A Foundation of Method Engineering and Self-Referential Enterprise Systems

Multi-Perspective Enterprise Modelling

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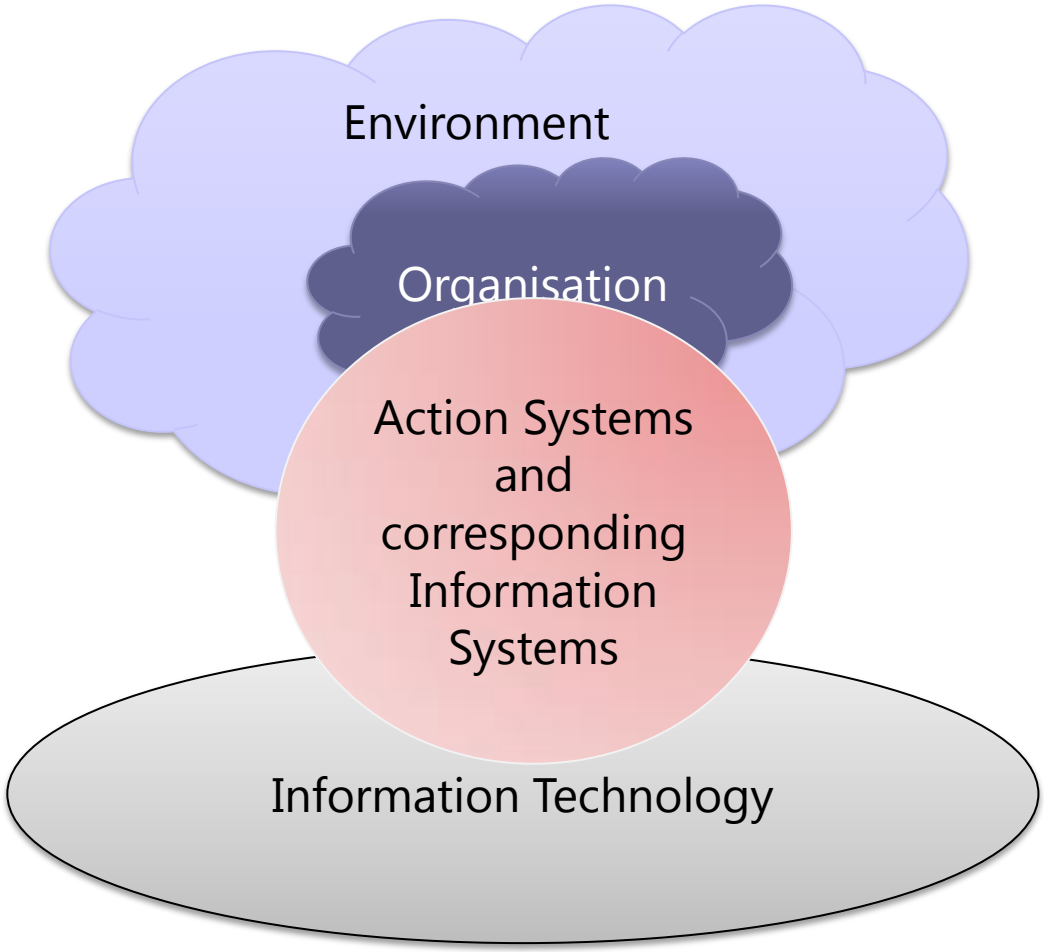
Overview

1 Enterprise Modelling: Foundational Concepts

2 Method Engineering

3 Self-Referential Enterprise Systems

The Subject



complexity

social constructions

technical artefacts

beliefs & myths

lack of understanding

cultural chasm

dissatisfactory practice

change

fear of change

Designing & Managing Business Information Systems: Some Objectives

- reduction of **complexity**, **risk** and **costs**
- fostering **communication** between management, users and IT-Experts
- promoting **integration** of
  - software systems
  - IT and business
- promoting **reuse**
- providing **versatile tools for thinking**
- fostering **flexibility** of the enterprise and its software systems
- coping with **technological progress** and **horrors of the past**
- creating **sense** of the enterprise and its IS

understanding

explanation

construction

Multi-Perspective Enterprise Model

An **enterprise model** integrates at least one conceptual model of the information system (e.g. a class diagram) with at least one model of the relevant action system (e.g. a business process model).

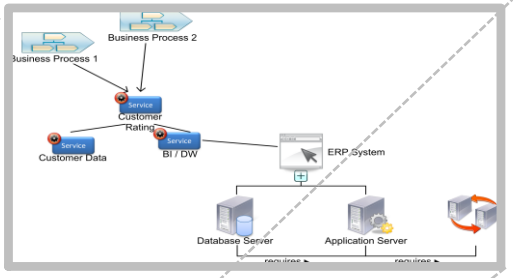
A **multi-perspective enterprise model** is an enterprise model that emphasizes accounting for *perspectives*, which will usually correspond to professional views. These perspectives are represented in models constructed with domain-specific modelling languages (DSML).

