TECHNISCHE UNIVERSITÄT DRESDEN
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32) Domain Models and Software Product Line Engineering (SPLC)

1. Domain Models and Product Lines
2. Domain Ontologies and the MDA

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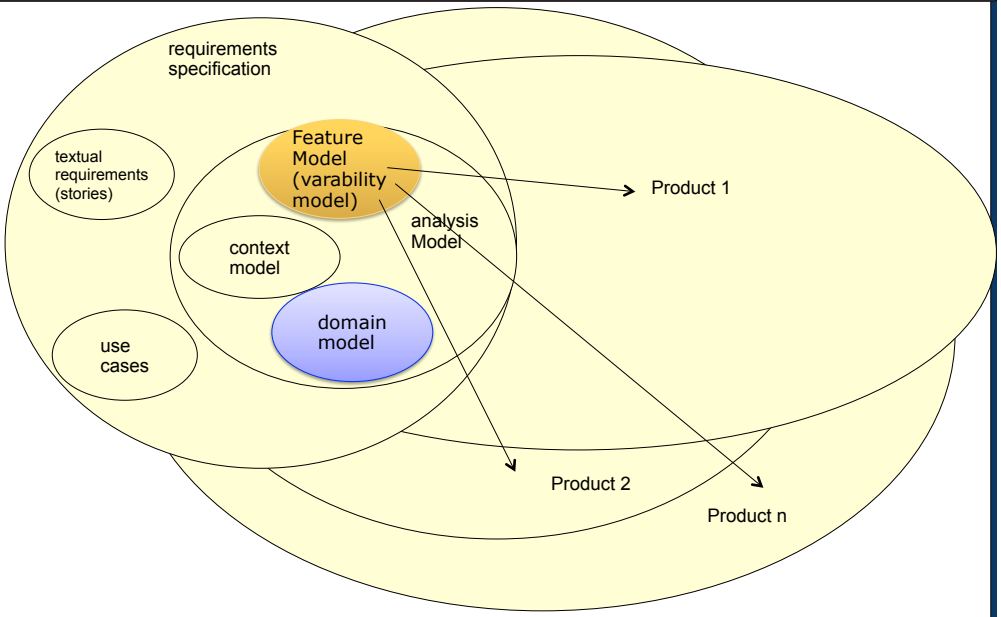
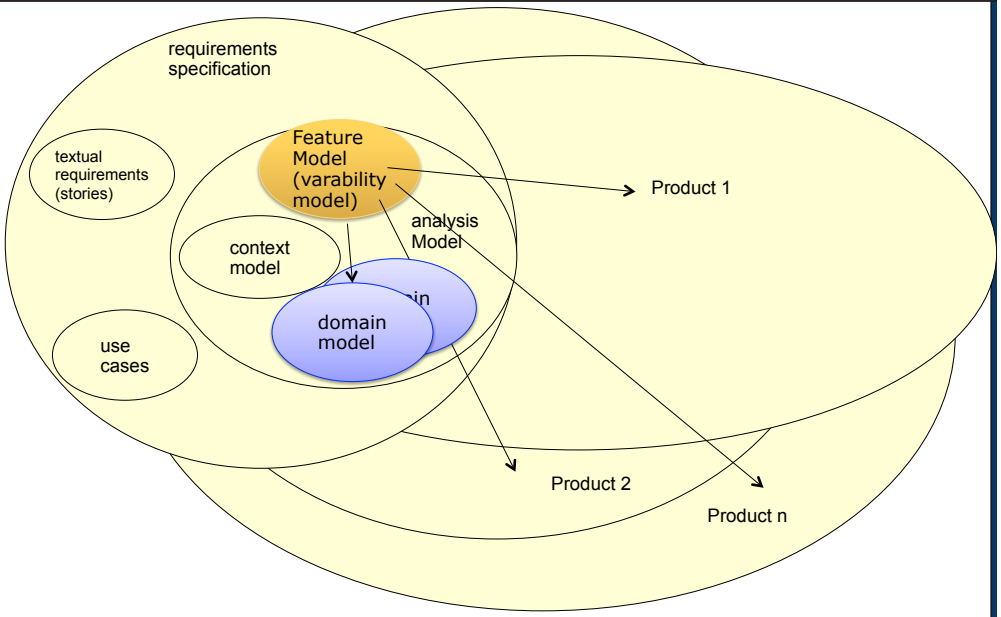
Literature

- Uwe Aßmann, Steffen Zschaler, and Gerd Wagner. Ontologies, meta-models, and the model-driven paradigm. In Coral Calero, Francisco Ruiz, and Mario Piattini, editors, Ontologies for Software Engineering and Technology. Springer, 2006.
- Ed Seidewitz. What models mean. IEEE Software, 20:26-32, September 2003.

