Ontology-based Enterprise Modeling for Human and Machine Interpretation

Prof. Knut Hinkelmann

For latest material see:
http://knut.hinkelmann.ch/lectures/nemo2019

About Me

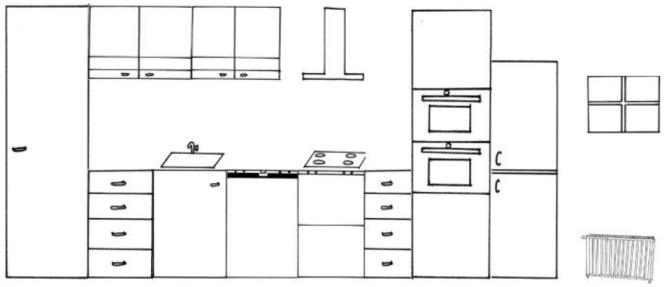
- Head of MSc in Business Information Systems
- Research Associate at University of Pretoria
- Visiting Professor at University of Camerino

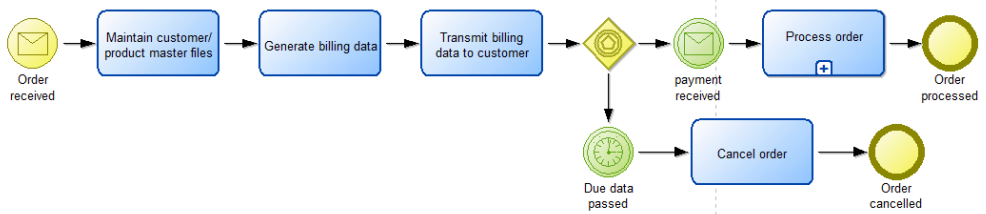
I
Modeling

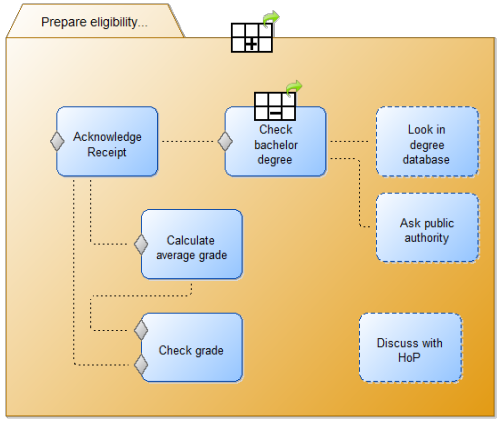
Models

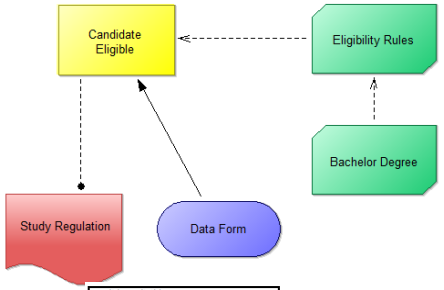
not what we are dealing with

Enterprise Modeling







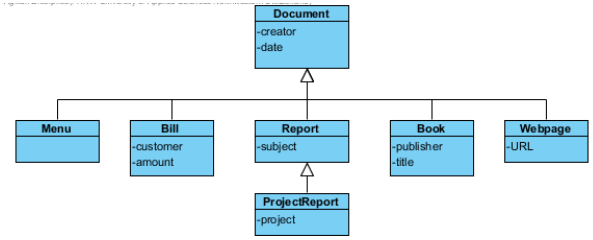


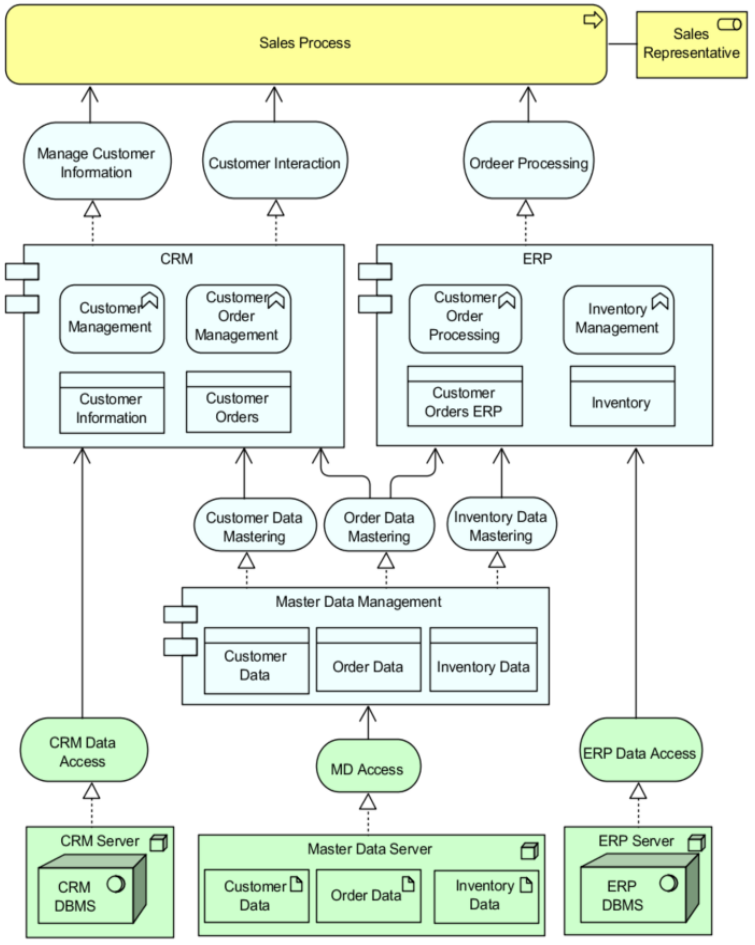
Candidate Eligible

FC	Bachelor Degree	University accredited	eligible
	yes, no	*yes, no, unclear*	*yes, no*
1	yes	yes	yes
2	no		no
3		no	no
4	yes	unclear	yes

Bachelor Degree

FC	Bachelor Degree in	Bachelor Degree
	Information Systems, Business Administration, Information Technology, other, none	*yes, no*
1	Information Systems	yes
2	Business Administration	yes
3	Information Technology	yes
4	other	yes
5	none	no





Learning Goal

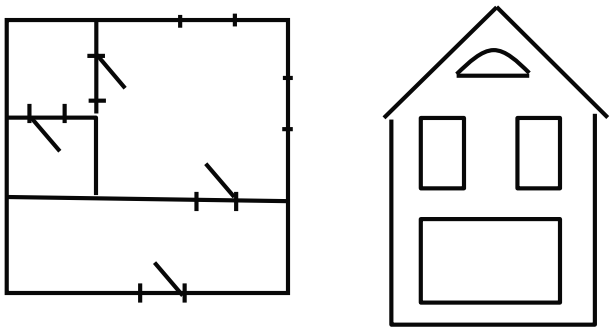
- Domain-specific Modeling
  - Appropriate for decision making and knowledge exchange between humans
  - Appropriate for automated analysis and decision making
  - Adaptable for specific requirements

Models

- A Model is a reproduction of a *relevant* part of reality which contains the essential aspects to be investigated.
- Relevance depends on the
  - purpose (also called concern or goal)
  - stakeholders

real object

models (plan)



Why Modeling: Dealing with Complexity and Change

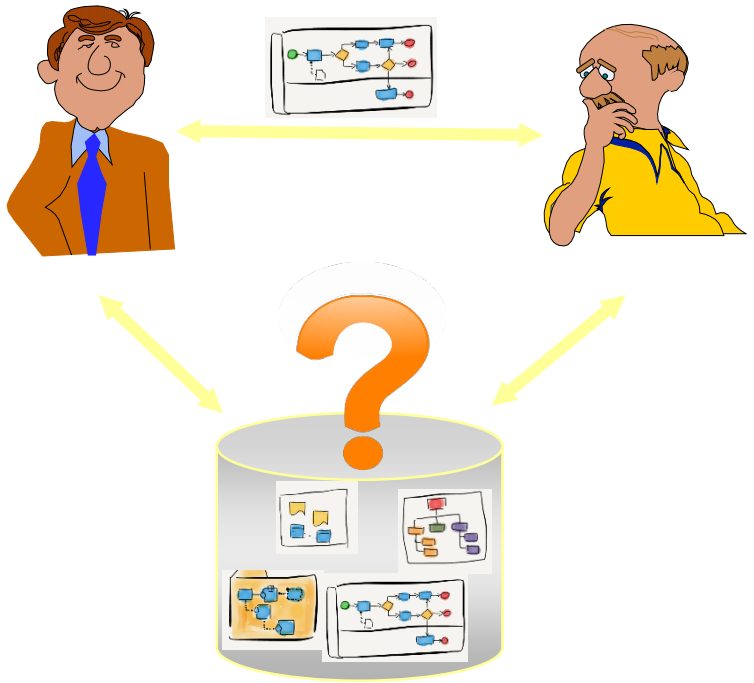
- If the object you want to create or change is simple, then you can do it directly.
- For **complex** systems that are likely to **change** over time, you need a **model**.

- Without explicit modeling there is a *high risk that the implementation is not what is intended*

(John Zachmann, 2012)

Business Value of Modeling

- **Communication between people**
- **Knowledge management and reuse**
- **Analysis of a business situation**
- **Decision Making**
- Training and learning
- Persuasion and selling
- Compliance management
- Development of software requirements
- Direct execution in software engines

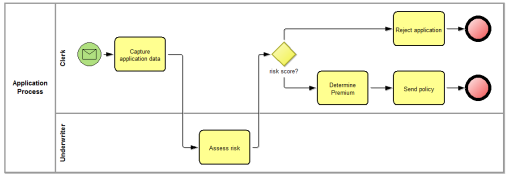


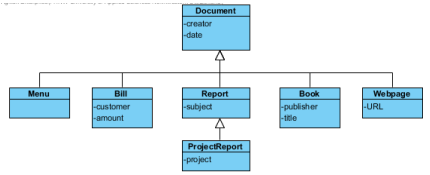
Based on (Bridgeland & Zahavi 2010)

Models

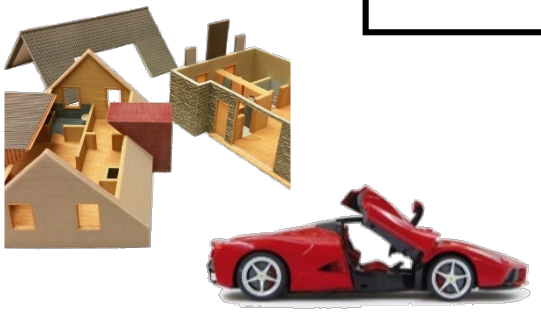
The Application Process
In the business process for health insurance, first the application data are captured by the clerk. Then the risk assessment is made by the underwriter. Depending on the risk score, the clerk determines the premiums and sends the policy or the application is rejected.

