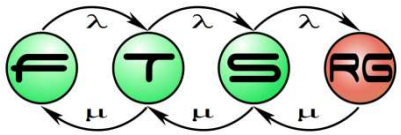
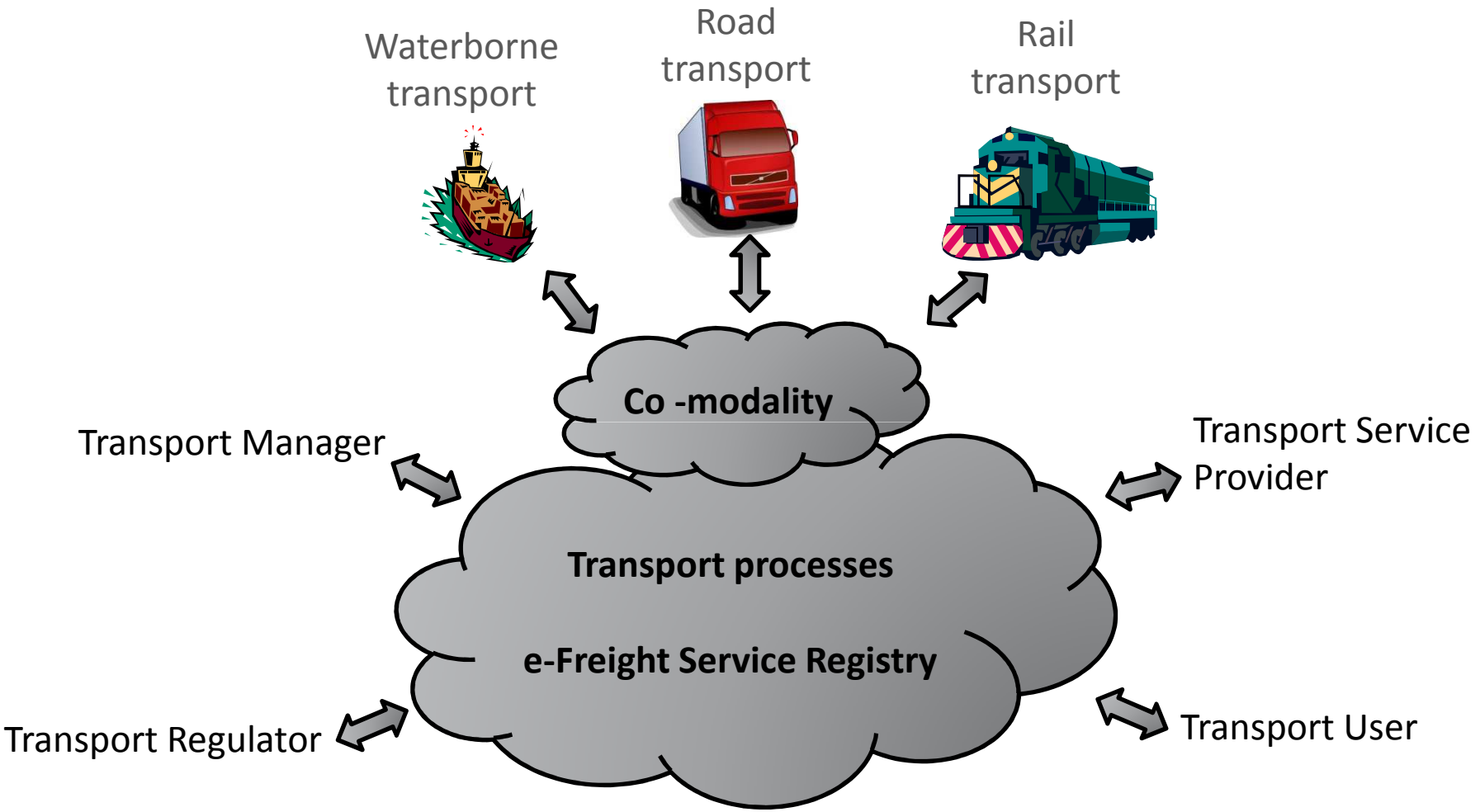
Ontology supported MDA for e-Freight

Budapest University of Technology and Economics (BME)



Overview


Waterborne transport
Road transport
Rail transport
Co -modality
Transport Manager
Transport Service Provider
Transport processes
e-Freight Service Registry
Transport Regulator
Transport User

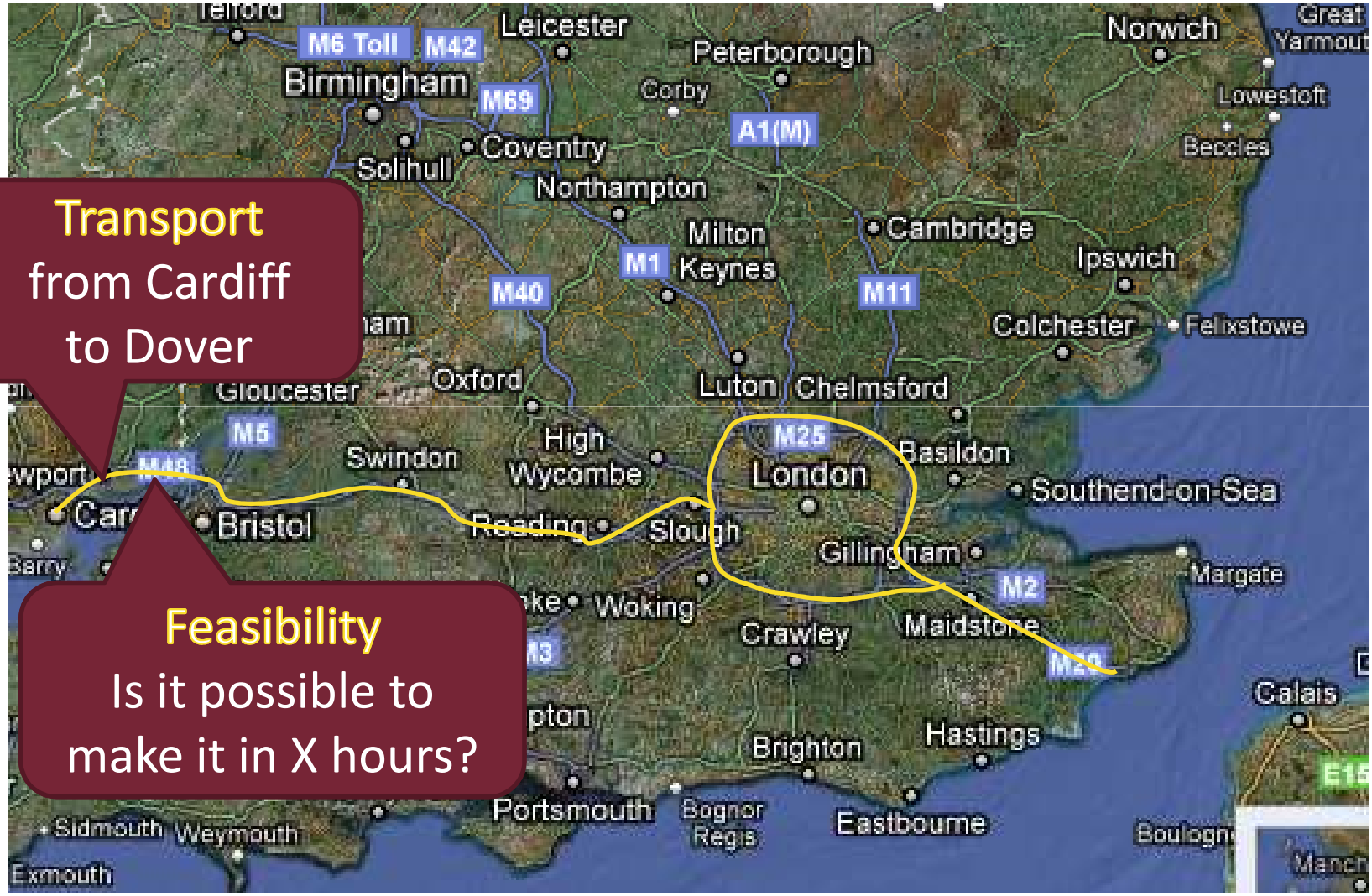
Support I.

- Planning
  - Initial estimate - hypothetic parameters
    - check feasibility, optimality
  - Reevaluation – based on input from Traffic Manager
  - Sensitivity analysis
    - constraints

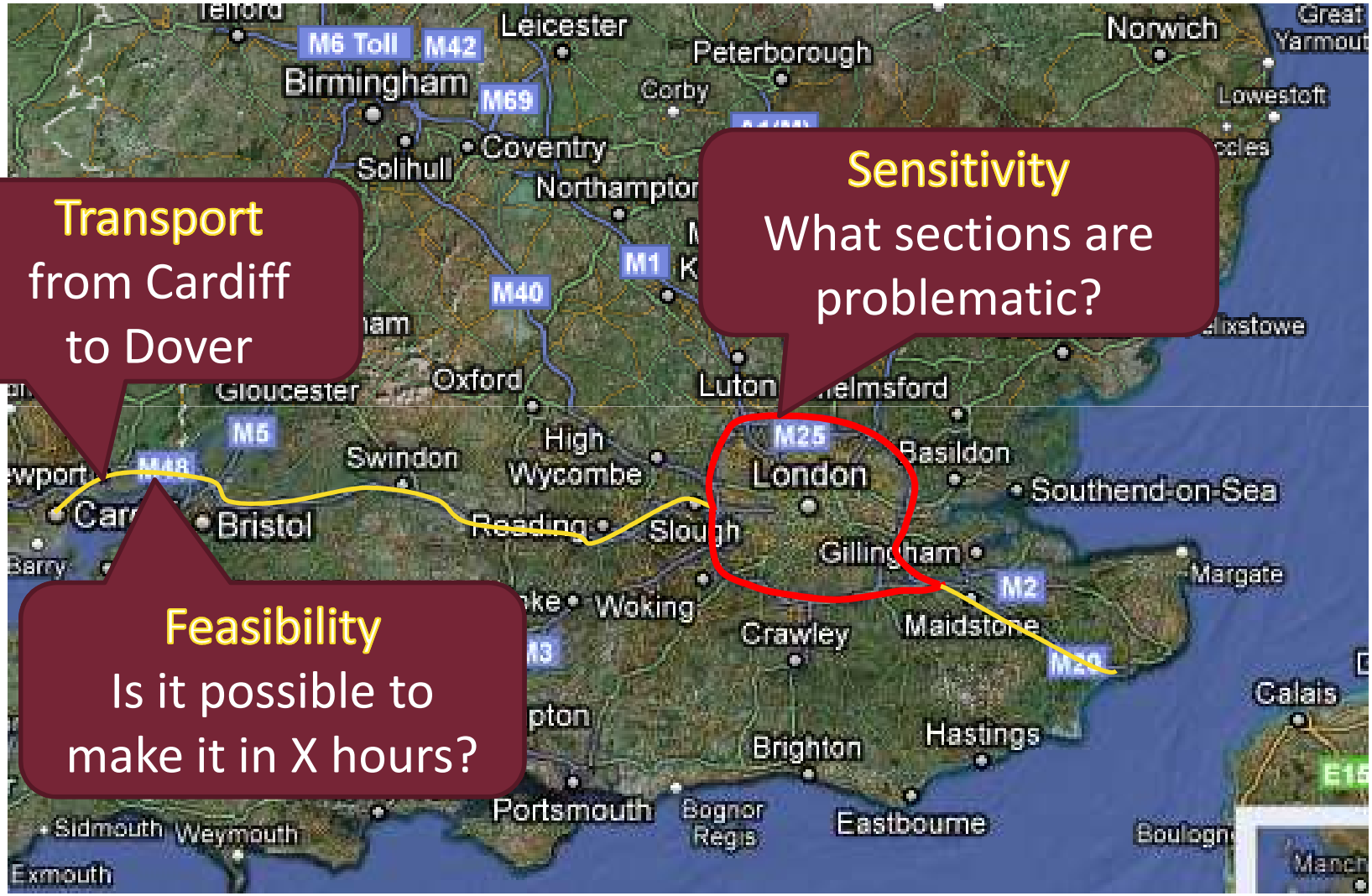
Support II.

- Monitoring
  - Processes augmented with Complex Event Processing
  - Deviation signaling
    - adaptive planning
  - Deviation prediction
    - aggregated infrastructure data + sensitivity analysis results
    - simulation
  - Vis major and contract violation level logging
  - Manual override
    - the responsible is named

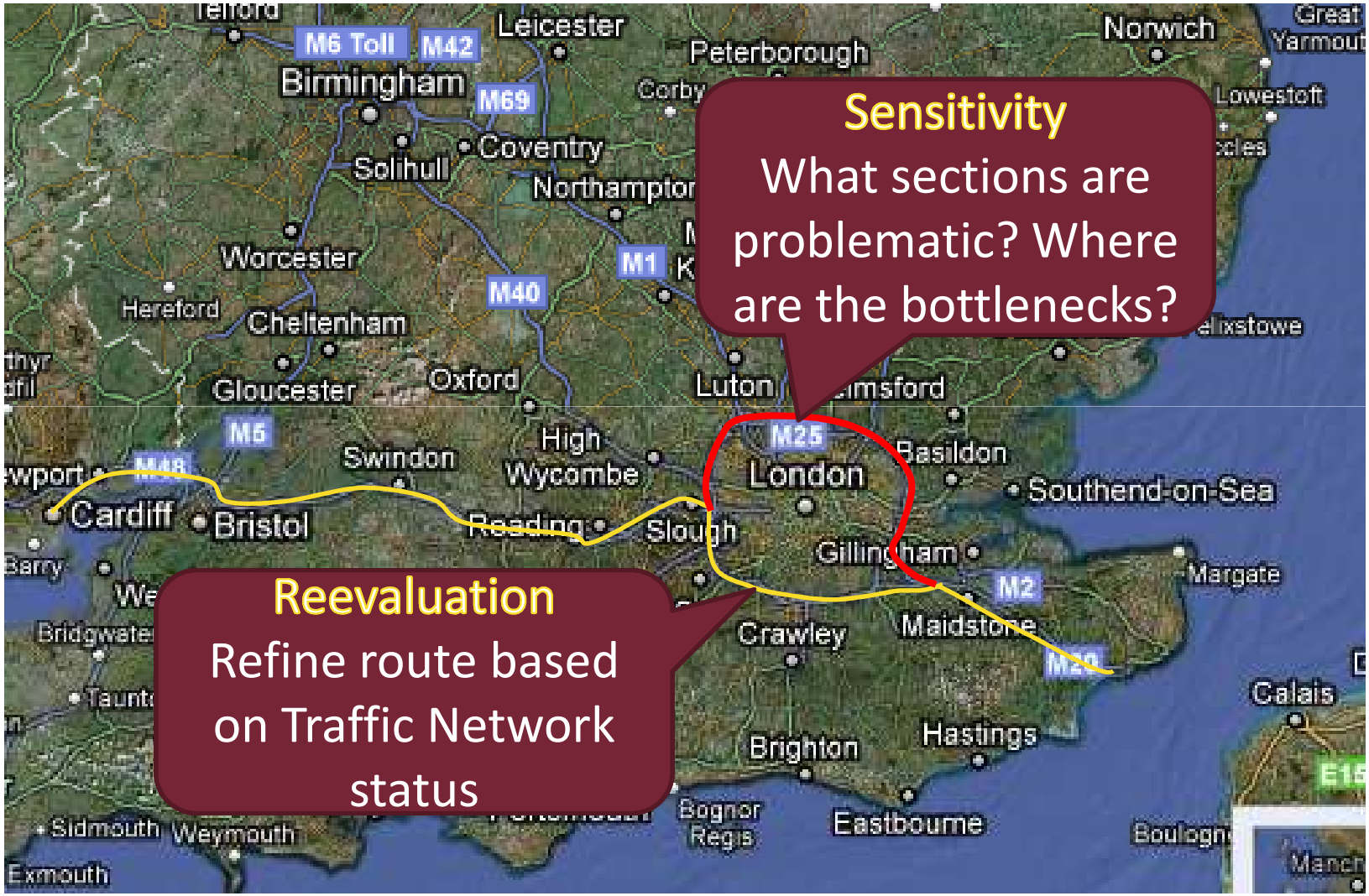
Planning


Transport
from Cardiff
to Dover
Feasibility
Is it possible to
make it in X hours?
Telford
Leicester
Peterborough
Norwich
Great Yarmouth
M6 Toll
M42
Birmingham
M69
Corby
A1(M)
Lowestoft
Beccles
Solihull
Coventry
Northampton
Milton Keynes
M1
Cambridge
Ipswich
M40
M11
Colchester
Felixstowe
Oxford
Luton
Chelmsford
Gloucester
M5
High Wycombe
M25
Basildon
Swindon
London
Southend-on-Sea
Bristol
Reading
Slough
Gillingham
Margate
Woking
M2
Crawley
Maidstone
Calais
Brighton
Hastings
Portsmouth
Bognor Regis
Eastbourne
Sidmouth
Weymouth
Exmouth
Boulogne

Planning


Transport
from Cardiff
to Dover
Sensitivity
What sections are
problematic?
Feasibility
Is it possible to
make it in X hours?
Leicester
Norwich
Peterborough
Birmingham
M6 Toll
M42
M69
Corby
Coventry
Solihull
Northampton
M1
M40
Oxford
Luton
Gloucester
M5
M25
Swindon
High
Wycombe
London
Basildon
Southend-on-Sea
Bristol
Reading
Slough
Gillingham
Margate
M2
Woking
Crawley
Maidstone
Calais
Brighton
Hastings
Portsmouth
Bognor
Regis
Eastbourne
Sidmouth
Weymouth
Exmouth

