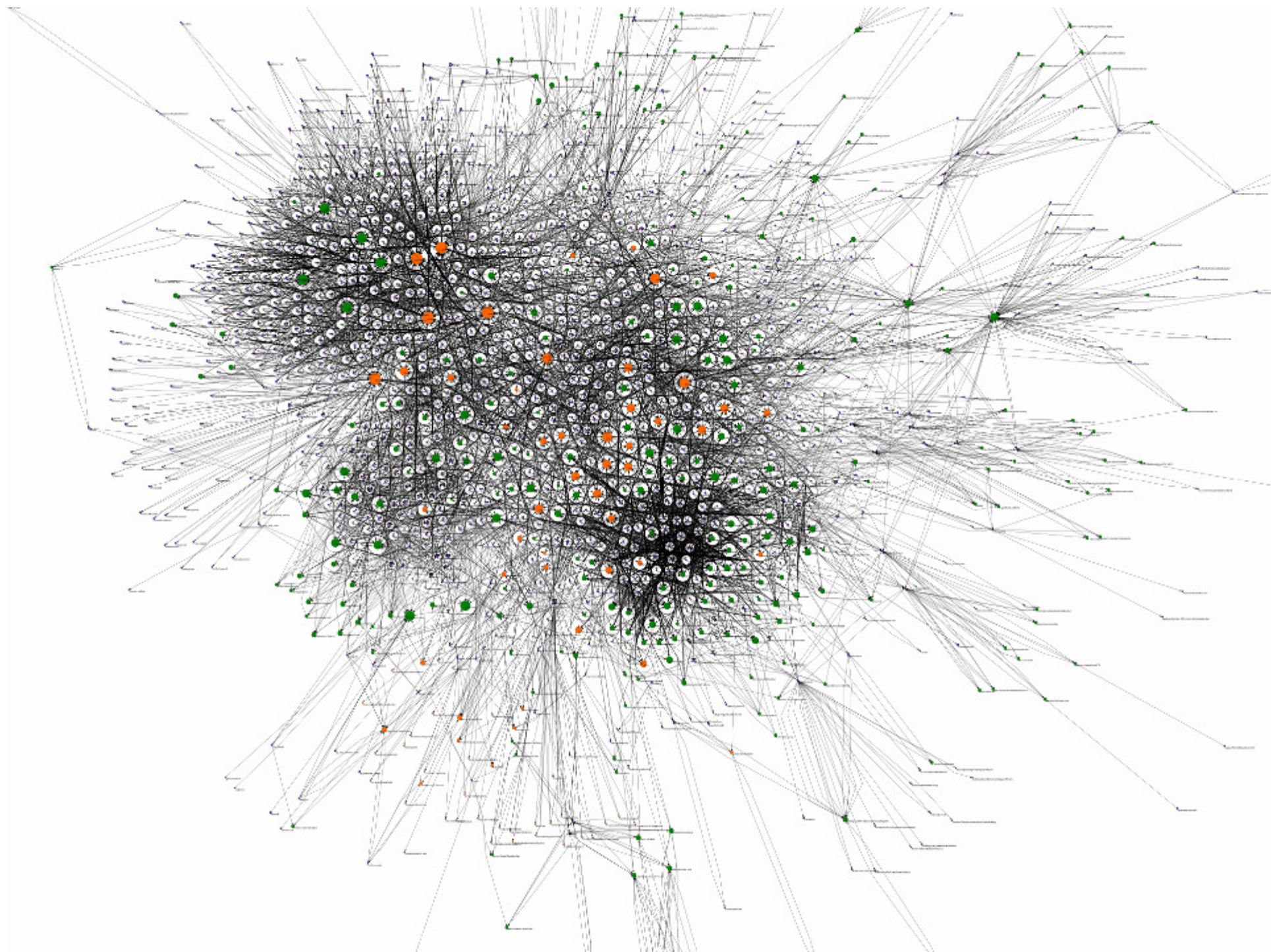
Applications



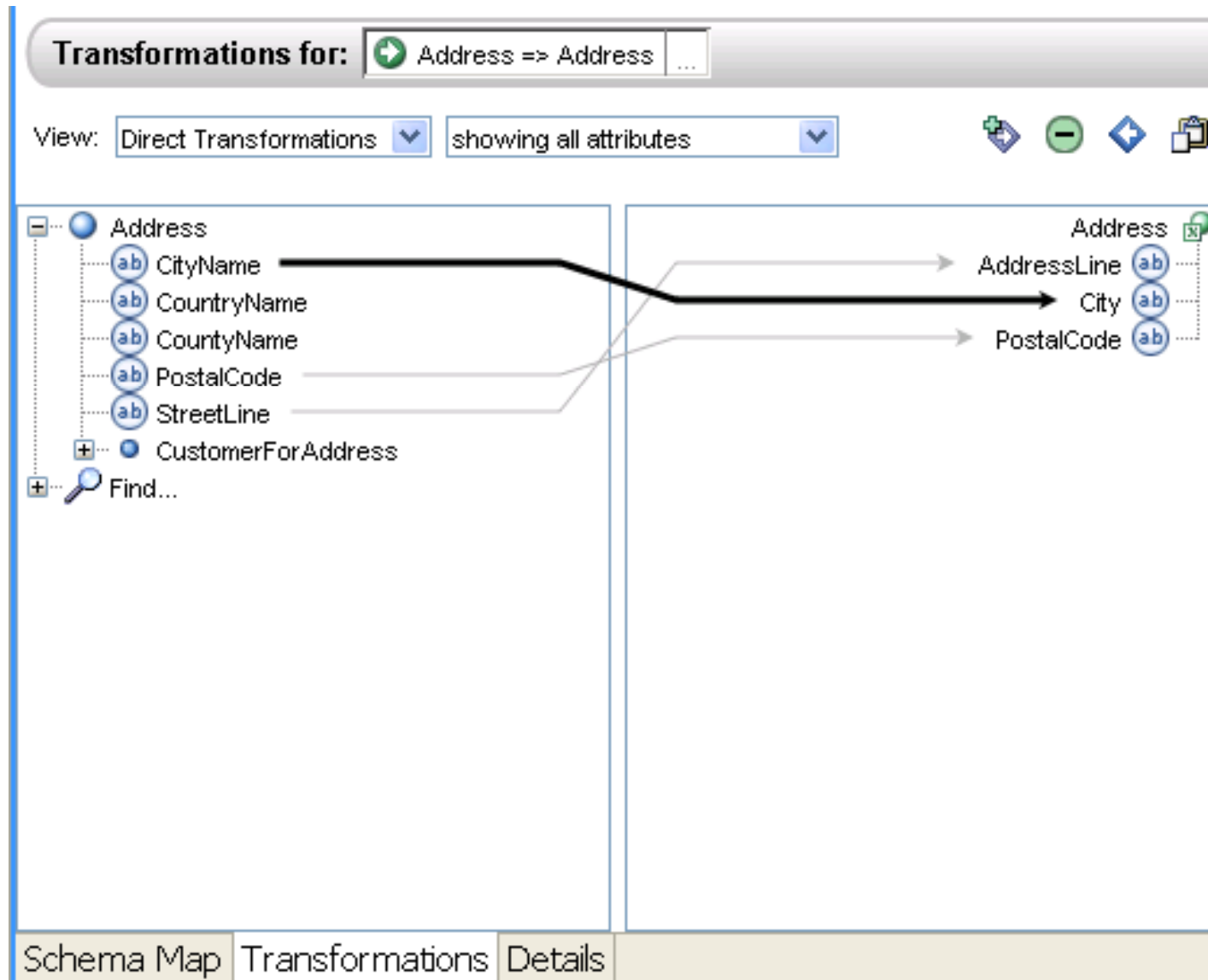
Analysing Large Information Systems

	X-Road	SOAT	E-Health (HL7)
Information Systems	60	15 000	3
Data Services	1 000	175 000	1
Data Fields	8 000	650 000	4 000