So Far: Product Lines Configured by Feature Models

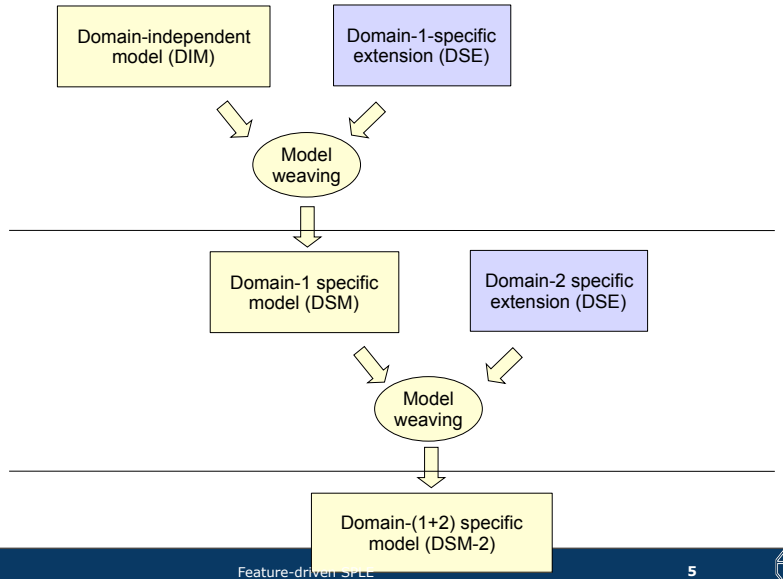


Now: Product Lines with different Domain Models



Adding Domain-Specific Extensions to Domain-Independent Models

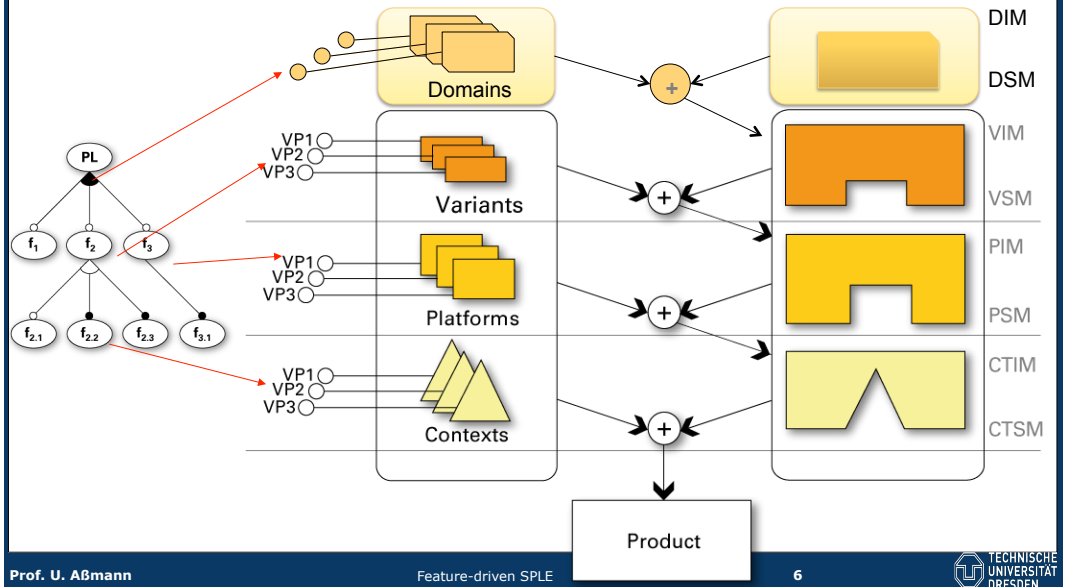
- **In a product line, domain-specific extensions can be treated like platform-specific extensions (see process FEASIPLE)**



