

# ***Ontology-based Enterprise Modeling for Human and Machine Interpretation***

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

## **NEXT GENERATION ENTERPRISE MODELLING IN THE DIGITAL TRANSFORMATION AGE**

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University of Vienna - Austria



## About Me



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





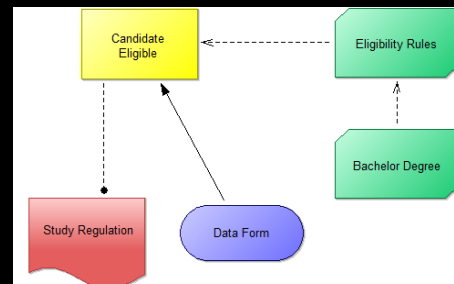
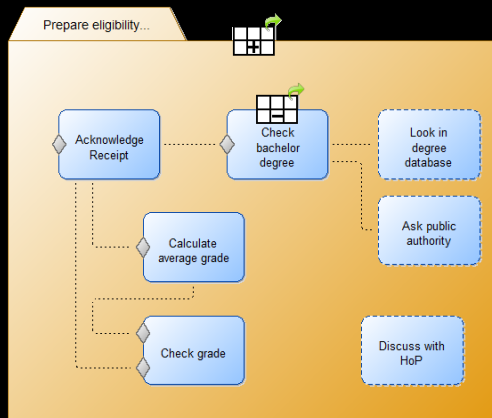
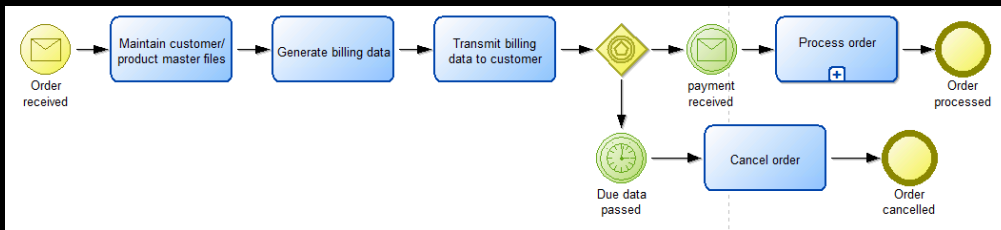
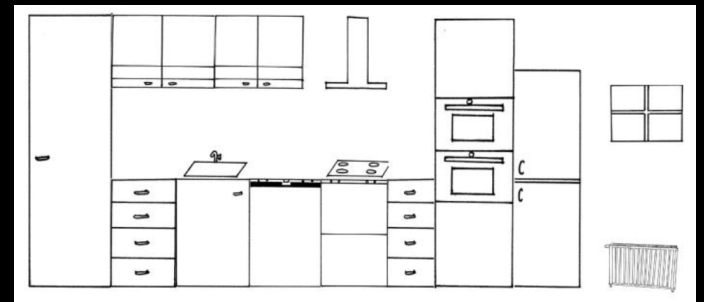
# Models



not what  
we are  
dealing with

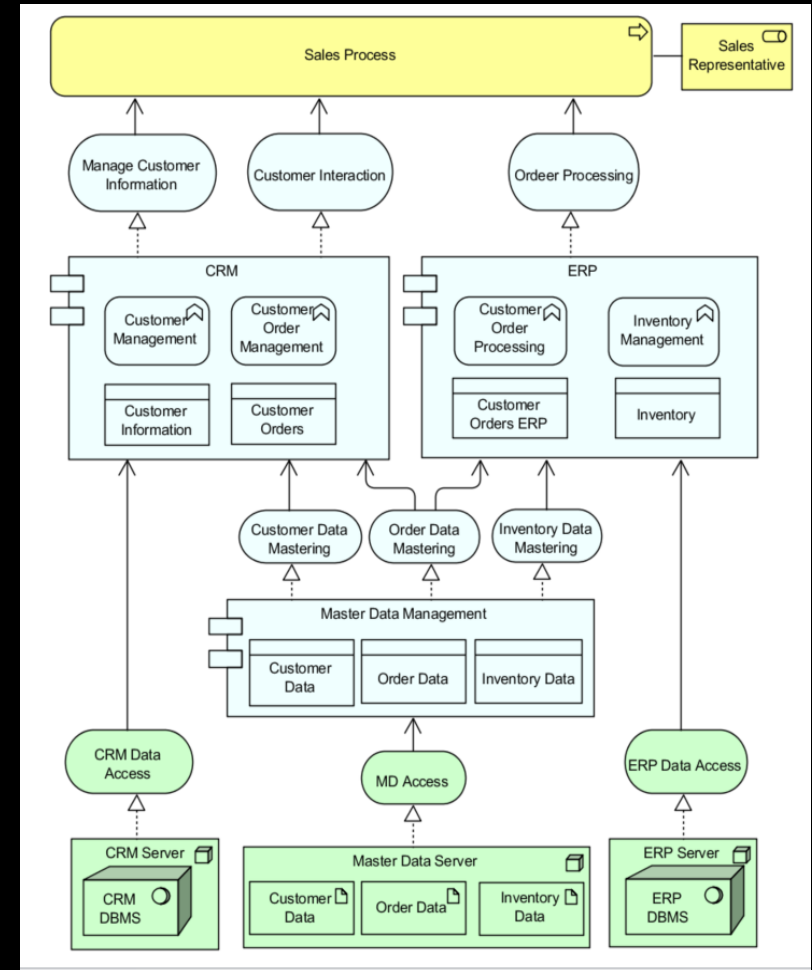
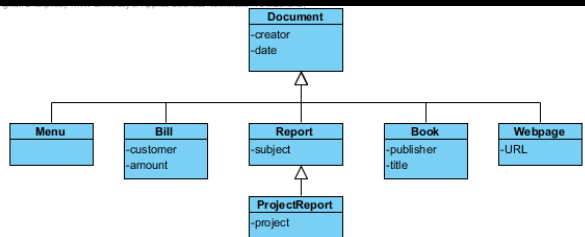


# Enterprise Modeling



| Candidate Eligible |                 |                       |          |
|--------------------|-----------------|-----------------------|----------|
| FC                 | Bachelor Degree | University accredited | eligible |
|                    | yes, no         | yes, no, unclear      | yes, no  |
| 1                  | yes             | yes                   | yes      |
| 2                  | no              | no                    | 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

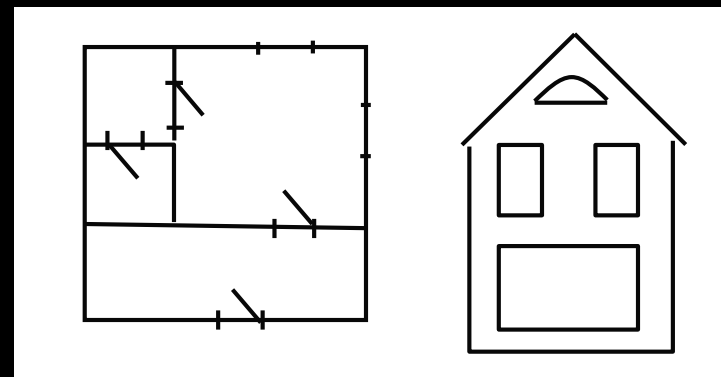
# Models

- 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**.



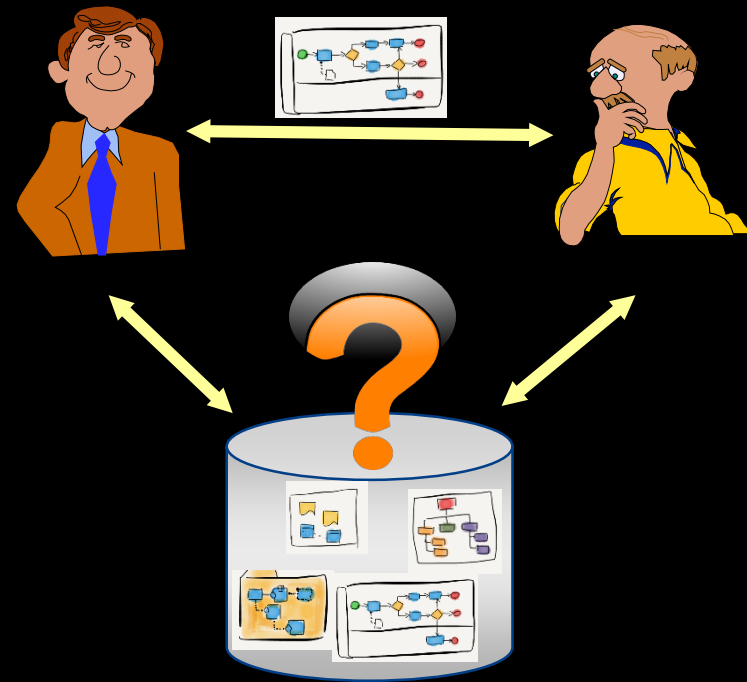
- Without explicit modeling there is a *high risk that the implementation is not what is intended*

(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

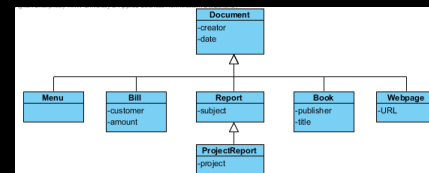
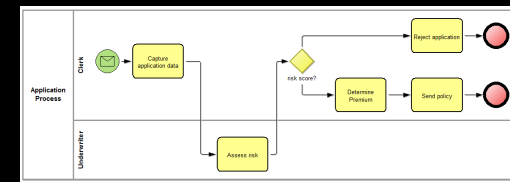


Based on (Bridgeland & Zahavi 2010)