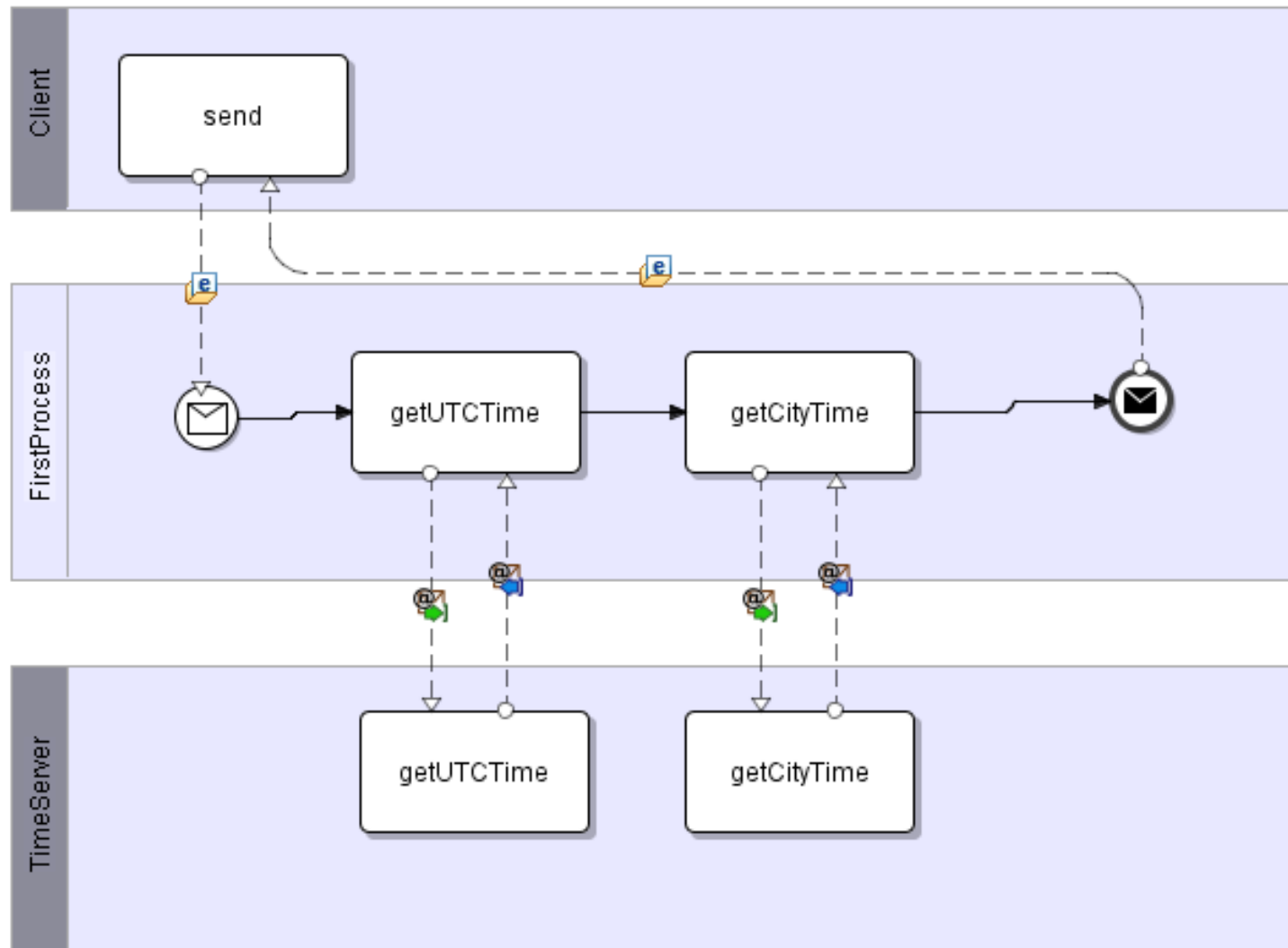




Semantic Integration



Automated Business Process Orchestration



Smart Selection of GUI components



Weather in Tallinn

Smart Search





Thank you!

peep@ut.ee