Planning


Sensitivity
What sections are problematic? Where are the bottlenecks?
Reevaluation
Refine route based on Traffic Network status
Telford
Leicester
Peterborough
Norwich
Great Yarmouth
Birmingham
M6 Toll
M42
M69
Corby
Lowestoft
Solihull
Coventry
Northampton
Worcester
M1
M40
Hereford
Cheltenham
Gloucester
Oxford
Luton
Felixstowe
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Cardiff
Bristol
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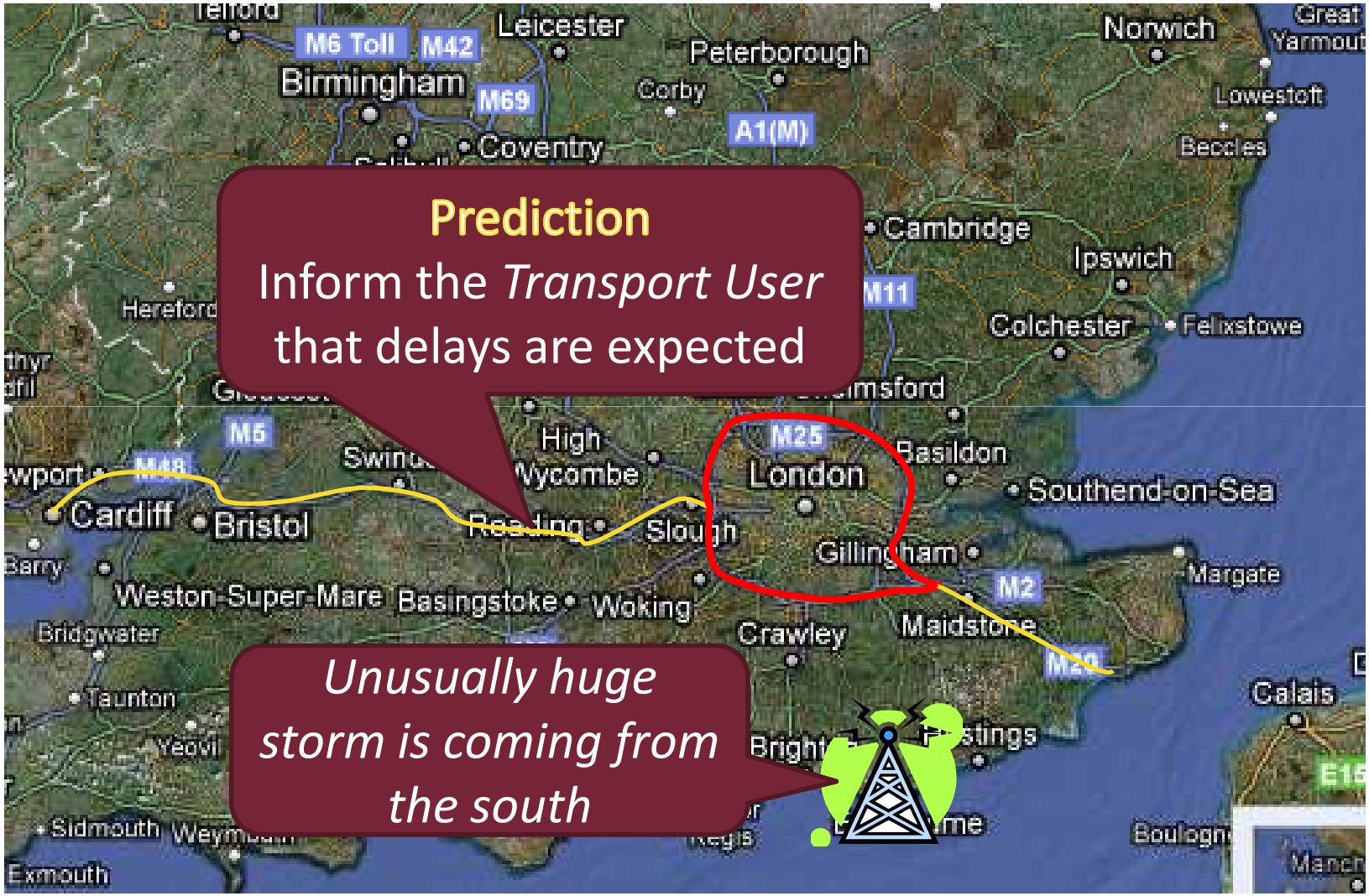
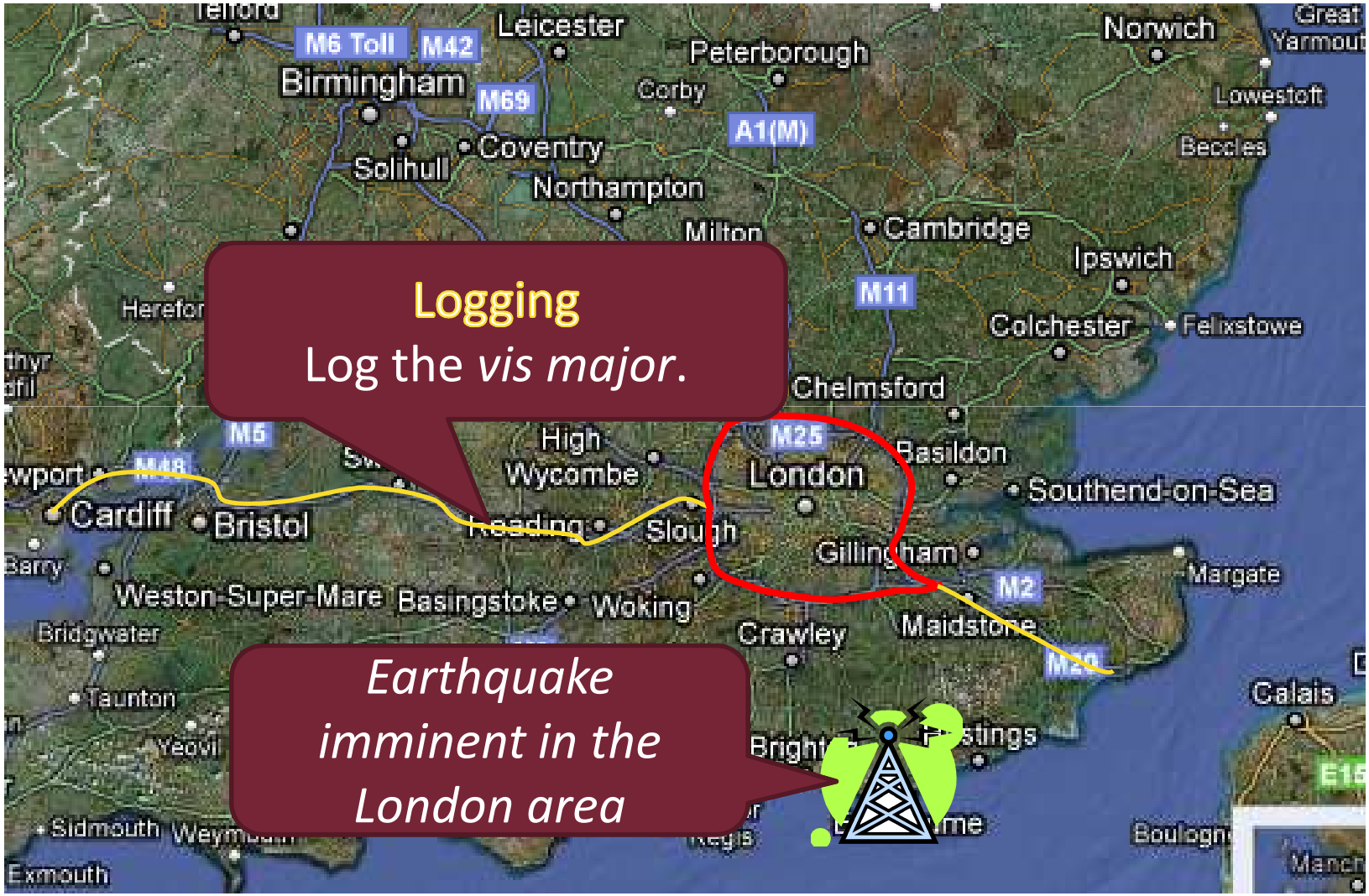
Gillingham
Margate
M2
Crawley
Maidstone
Bridgwater
Calais
Brighton
Hastings
Sidmouth
Weymouth
Bognor Regis
Eastbourne
Exmouth

Monitoring – adaptation

Monitoring - prediction



Monitoring – service level logging



Monitoring – service level logging

Analysis & Simulation

- Sensitivity analysis → **constraints**
  - The min speed needs to be 20mph
- Simulation
  - Suppose: Skiing season is starting in these days
  - Result: the constraints will be violated
- Manual override
  - We know there is no snow in the mountains
  - Invalid values and suppositions are overridden
    - The overrider is named

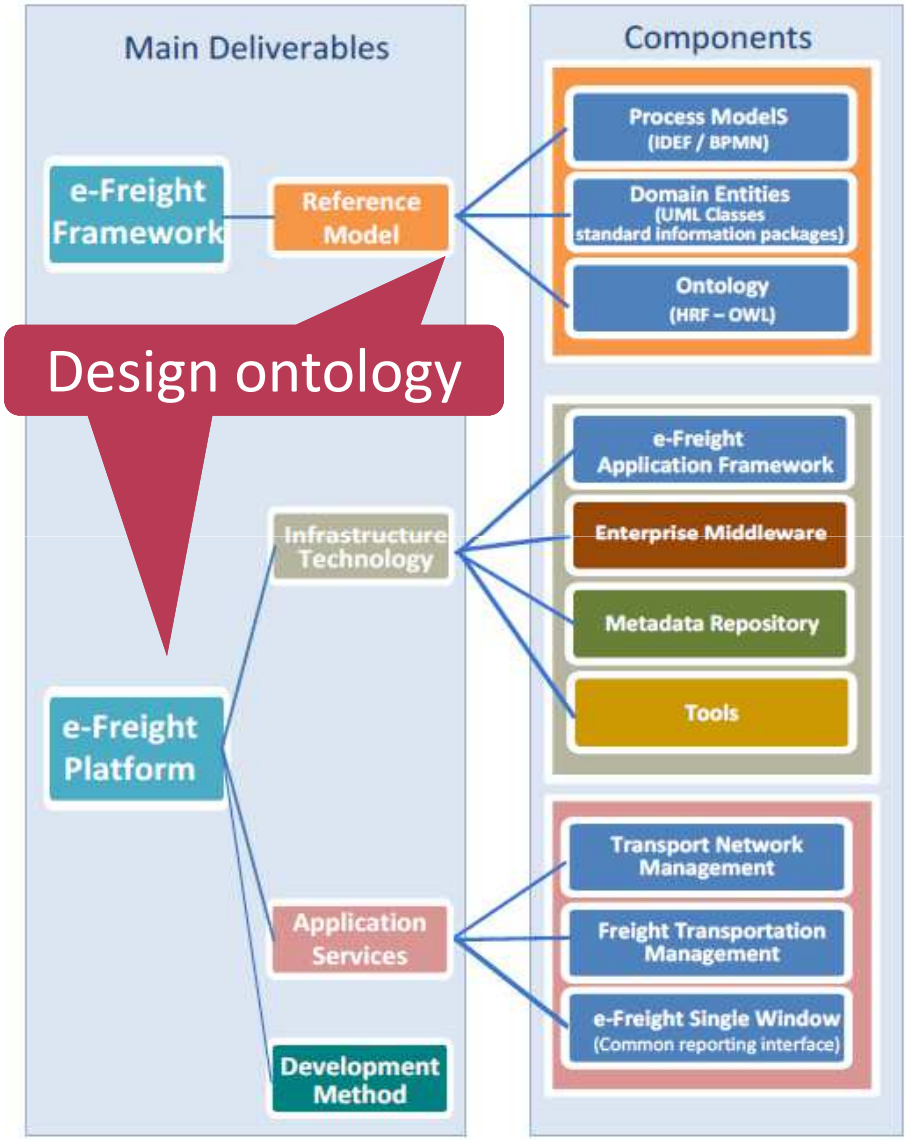
Motivation

- Business processes/services are continuously changing
  - Process logic
  - Data formats and standards
  - Service interfaces
  - Regulatory requirements
- Rigorous refinement is needed to ensure consistency and maintainability
- Design driven by ontology
  - Data structures (derived from standards)
  - Use cases
  - Requirements (“input should be validated”)
  - Patterns

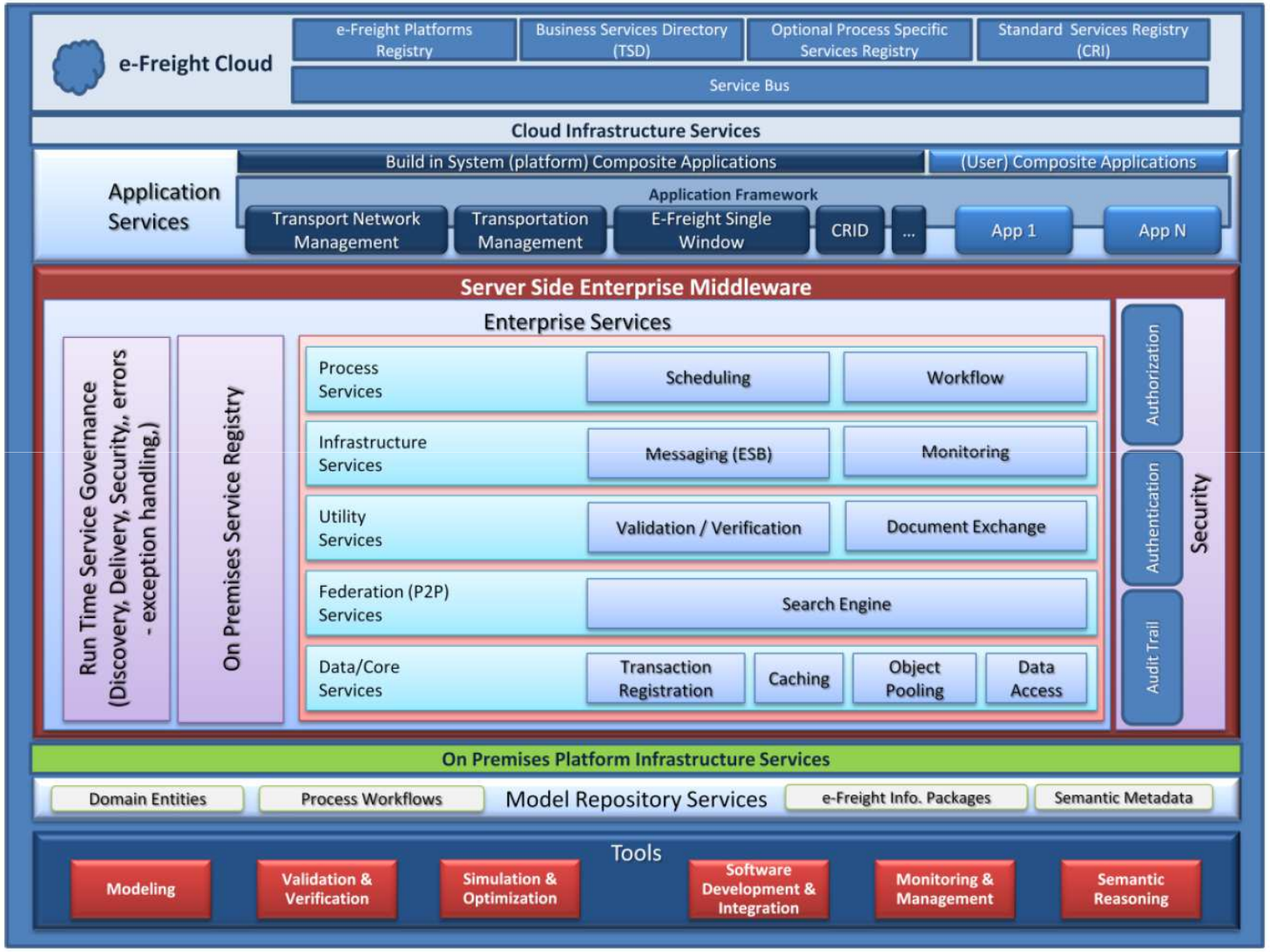
Goals

1. Guided expert review in early design
2. Systematic use of standards and design patterns
3. Portable and maintainable models
4. Multi-aspect validation
5. Deployment support