# Models

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

**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.



$$E = m c^2$$



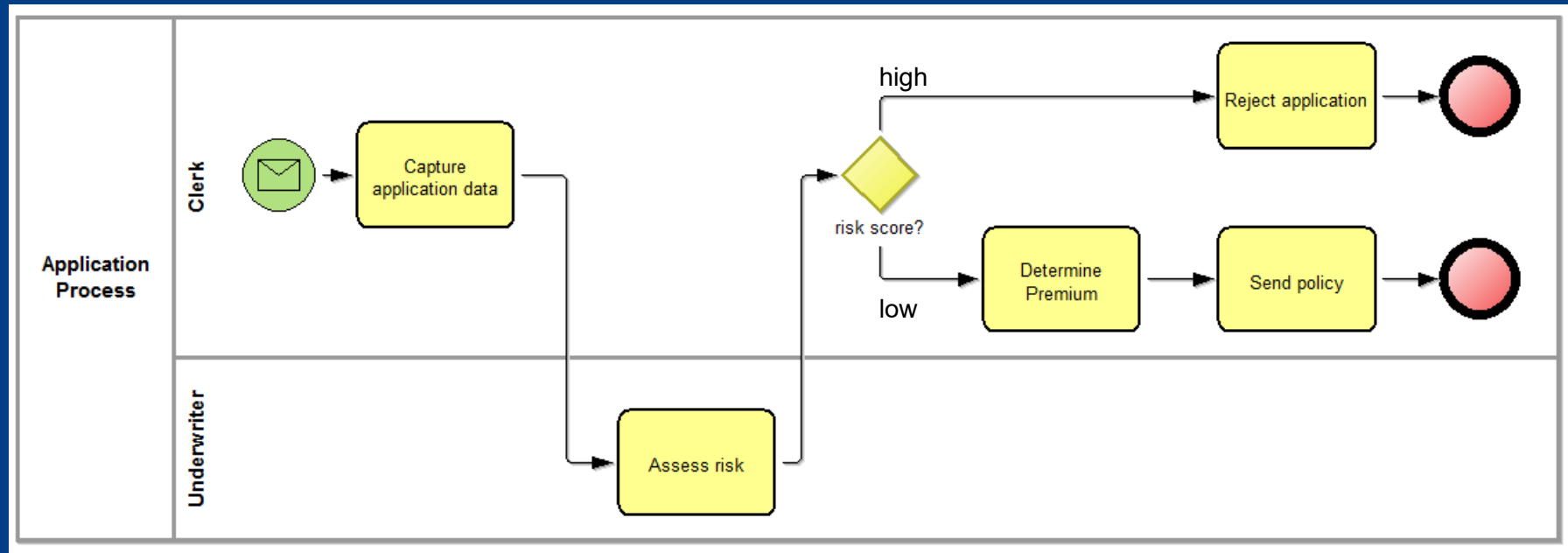
## *Experiment: Text vs. Model (1)*

### 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)



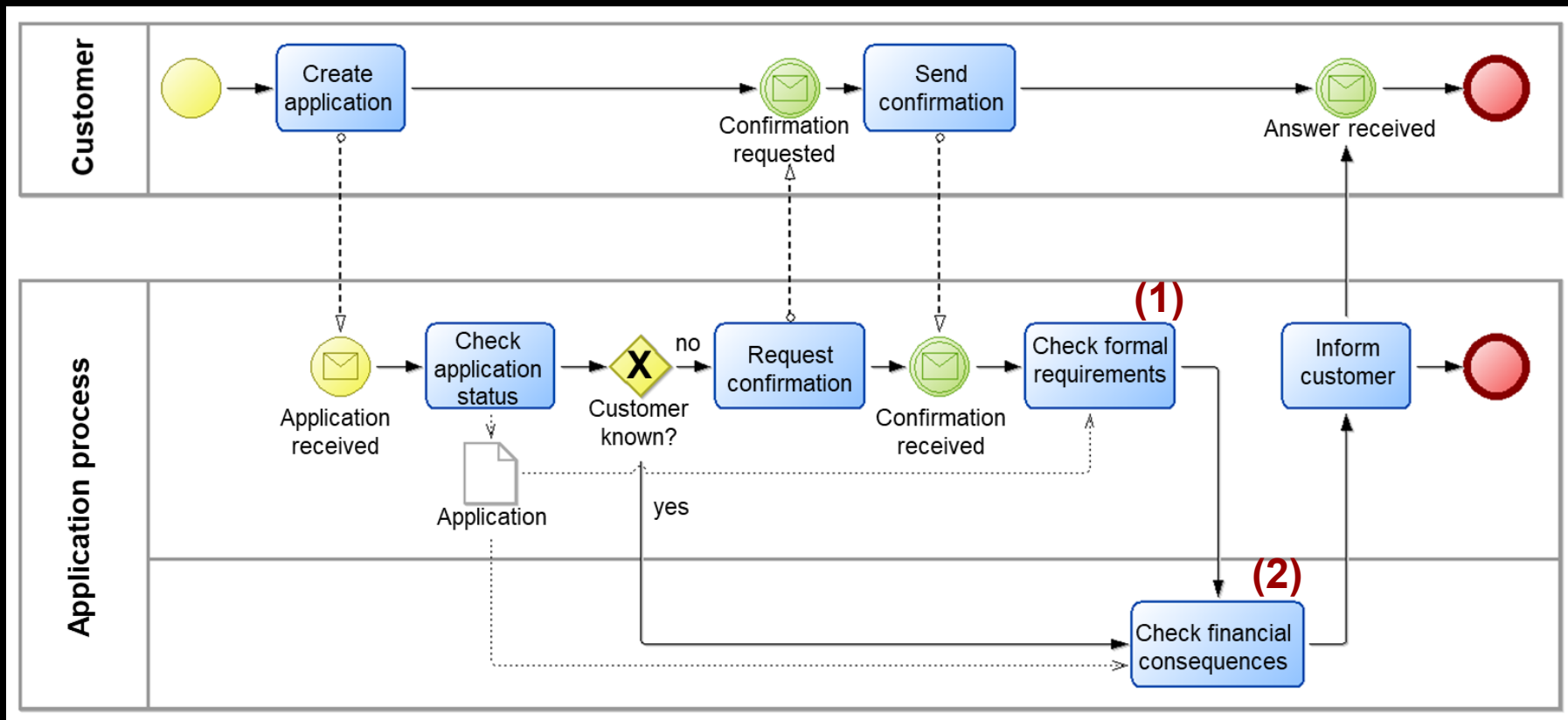
- Is the rejection of the application a task or an event?
- Which tasks are executed in parallel?

# 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.

# Process Analysis

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



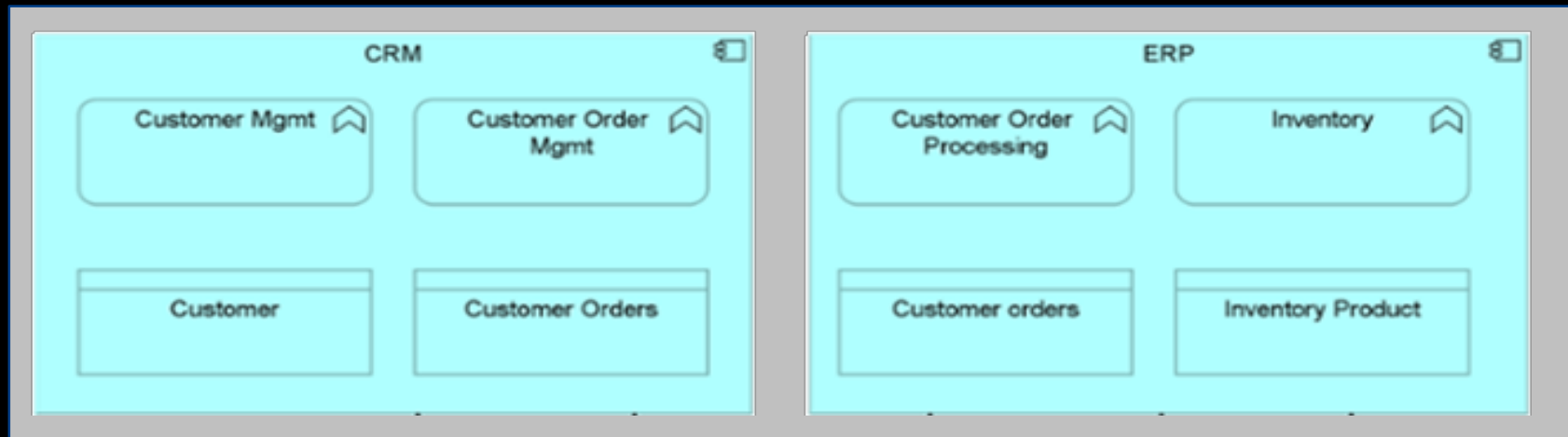
## *Example: Alignment of Business and IT*

**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

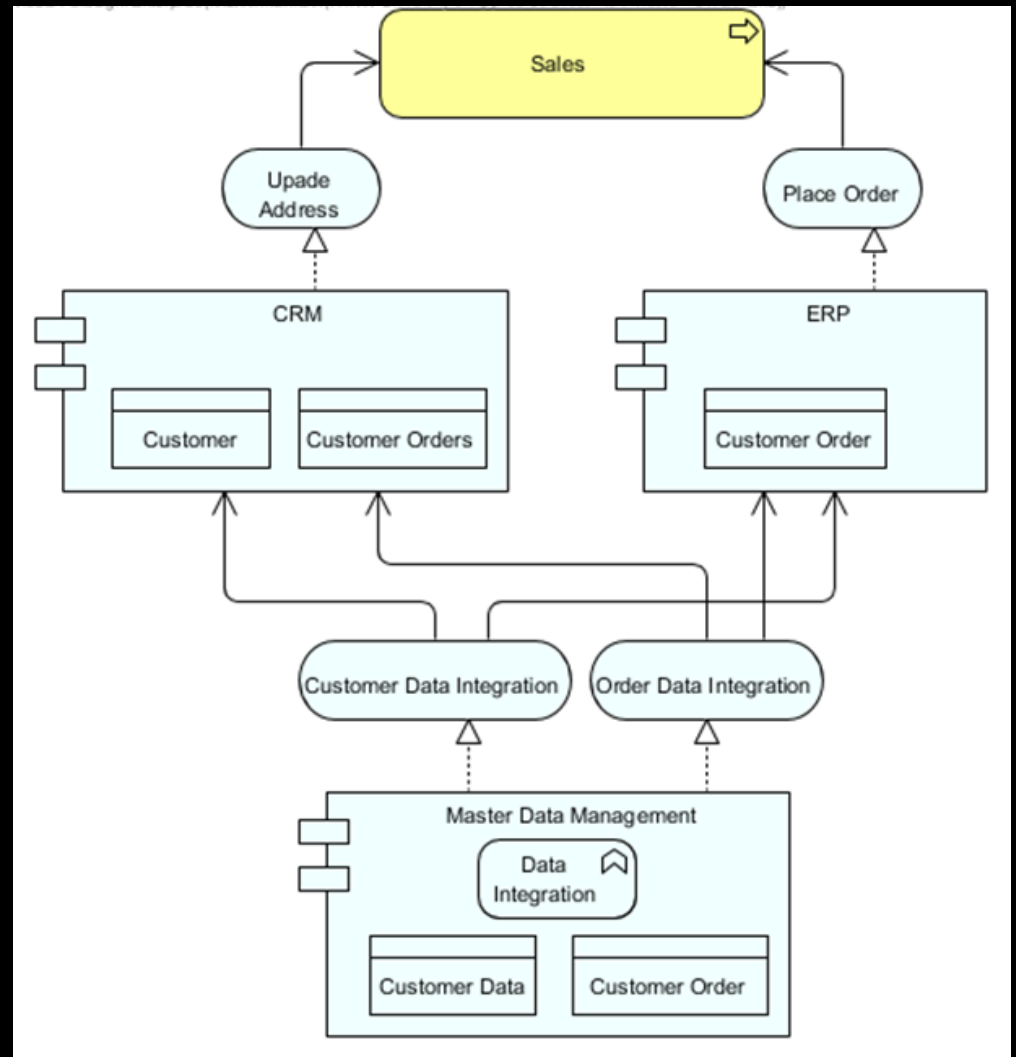


- What are problems of this situation with respect to data management?
- How could an architecture look like to deal with this problem?