Multi-Perspective Enterprise Modelling (MEMO)

- comprehensive approach to enterprise modelling
- development started in the early 1990s
- various components:
  - adaptable high-level framework
  - extensible set of DSML
  - reference models
  - language architecture
- supplemented by (meta) modelling environment (*MEMO Center*)

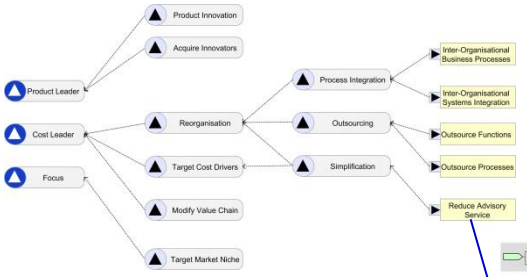
Frank, U.: Multi-Perspective Enterprise Modeling: Foundational Concepts, Prospects and Future Research Challenges. In: Software and Systems Modeling 2013 (http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s10270-012-0273-9)

Generic Framework: „Map of the Enterprise“

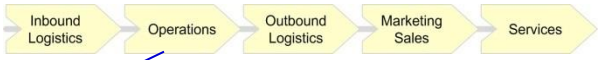


Perspectives	Resource	Structure	Process	Goal
Strategy	Human Resources Technology	Strategic Business Units Joint Ventures	Value Chain Value System	Competitiveness Strategic Goals Opportunities
Organisation	Employees Skills Machinery	Organisation Structure Project	Service Process Task	Operational Goals Performance Indicators
Information System	Platforms Applications	IT Infrastructure IS Architecture Object Model	Service Transaction Workflow	SLA Performance Indicators