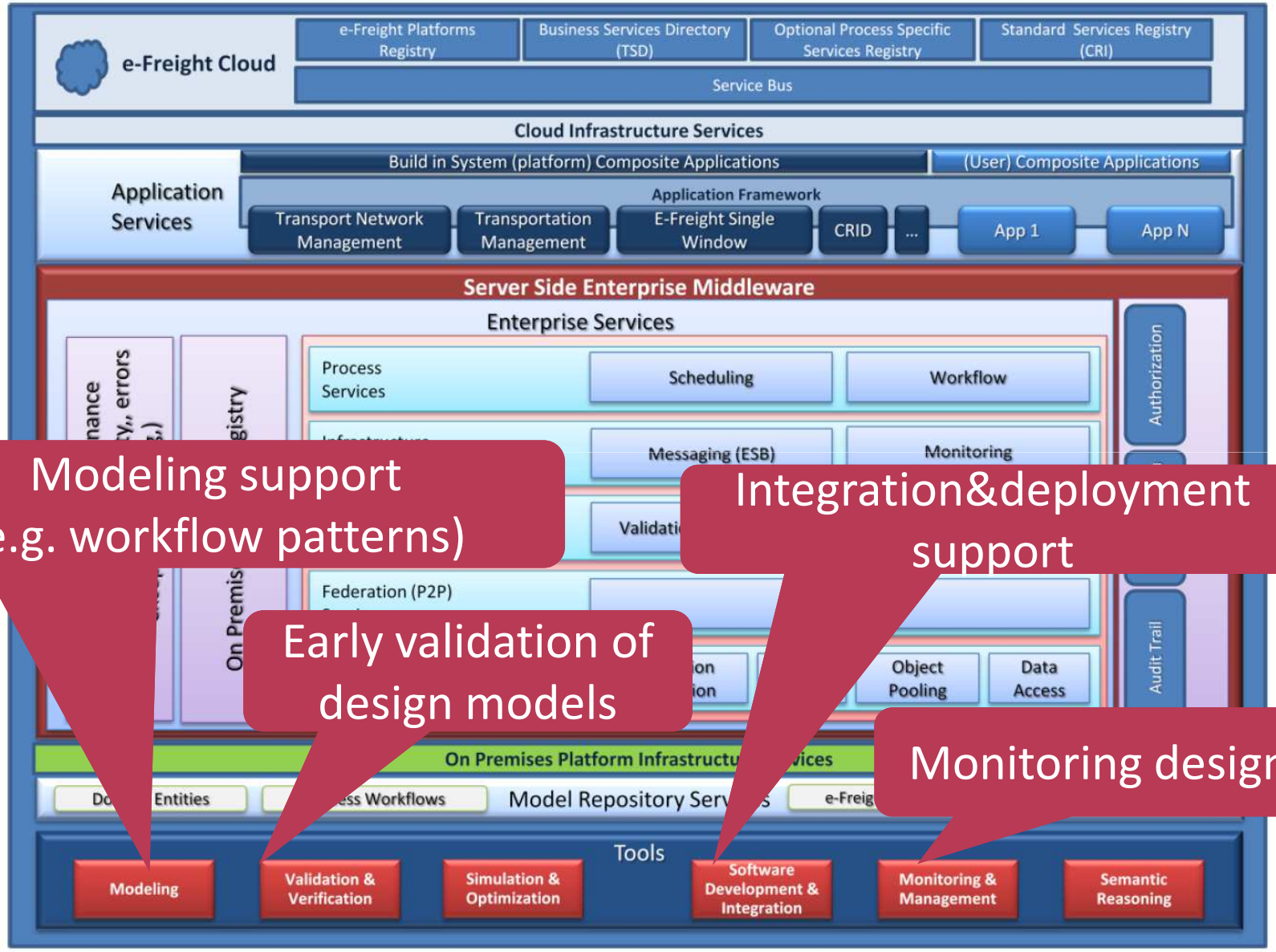
E-Freight approach



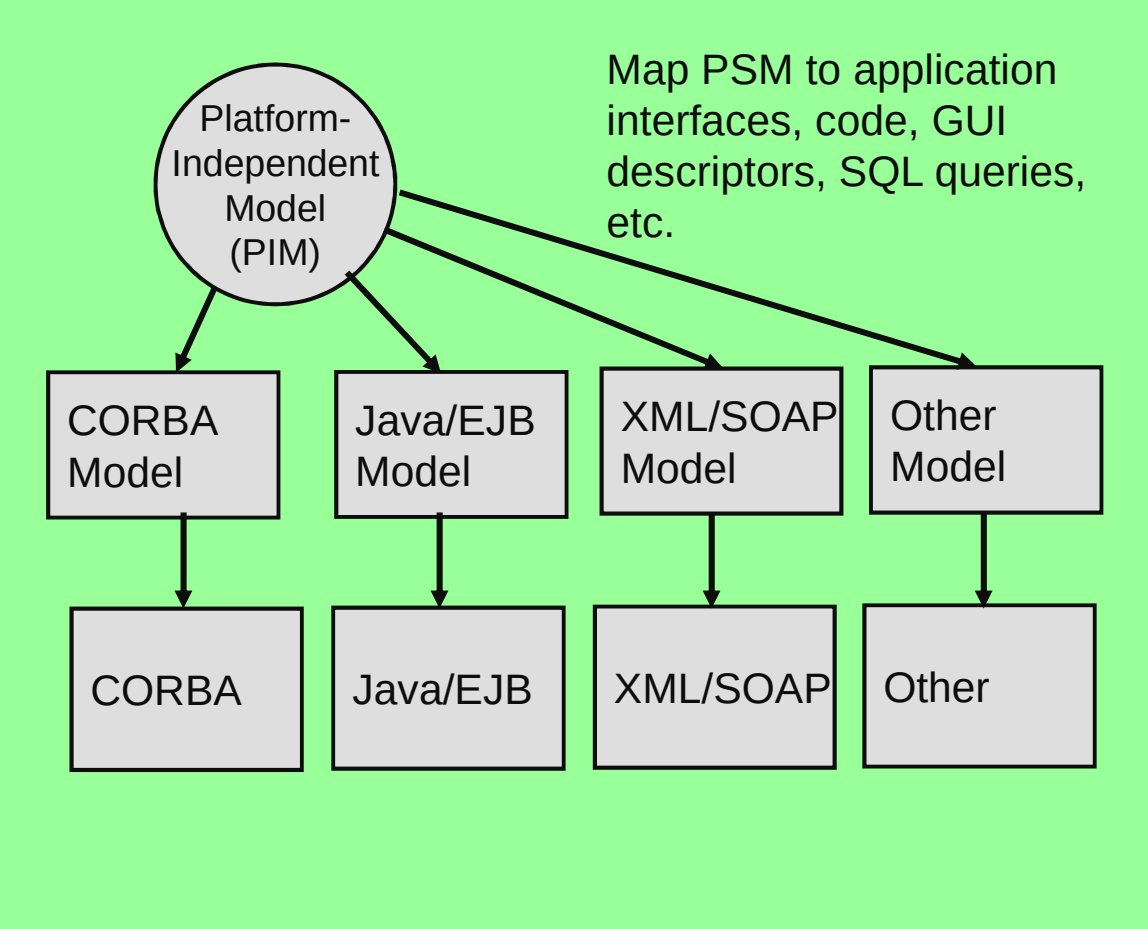
Relationship with e-Freight platform



Relationship with e-Freight platform

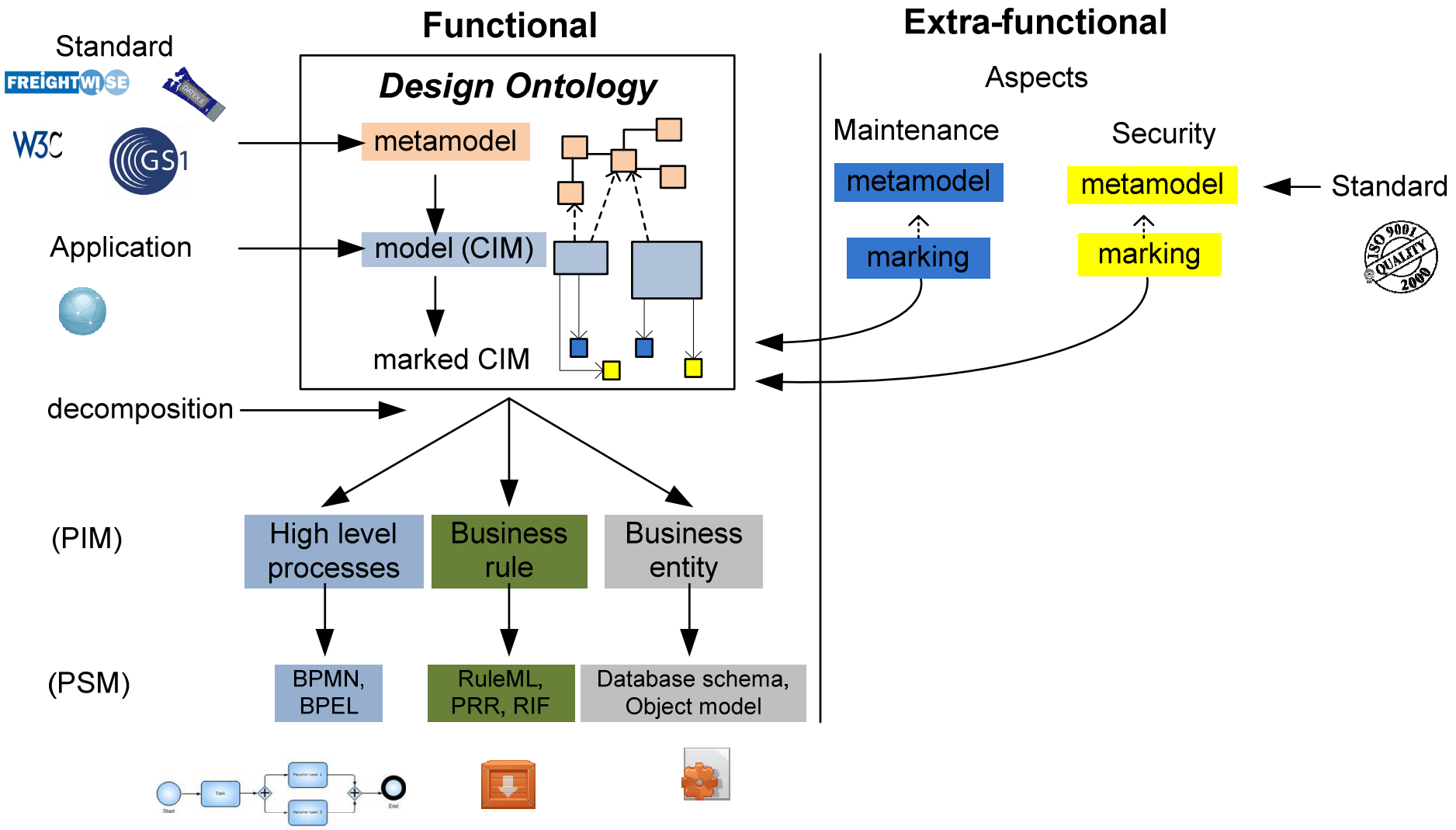


Traditional MDA (deployment)

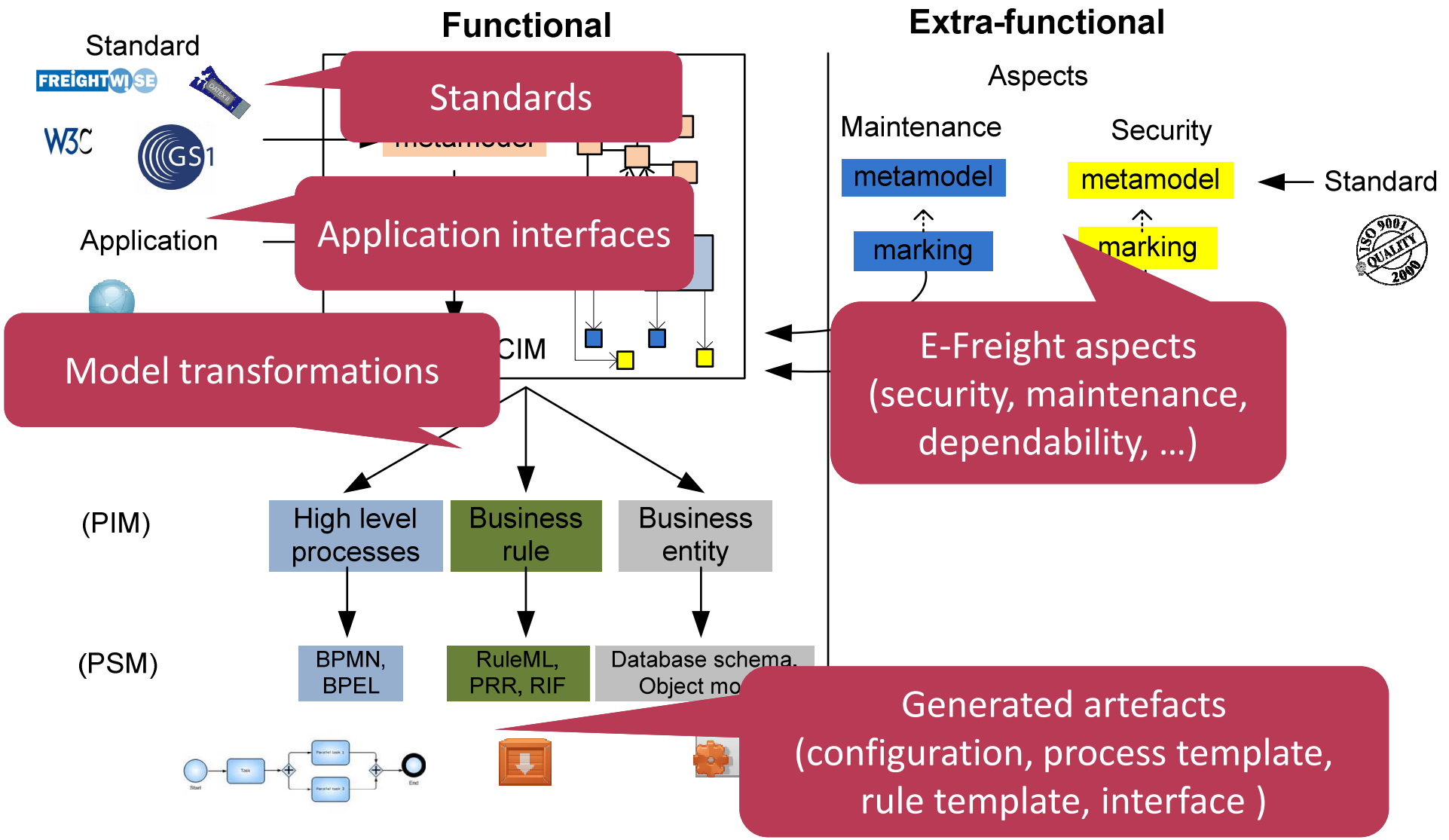


MDA Tool should generate all or most of the implementation code for deployment technology selected by the developer.