32.1 DOMAIN MODELS AND SOFTWARE PRODUCT LINES (SPLC)

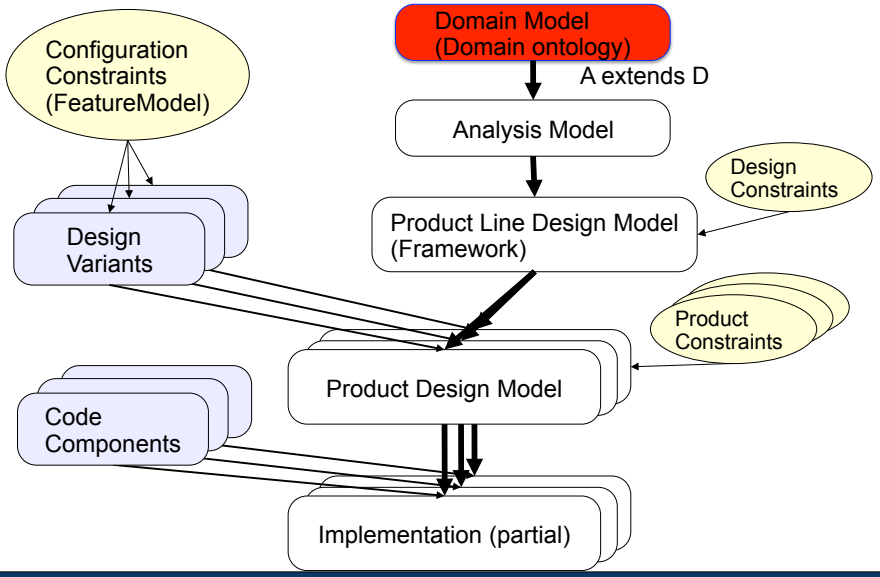
FEASIPLE: A Multi-Stage Process Architecture for PLE

- **FEASIPLE can be extended by a stage for selecting domain models**

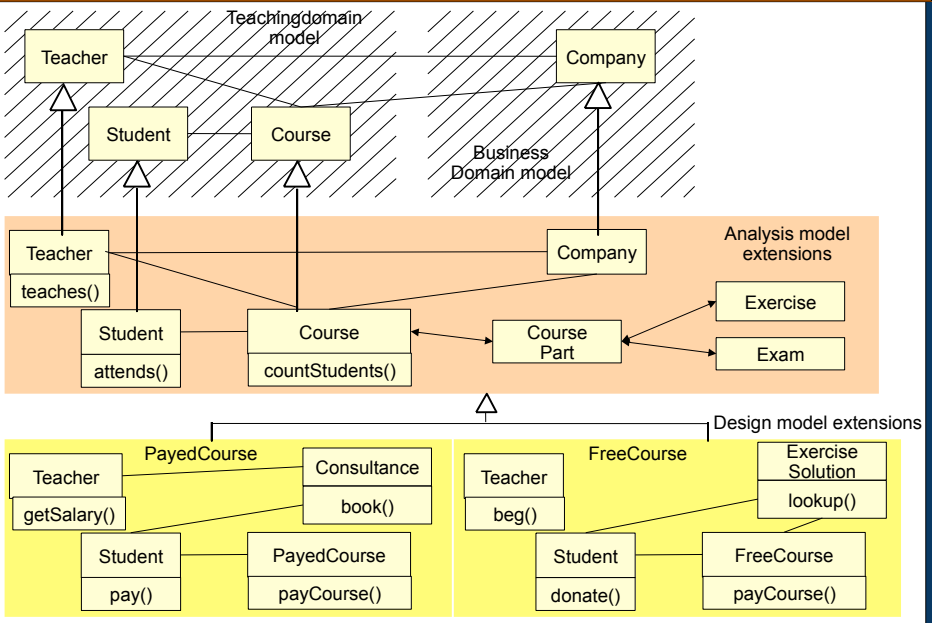


Domain Models can be Integrated into PL in Different Ways

- **As "base model" of the analysis model: analysis classes inherit from domain classes (standard was of ST-I)**