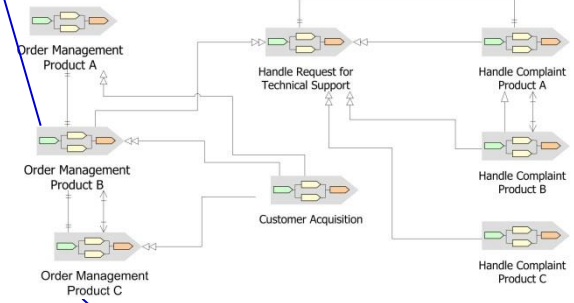
Example: Multi-Language Diagram



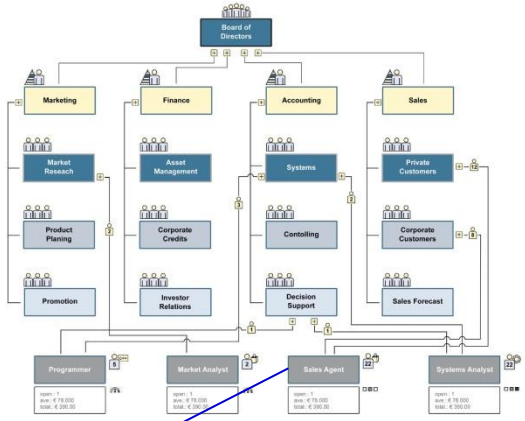
Strategy Net



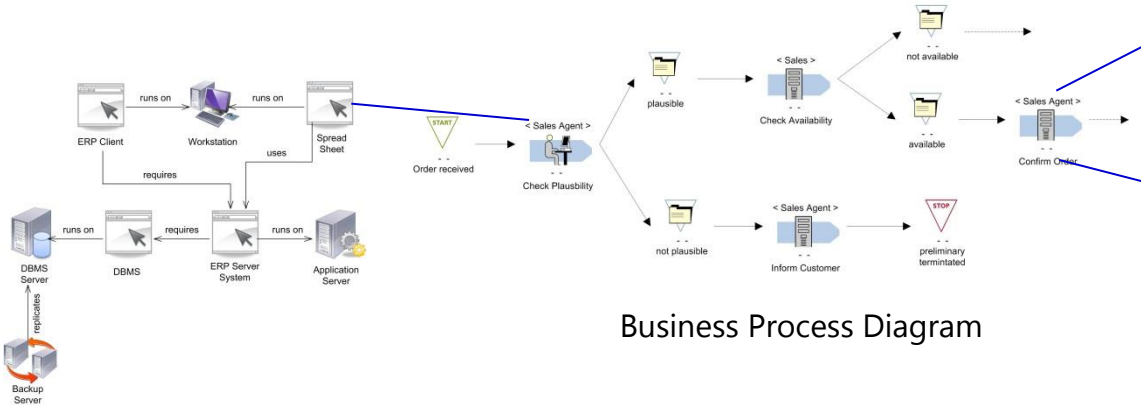
Value Chain Diagram



Business Process Map

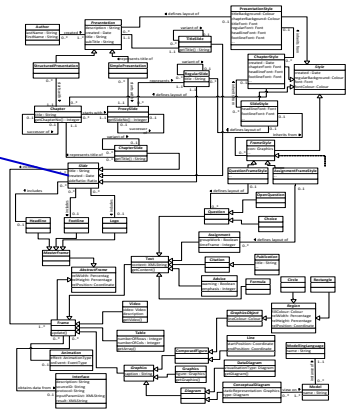