- There can be different kinds of models
  - textual model
  - graphical model
  - conceptual models
  - mathematical model
  - physical model





$$E = m\,c^2$$



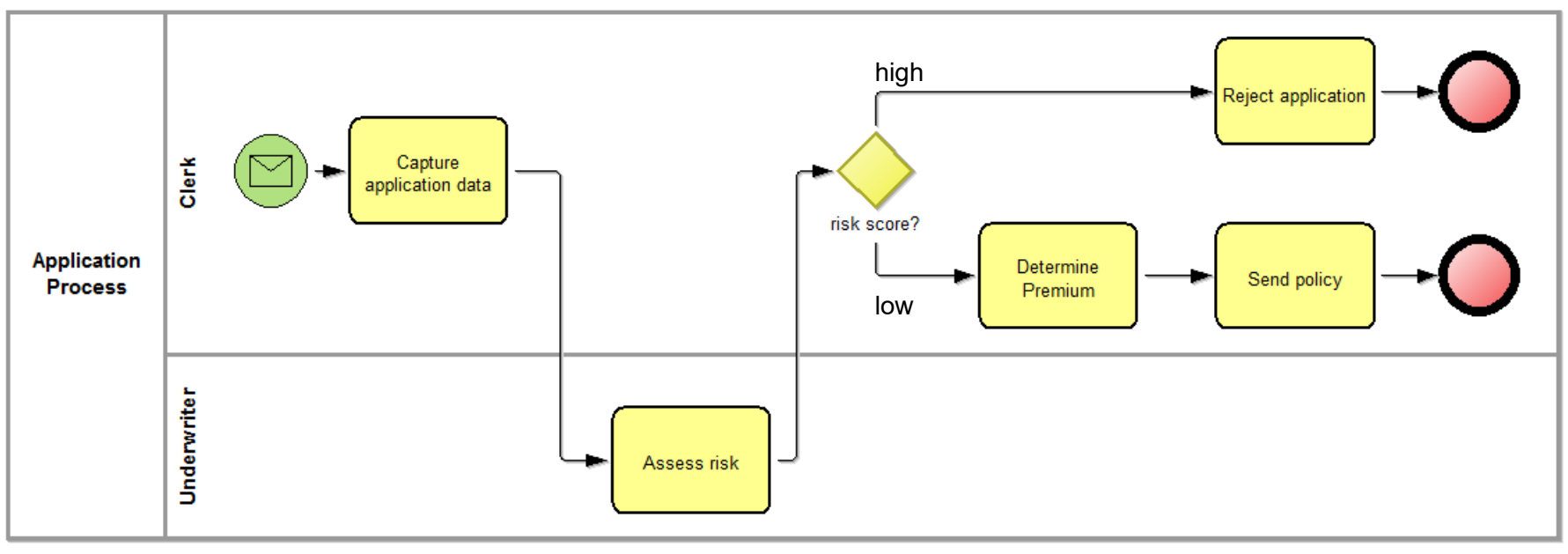
Experiment: Text vs. Model (1)

Process description:

In the business process for health insurance, first the application data are captured by the clerk. Then the risk assessment is made by the underwriter. Depending on the risk score, the clerk determines the premiums and sends the policy or the application is rejected.

- Is the rejection of the application a task or an event?
- Which tasks are executed in parallel?

Experiment: Text vs. Model (2)



- Is the rejection of the application a task or an event?
- Which tasks are executed in parallel?

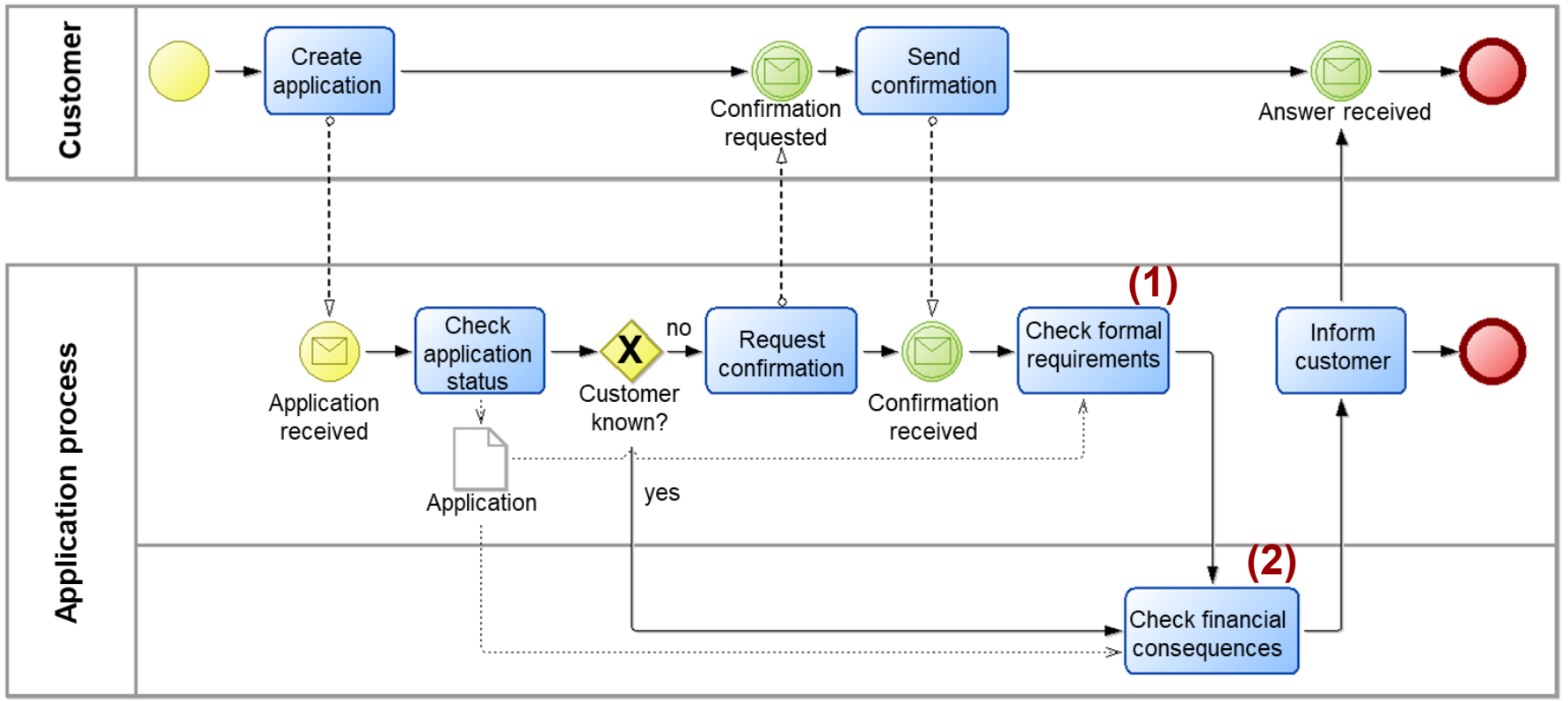
Models

- Models are not mere pictures; rather, they
  - provide a precise, meaningful description that can be visualized in different ways for different stakeholders;
  - can also be used to analyze the impact of changes, cost, risk, security, compliance and other relevant KPIs.

http://blog.bizzdesign.com/how-to-not-fail-when-implementing-strategy

Process Analysis

- What is wrong with this process model?
- Can the tasks (1) and (2) be executed in parallel?



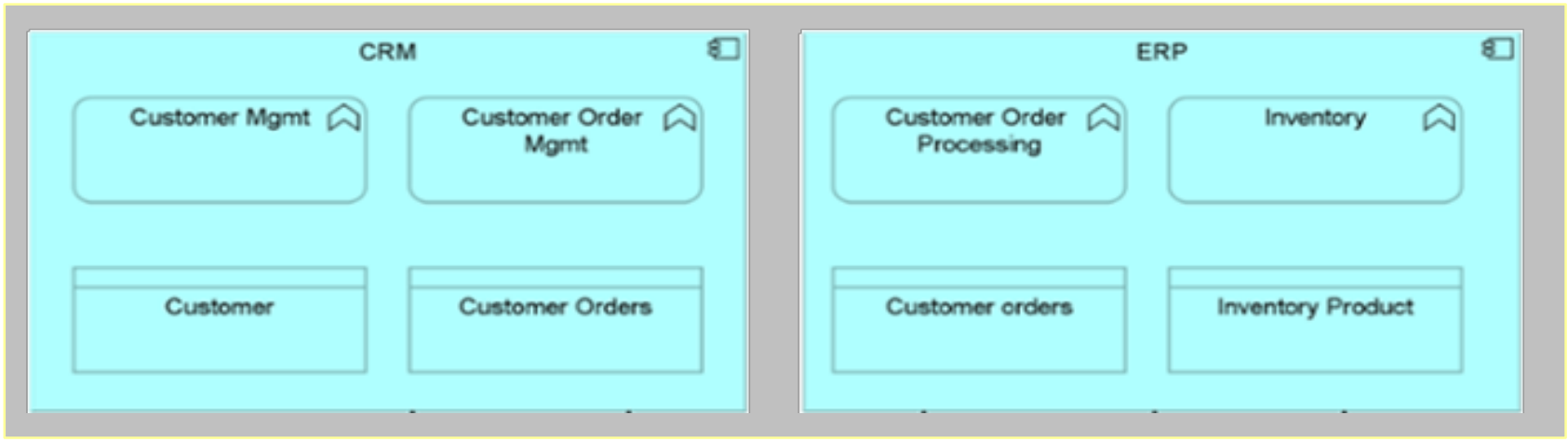
Example: Alignment of Business and IT

Business-IT alignment is a dynamic state in which a business organization is able to use information technology effectively to achieve business objectives

Typical questions and principles:

- Which processes are affected by the replacement of an application?
- Which applications share data?
- Which services can be provided as cloud services?
- Each function should realized exactly once
- Why did we decide to customize this application?

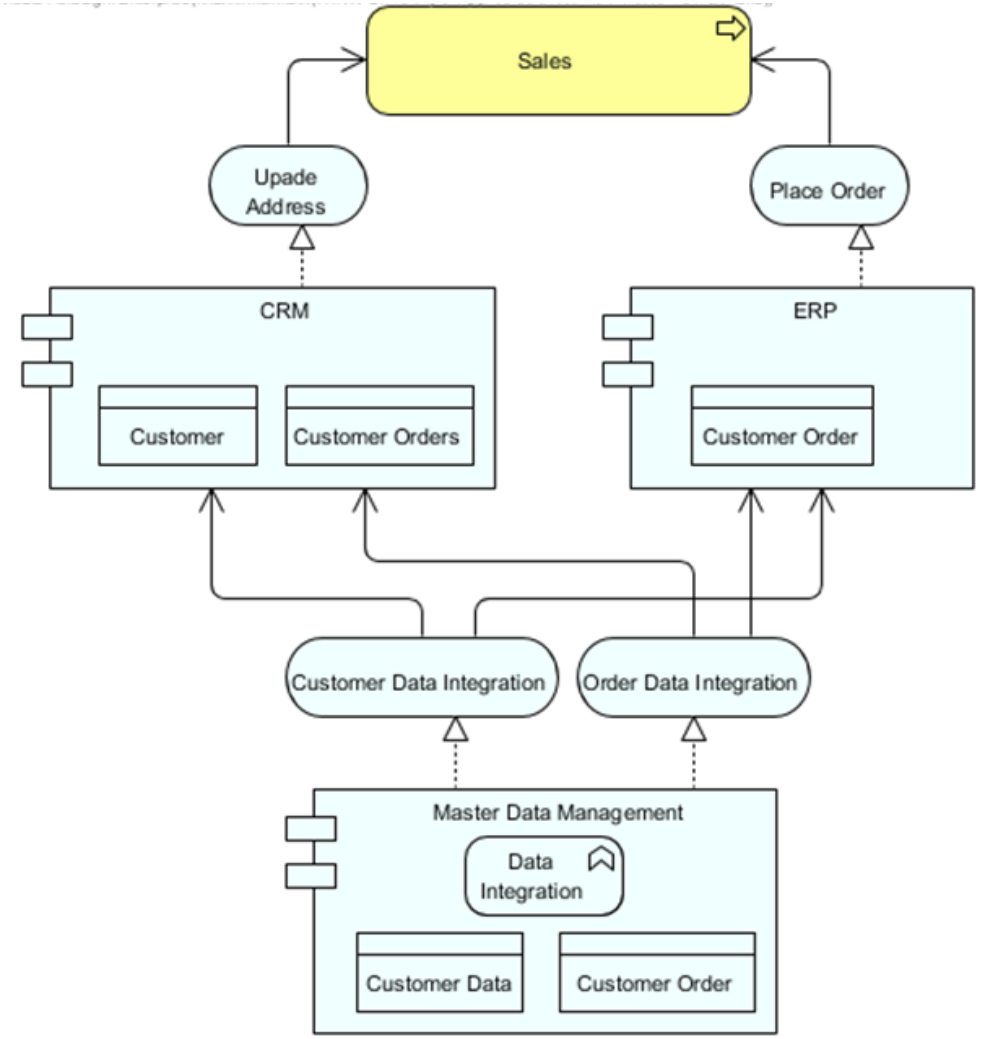
Example: Application Architecture



- What are problems of this situation with respect to data management?
- How could an architecture look like to deal with this problem?