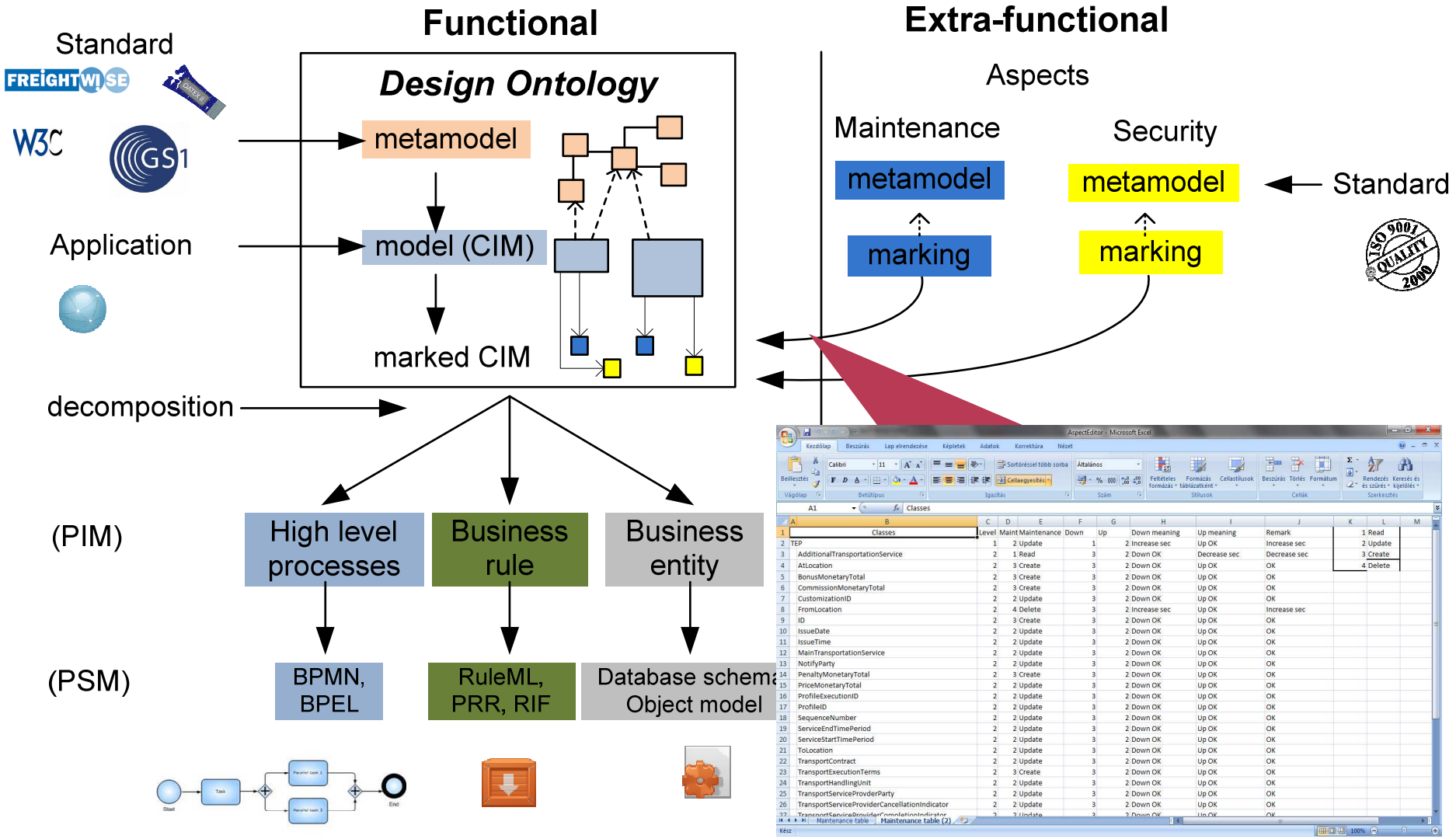
Ontology-supported MDA



Ontology-supported MDA



Ontology-supported MDA



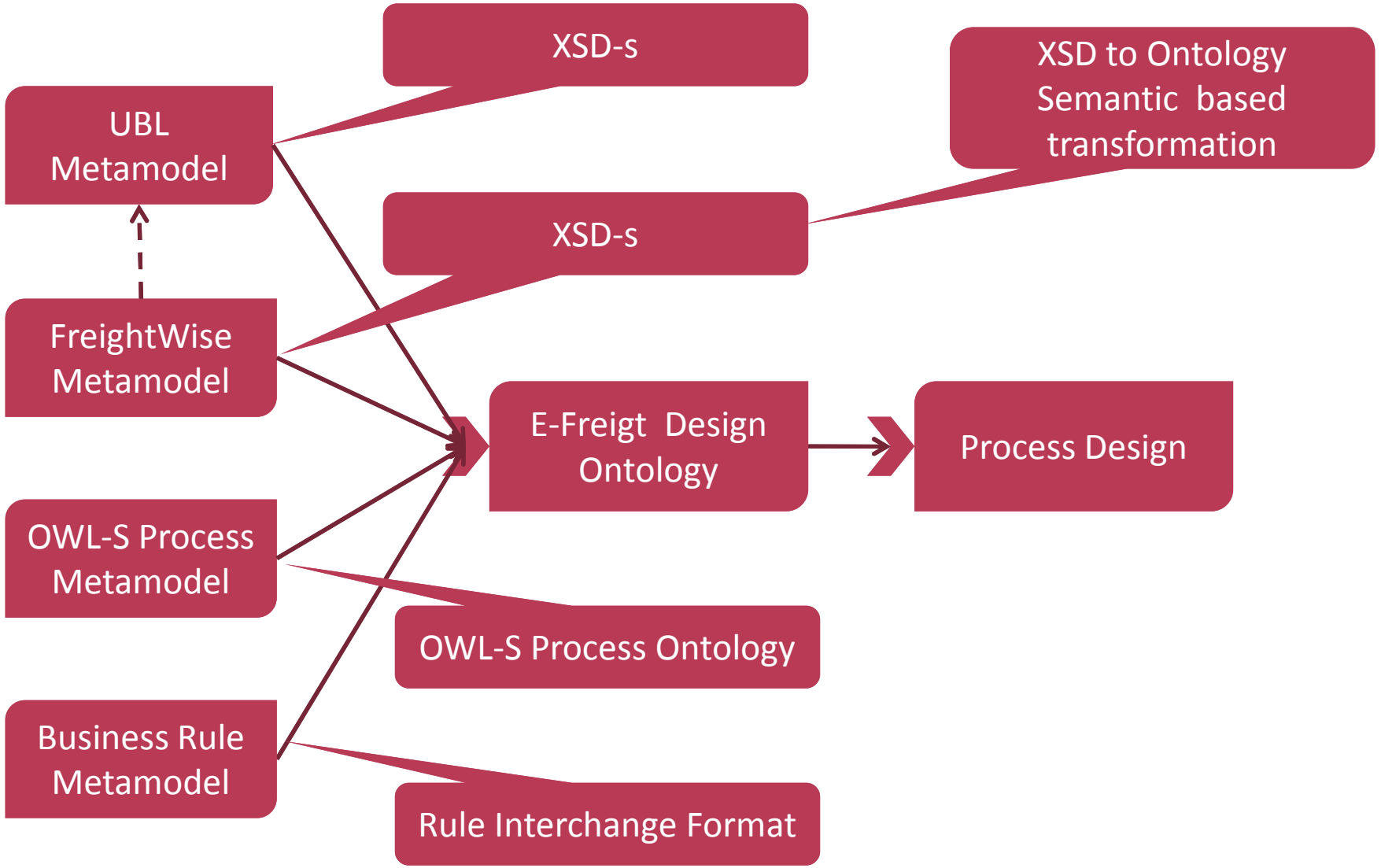
Use case collection

- Functionalities of the system
- Can be derived from
  - User requirements
  - Protocols (existing)
  - Service Interfaces (existing)
  - Regulations
- Semi-automated help for process design

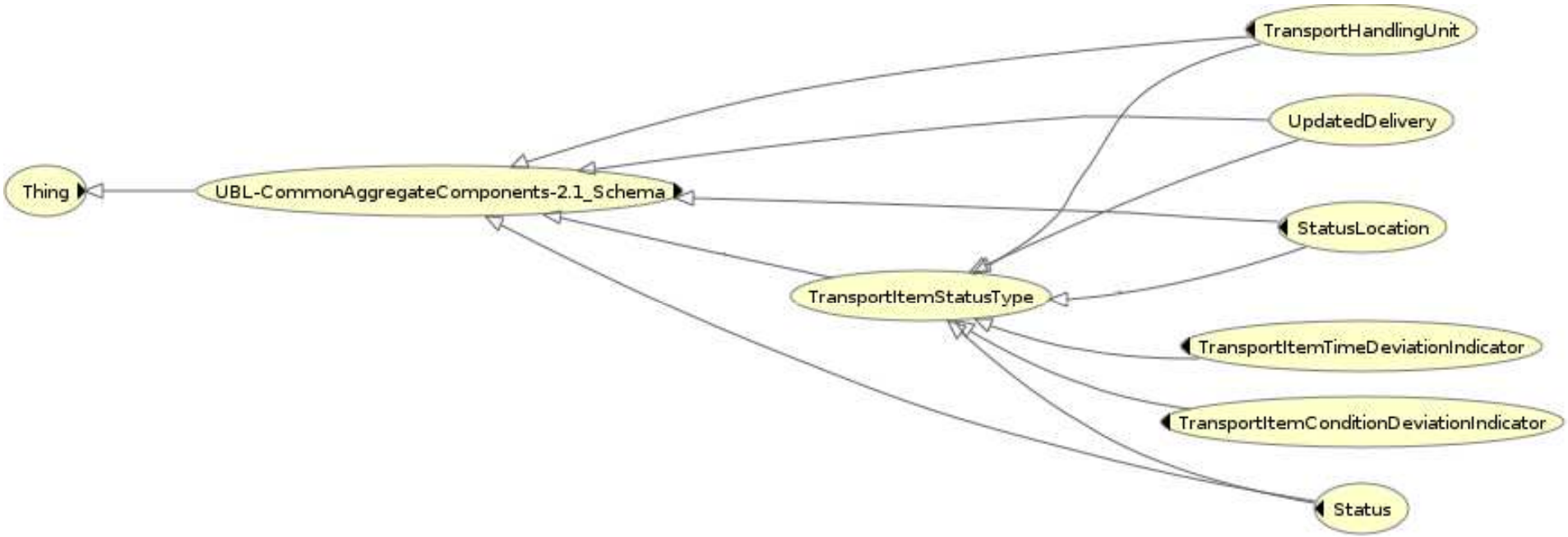
Business action collection

- Refinement from use cases
- Based on service descriptors
- Regulations (e.g. “upload transport data”)
- Business cases (“load frozen cargo”)
- Patterns
  - “collect all quotes with time limit”,
  - “apply four eye principle”
- “Meet in the middle” approach
- Will translate to
  - Subprocesses
  - Rulesets
  - Human tasks
  - Service invocations
  - Database procedures (as services)
  - (Local data transformation)

E-Freight Design Ontology – current status



E-Freight Design Ontology excerpt

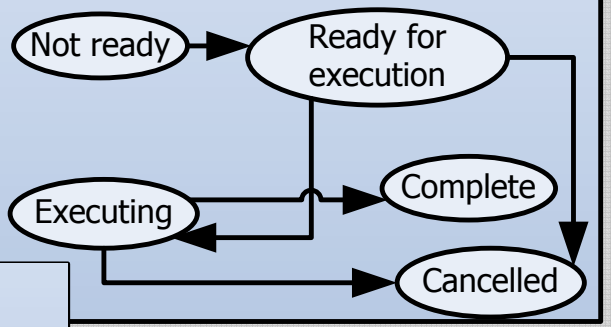


Role of business entities

Access Rights

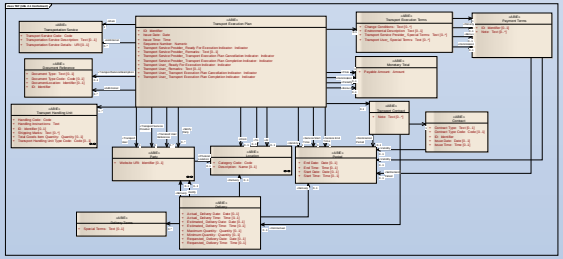
	NotR	RFE	E	Cmpl	Ccd
TU	C,R,U,D	R,U	R	R	R
TO	R,U,D	R,U	R,U	R	R
TSP	R,U	R,U	R,U	R	R
TR	R,U	R	R,U	R	R

Life Cycle



Business Entity Type

Information Model



Notifications

Update notification

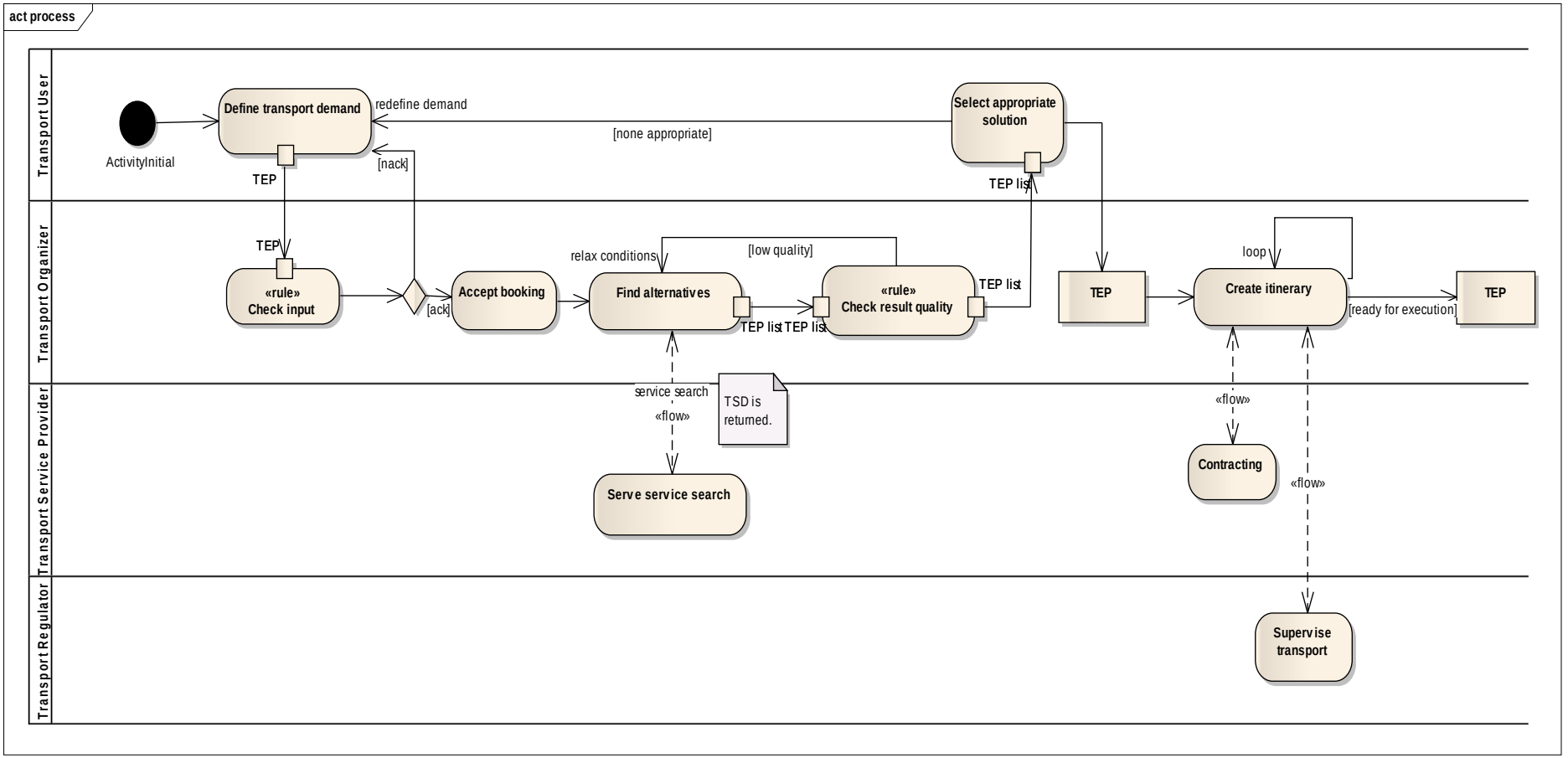
Incompliance notification

High level business processes

- Similars to those in current specifications (e.g. Freightwise, internal project docs)
- At the level of UML Activity Diagrams/BPMN
- Not executable
- Typically without
  - Exception handling
  - Compensation activities
  - Non-functional aspects
- Business objects
  - “Vocabulary” for business rules
  - Data extended with non-functional attributes
  - From ontology extensions (by experts)