# Managing Shared Data

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



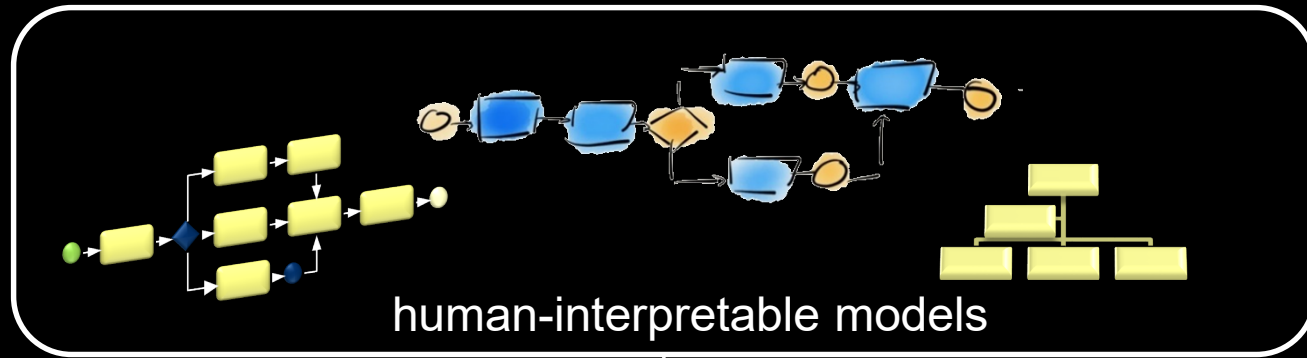
# *Ontology-based Metamodeling*

# Human Problem Solving

*Communication/  
Analysis/  
Decision Making*



*Models*

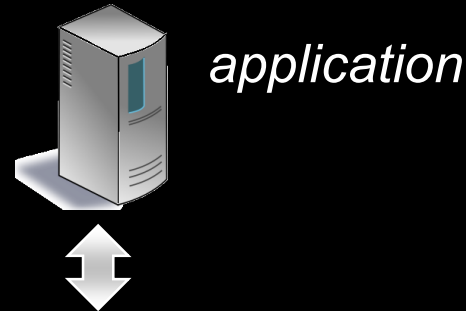


*Reality*

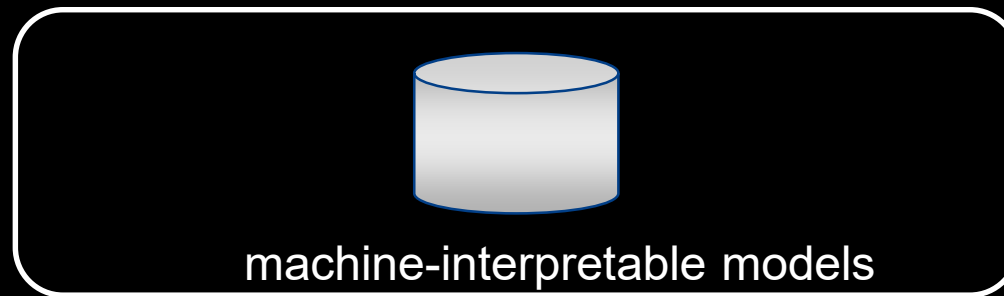


# Automated Analysis / Decision Making

*Analysis/  