Organisational Chart



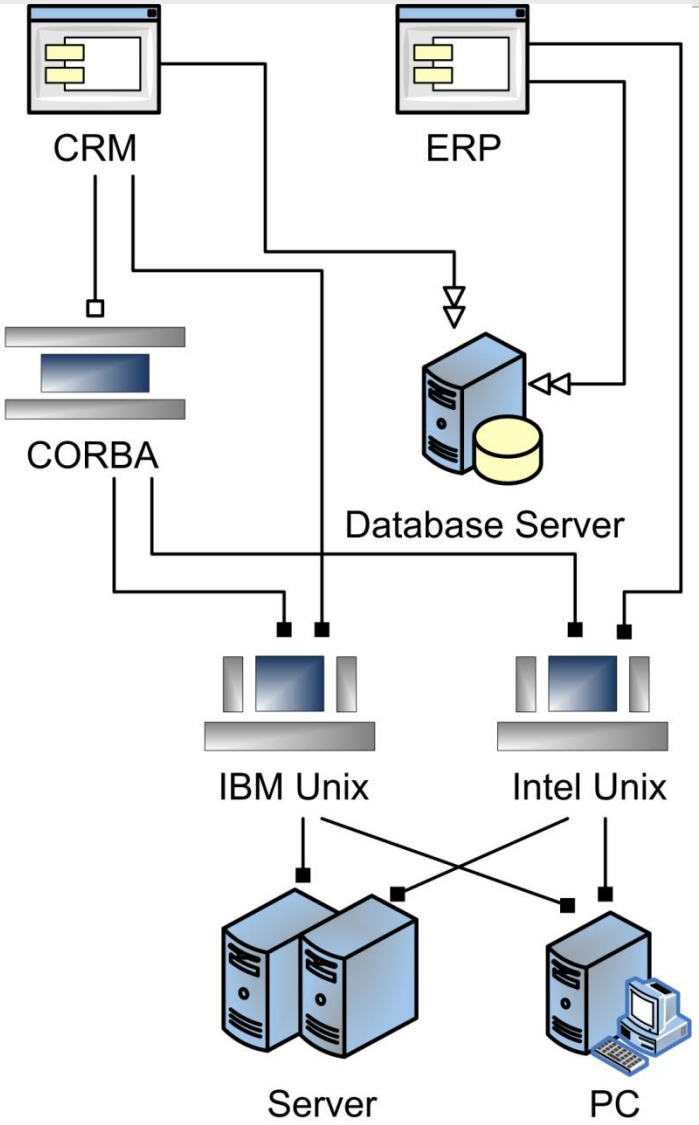
Business Process Diagram

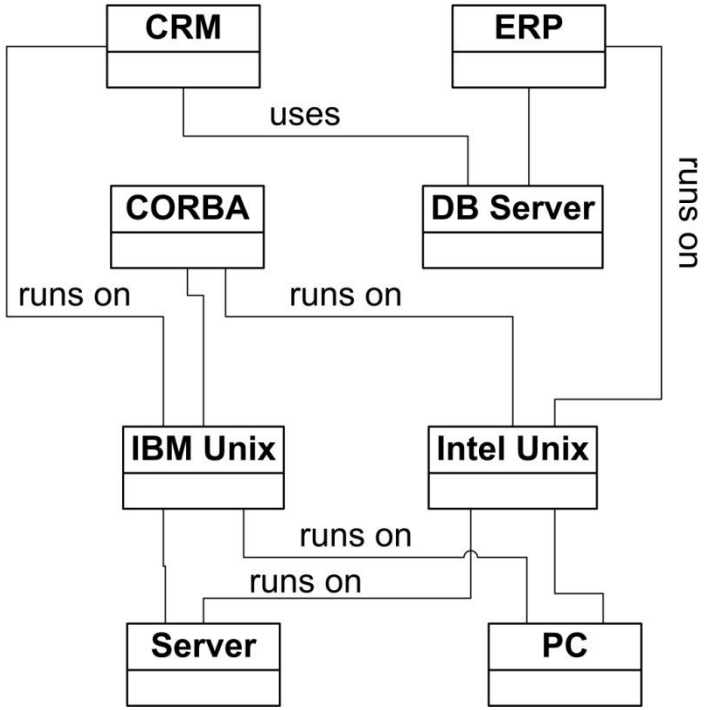
IT Resource Diagram



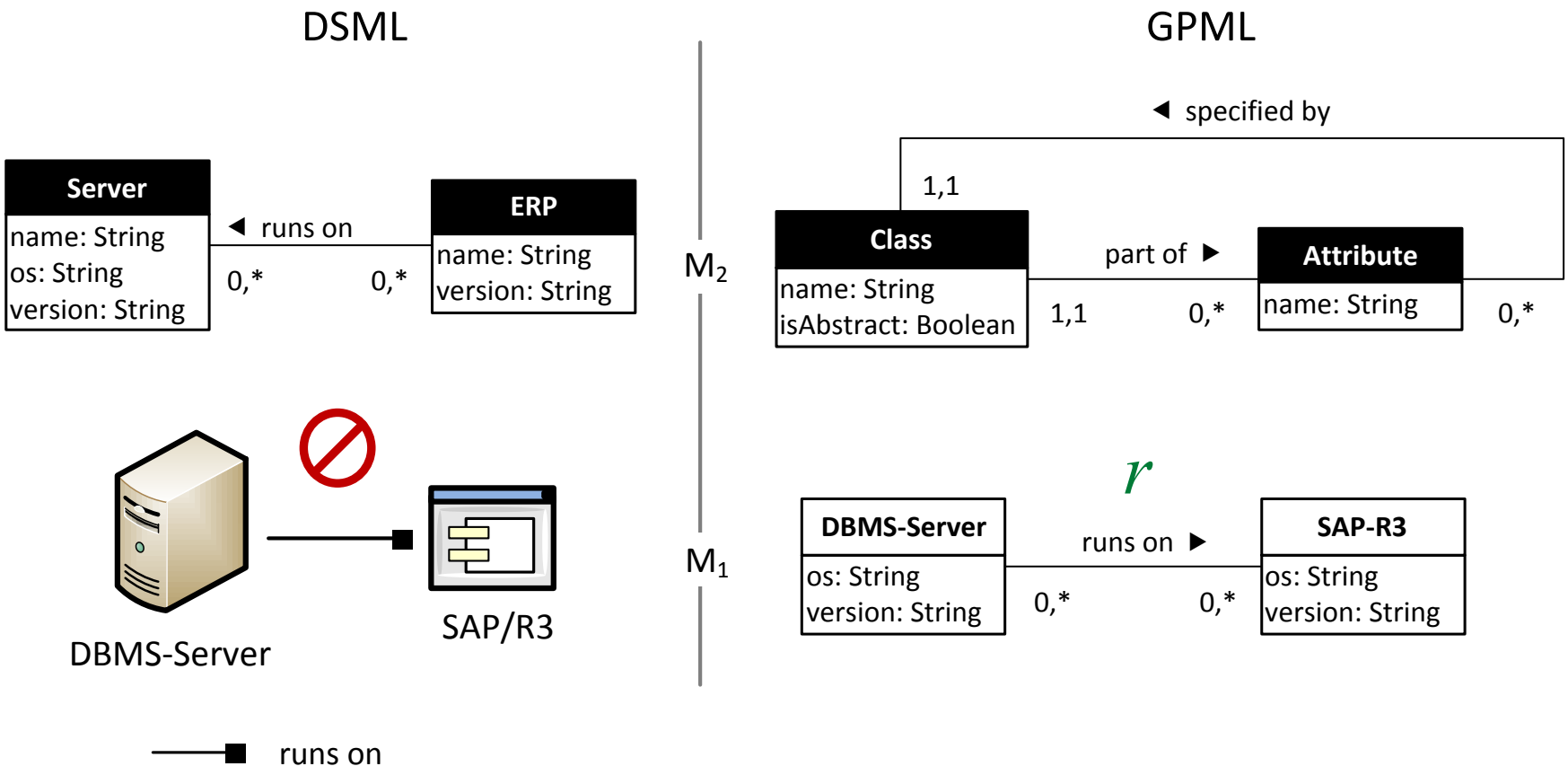
Object Model

DSML vs. GPML (1)