High level example

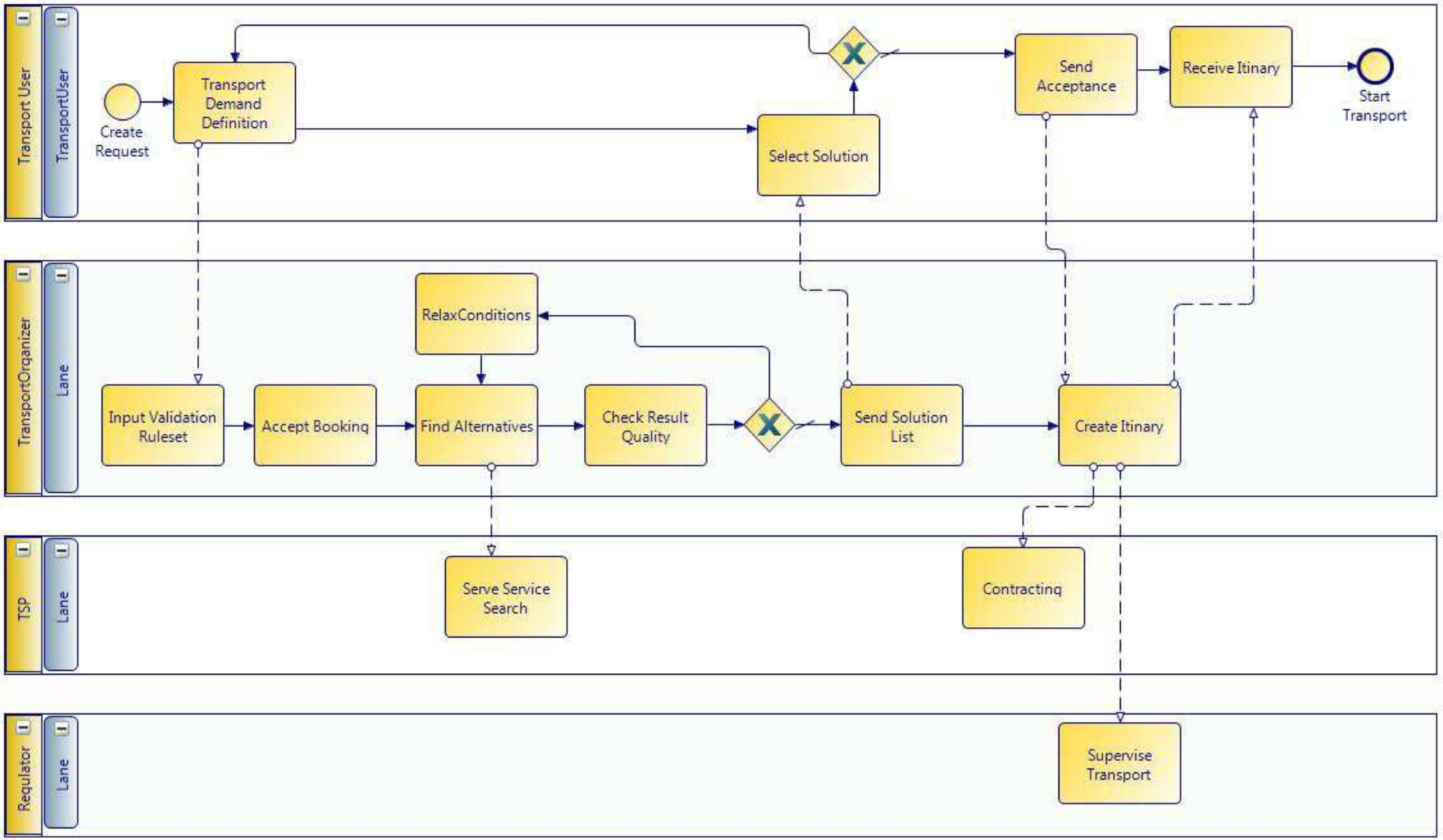
- TEP creation



Platform independent model

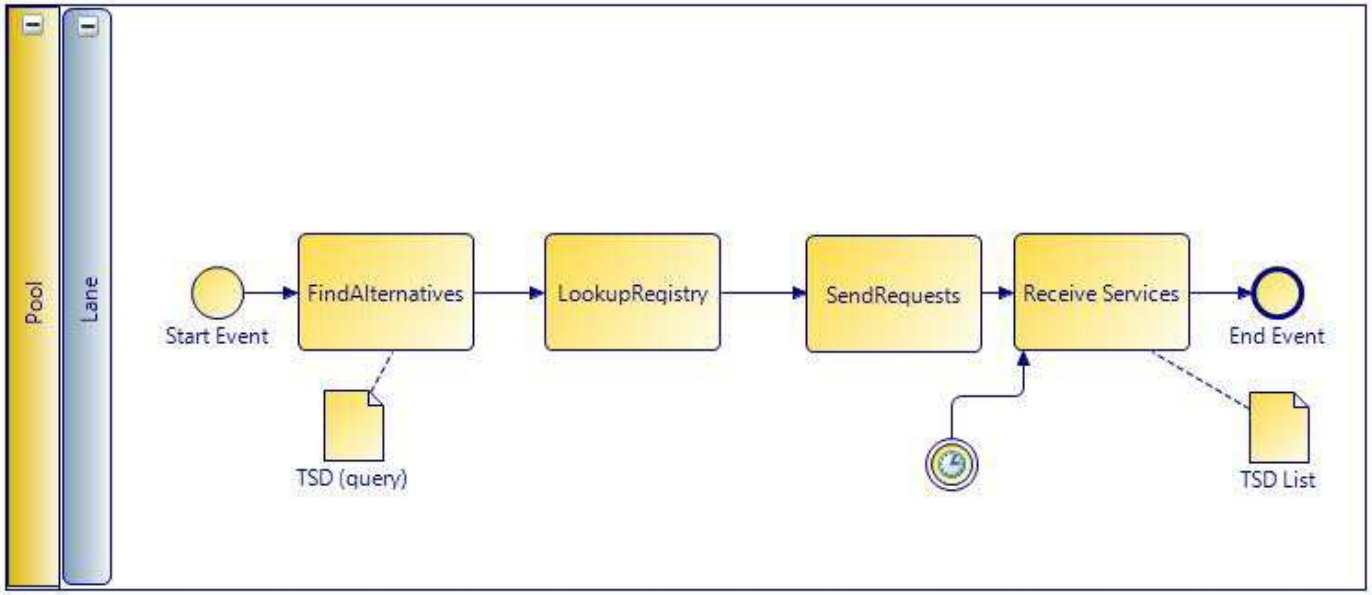
- Logically executable
- Tool/platform independent
- Enriched with aspects from ontology
  - Maintainability (e.g. price calculation)
- Refinement
  - According to protocols/interfaces
  - Maintainability aspects
  - Security aspects
  - Other? (Physical security?)

Example: BPMN for TEP creation



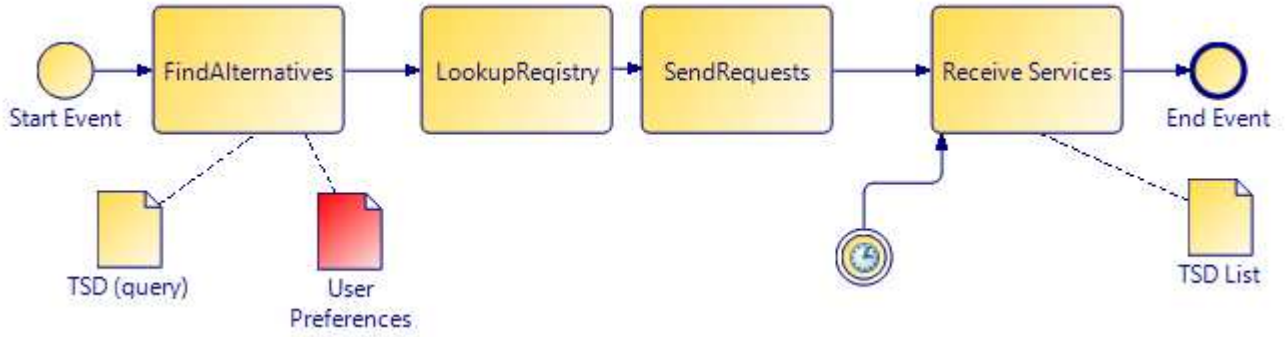
Example: refinement#1

- How to refine the service lookup step?
  - ("Find alternatives")
- The atomic action will be replaced by a subprocess (Local viewpoint)
- Only functional refinement, no additional aspects



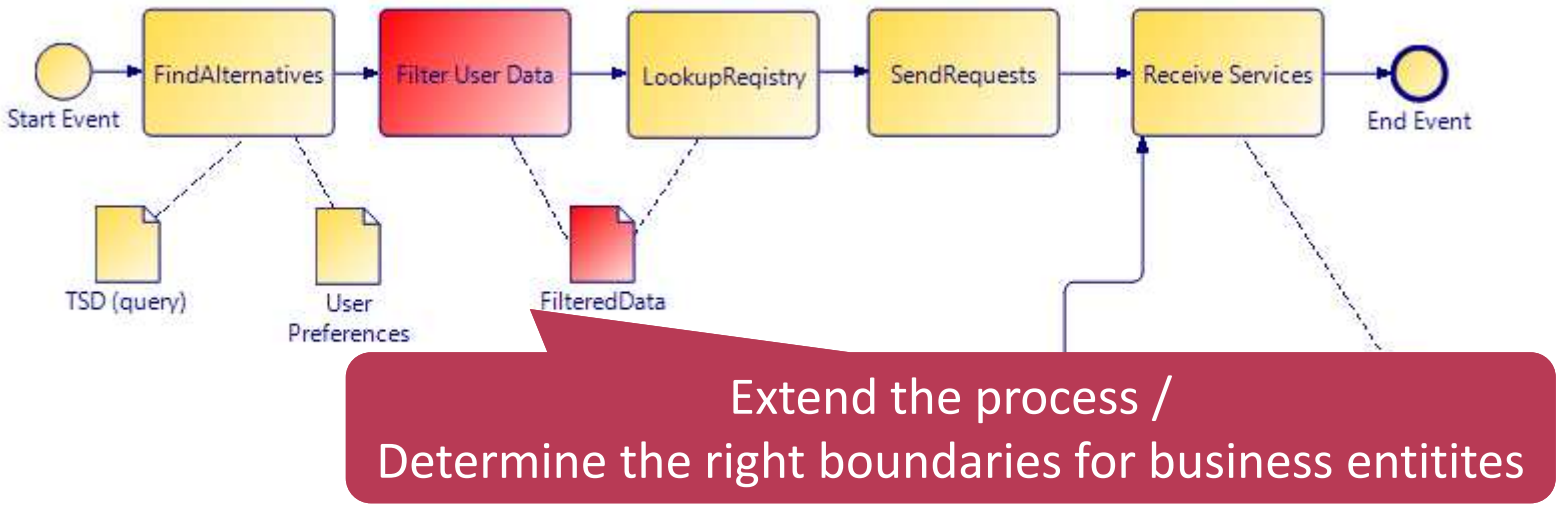
Example refinement#2

- Additional user preferences added to prepare for future service interface enrichment
  - E.g. type of preferred container will be included in some search
- Process maintainability increased



Example: refinement#3

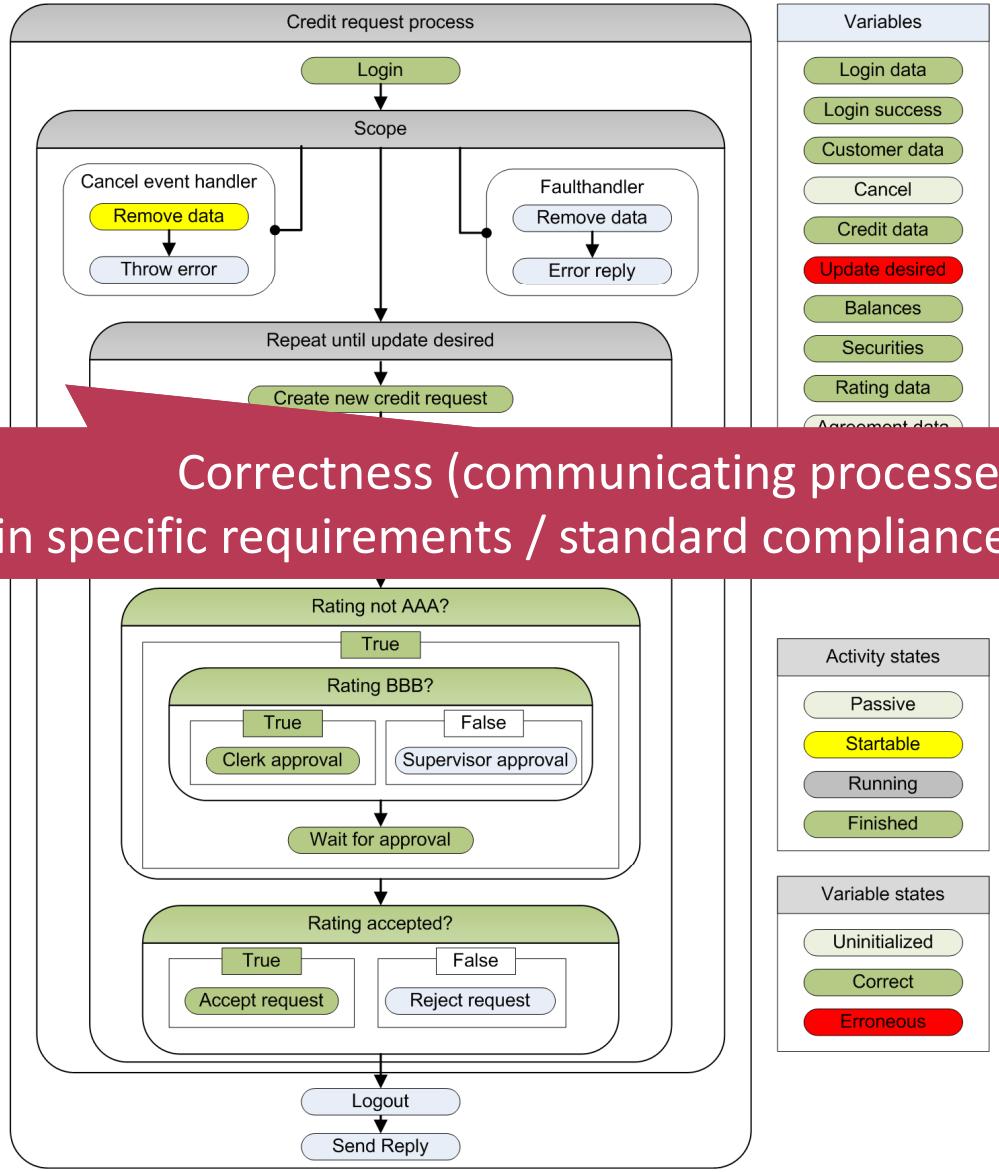
- Security considerations: only a subset of TSD is forwarded in certain cases
  - E.g. in case of protected transport items
- Guidelines: security classification of TSD elements (in the extended ontology)



Platform specific model

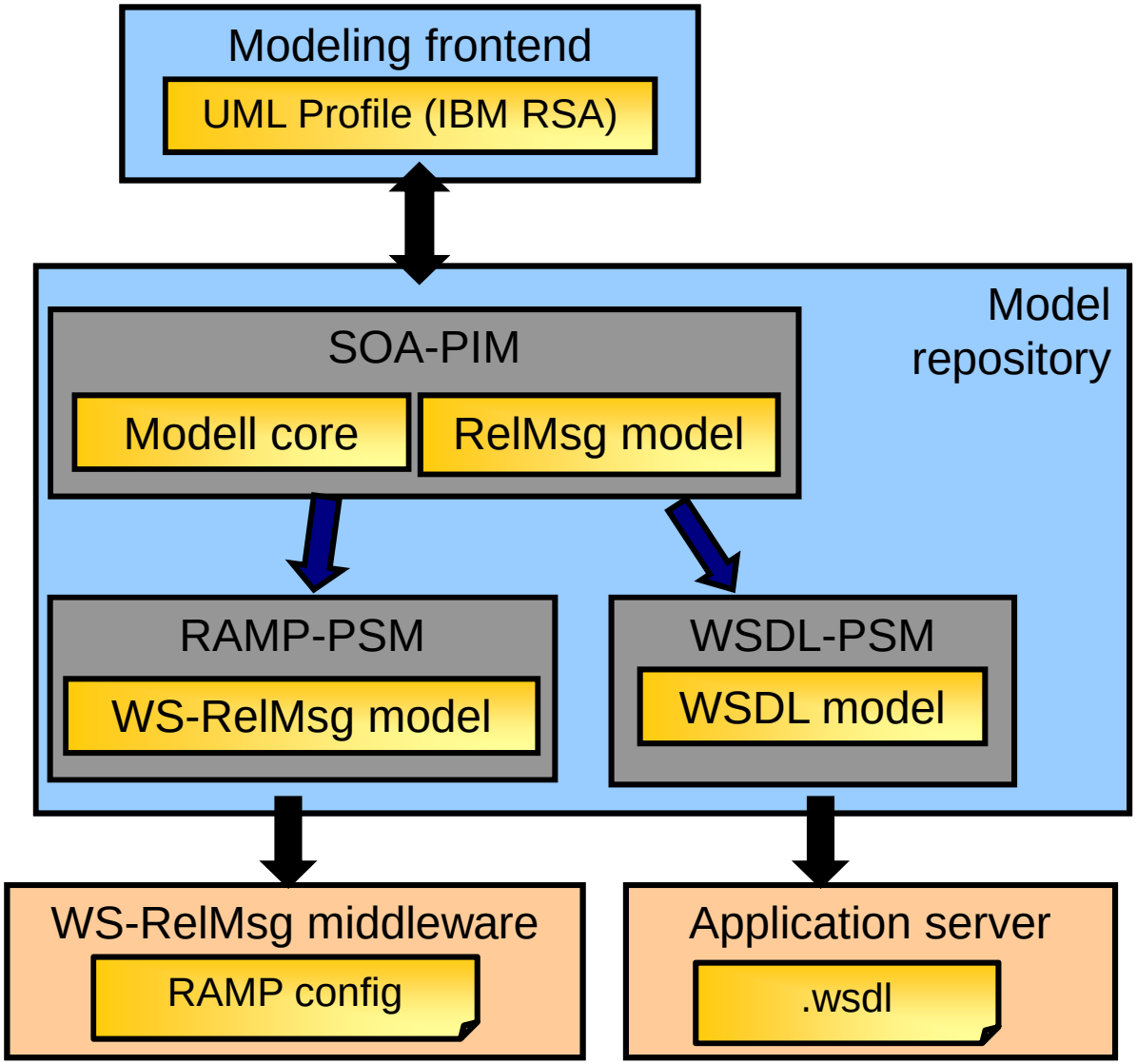
- Binds the process to the execution environment
- E.g. Drools Flow, JBoss jBPM, Microsoft BizTalk BPEL engines, IBM WS Process Server….
- Could be generated automatically
  - Needs additional information from platform library/ service registry

Outlook: Business Process Verification



Correctness (communicating processes)
Domain specific requirements / standard compliance (e.g. reporting)

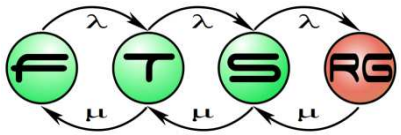
Outlook: Model driven deployment (SENSORIA)



- Apache Axis platform
- IBM RAMP platform (IBM WebSphere)
- AIS (SA Forum): High availability services