Decision Making*



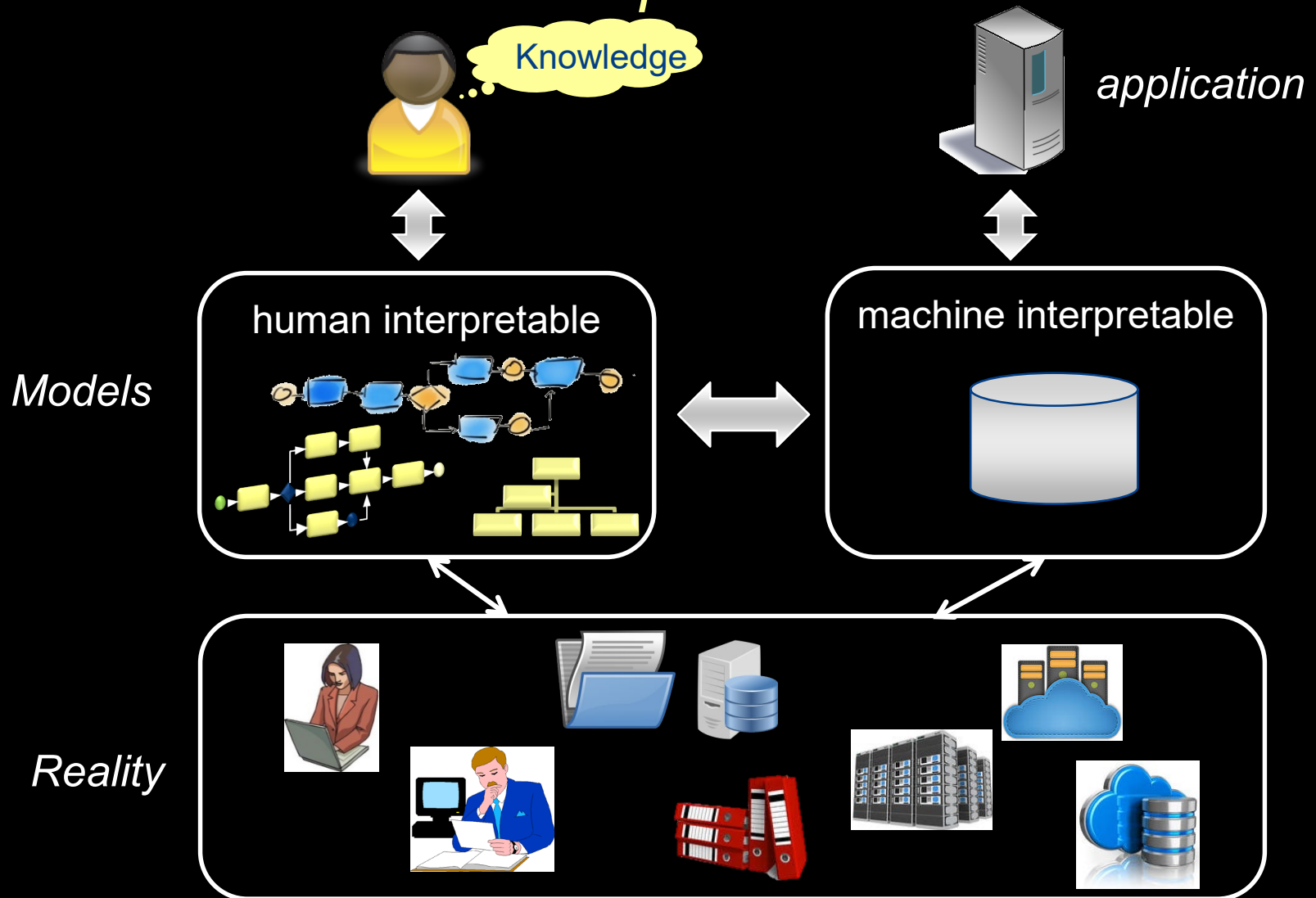
*Models*



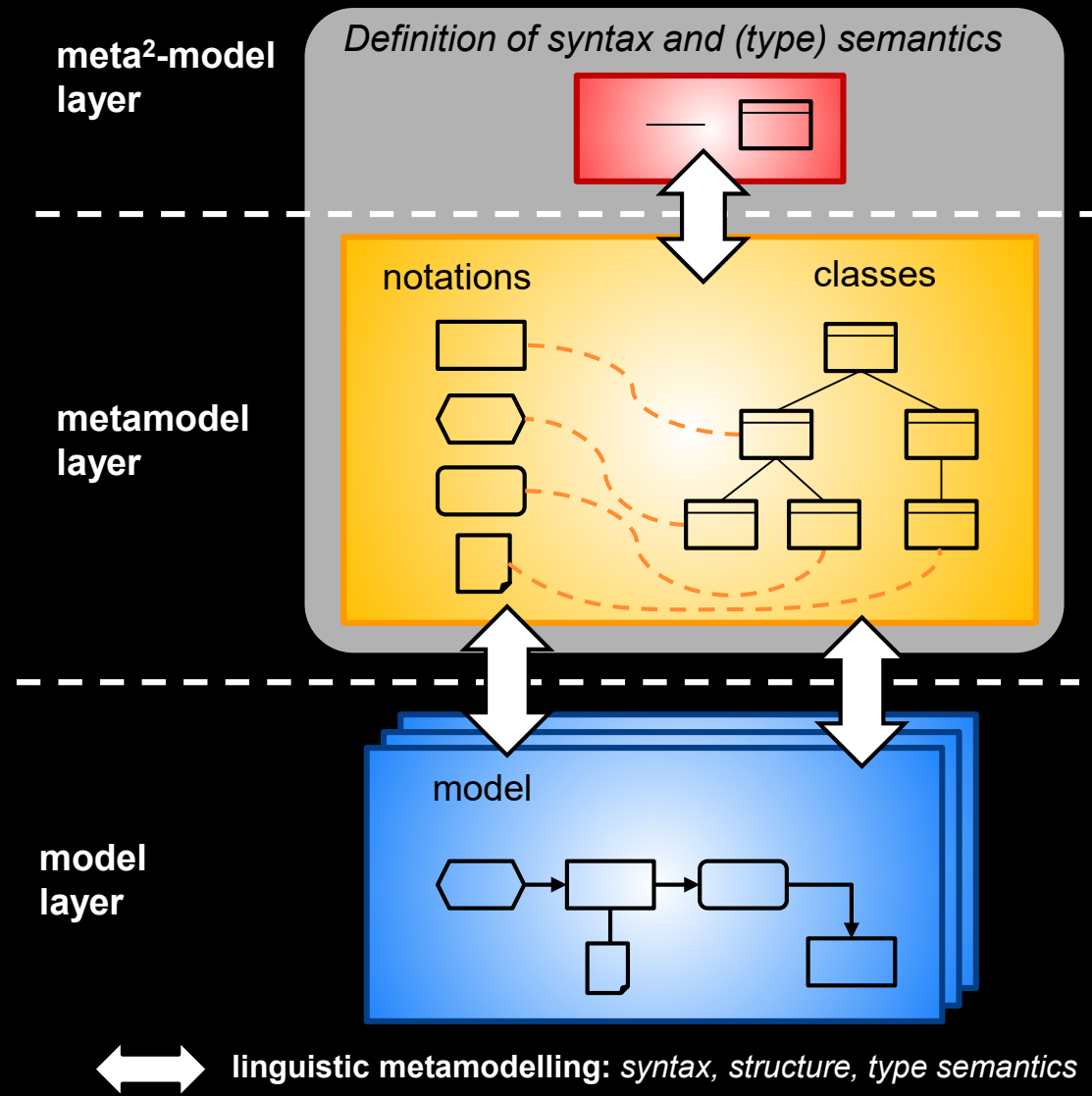
*Reality*

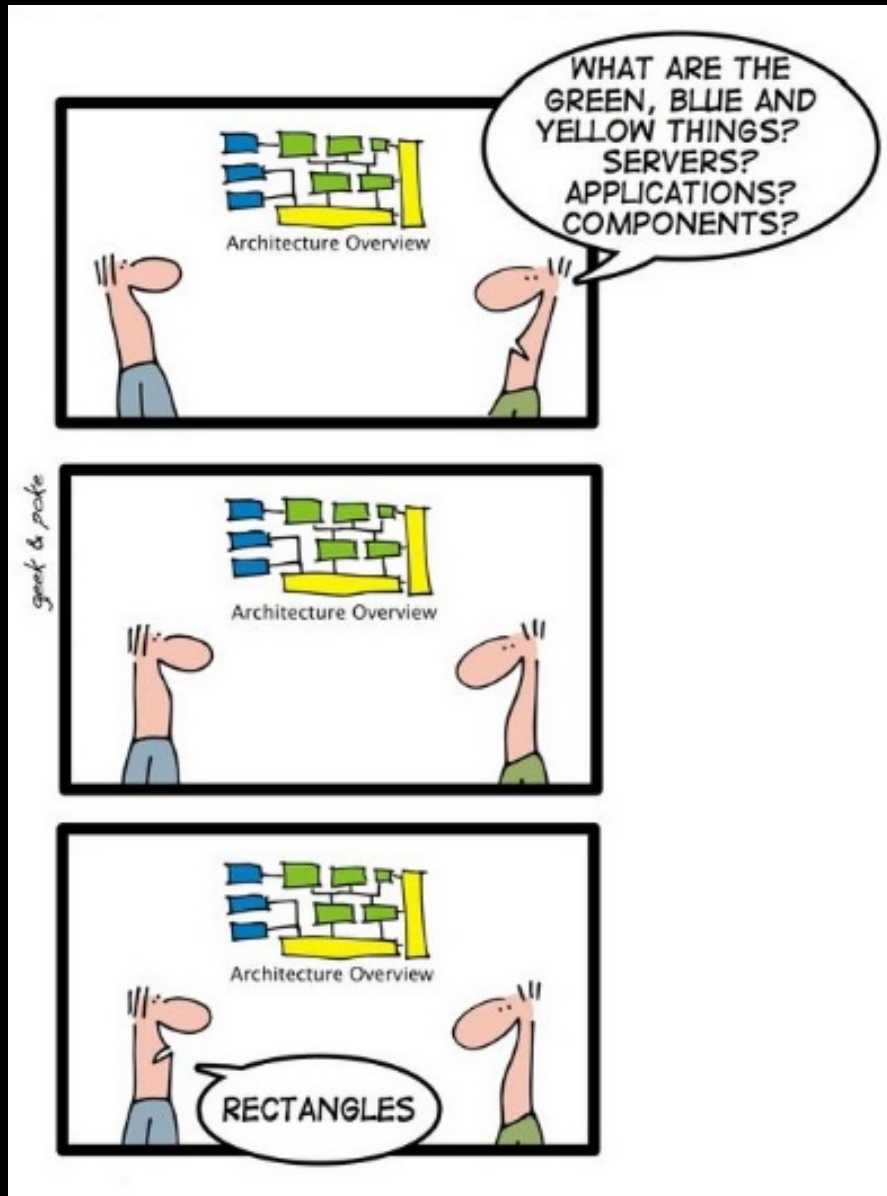


# Human and Machine Interpretation



# Modelling Environment

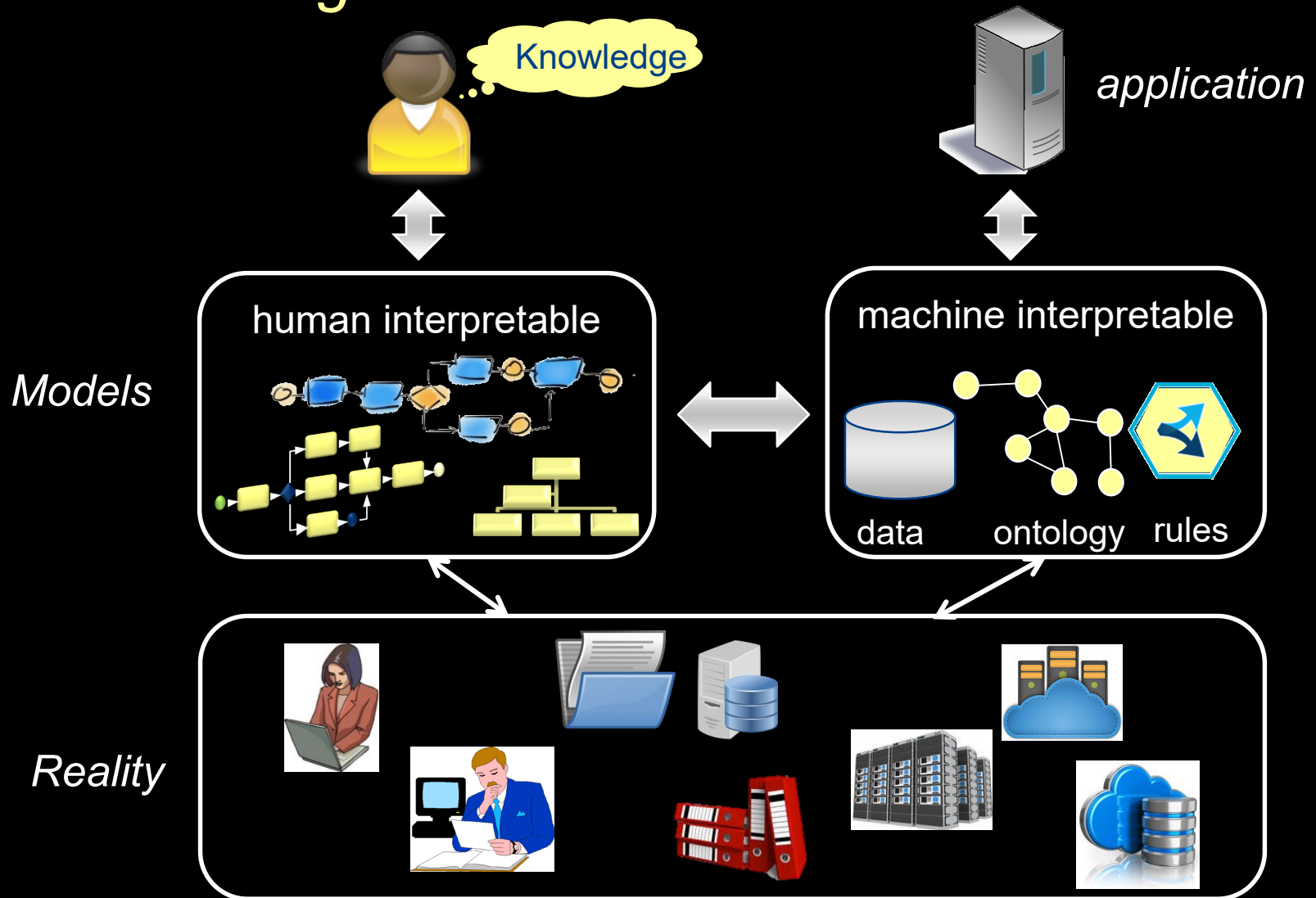




Humans and machines should «know» the meaning of the modeling objects:

→ **Enterprise Ontology**

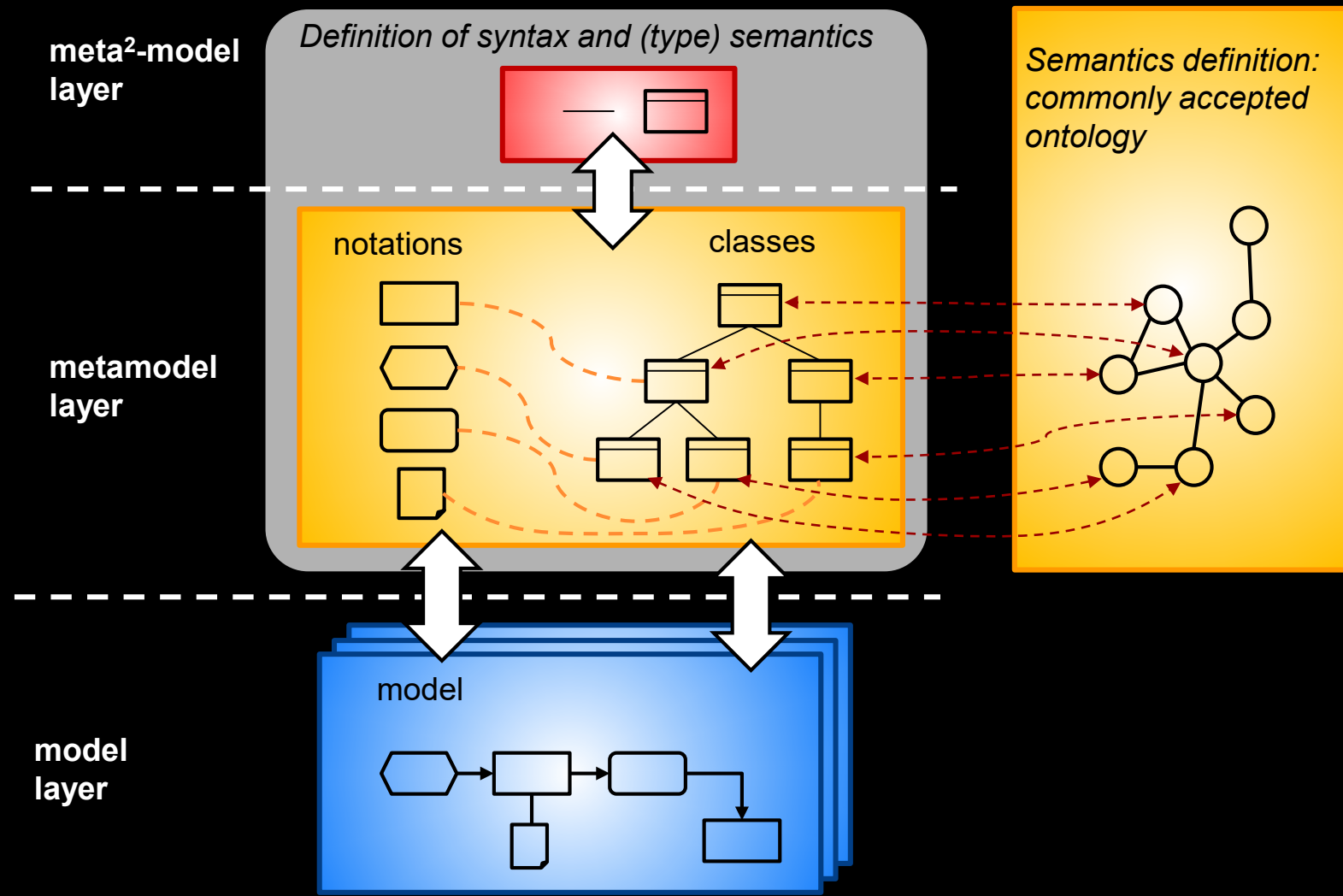
# Semantic Lifting





## Modelling Environment

## Ontology



linguistic metamodelling: *syntax, structure, type semantics*

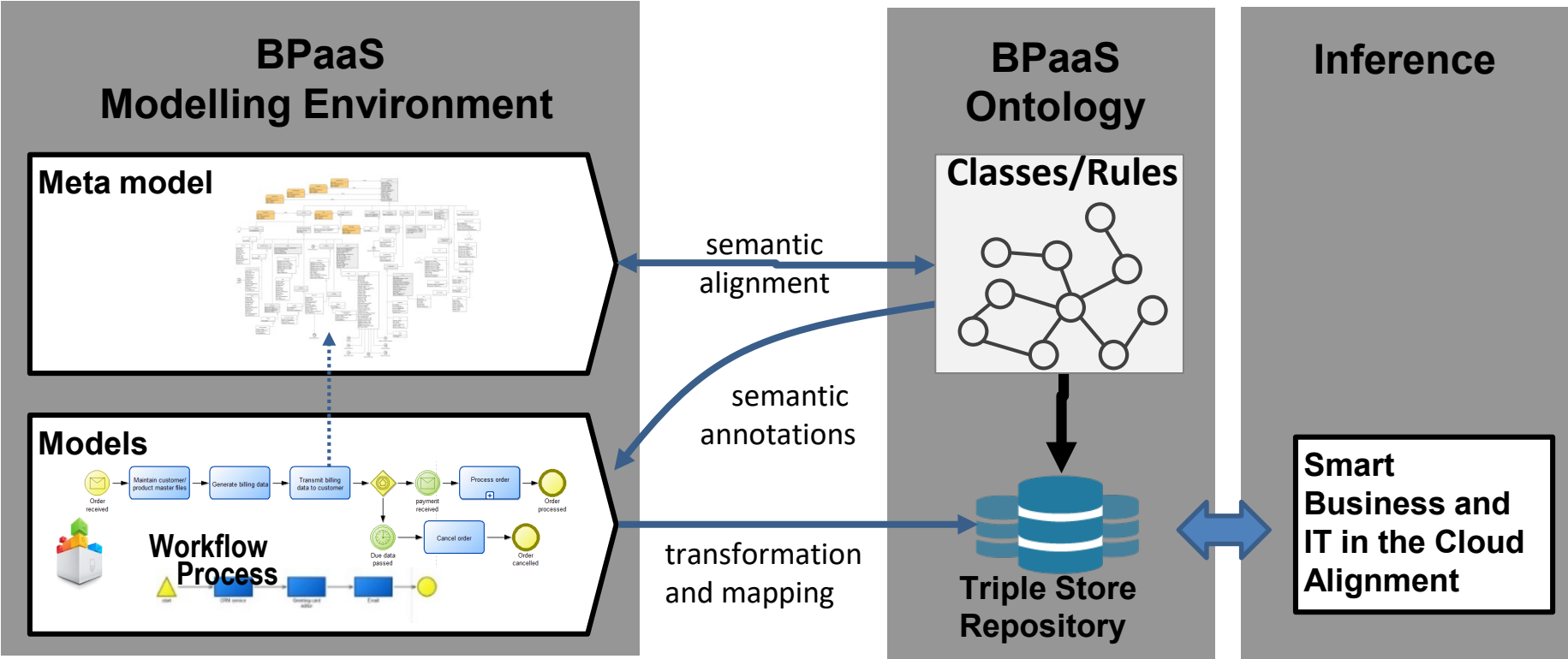


ontological metamodelling (lifting): *explication of type semantics*

# Example: Business Process as a Service

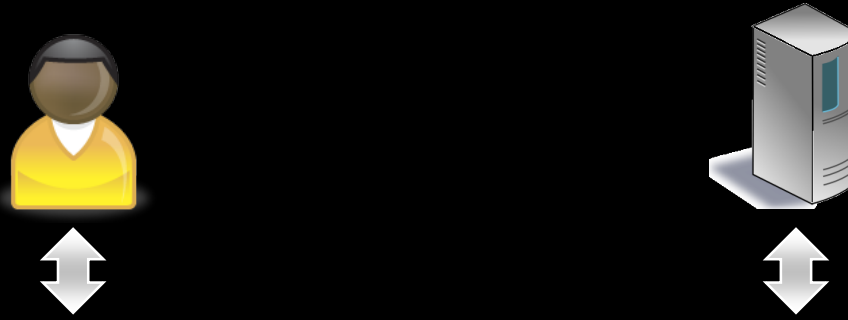
**human interpretation**  
informal and semi-formal