Managing Shared Data

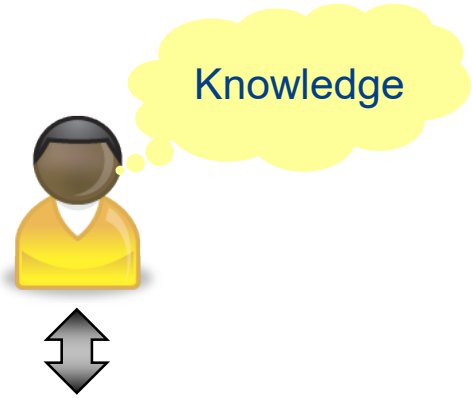
- Master Data Management ensures that there is a «single source of truth» for shared data



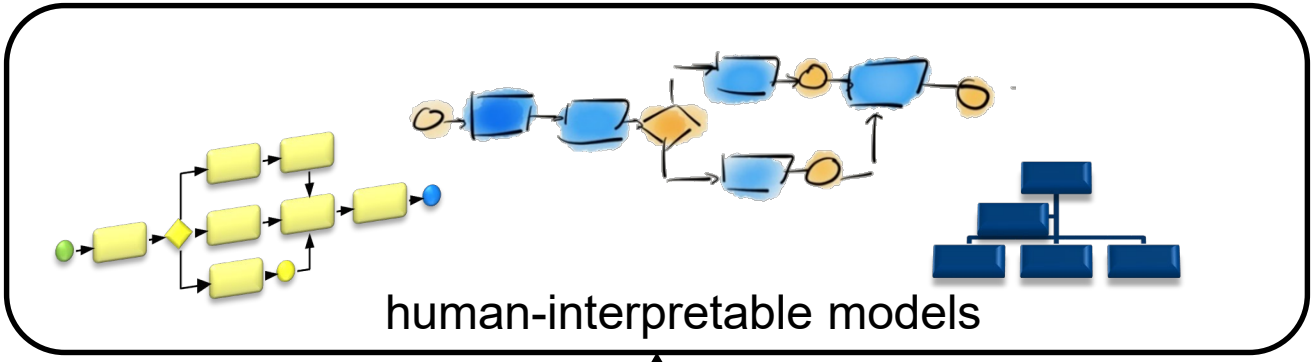
Ontology-based Metamodeling

Human Problem Solving

Communication/
Analysis/
Decision Making

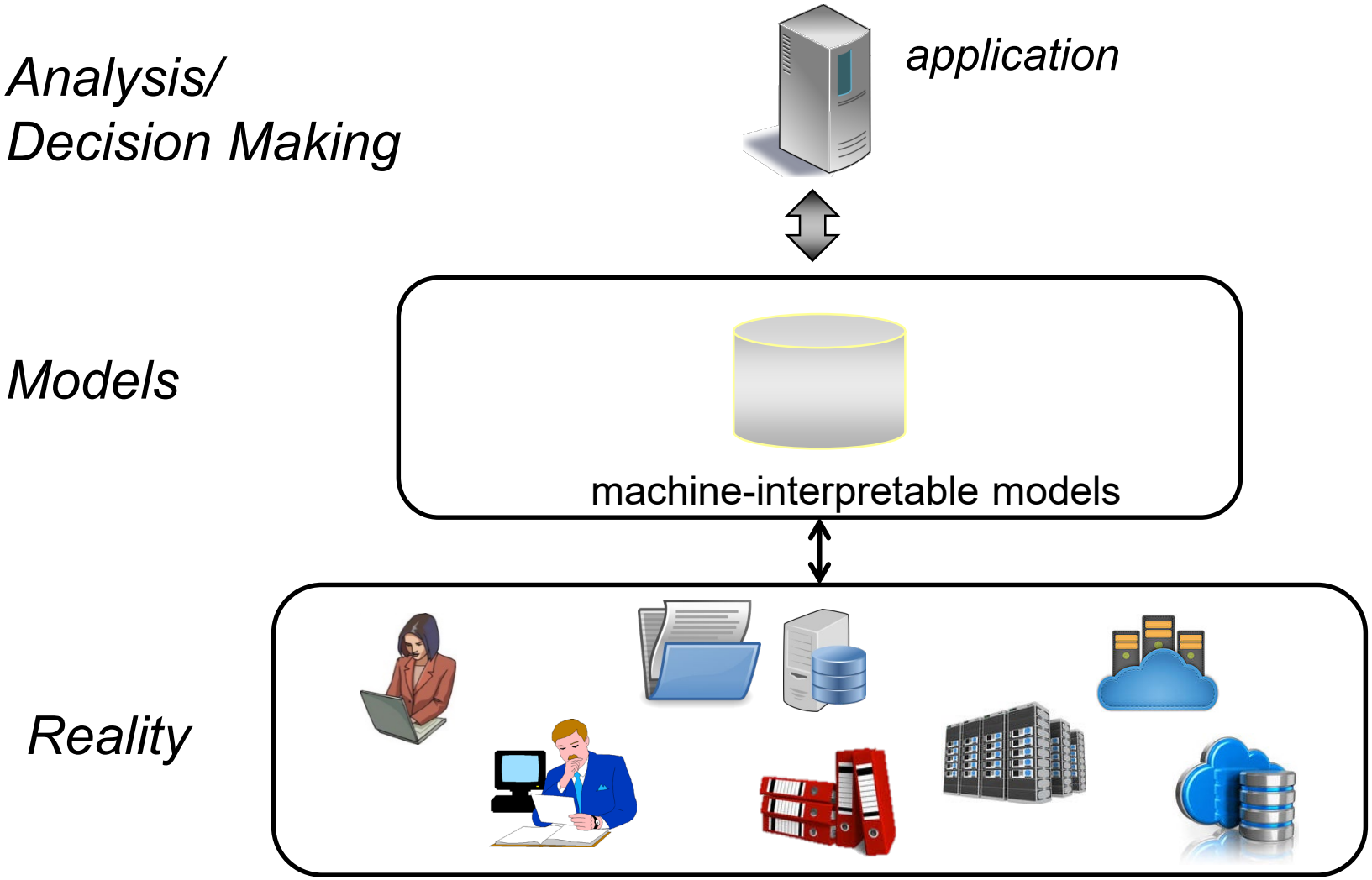


Models

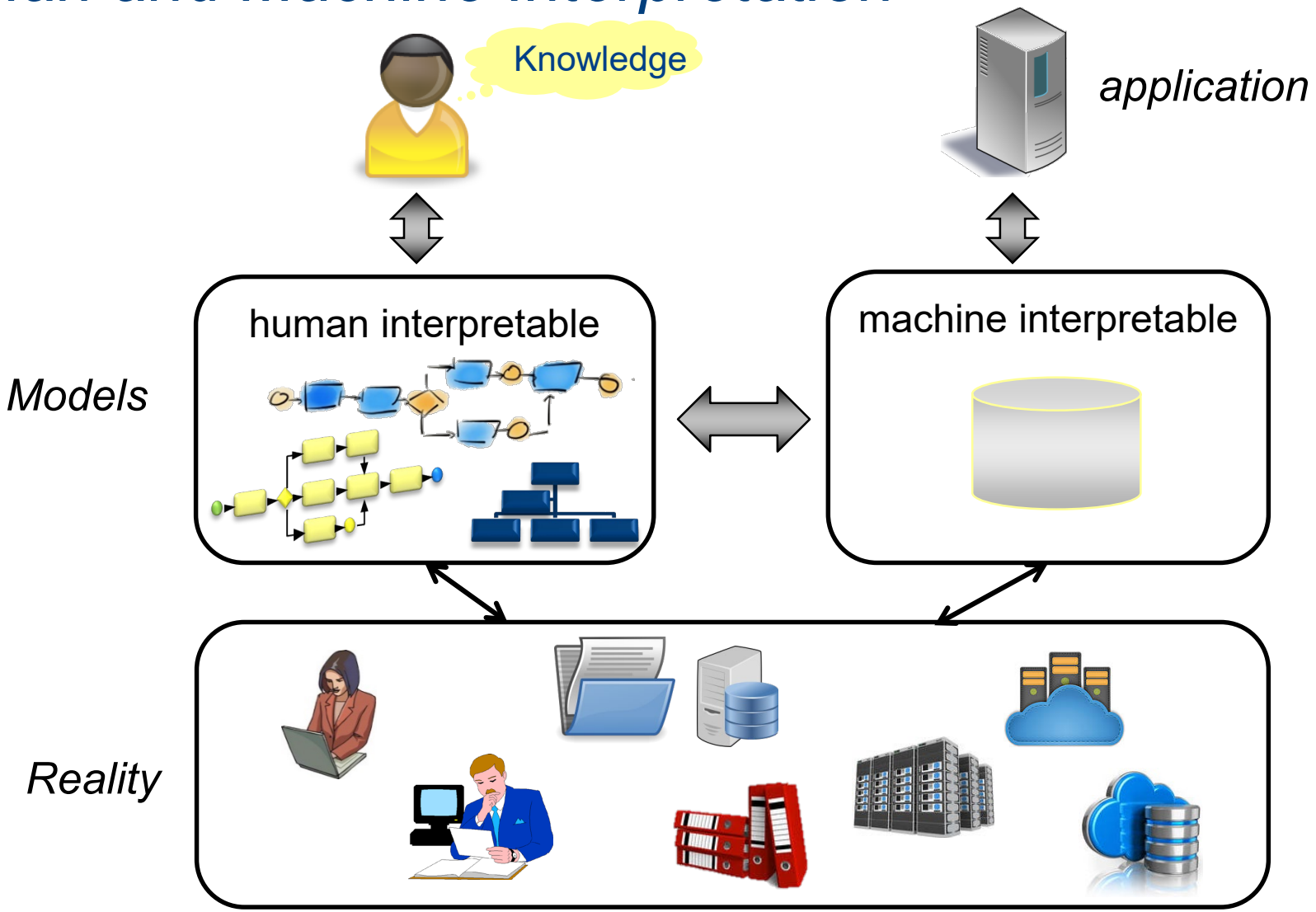