Application of e-Freight metamodel

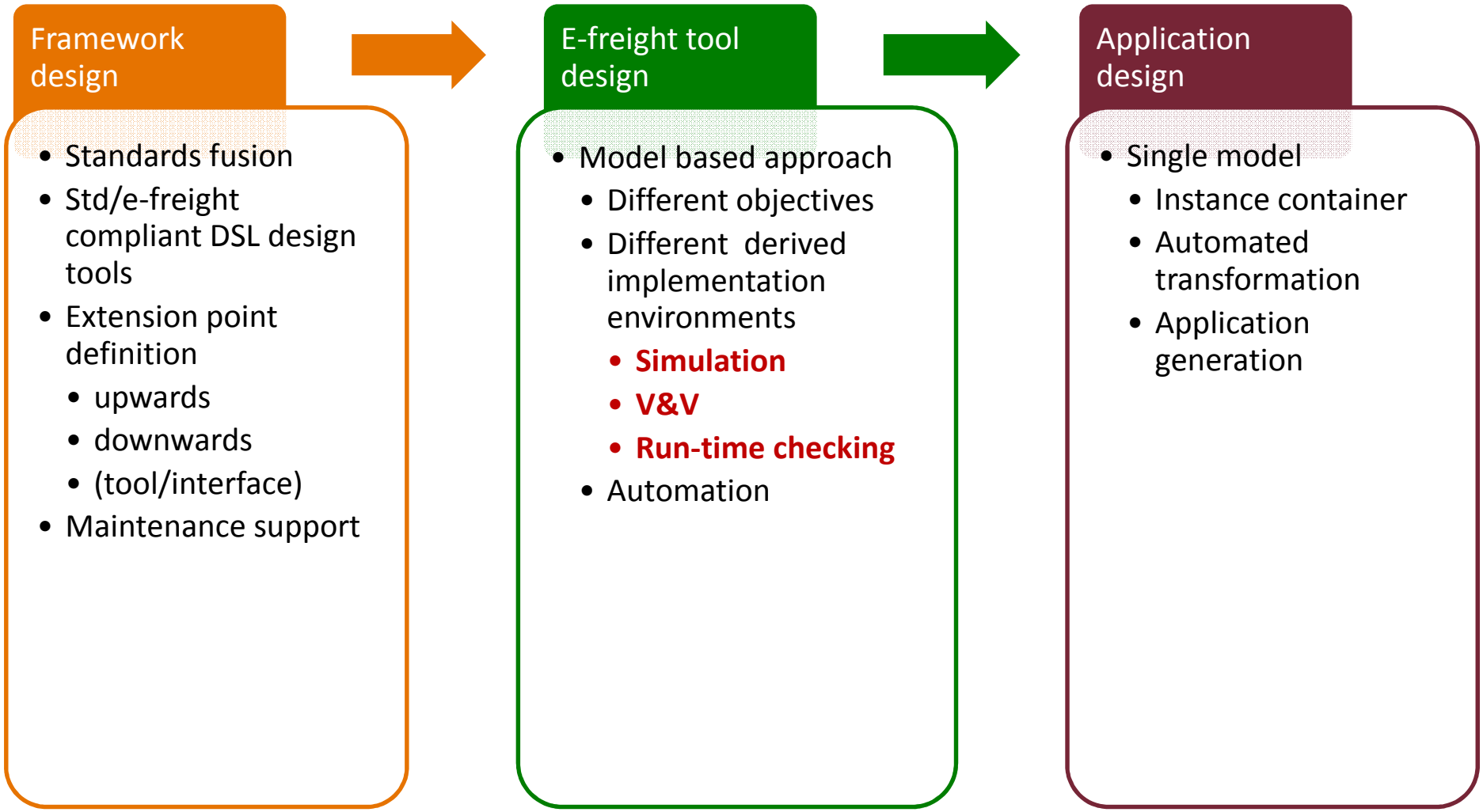
Budapest University of Technology and Economics (BME)
Prof. András Pataricza, László Gönczy, András Kövi, Zoltán Szatmári
{pataric,gonczy,kovi,szatmari}@mit.bme.hu



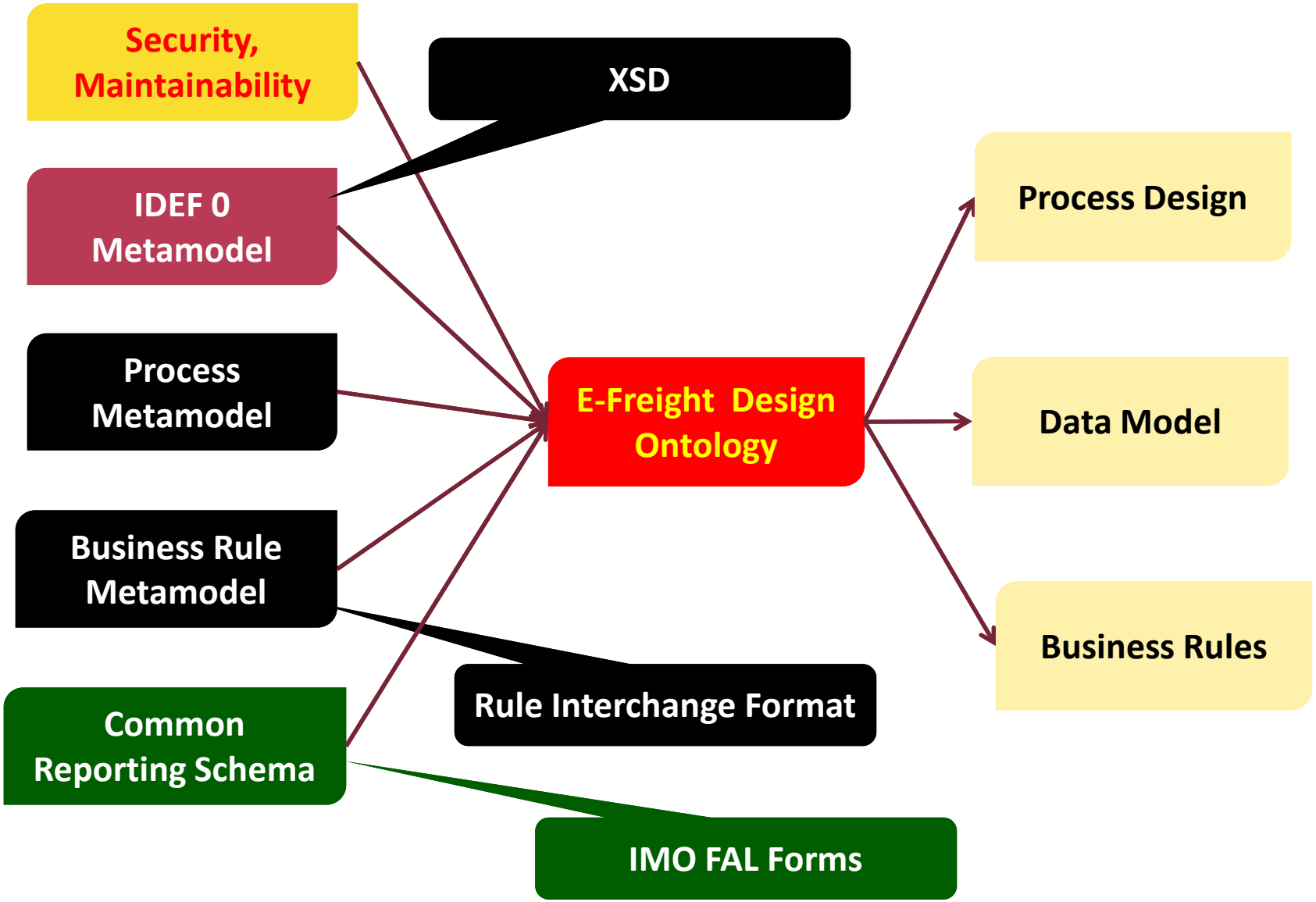
Added value

- Extra-functional properties
  - Maintainability
  - Dependability (availability)
  - Security (confidentiality, integrity)
  - Performance (throughput)
  - Adaptivity
- Design support for
  - Exception handling
  - Format checks
  - „Semantic” checks

e-Freight „design ontology”



E-Freight Design Ontology – current status

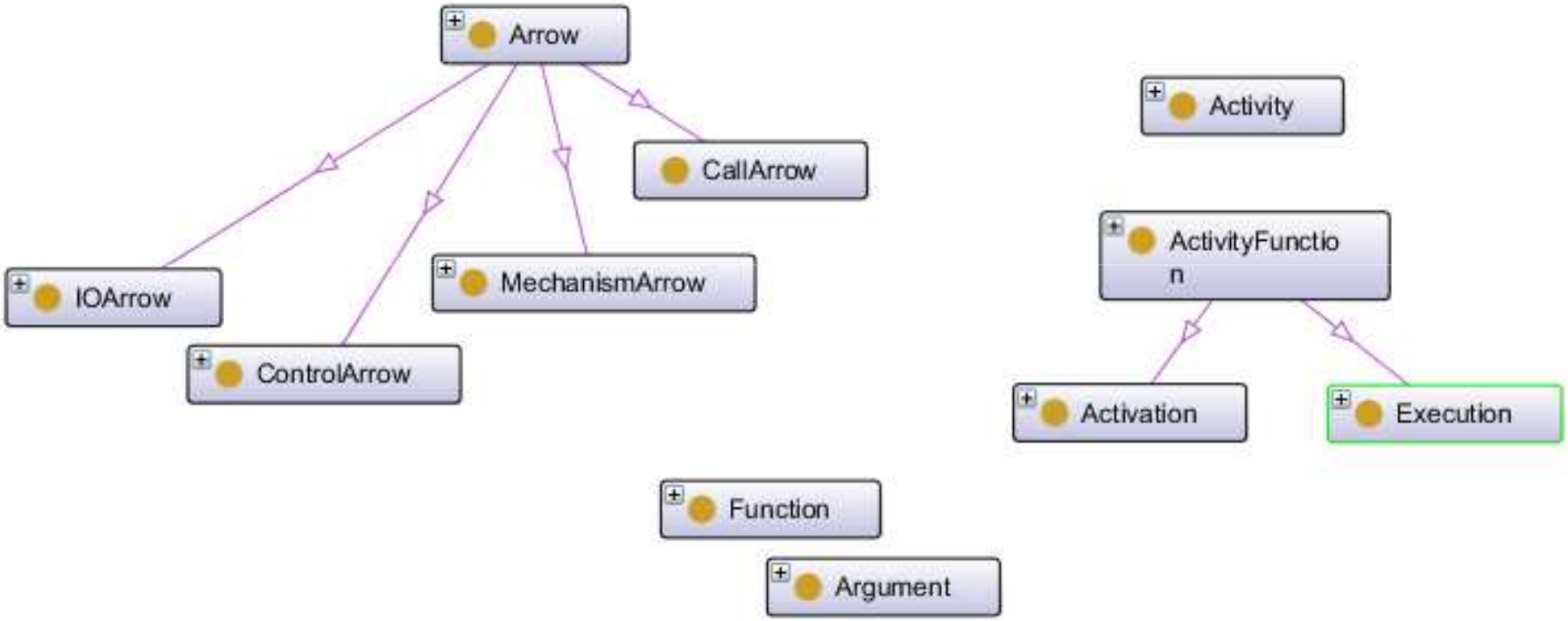


Related ontologies

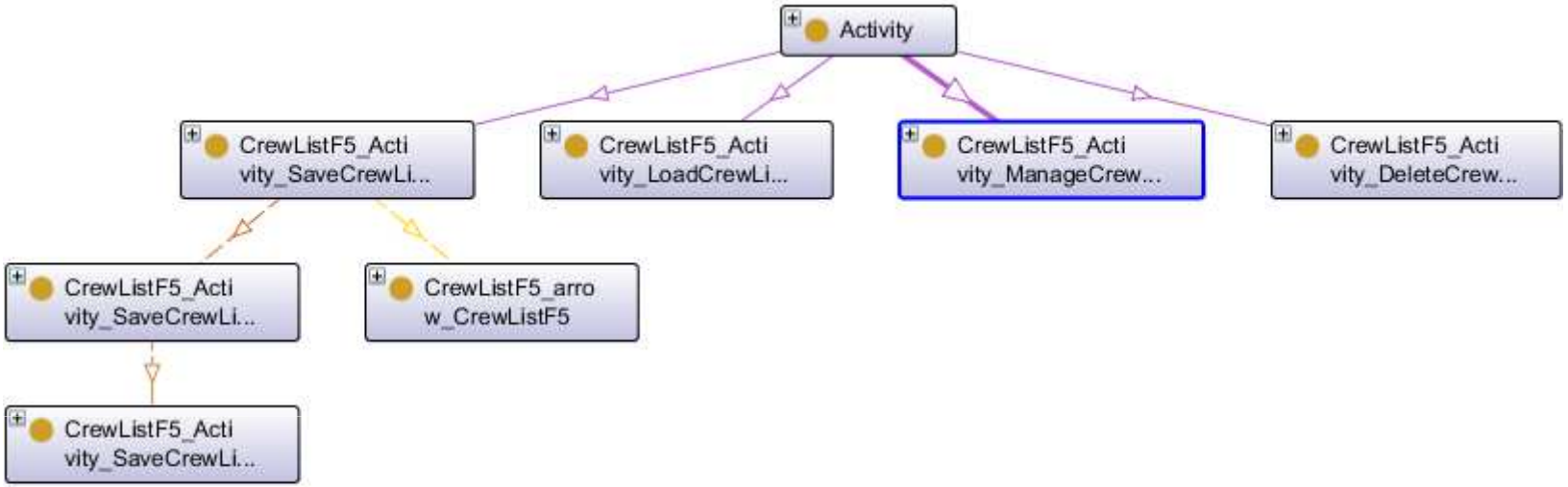
- **Transportation Ontology**
  - RDF: http://owl.cs.manchester.ac.uk/repository/download?ontology=http://reliant.teknowledge.com/DAML/Transportation.owl&format=RDF/XML
  - On-line: http://pellet.owldl.com/owlsight/?ontology=http://owl.cs.manchester.ac.uk/repository/download?ontology%3Dhttp://reliant.teknowledge.com/DAML/Transportation.owl%26format%3DRDF/XML
- **DAML – Transportation**
  - http://www.daml.org/ontologies/409
- „Information system for freight traceability management in a multimodal transportation context”
  - http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5069433