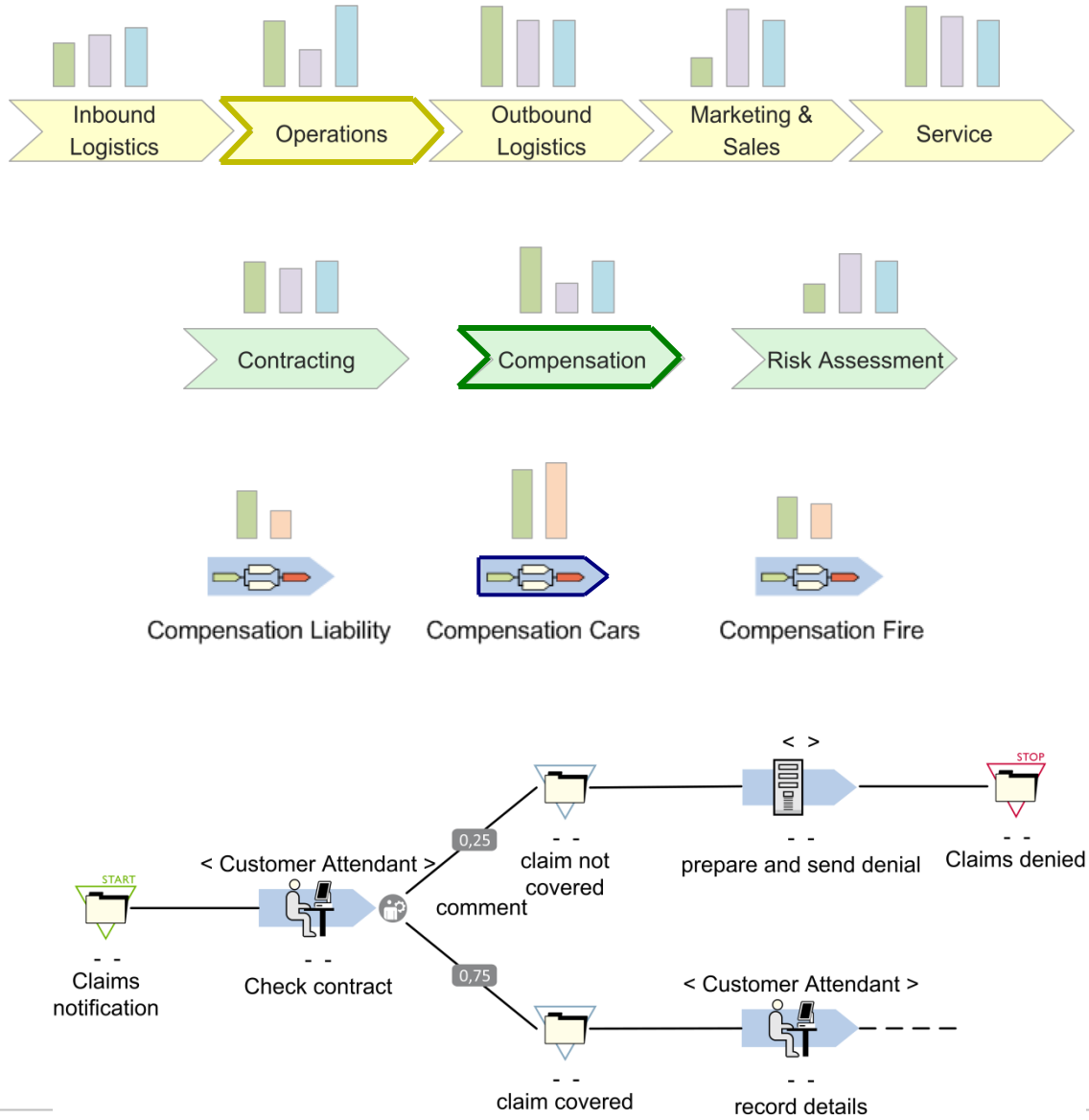




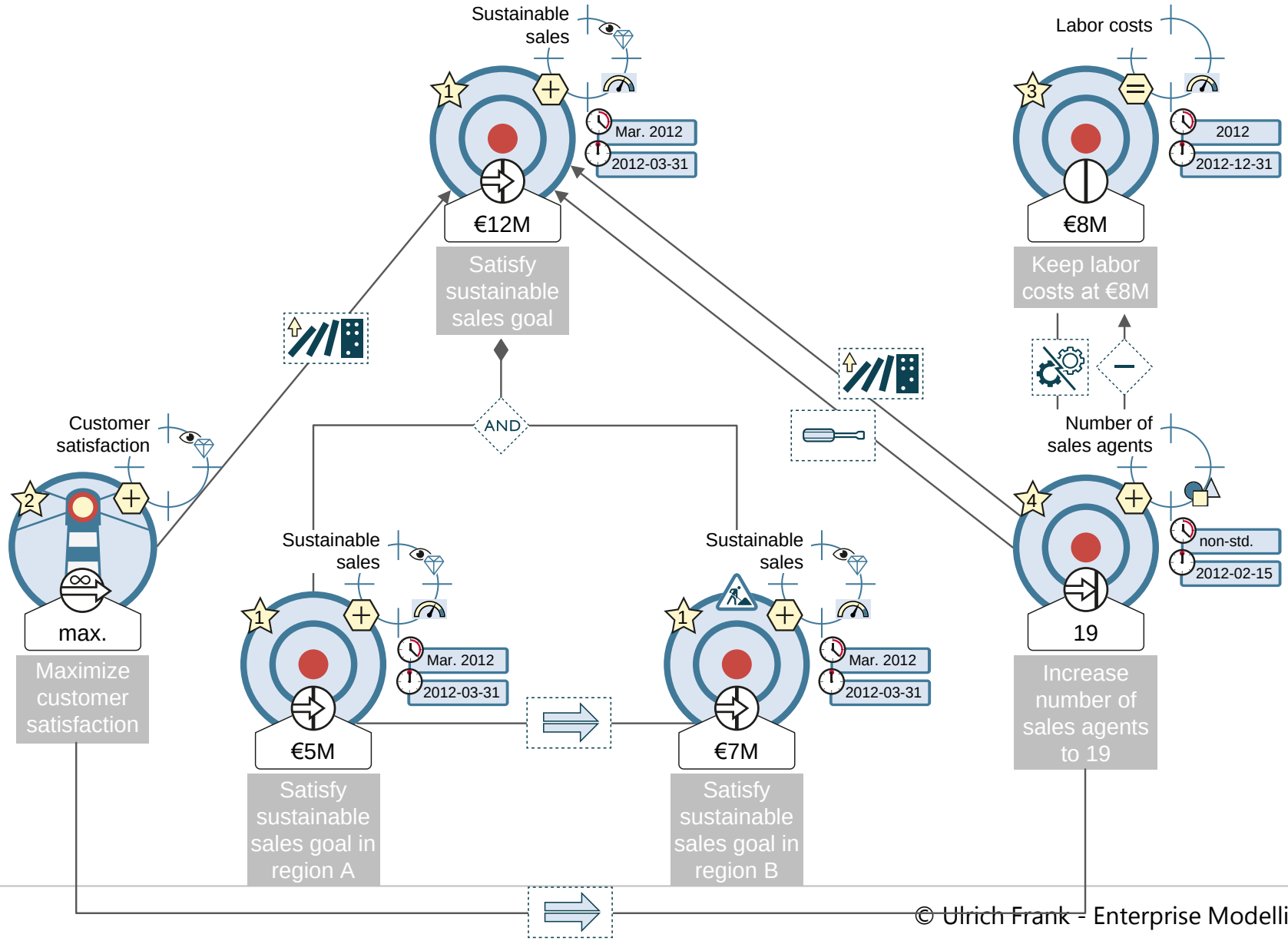
DSML vs. GPML (2)