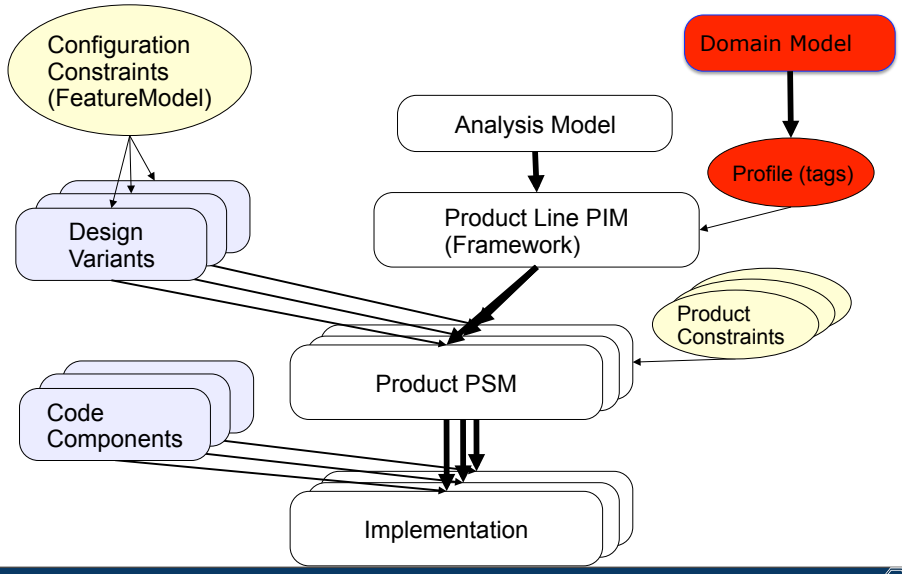


Domain Models as Base Models



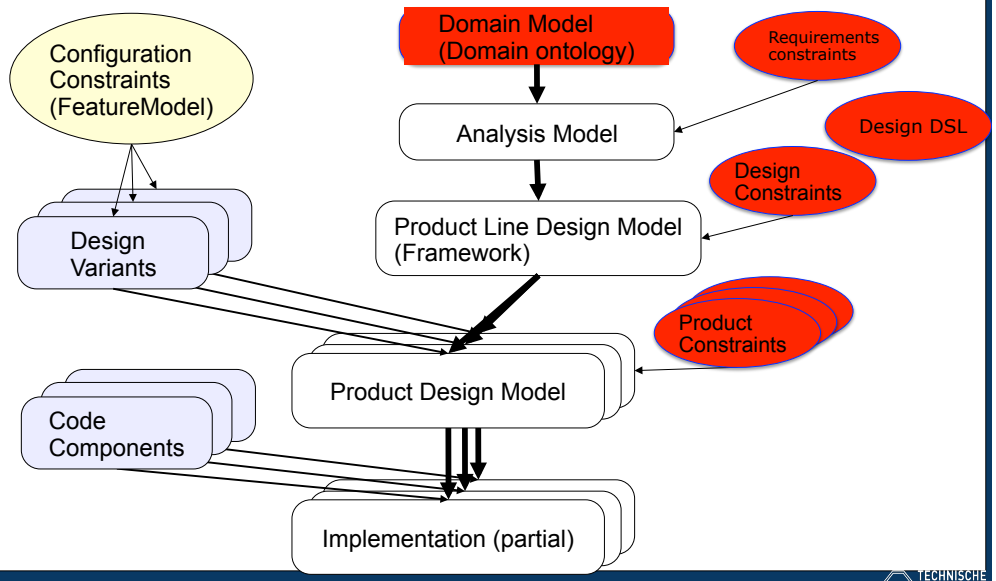
Domain Models as Domain Profiles in Marked PIM

- **Marked PIM in MDA**



MOST Product Family Architecture (MOPF) As Contraints

- **Domain models are used in several places in the SPLC: As design constraints, as product constraints, as design DSL**



32.2 USING DOMAIN ONTOLOGIES IN THE MDA

- **Ontologies offer reasoning power**
  - Ontologies are modeled by domain experts and standardized
    - Gene Ontology, SnoMed, Mouse Ontology, ..
  - OWL language is standardized, reasoners are available
- **Can we use them in the Product-Line Engineering, resp. MDA?**
- **How do ontologies and system models relate?**
  - Ontology
  - Metamodels
  - Model-Driven Engineering (MDE)
  - Model-Driven Architecture (MDA)

- **How can we find a place for ontologies in the world of MDA?**

A model is an external and explicit representation of a part of reality as seen by the people who wish to use that model to understand, change, manage, and control that part of reality. [Pidd]

A model of a system is a description or specifiation of that system and its environment for some certain purpose. [MDA Guide]

But....

Ontologies are formal explicit specifications of a shared conceptualization.[Gruber]

- **[Aßmann, Zschaler, Wagner 06]**

An **ontology:**

a standardized,
descriptive model,

representing reality
by a set of concepts, their interrelations, and constraints
under
open-world assumption.

A **system model:**

a non-standardized,
prescriptive model,

representing a set of systems
by a set of concepts, their interrelations, and constraints
under
closed-world assumption.