Reality

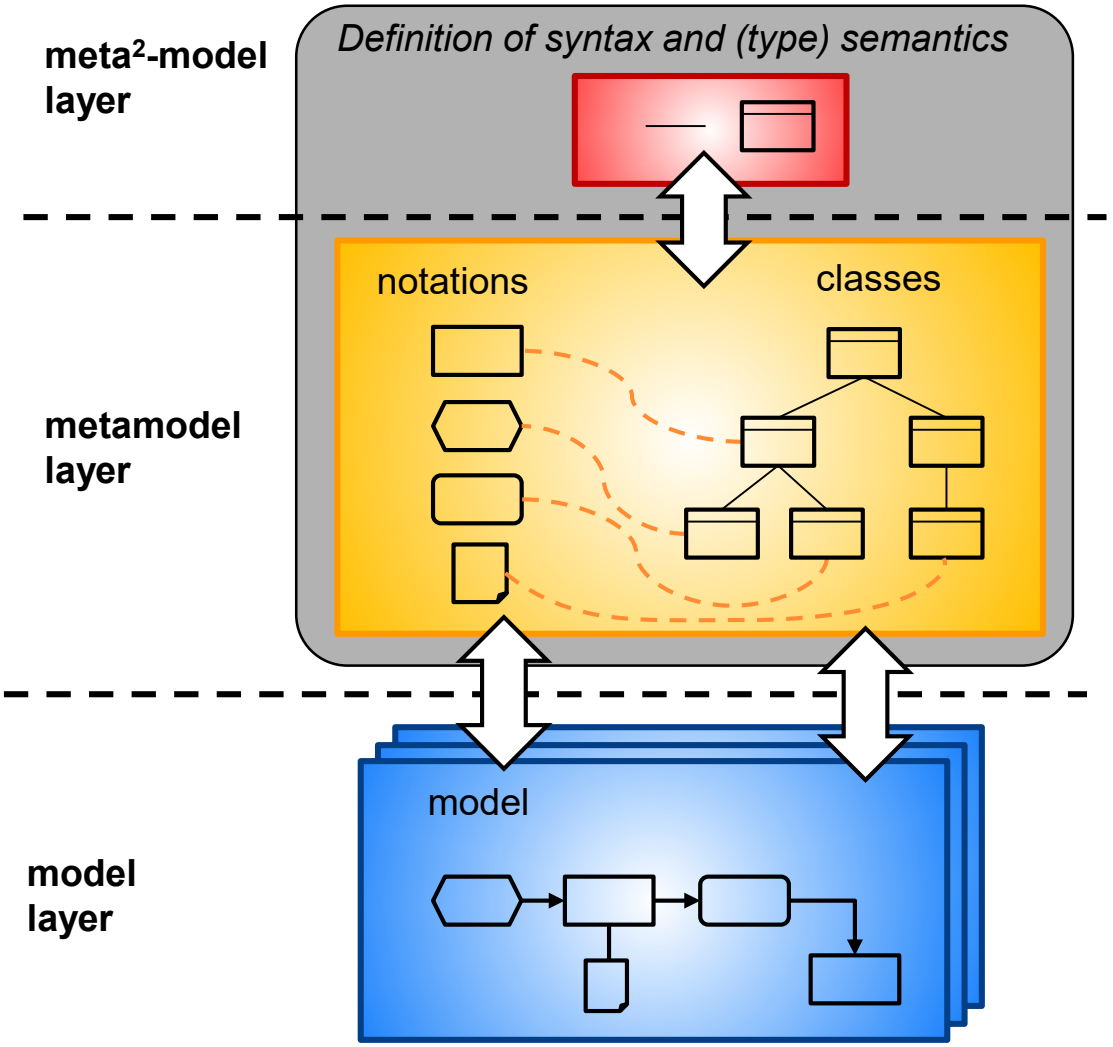
Automated Analysis / Decision Making

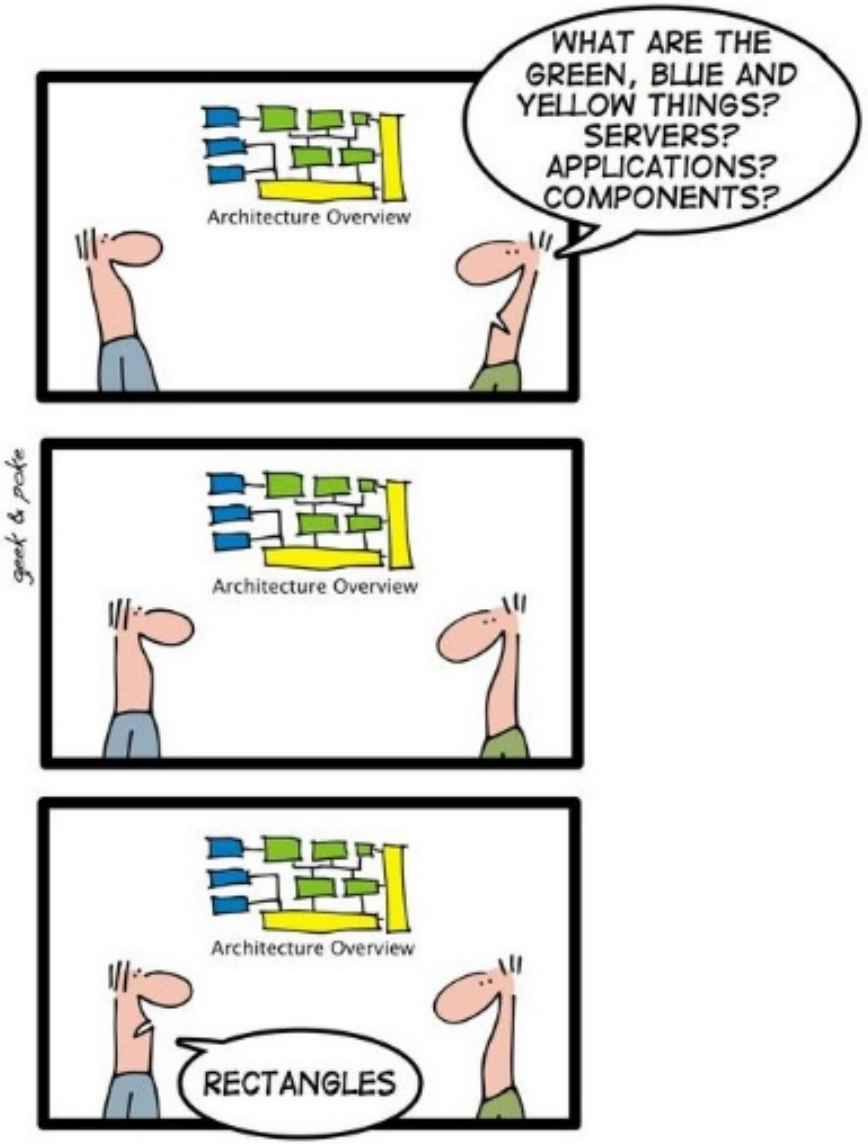


Human and Machine Interpretation



Modelling Environment

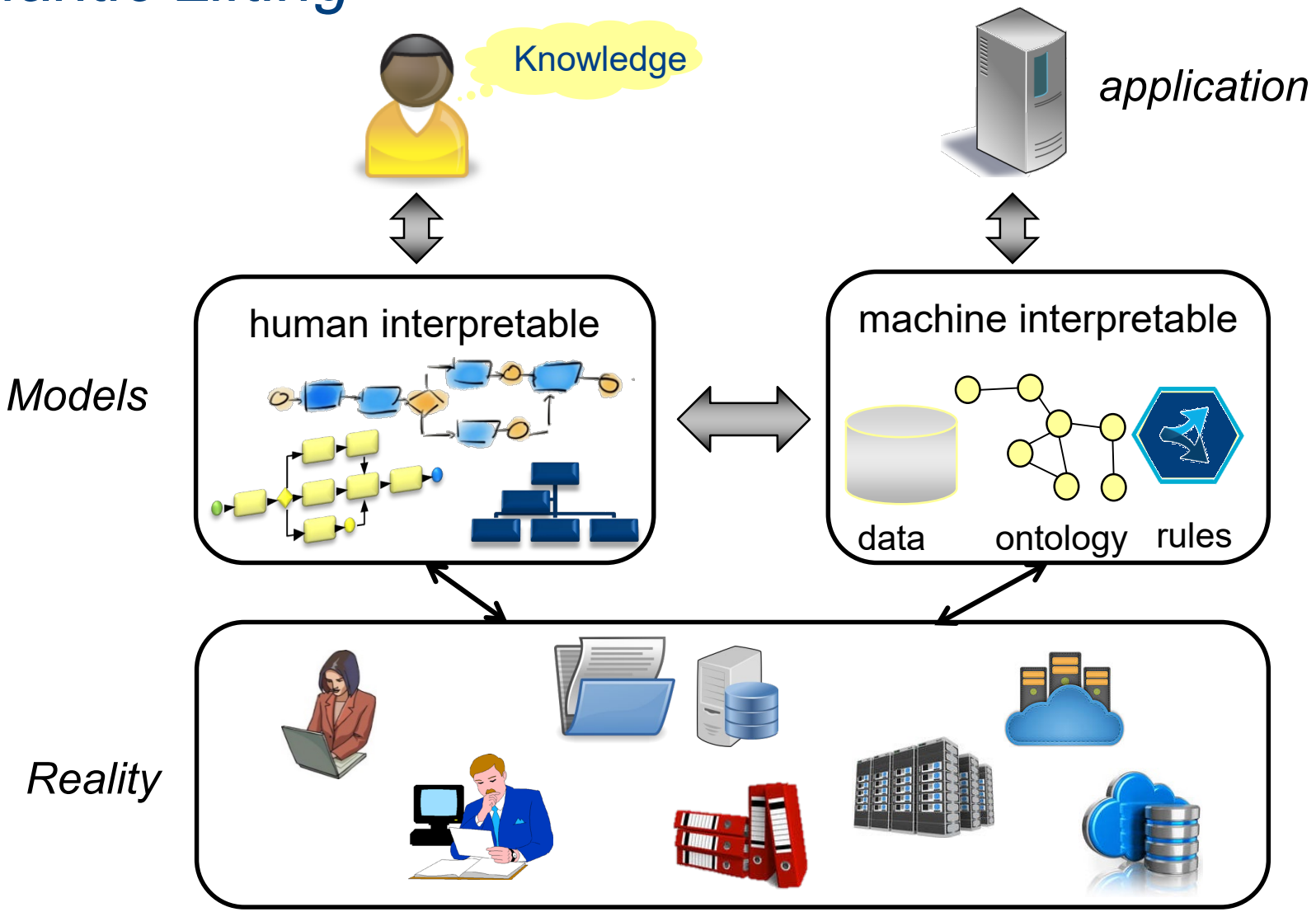


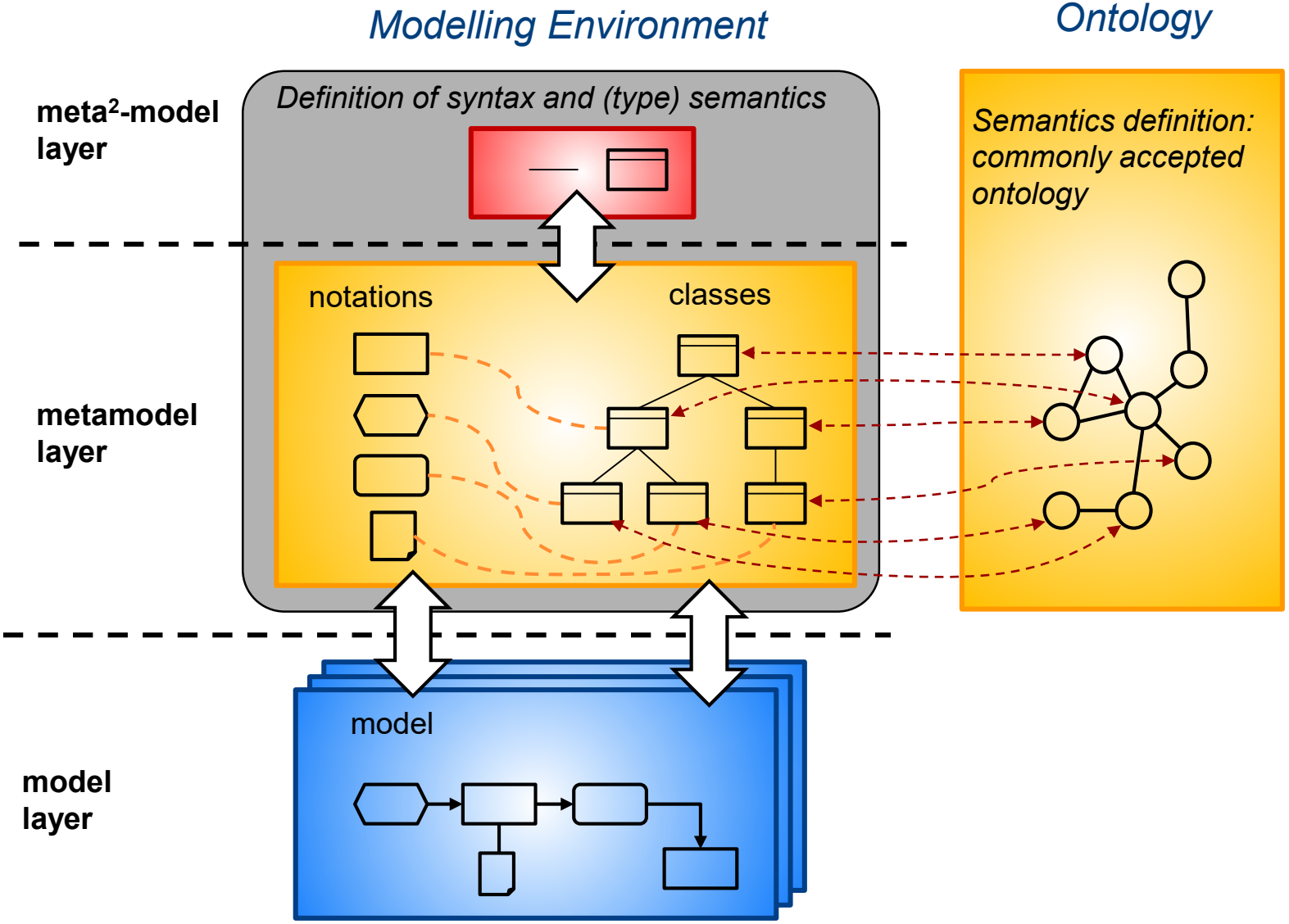


Humans and machines should «know» the meaning of the modeling objects:

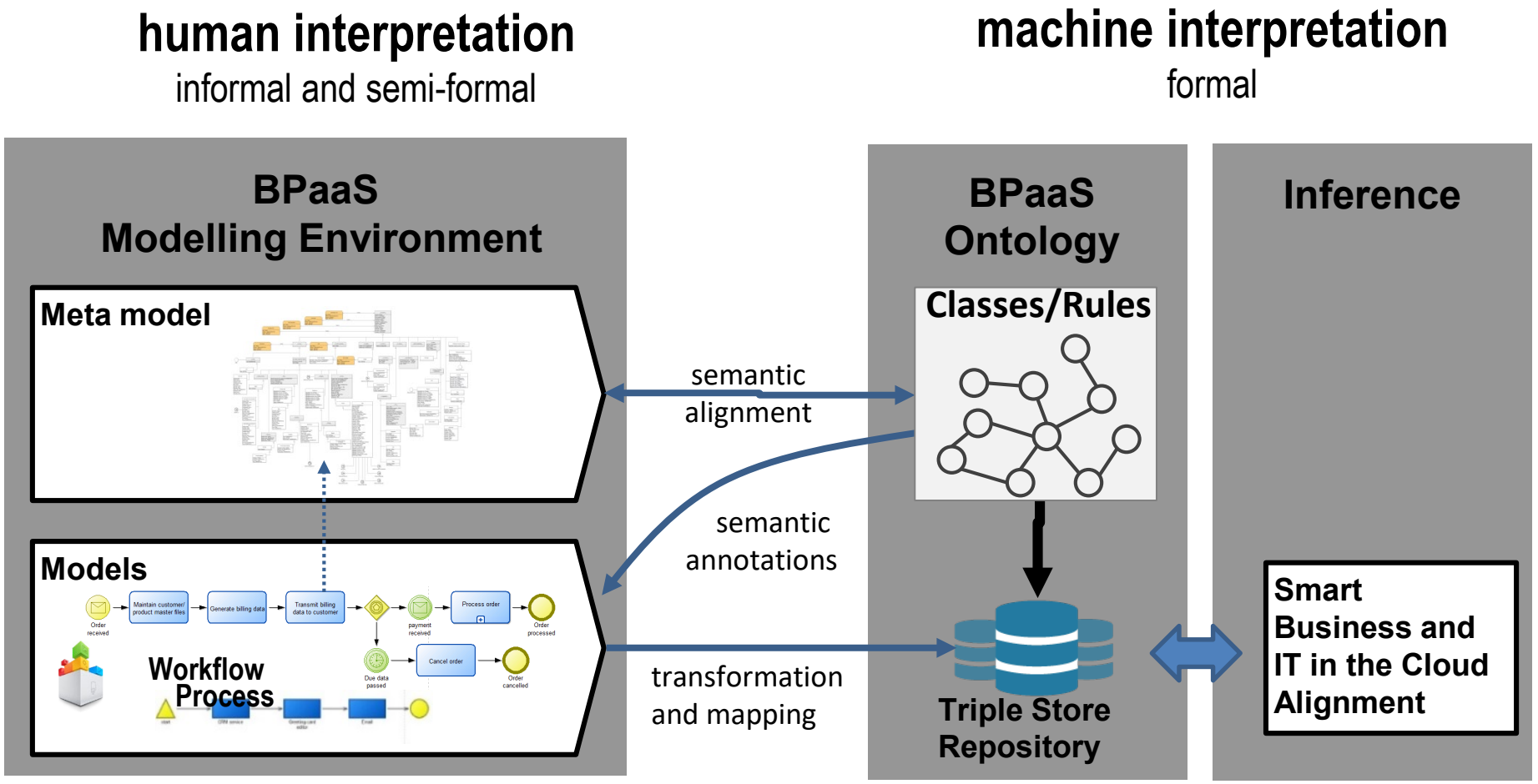
→ **Enterprise Ontology**

Semantic Lifting




Modelling Environment
Ontology
meta²-model layer
Definition of syntax and (type) semantics
Semantics definition: commonly accepted ontology
notations
classes
metamodel layer
model
model layer
linguistic metamodelling: syntax, structure, type semantics
ontological metamodelling (lifting): explication of type semantics