**machine interpretation**  
formal

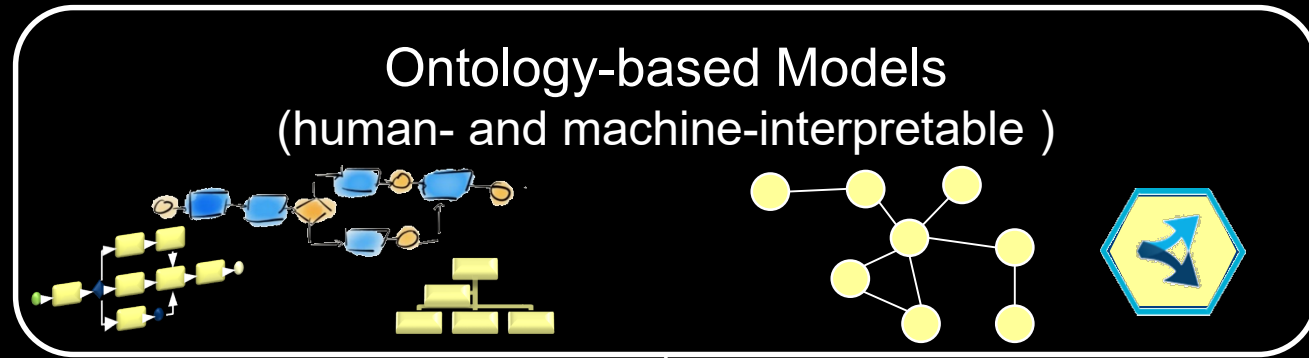


# CloudSocket

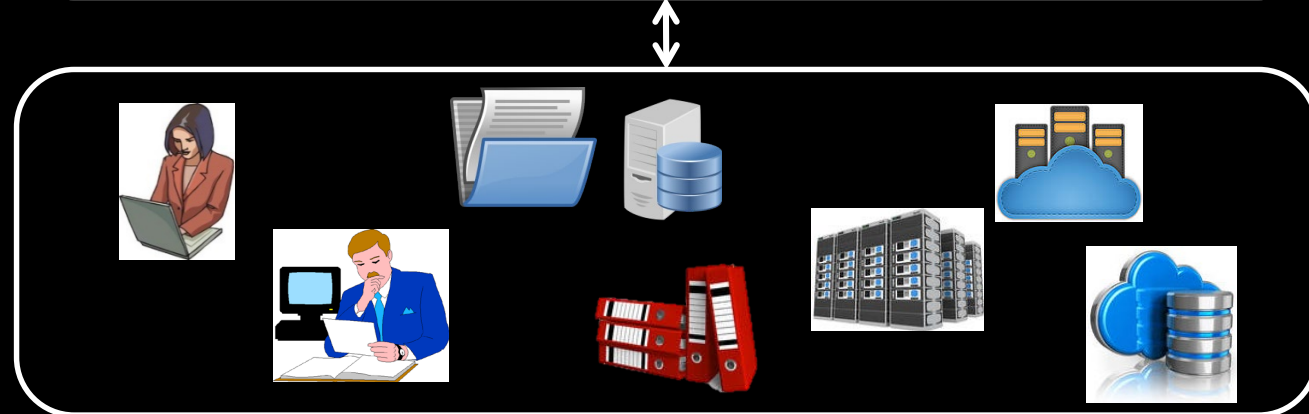
# Objective



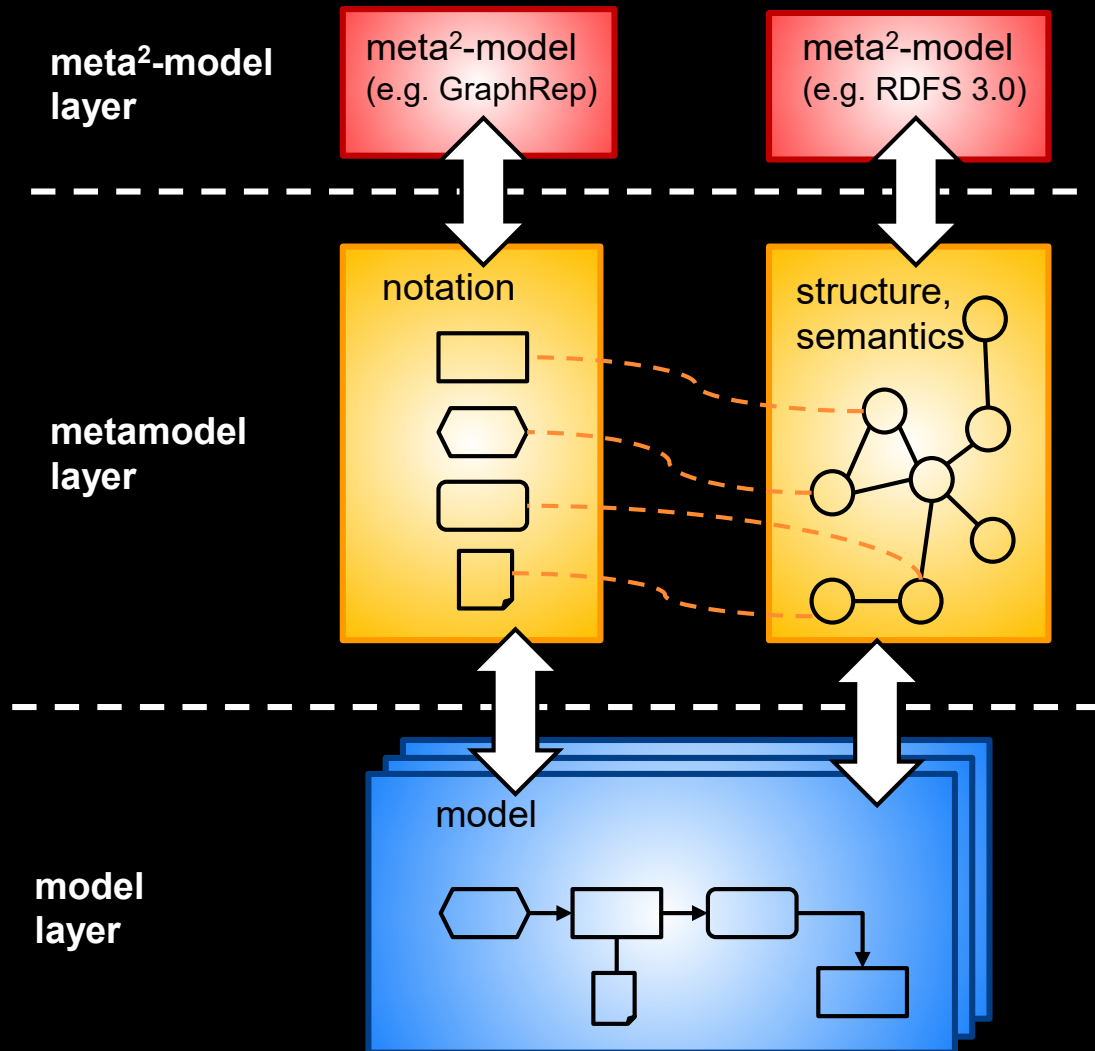
*Models + Knowledge*



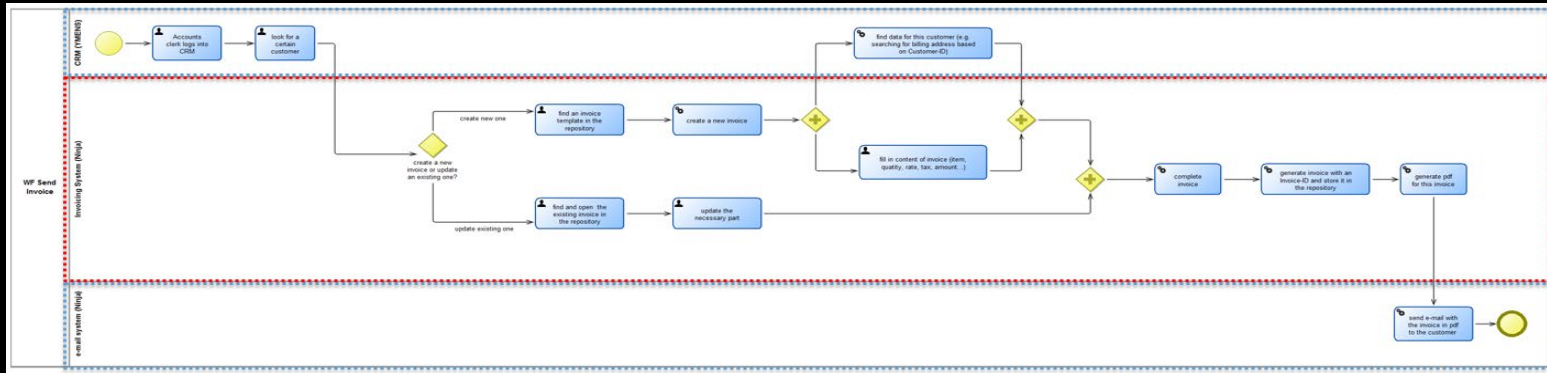
*Reality*



# Ontology-based Metamodeling



# Example



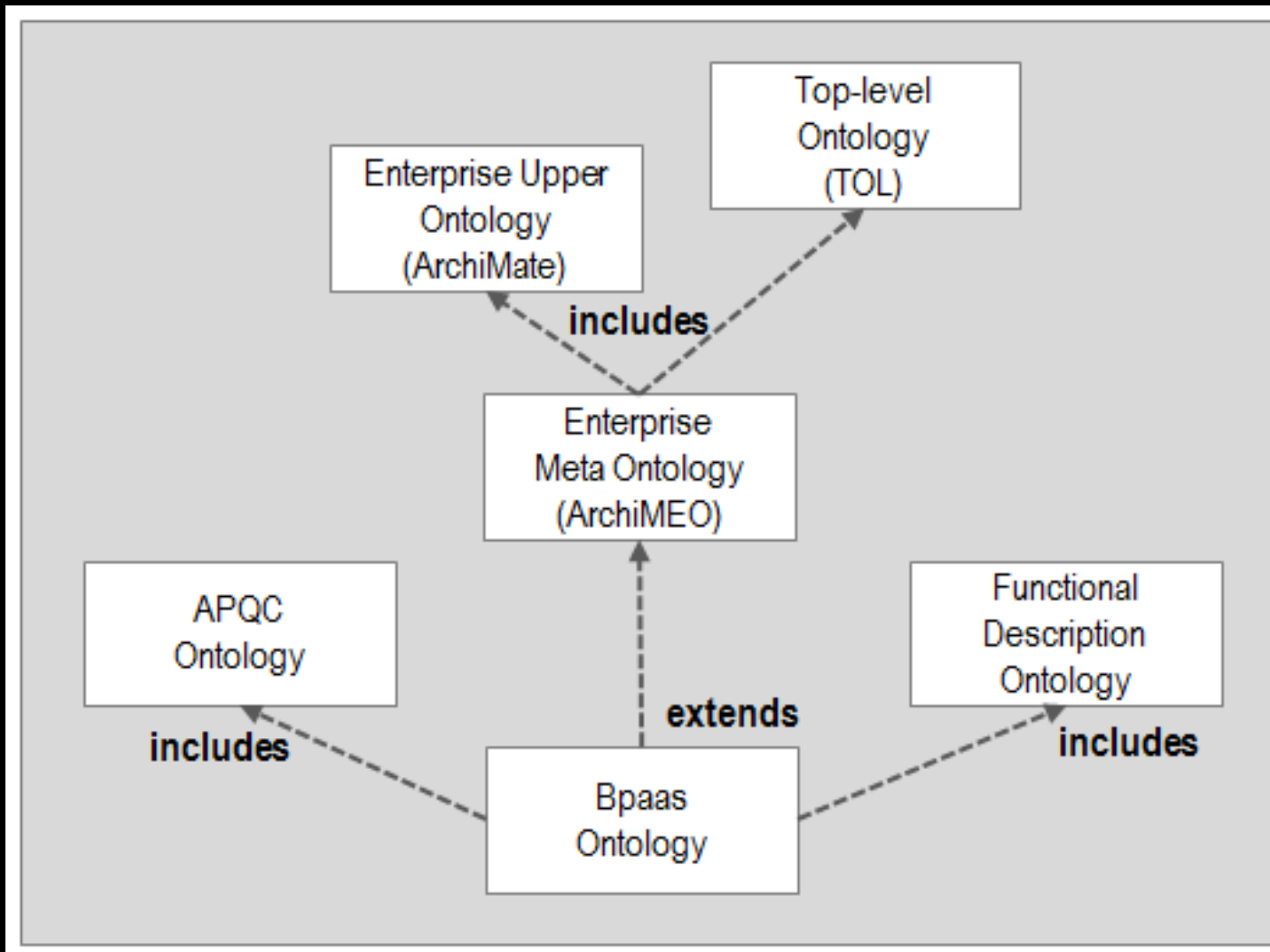
## Functionality

## Non-functional requirements

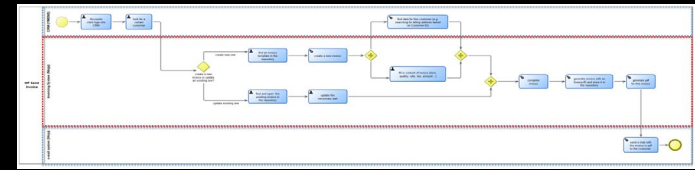
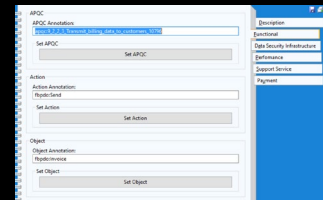
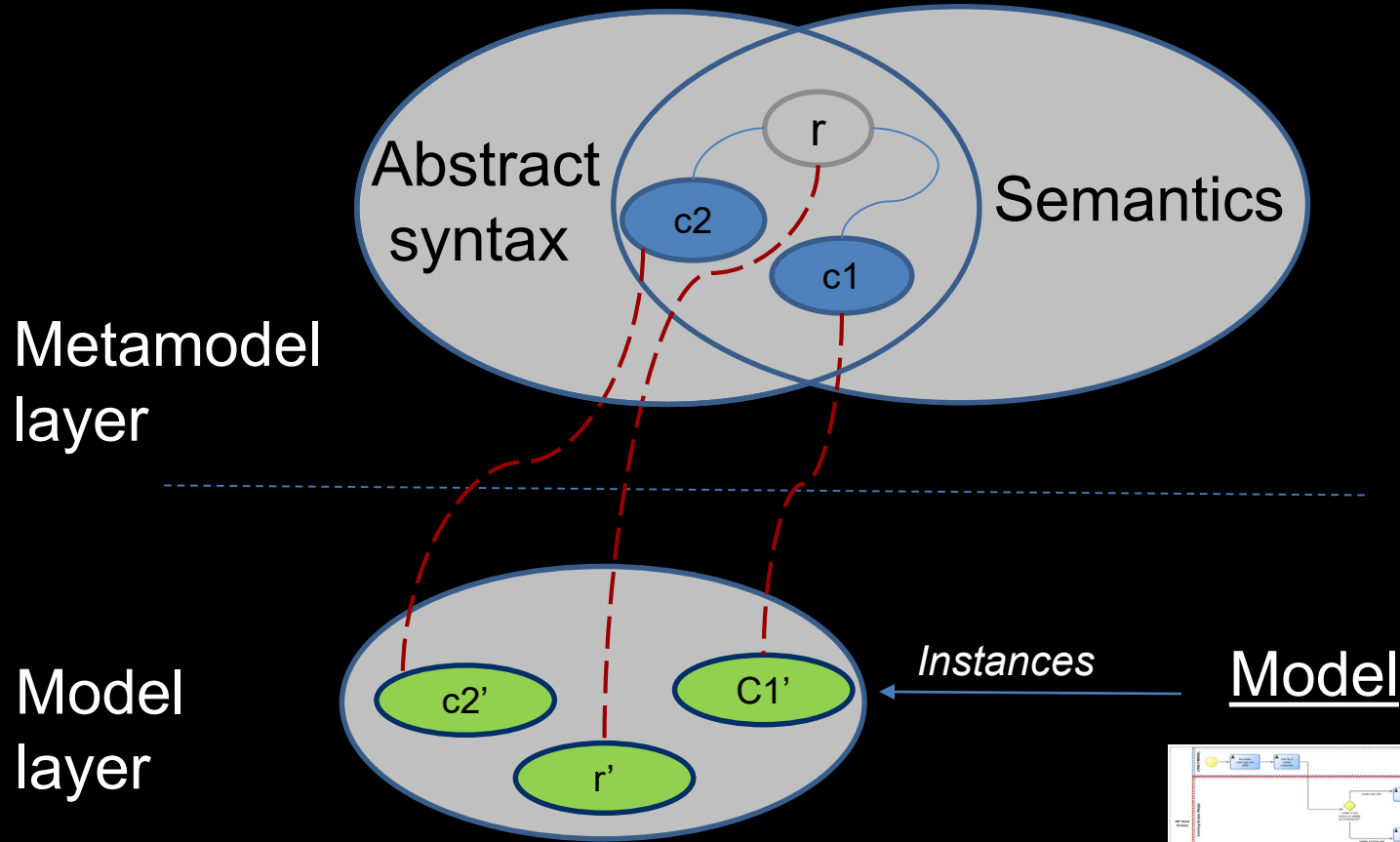
*All Concepts are defined in the Ontology*

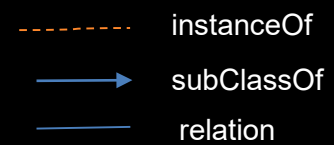


# ArchiMEO Enterprise Ontology

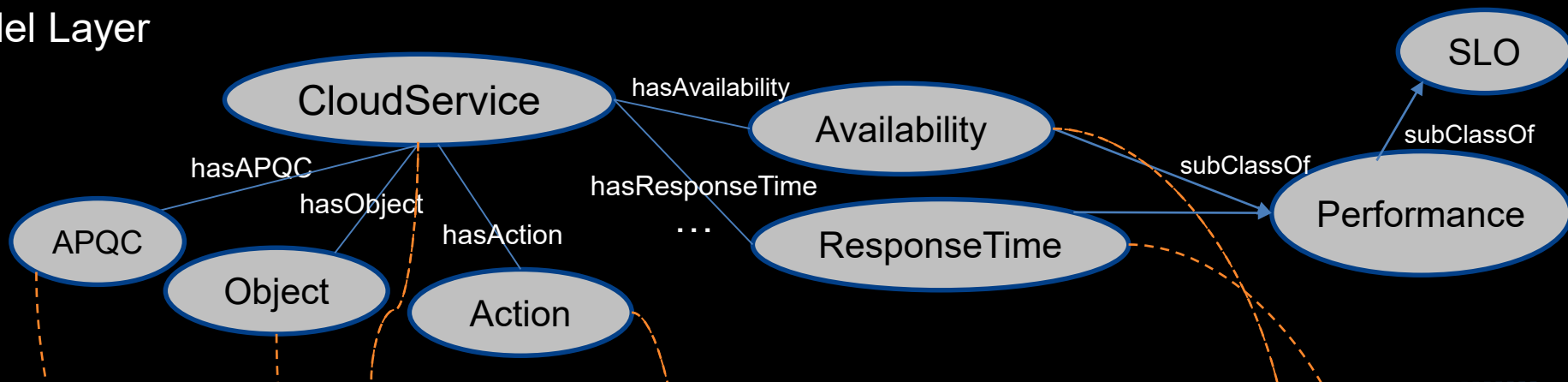


# Ontology

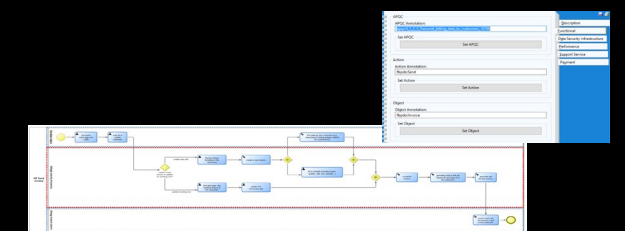
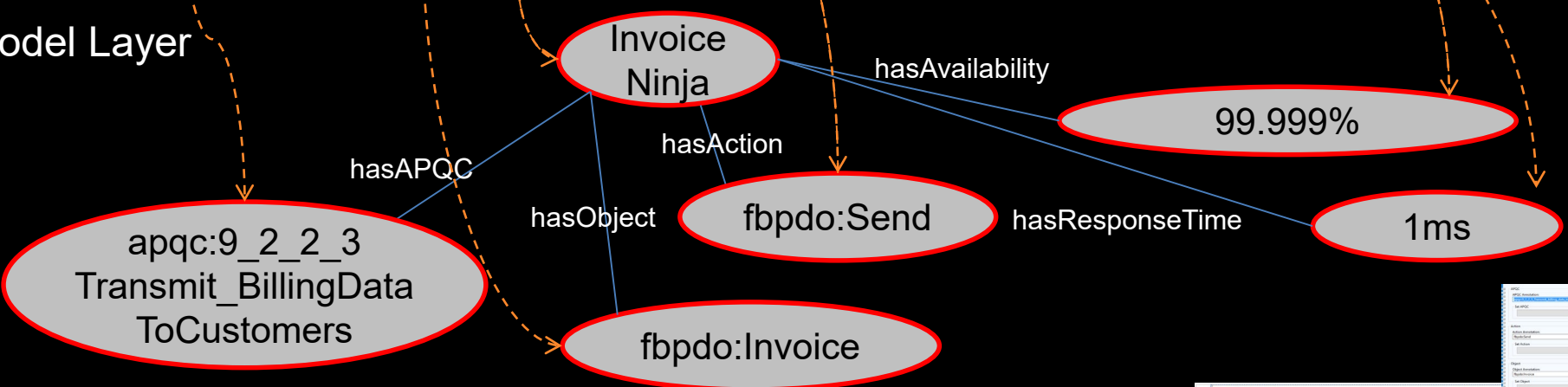