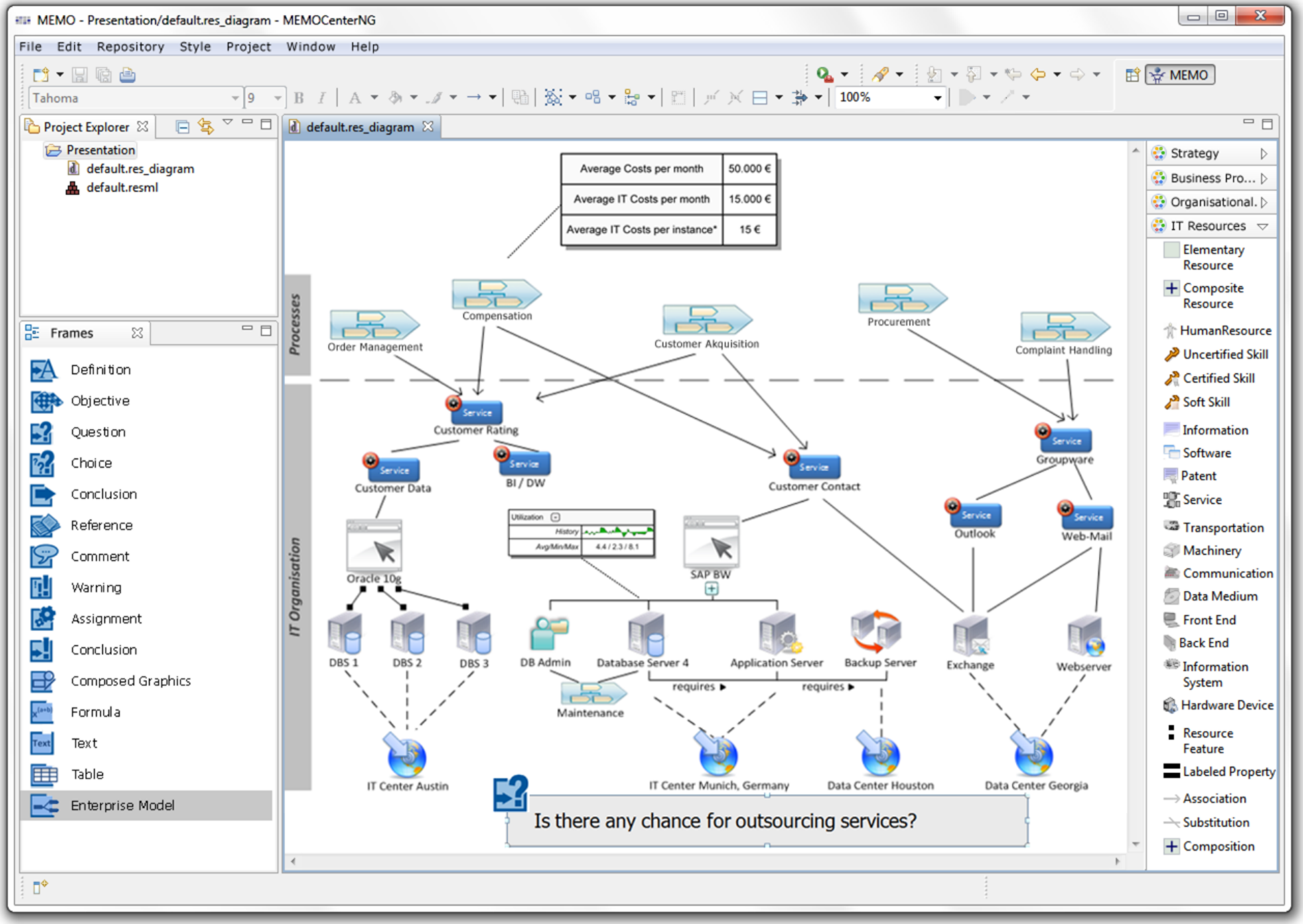


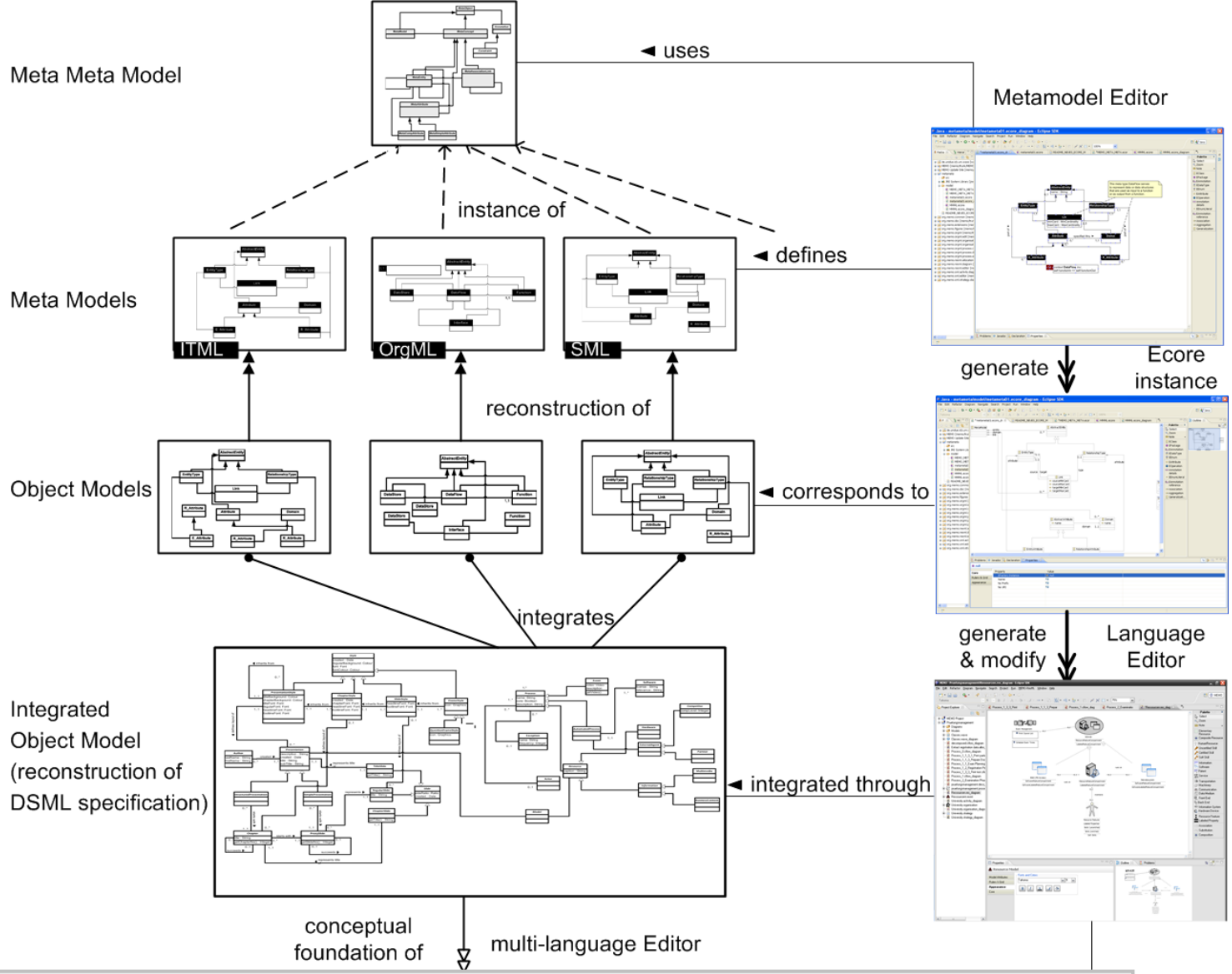
Example: Decomposition of Value Chain



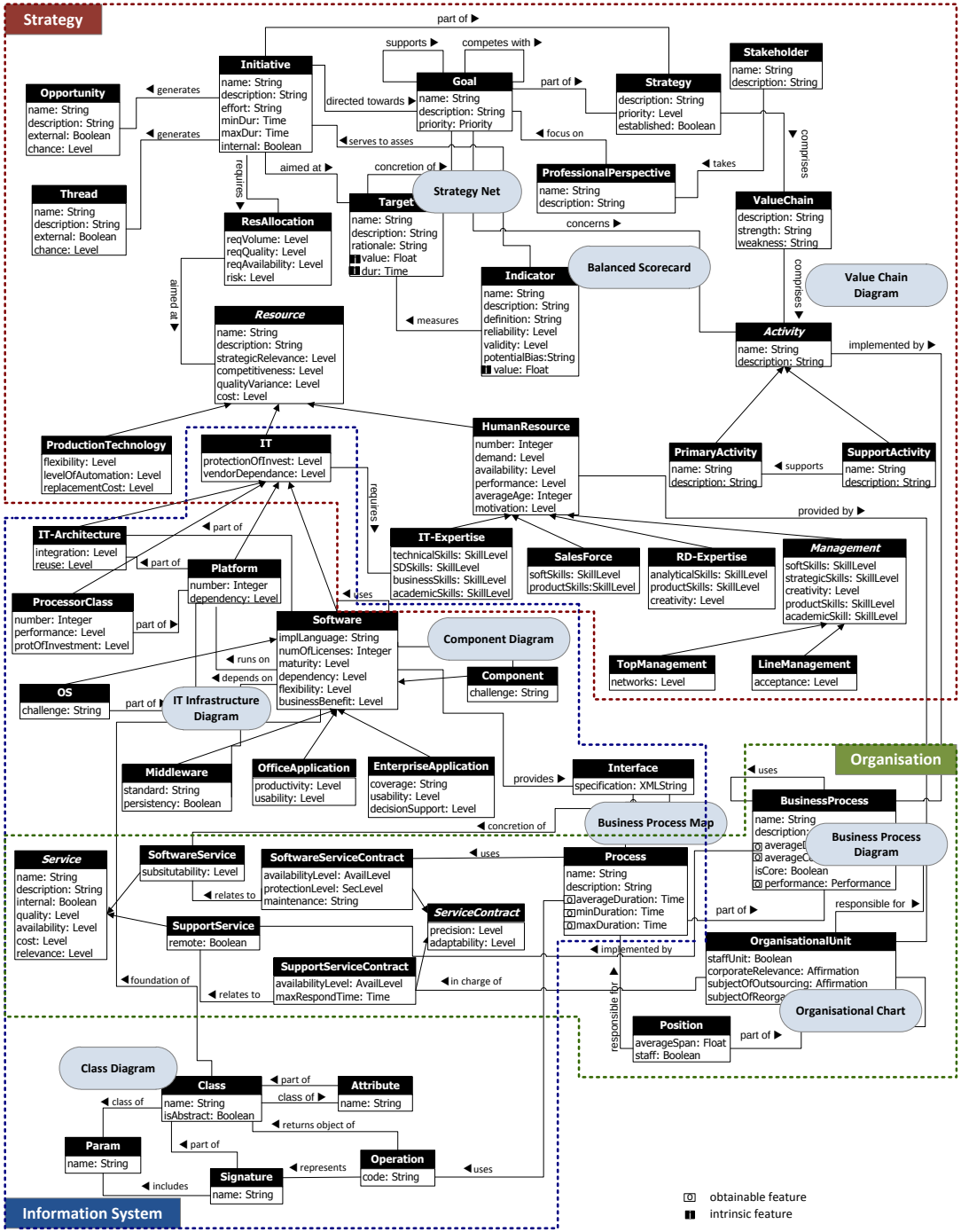
Example: Goal Model



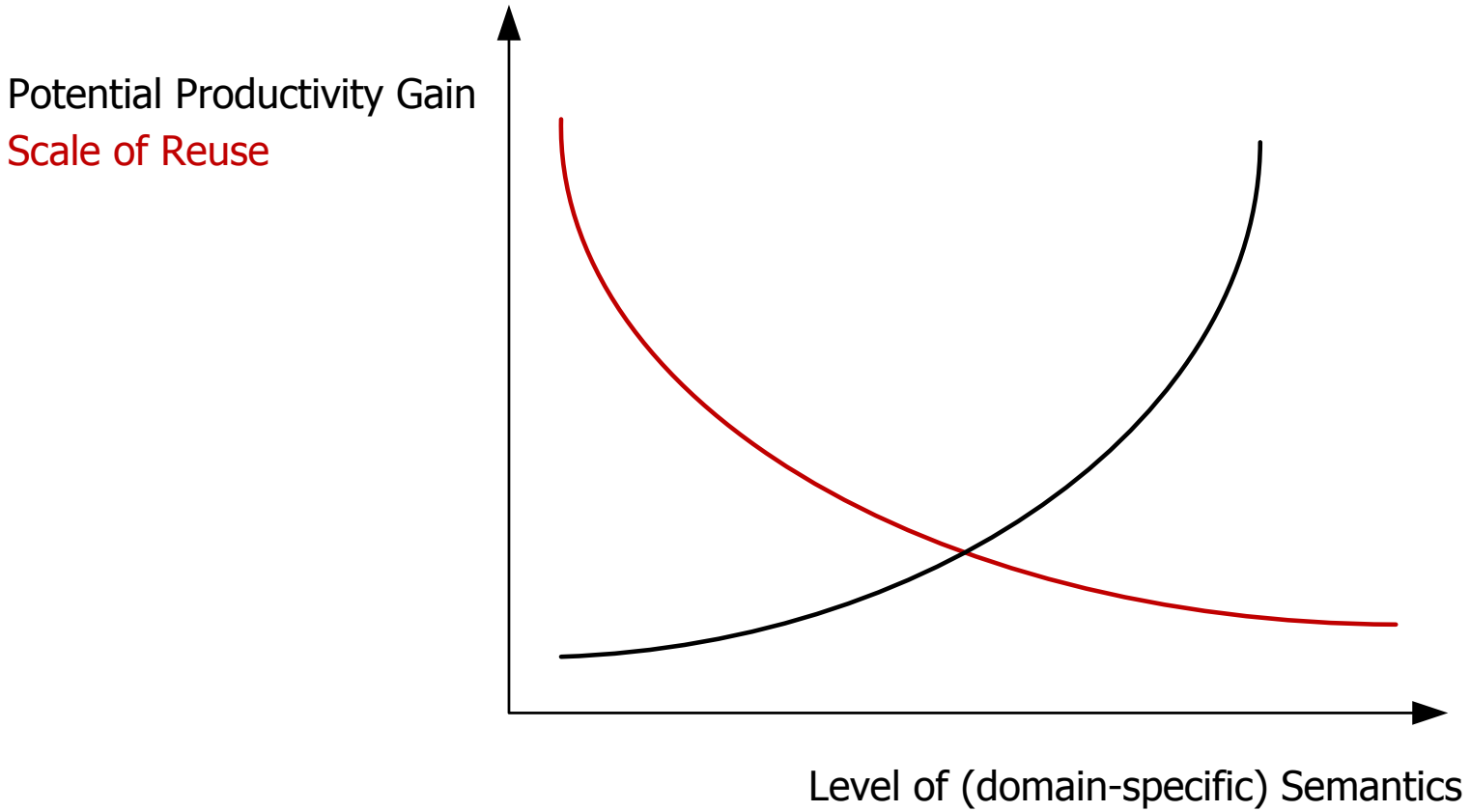

MEMO - Presentation/default.res_diagram - MEMOCenterNG
File Edit Repository Style Project Window Help
MEMO
Project Explorer
Presentation
default.res_diagram
default.resml
Frames
Definition
Objective
Question
Choice
Conclusion
Reference
Comment
Warning
Assignment
Conclusion
Composed Graphics
Formula
Text
Table
Enterprise Model
default.res_diagram
Average Costs per month 50.000 €
Average IT Costs per month 15.000 €
Average IT Costs per instance* 15 €
Processes
IT Organisation
Order Management
Compensation
Customer Akquisition
Procurement
Complaint Handling
Customer Rating
Customer Data
BI / DW
Customer Contact