Example: Business Process as a Service

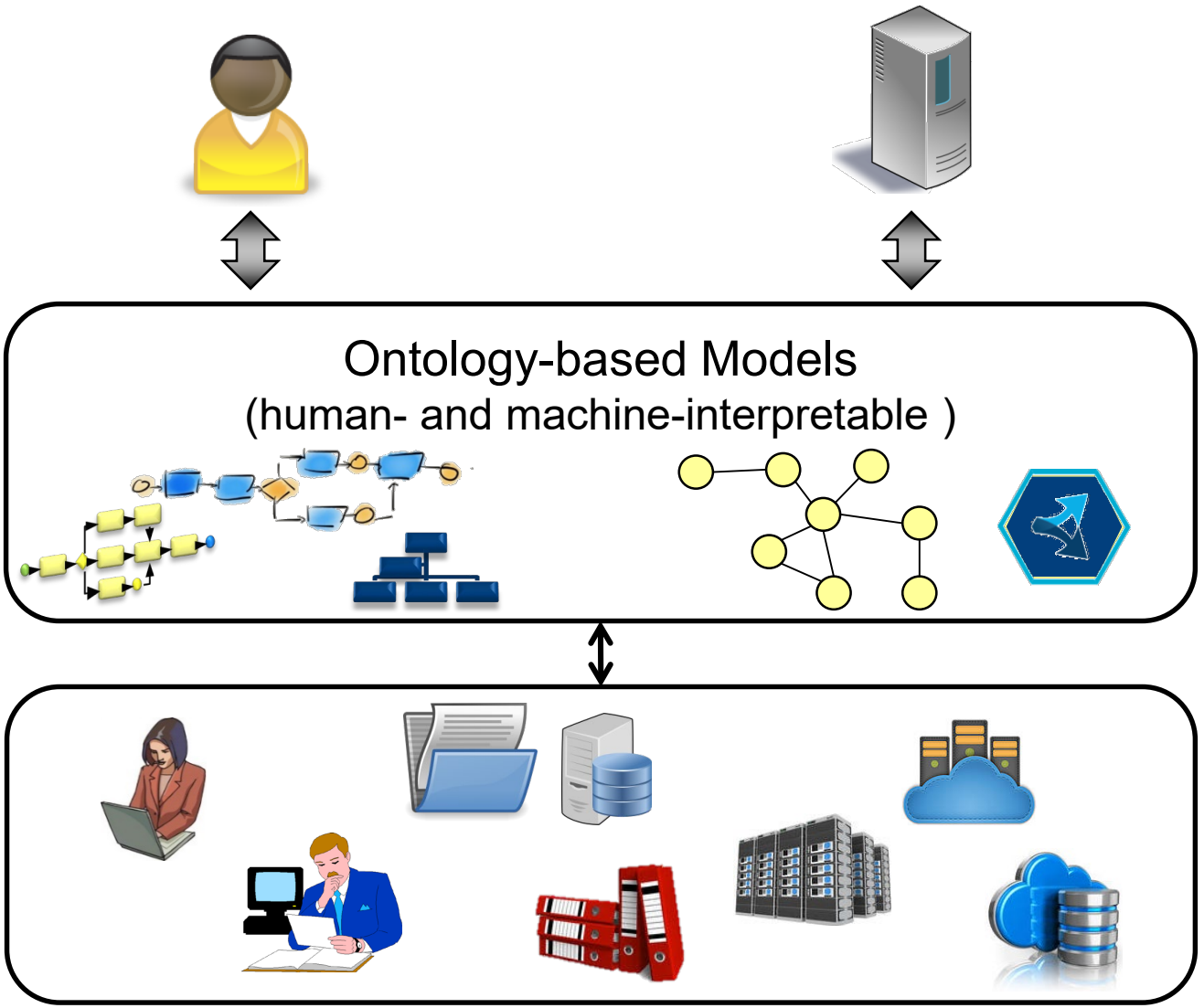


CloudSocket

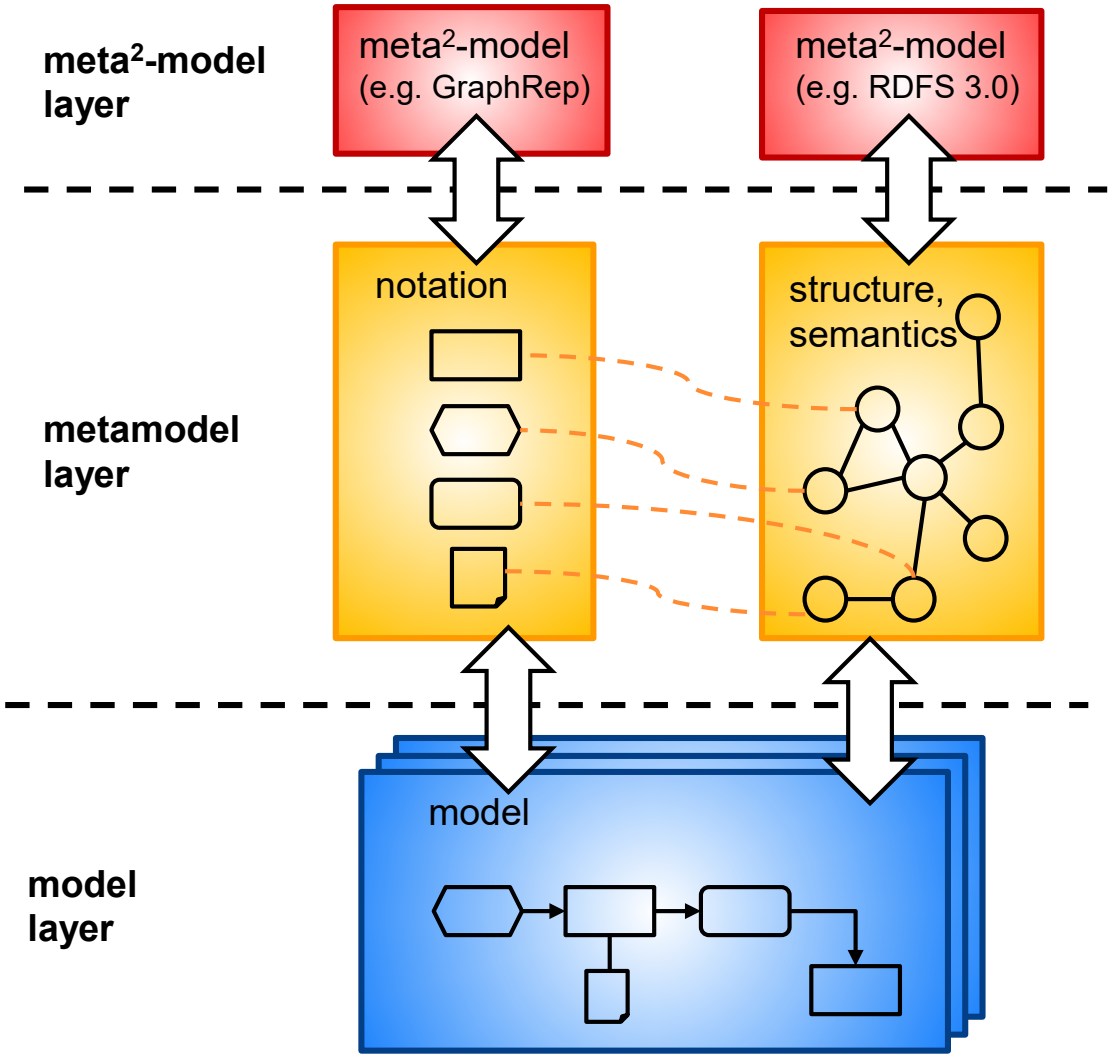
Objective

Models + Knowledge

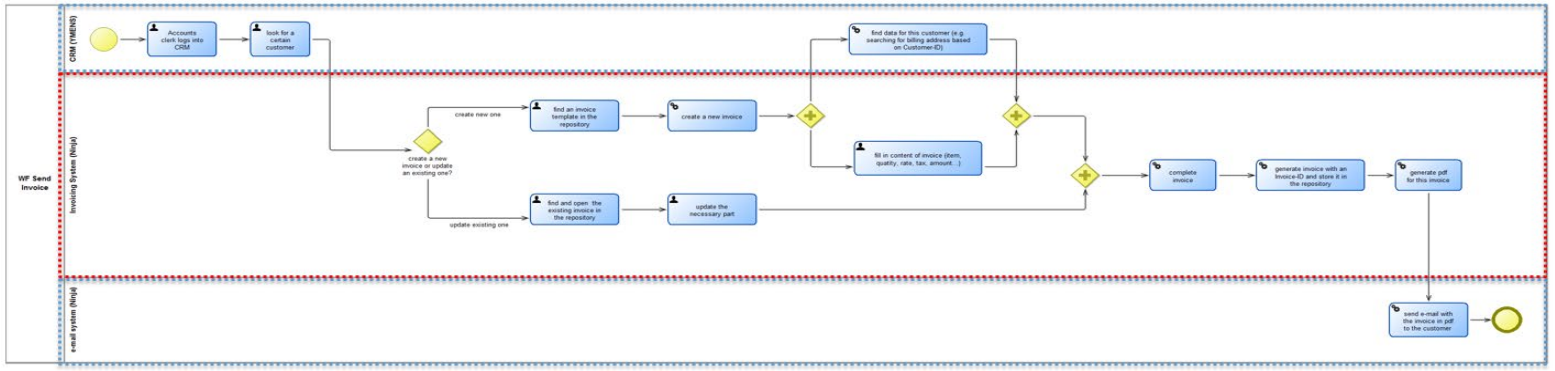
Reality



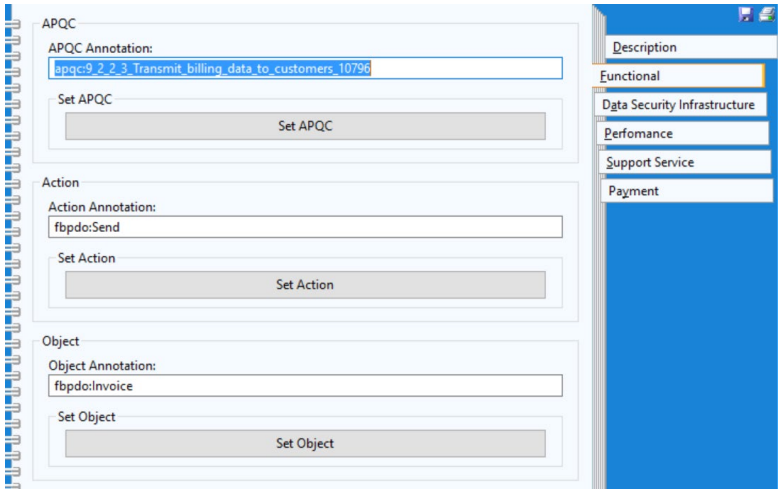
Ontology-based Metamodeling



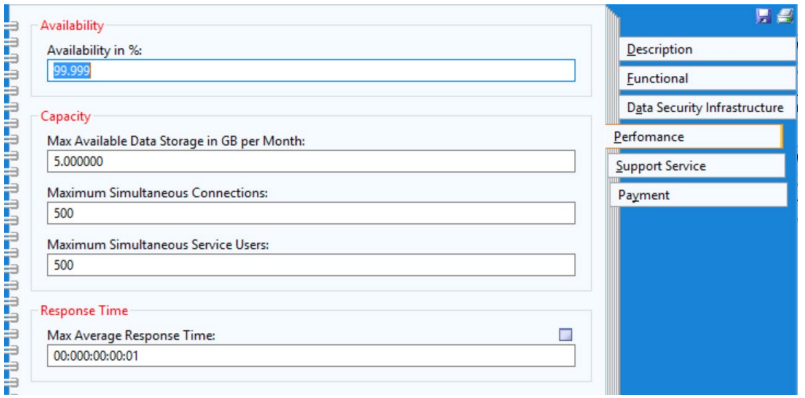
Example



Functionality

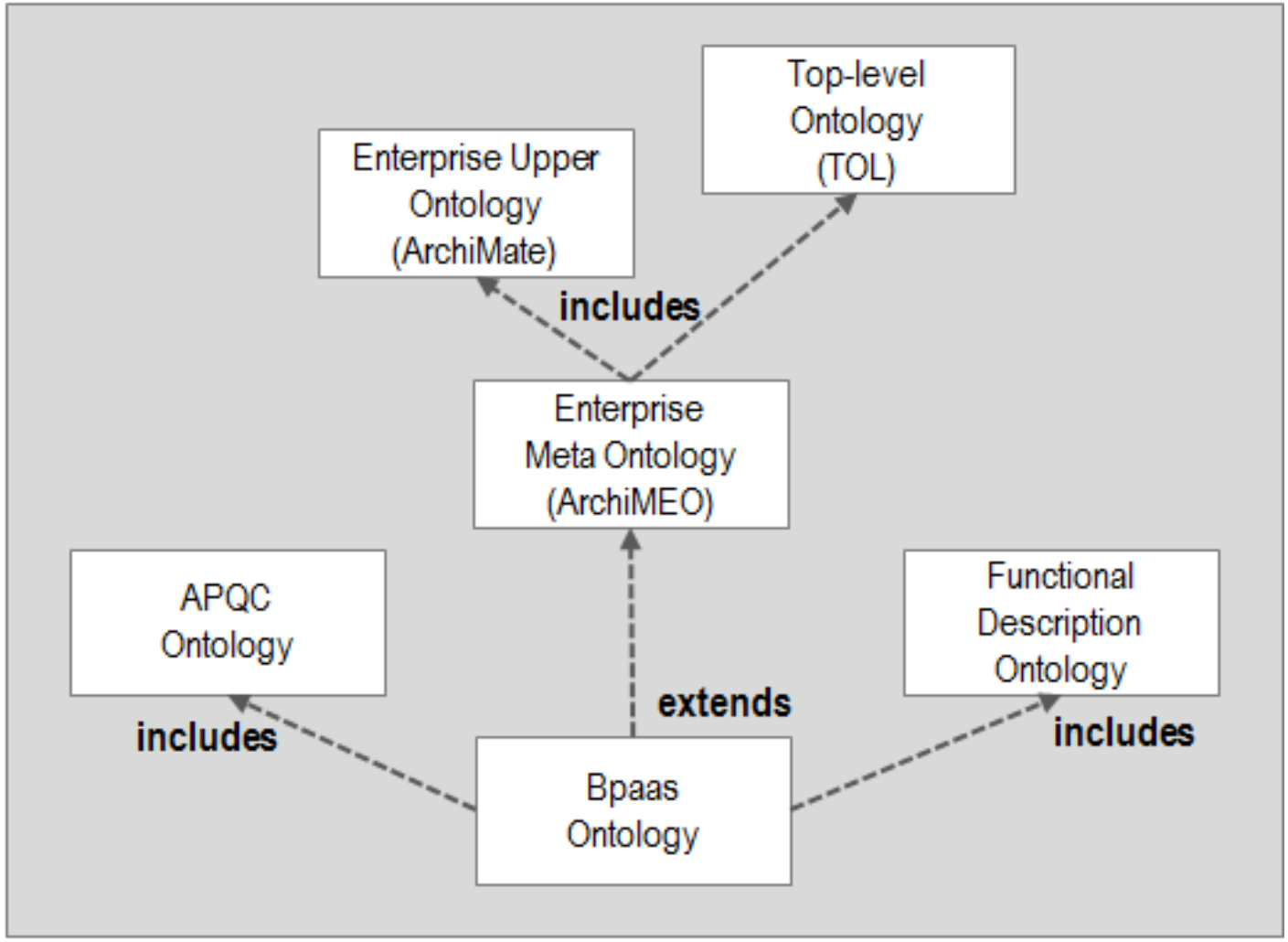


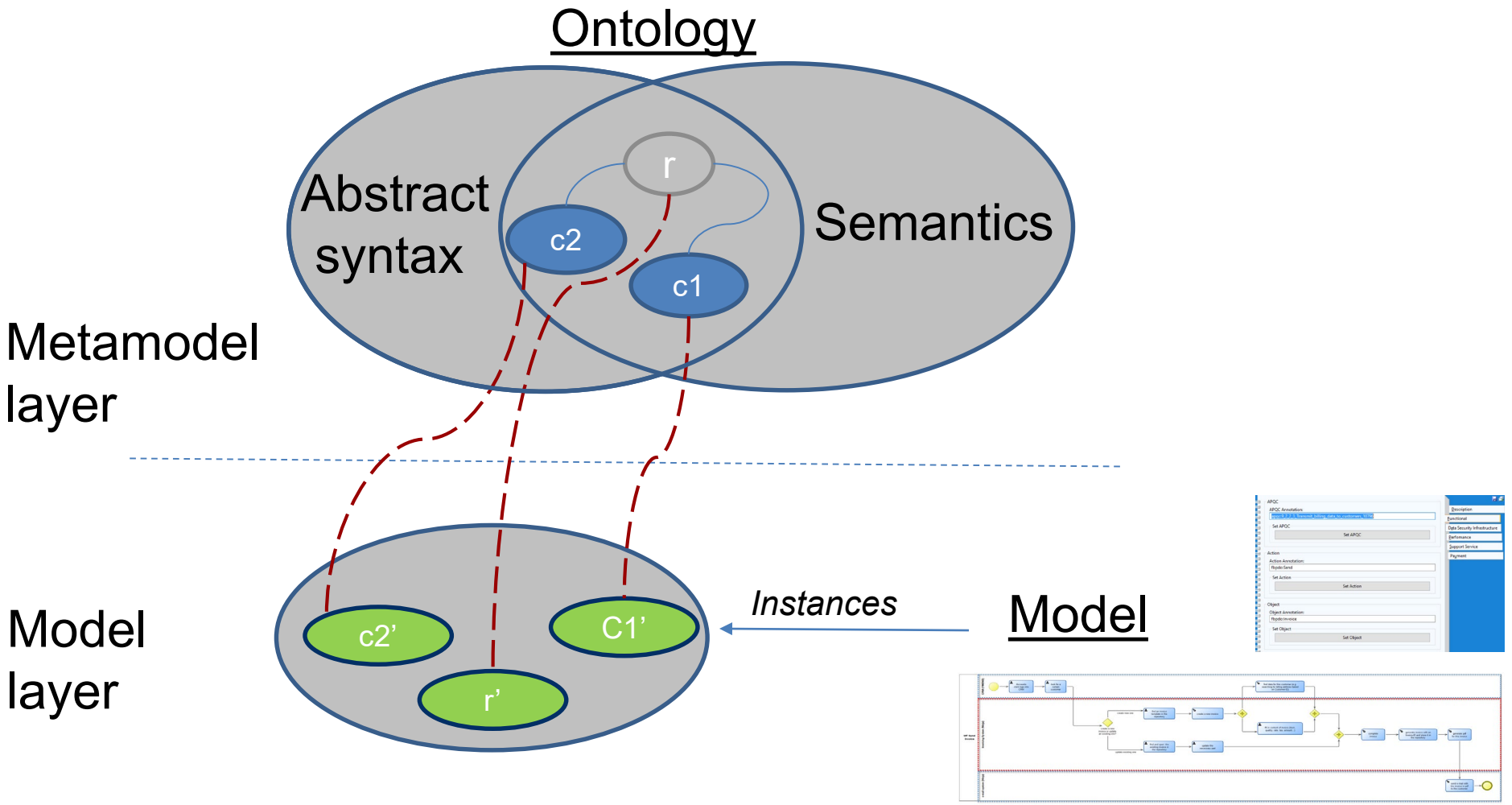
Non-functional requirements

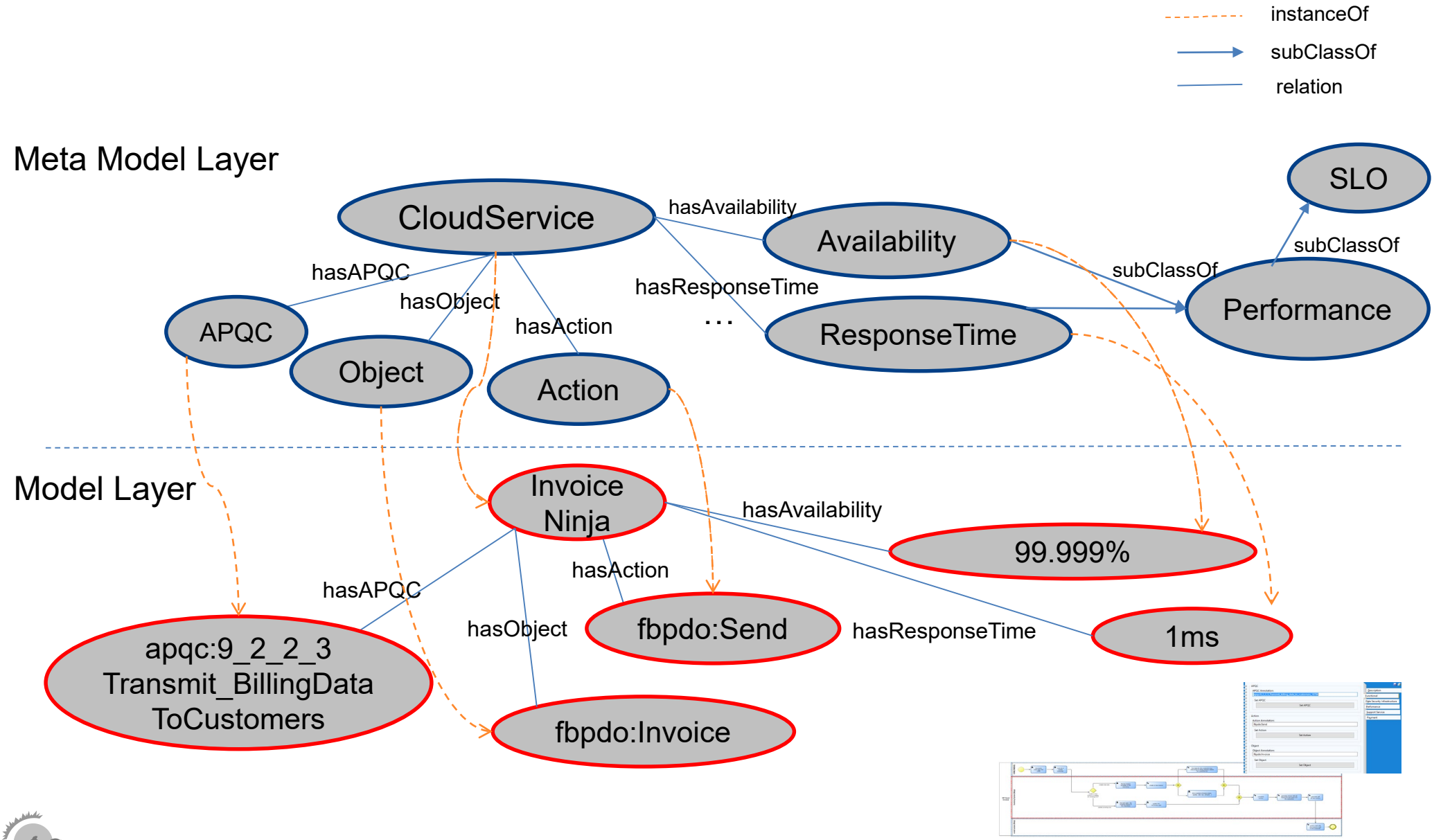


All Concepts are defined in the Ontology

ArchiMEO Enterprise Ontology