A model can be *descriptive* or *prescriptive*.
[Seidewitz CACM 03]

•Models describe or control reality.
•If they describe, they monitor reality and form true, or faithful, abstractions (Analysis, Reengineering)
•If they control, they prescribe reality (Construction, Specification)

- Ontologies need the **open-world assumption**
  - Analysis perspective
  - **Anything not explicitly expressed is unknown**
  - Ontologies use a form of partial description to abstract

Descriptive

- System models need **closed-world assumption**
  - Design perspective
  - **Anything not explicitly expressed is wrong**
  - System models specify completely

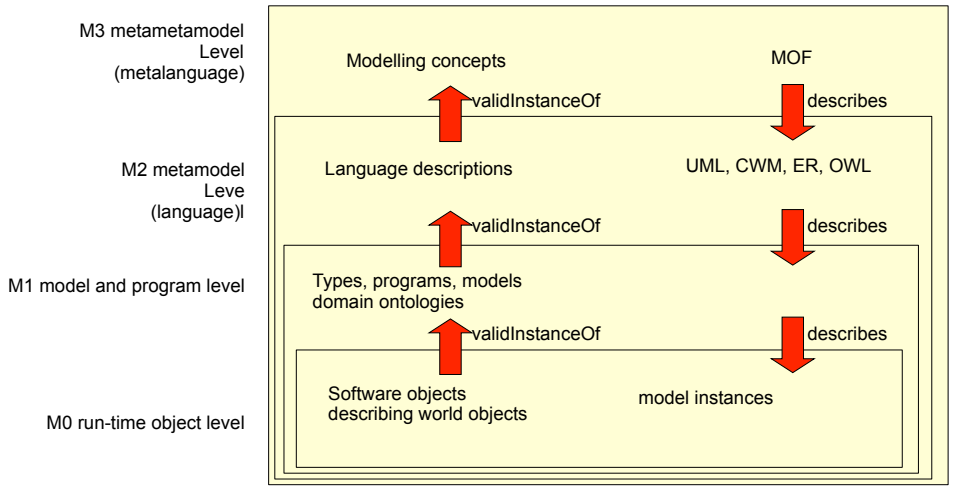
Prescriptive

What to Do with What

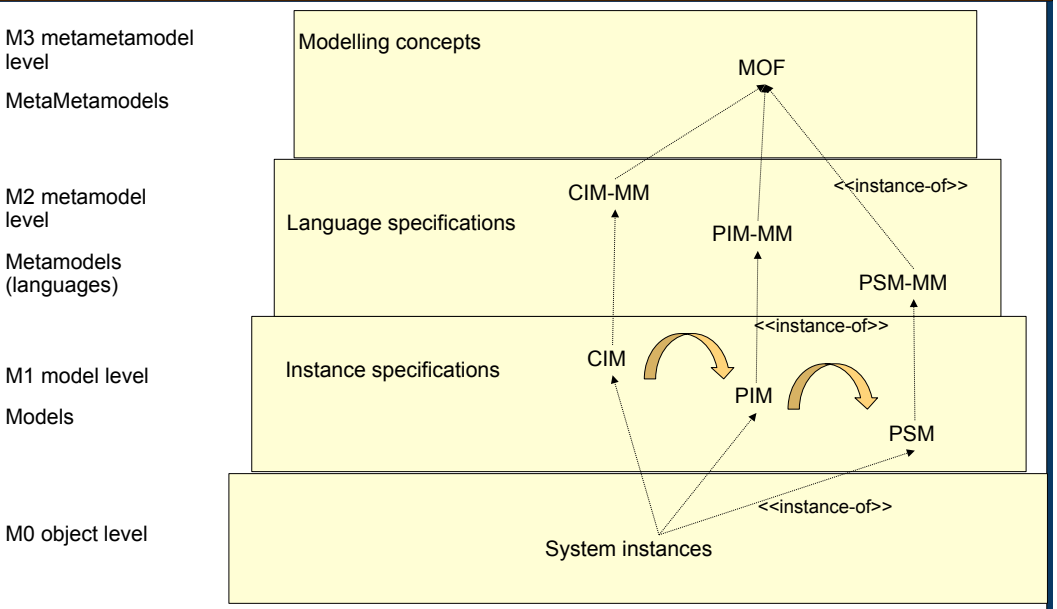
- **With Closed World Assumption (Reasoning)**
  - Querying
    - needs CWA to exclude erroneous data
  - Metamodeling:
    - needs CWA to exclude erroneous programs
  - Integrity constraints
    - needs CWA to exclude erroneous models
- **With Open World Assumption**
  - Domain modeling
    - needs OWA because of partial specification of domain

The MOF Metamodelling Hierarchy (Metapyramid)