IDEF models in ontology

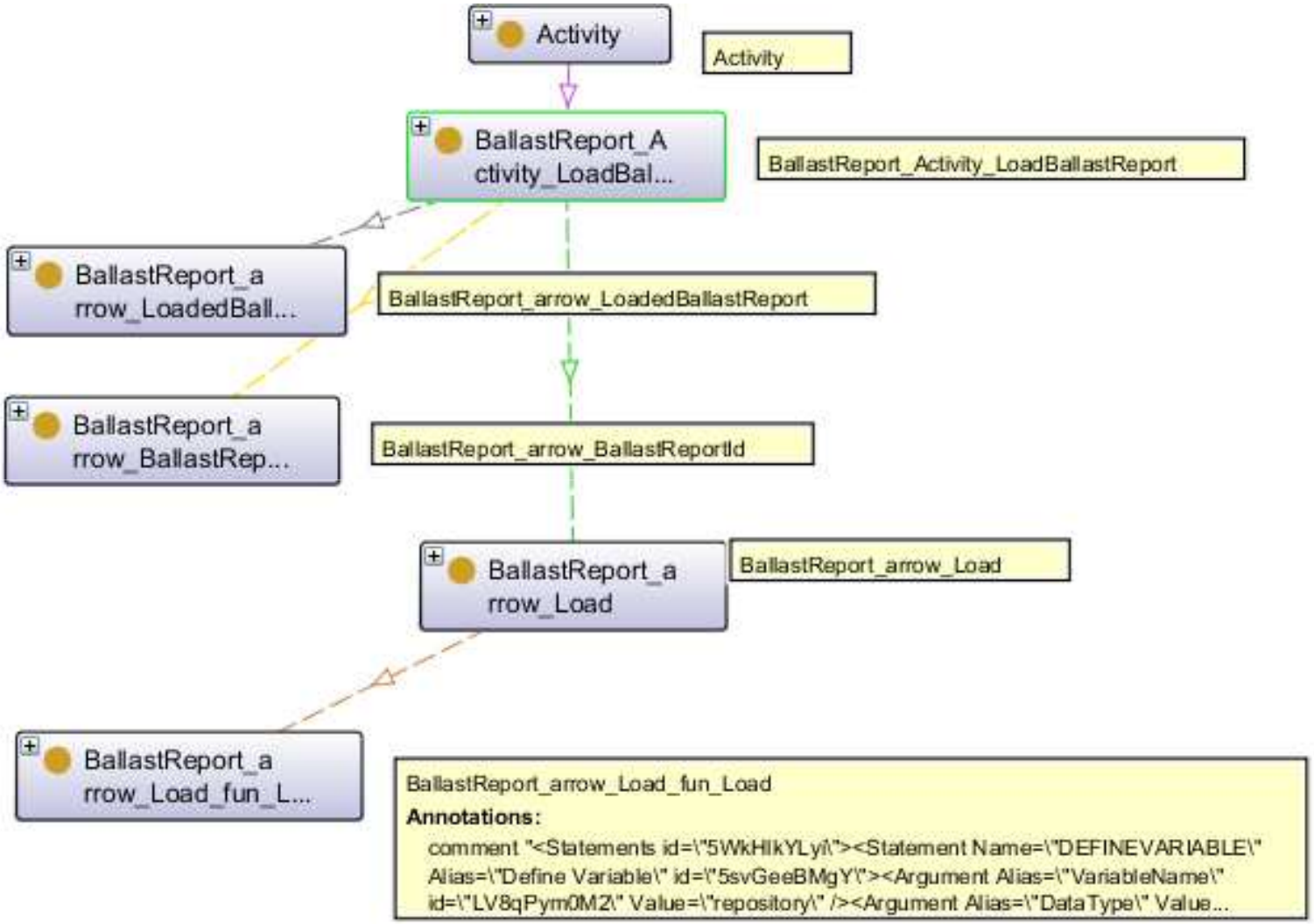
IDEF0 in metamodel



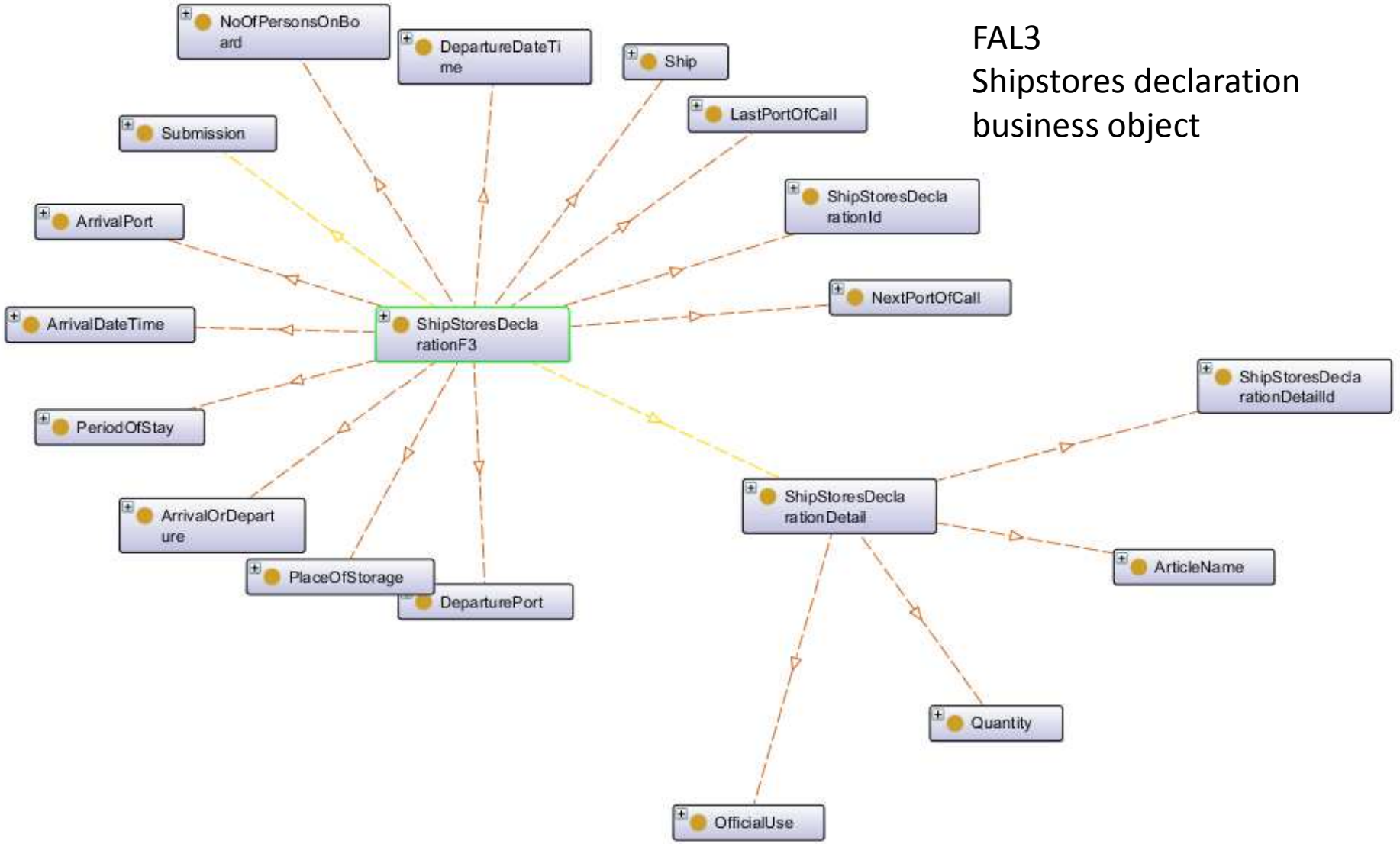
Instance


Activity
CrewListF5_Acti vity_SaveCrewLi...
CrewListF5_Acti vity_LoadCrewLi...
CrewListF5_Acti vity_ManageCrew...
CrewListF5_Acti vity_DeleteCrew...
CrewListF5_Acti vity_SaveCrewLi...
CrewListF5_arro w_CrewListF5
CrewListF5_Acti vity_SaveCrewLi...