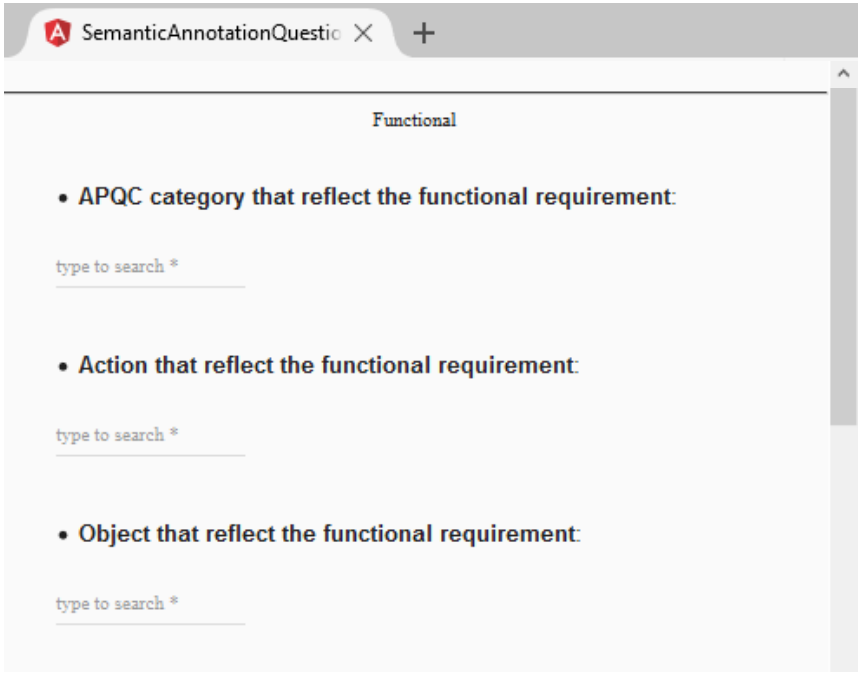

Ontology
Abstract syntax
Semantics
r
c2
c1
Metamodel layer
Model layer
c2'
C1'
r'
Instances
Model


instanceOf
subClassOf
relation
Meta Model Layer
CloudService
hasAvailability
Availability
SLO
subClassOf
hasAPQC
hasObject
hasResponseTime
subClassOf
Performance
APQC
hasAction
...
ResponseTime
Object
Action
Model Layer
Invoice Ninja
hasAvailability
99.999%
hasAPQC
hasAction
hasObject
fbpdo:Send
hasResponseTime
1ms
apqc:9_2_2_3 Transmit_BillingData ToCustomers
fbpdo:Invoice

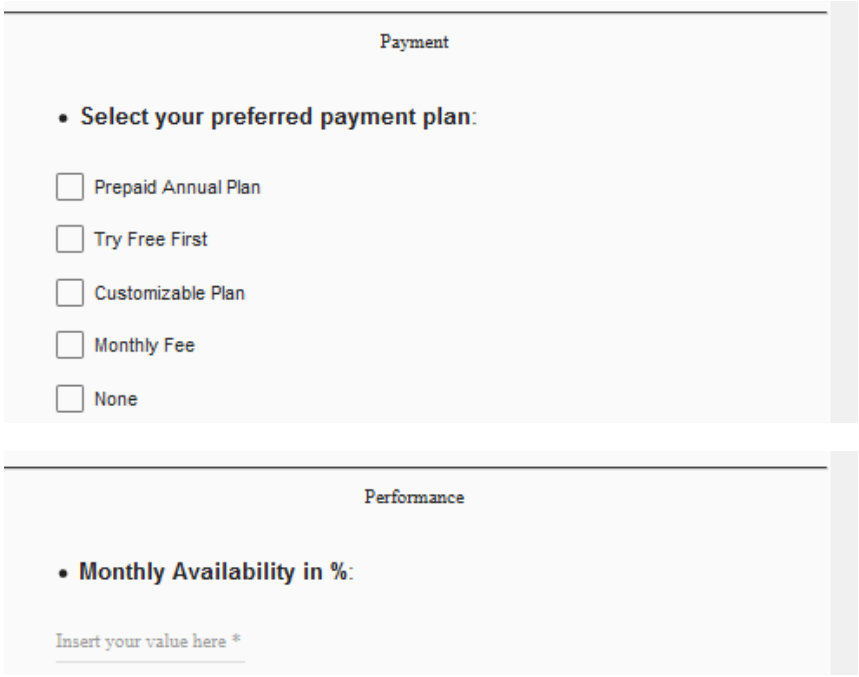
Application Example for Ontology-based Metamodel