### Meta Model Layer



### Model Layer





# Application Example for Ontology-based Metamodel

## Cloud Service Selection

### Functionality

SemanticAnnotationQuestio X +

Functional

- APQC category that reflect the functional requirement:  
type to search \*
- Action that reflect the functional requirement:  
type to search \*
- Object that reflect the functional requirement:  
type to search \*

### Non-functional requirements

Payment

- Select your preferred payment plan:
  - Prepaid Annual Plan
  - Try Free First
  - Customizable Plan
  - Monthly Fee
  - None

Performance

- Monthly Availability in %:  
Insert your value here \*

# *Agile Meta-Modeling*

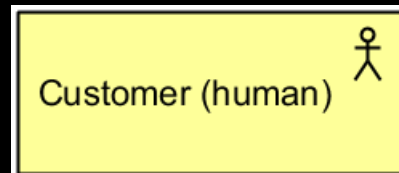
## Example: Customization in Archimate

- One single concept for Actors

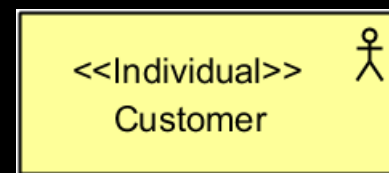
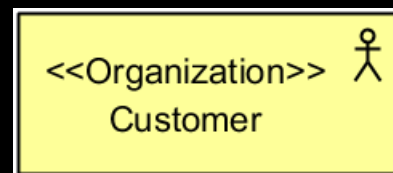