Example activity



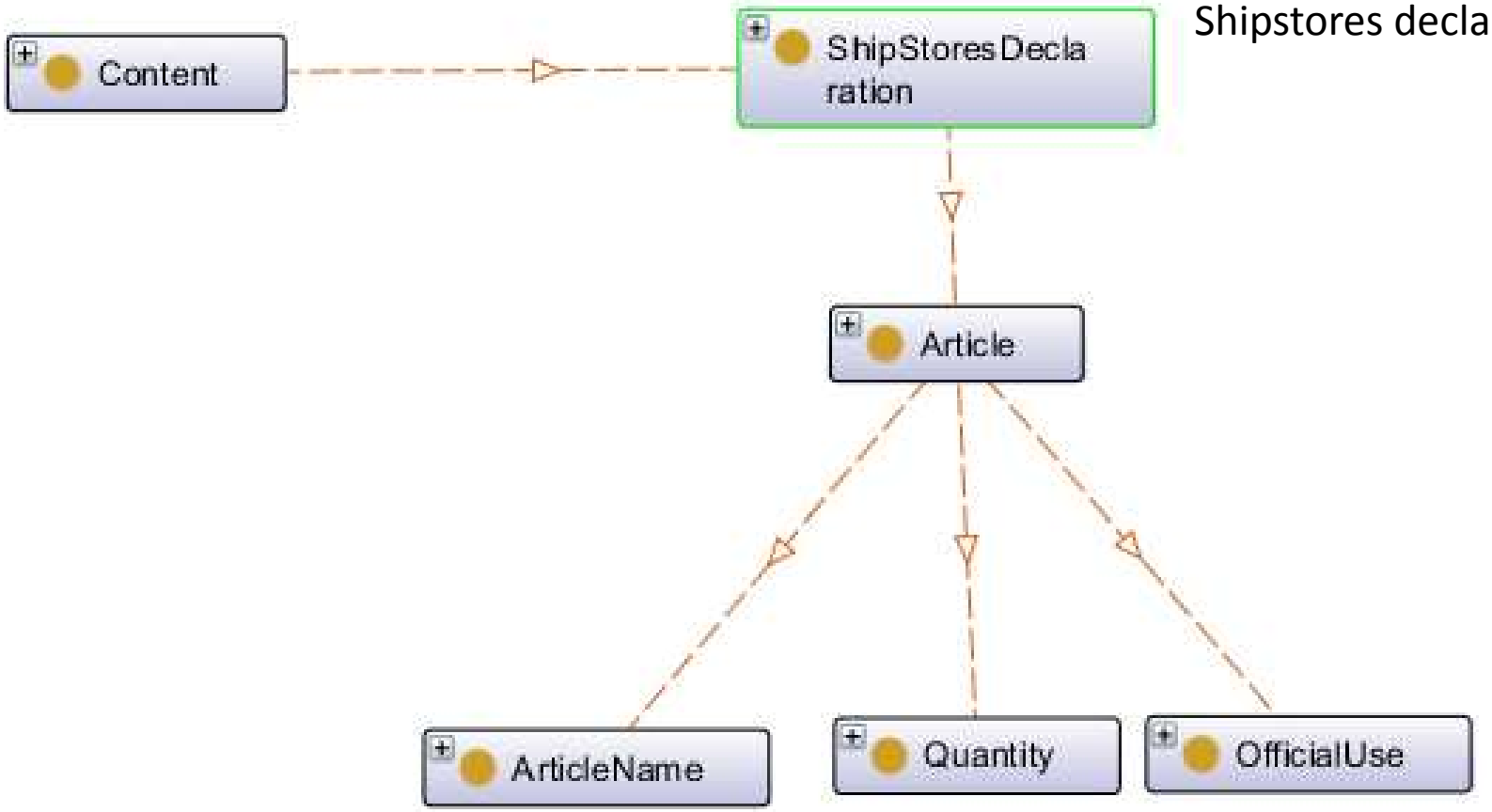
Metamodel integration



FAL3
Shipstores declaration business object

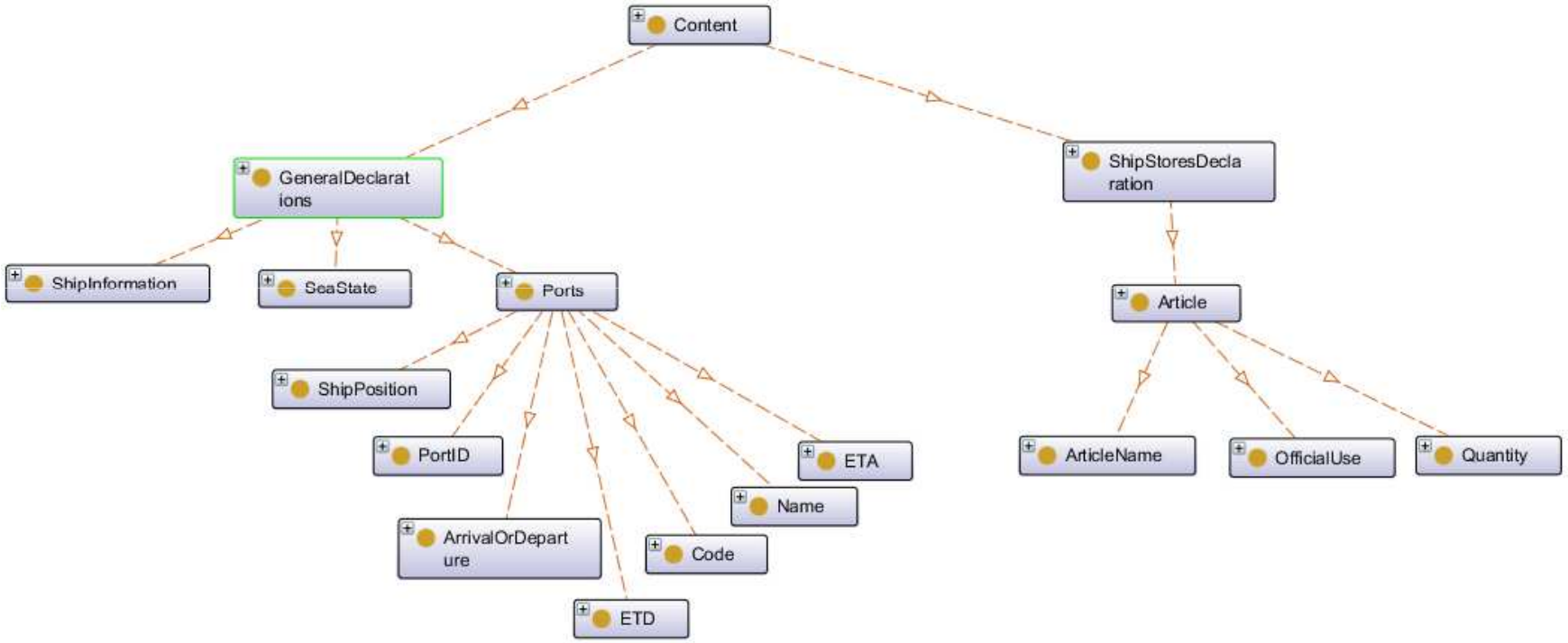
Metamodel integration

CRS
Shipstores declaration

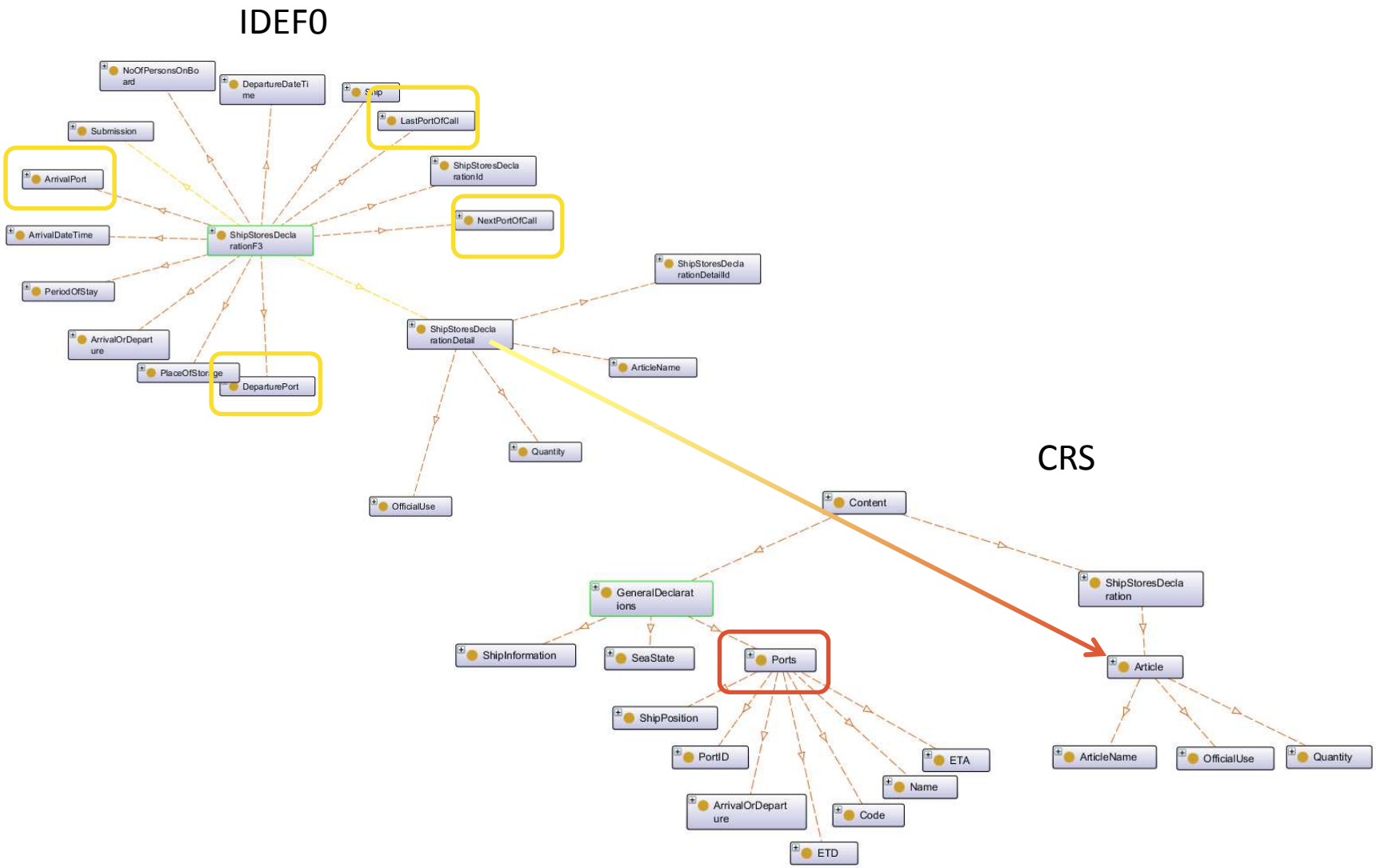


Metamodel integration

FAL3 information in CRS

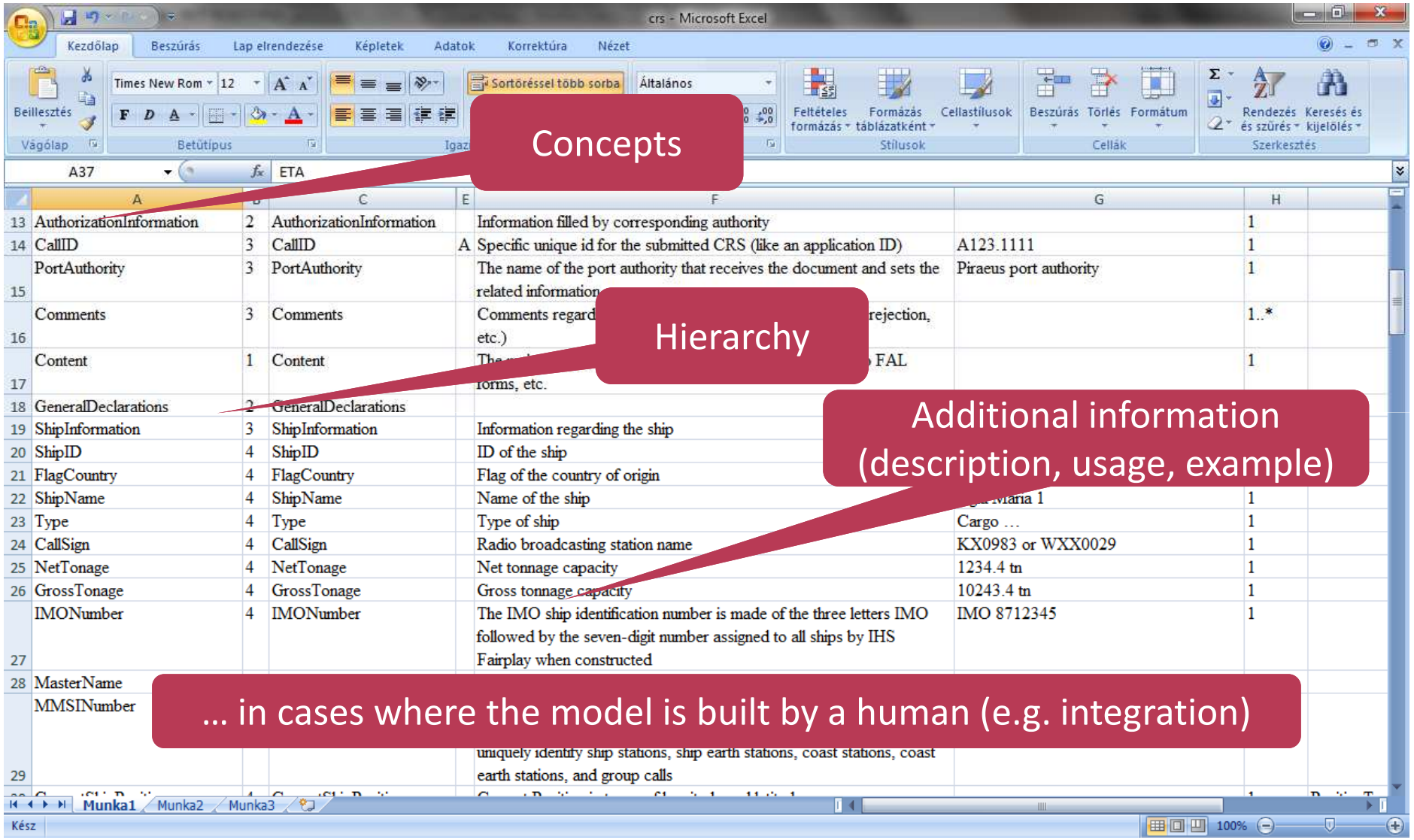


IDEF – CRS mapping



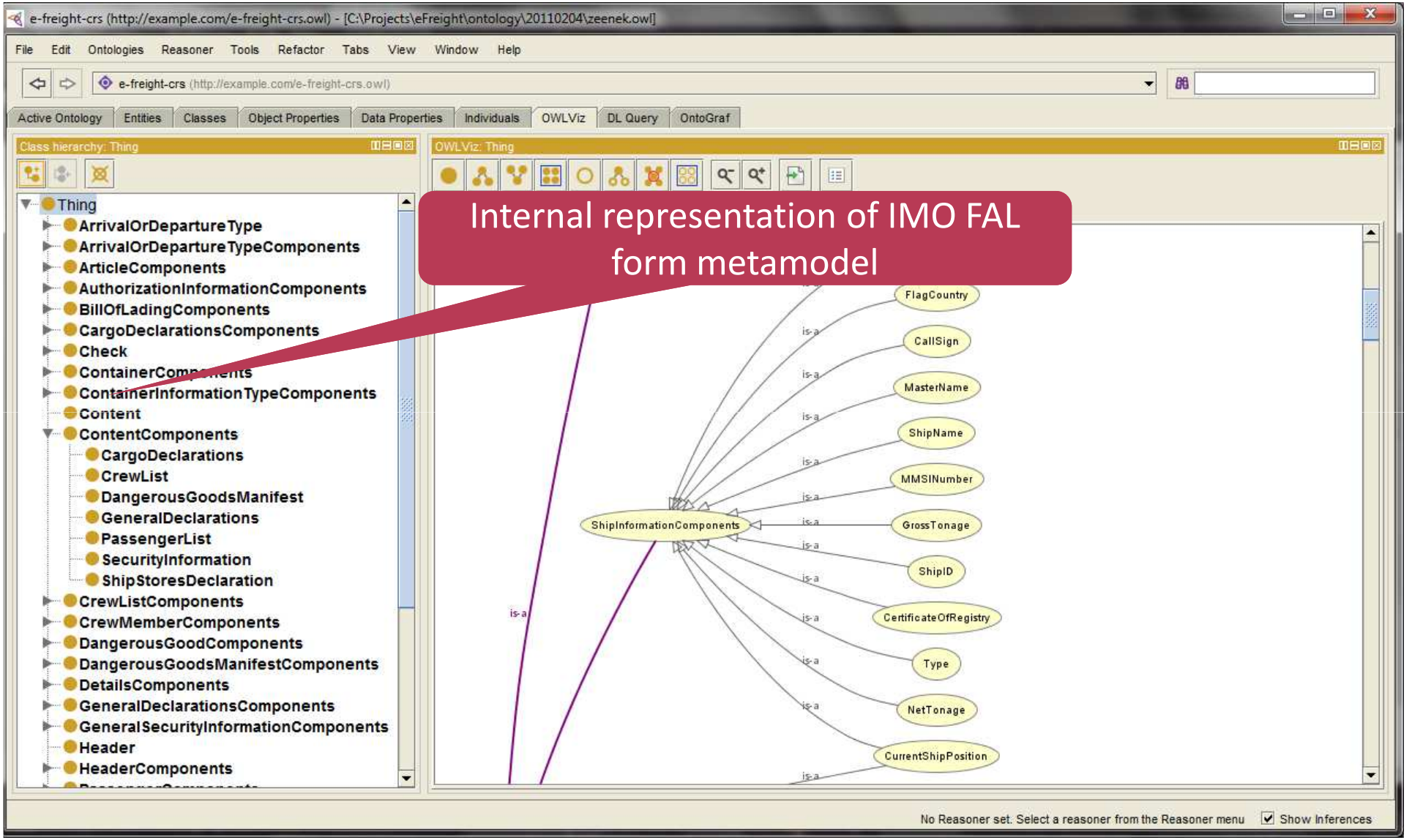
Application

Template-based modeling in Excel

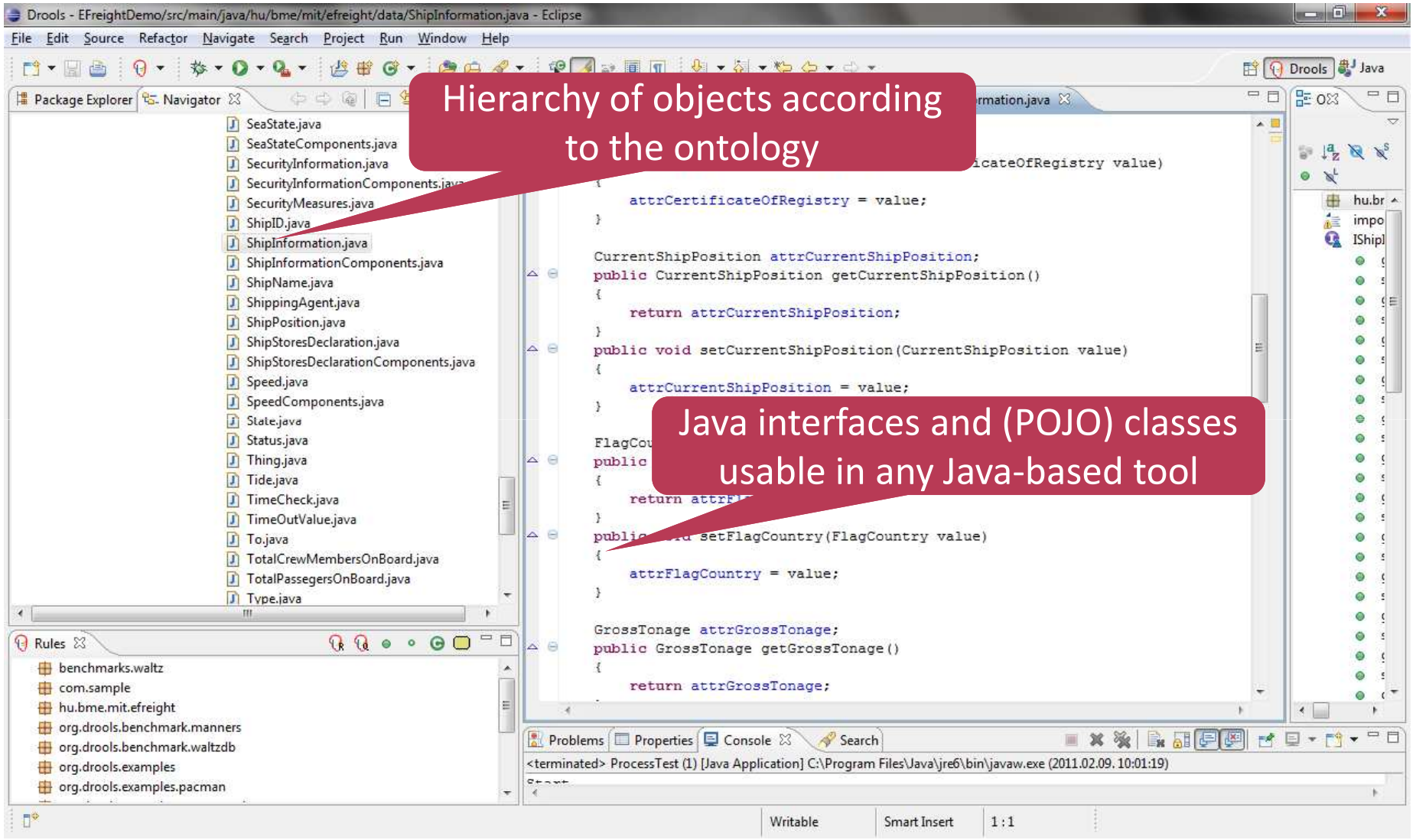


	A	B	C	E	F	G	H
13	AuthorizationInformation	2	AuthorizationInformation		Information filled by corresponding authority		1
14	CallID	3	CallID	A	Specific unique id for the submitted CRS (like an application ID)	A123.1111	1
15	PortAuthority	3	PortAuthority		The name of the port authority that receives the document and sets the related information	Piraeus port authority	1
16	Comments	3	Comments		Comments regard … rejection, etc.)		1..*
17	Content	1	Content		The … FAL forms, etc.		1
18	GeneralDeclarations	2	GeneralDeclarations				
19	ShipInformation	3	ShipInformation		Information regarding the ship		
20	ShipID	4	ShipID		ID of the ship		
21	FlagCountry	4	FlagCountry		Flag of the country of origin		
22	ShipName	4	ShipName		Name of the ship	… Maria 1	1
23	Type	4	Type		Type of ship	Cargo …	1
24	CallSign	4	CallSign		Radio broadcasting station name	KX0983 or WXX0029	1
25	NetTonage	4	NetTonage		Net tonnage capacity	1234.4 tn	1
26	GrossTonage	4	GrossTonage		Gross tonnage capacity	10243.4 tn	1
27	IMONumber	4	IMONumber		The IMO ship identification number is made of the three letters IMO followed by the seven-digit number assigned to all ships by IHS Fairplay when constructed	IMO 8712345	1
28	MasterName						
29	MMSINumber				uniquely identify ship stations, ship earth stations, coast stations, coast earth stations, and group calls		

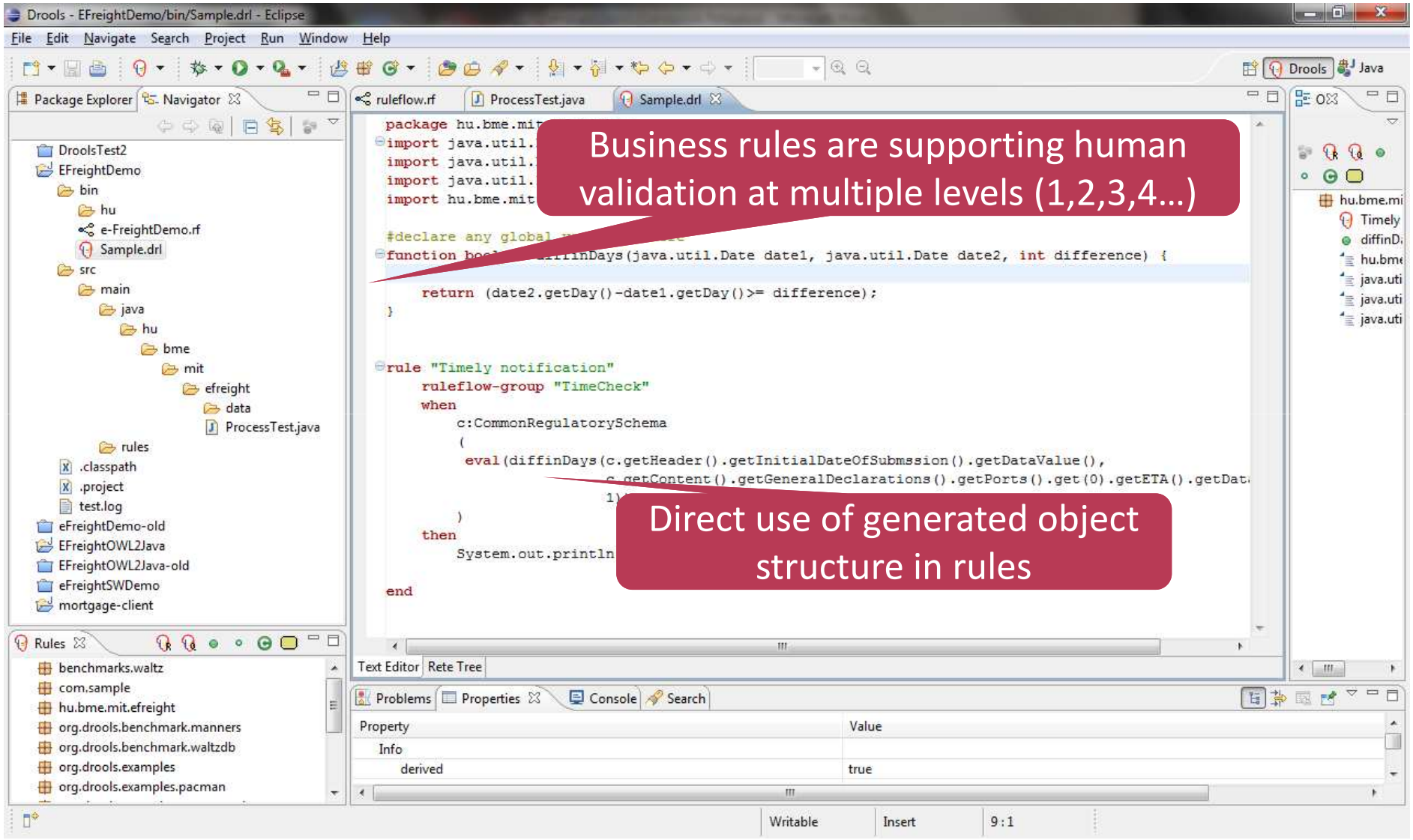
Excerpt of e-Freight ontology



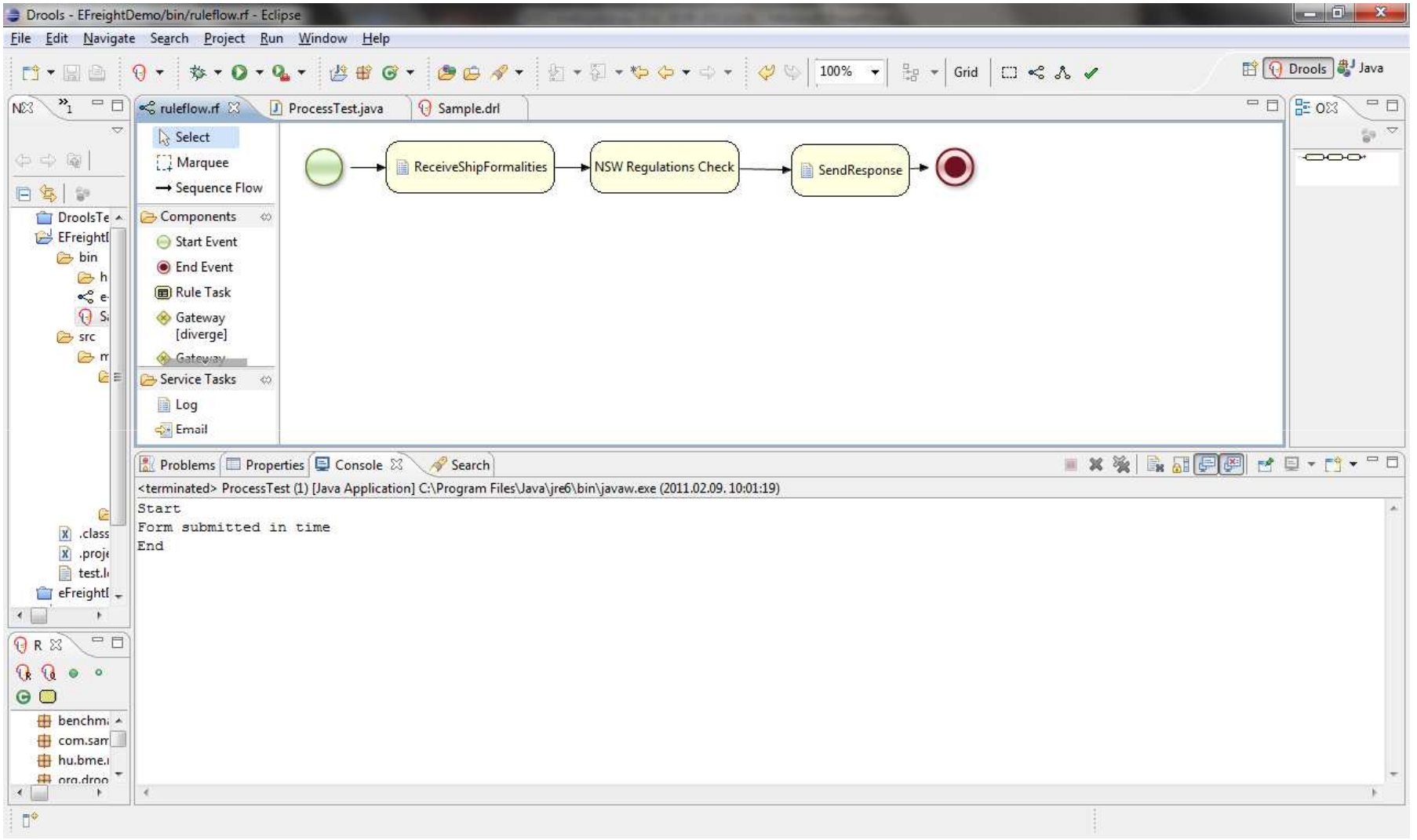
Generated Java classes



Business rule in DROOLS



Business process in DROOLS



Analysis features

- Compliance check: design time / runtime
  - „Is the service provider conform with e-Freight?”
  - „Is a new e-Freight solution using services in the proper way?”
  - „Are we meeting standard/legal/local requirements?”
- Security checks
  - Data access is conformant with security regulations
  - May change from country to country
- Impact analysis of a change
  - Guidance for designers

Models in e-Freight (D2.1)