Cloud Service Selection

Functionality



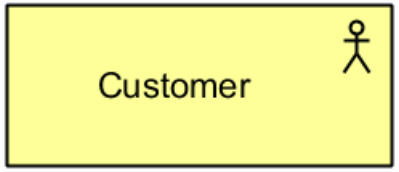
Non-functional requirements



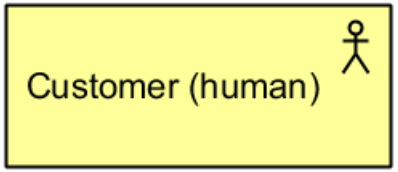
Agile Meta-Modeling

Example: Customization in Archimate

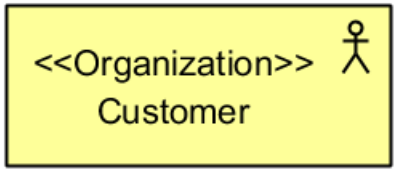
- One single concept for Actors

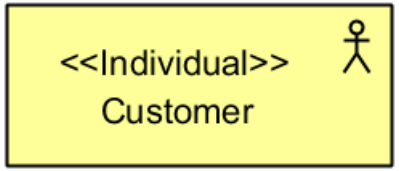


- Objective: Distinguish between human and organisation unit
  - Name



  - Stereotyping



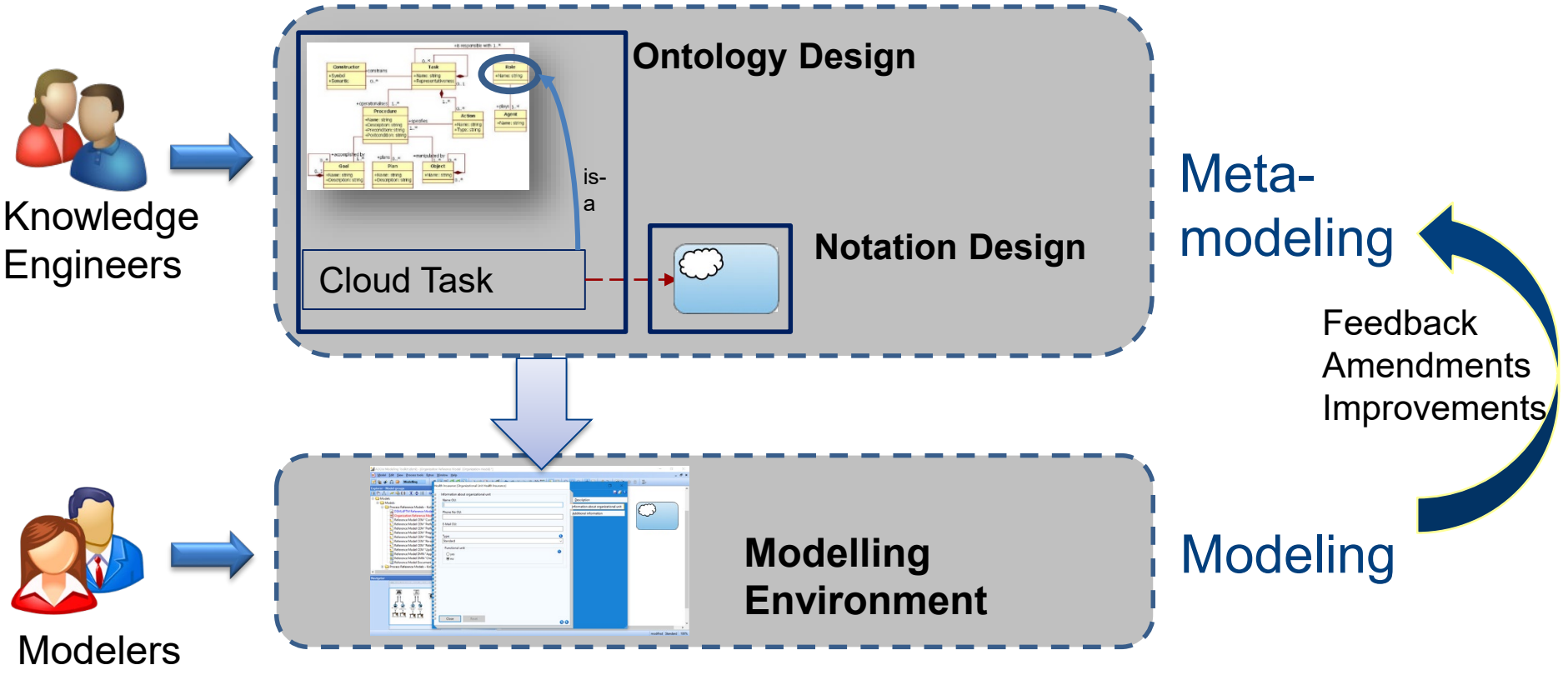


Semantics only for human, not machine-interpretable

Objective

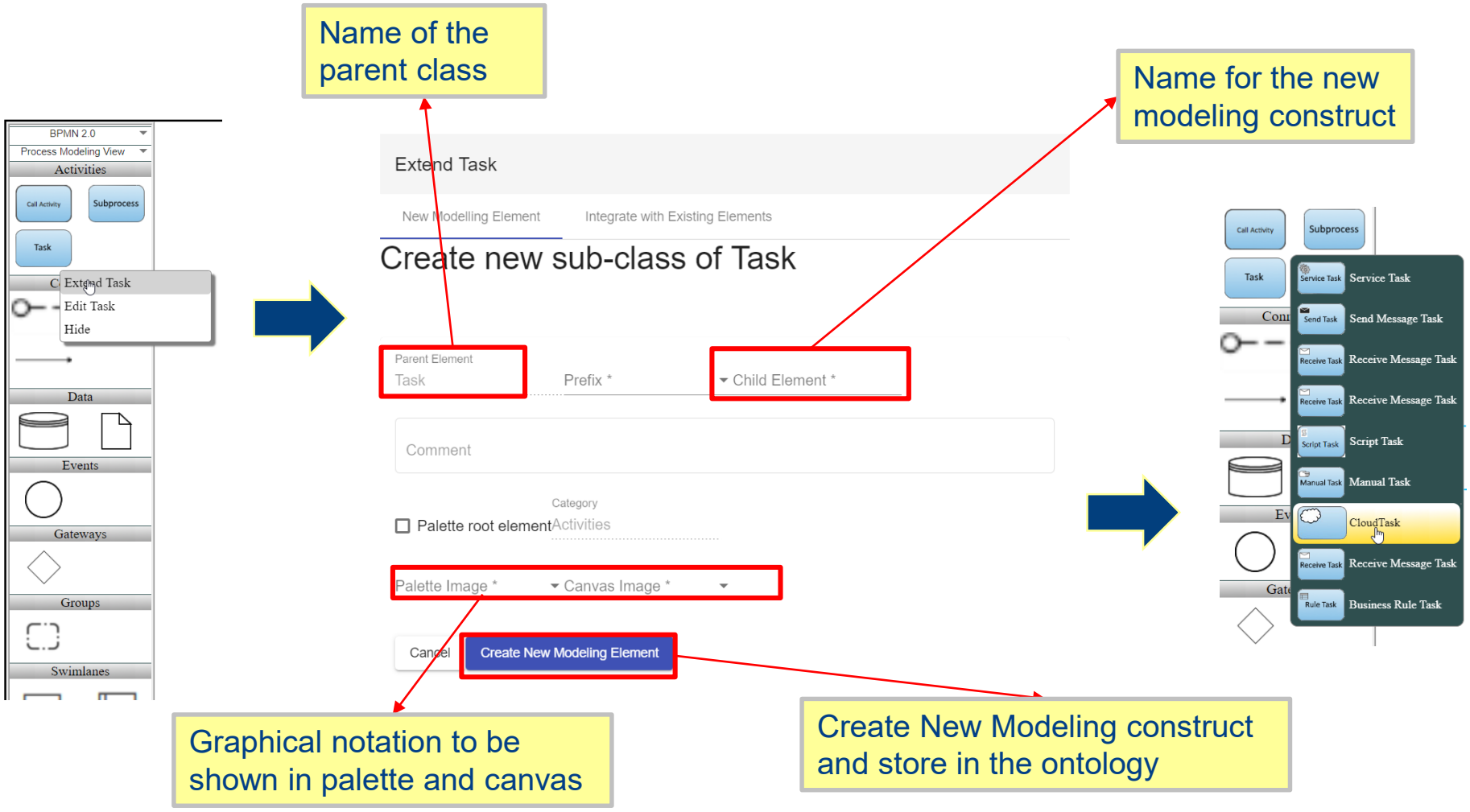
Ensure a precise shared interpretation of new modeling constructs to both **humans and machines**

Change of Metamodel

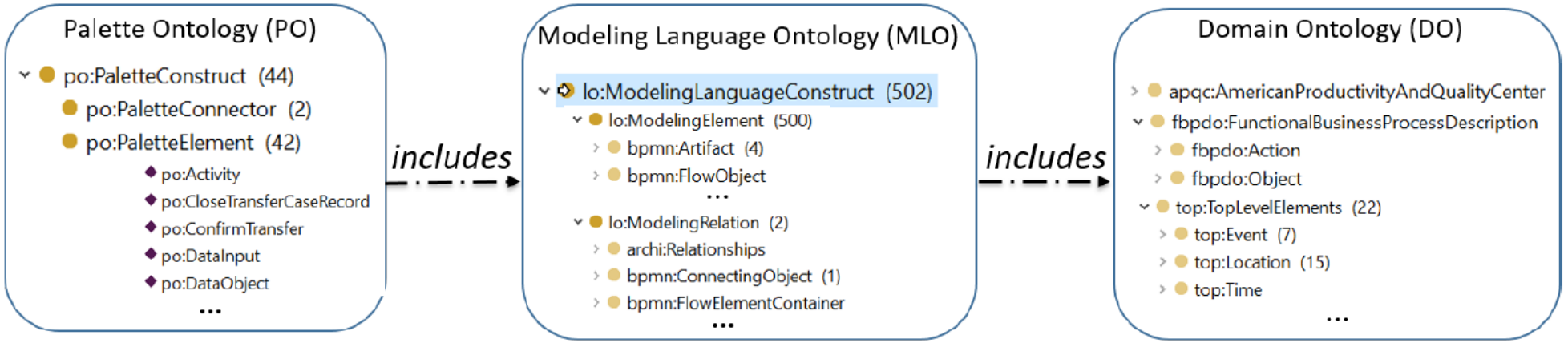


Time-consuming engineering effort!

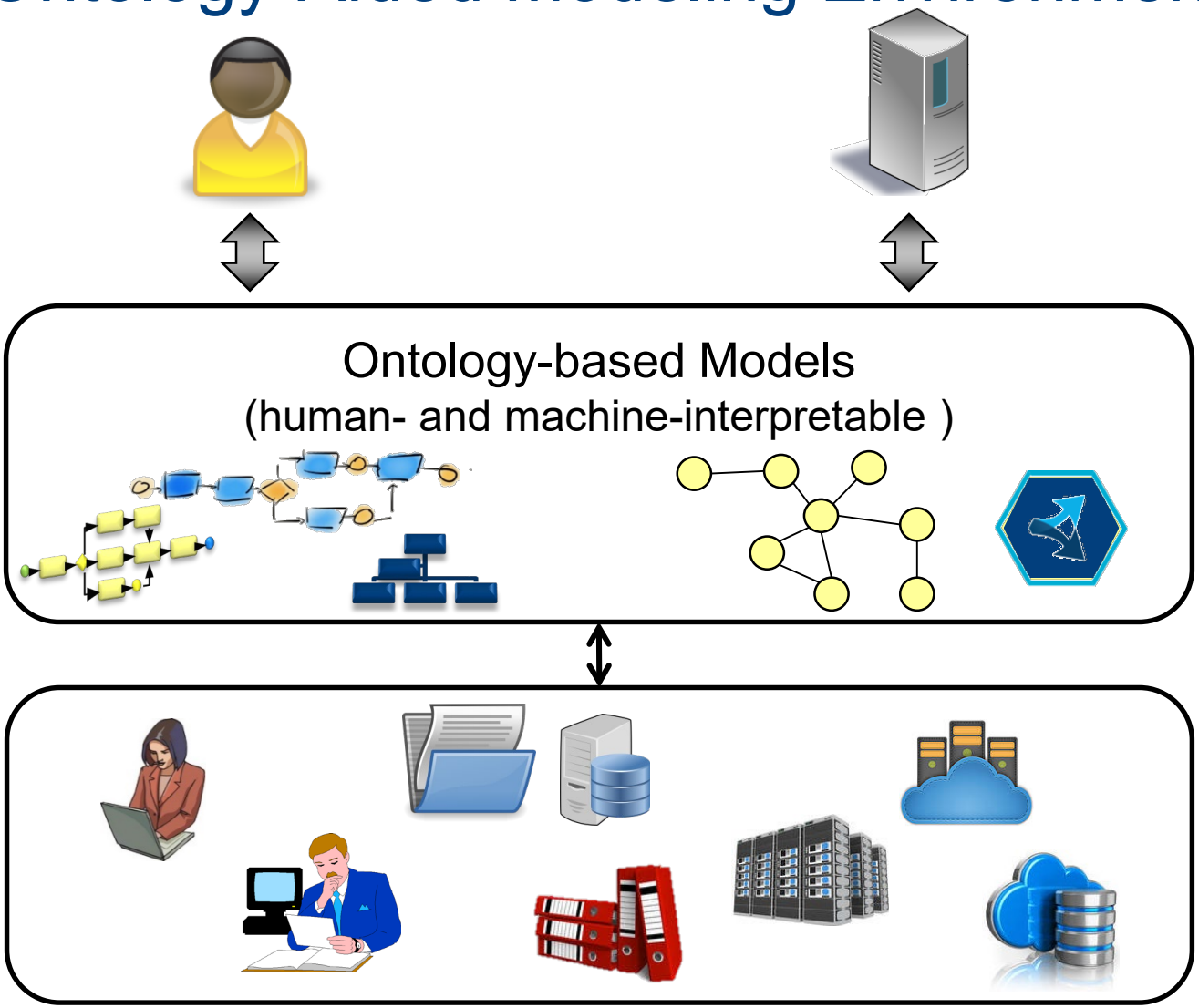
Integration of Meta-modeling and Modeling: On-the-fly Modeling Language Adaptation



Ontologies


Palette Ontology (PO)
po:PaletteConstruct (44)
po:PaletteConnector (2)
po:PaletteElement (42)
po:Activity
po:CloseTransferCaseRecord
po:ConfirmTransfer
po:DataInput
po:DataObject
...
includes
Modeling Language Ontology (MLO)
lo:ModelingLanguageConstruct (502)
lo:ModelingElement (500)
bpmn:Artifact (4)
bpmn:FlowObject
...
lo:ModelingRelation (2)
archi:Relationships
bpmn:ConnectingObject (1)
bpmn:FlowElementContainer
...
includes
Domain Ontology (DO)
apqc:AmericanProductivityAndQualityCenter
fbpdo:FunctionalBusinessProcessDescription
fbpdo:Action
fbpdo:Object
top:TopLevelElements (22)
top:Event (7)
top:Location (15)
top:Time
...

Agile and Ontology-Aided Modeling Environment (AOAME)



Thanks to …

Emanuele Laurenzi

Charuta Pande