- Objective: Distinguish between human and organisation unit

- ◆ Name



- ◆ Stereotyping

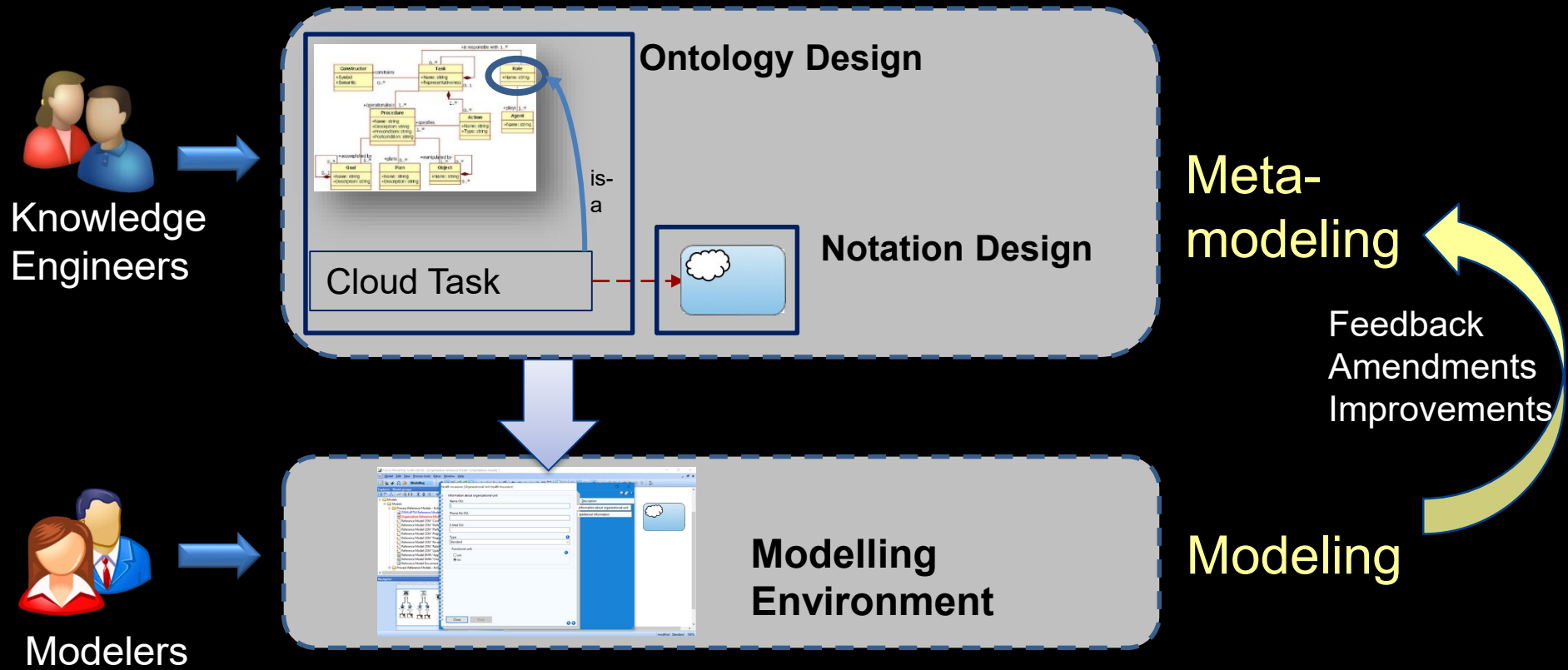


*Semantics only for human, not machine-interpretable*

# *Objective*

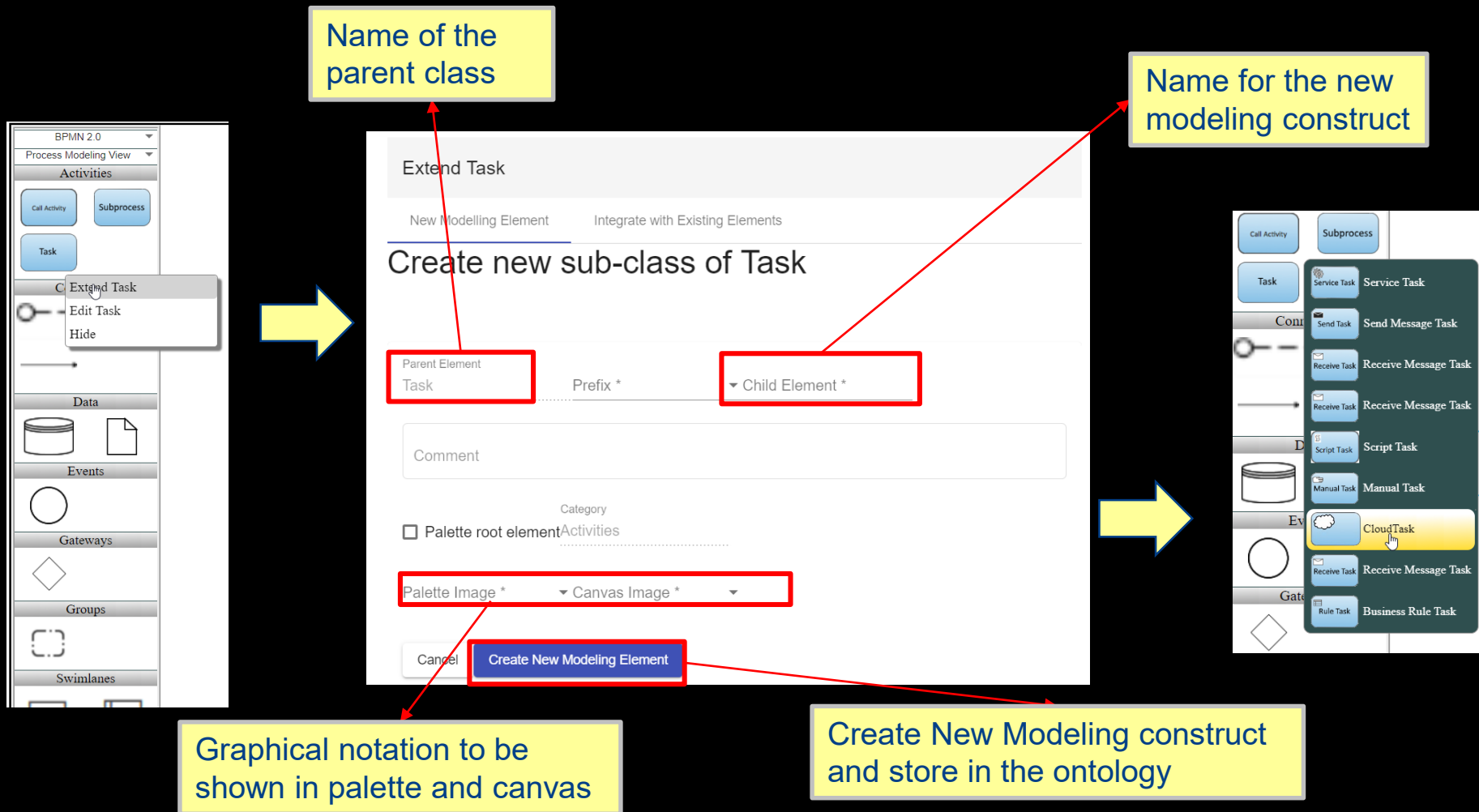
Ensure a precise shared interpretation  
of new modeling constructs to both  
**humans and machines**

# Change of Metamodel

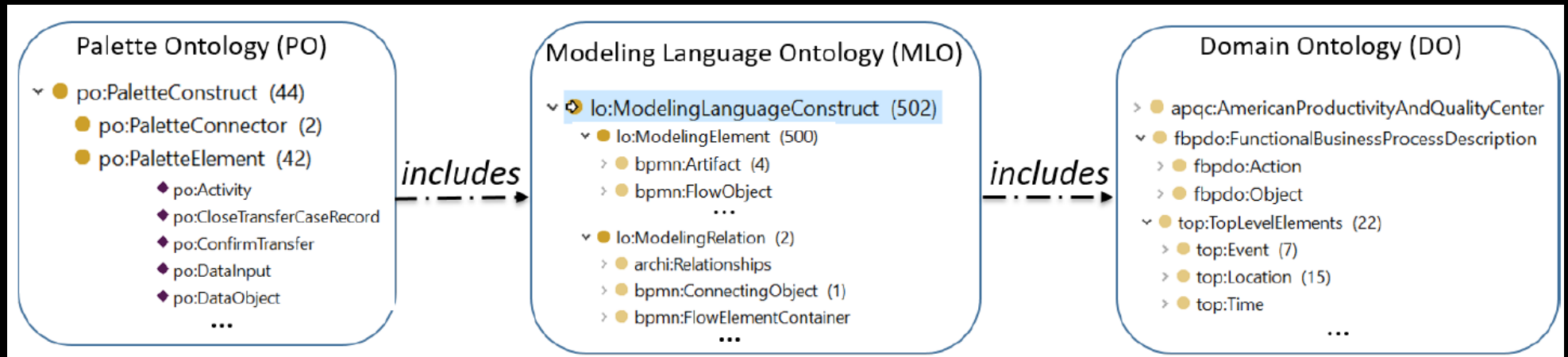


*Time-consuming engineering effort!*

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



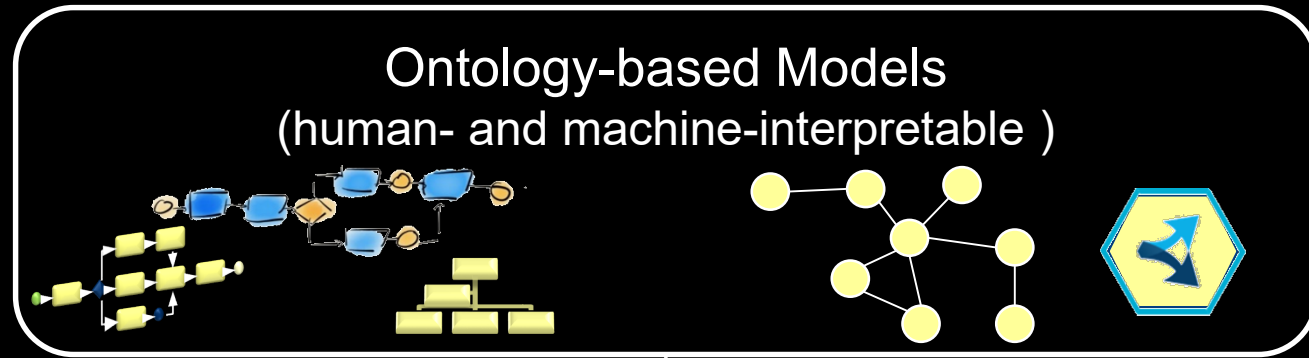
# Ontologies



# Agile and Ontology-Aided Modeling Environment (AOAME)



*Models +  
Knowledge*



*Reality*





# Thanks to ...



Emanuele Laurenzi



Charuta Pande