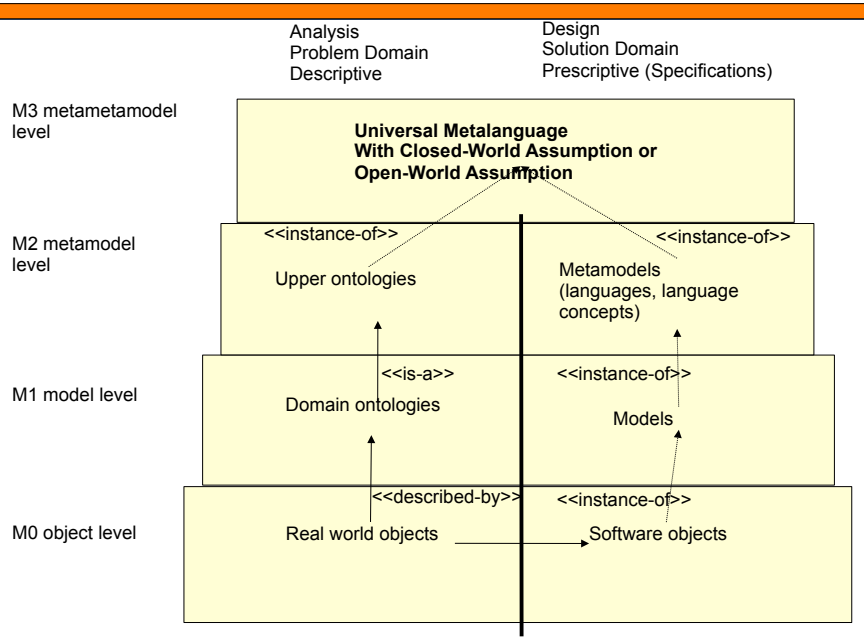
- **A *technical space* uses a metapyramid, formed by a specific metalanguage on M3**
- **More in course "Softwarewerkzeuge" (WS)**



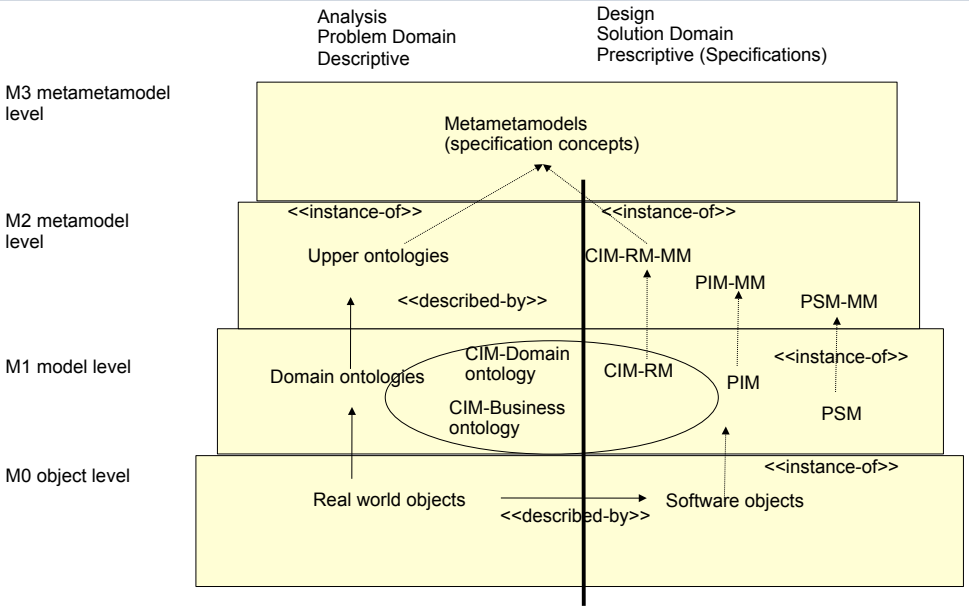
The MDA Process Embedded in the MOF Metapyramid



Integration with a Universal Metalanguage



Embedding Ontologies into the MOF Metapyramid and MDA



Conclusions

- **Ontologies are advantageous in SPLE for**
  - domain ontologies
  - integrity constraint ontologies in product lines
- **but...**
  - Ontologies should not be misused as system models
  - Ontologies *complement* system models
  - Ontologies in OWA for domain modeling, CWA for the rest
- **Integration technology and tools needed!**
- **MOST project (Marrying Ontologies and Software Technology)**
- **www.most-project.eu**

Master's Courses (weiteres Hauptstudium)