Groupware
Outlook
Web-Mail
Oracle 10g
SAP BW
DBS 1
DBS 2
DBS 3
DB Admin
Database Server 4
Application Server
Backup Server
Exchange
Webserver
Maintenance
requires
requires
IT Center Austin
IT Center Munich, Germany
Data Center Houston
Data Center Georgia
Is there any chance for outsourcing services?
Strategy
Business Pro...
Organisational.
IT Resources
Elementary Resource
Composite Resource
HumanResource
Uncertified Skill
Certified Skill
Soft Skill
Information
Software
Patent
Service
Transportation
Machinery
Communication
Data Medium
Front End
Back End
Information System
Hardware Device
Resource Feature
Labeled Property
Association
Substitution
Composition



currently major re-launch of language architecture


Strategy
Initiative
name: String
description: String
effort: String
minDur: Time
maxDur: Time
internal: Boolean
Goal
name: String
description: String
priority: Priority
Strategy
description: String
priority: Level
established: Boolean
Stakeholder
name: String
description: String
Opportunity
name: String
description: String
external: Boolean
chance: Level
Thread
name: String
description: String
external: Boolean
chance: Level
ResAllocation
reqVolume: Level
reqQuality: Level
reqAvailability: Level
risk: Level
Target
name: String
description: String
rationale: String
value: Float
dur: Time
Strategy Net
ProfessionalPerspective
name: String
description: String
ValueChain
description: String
strength: String
weakness: String
Indicator
name: String
description: String
definition: String
reliability: Level
validity: Level
potentialBias:String
value: Float
Balanced Scorecard
Value Chain Diagram
Resource
name: String
description: String
strategicRelevance: Level
competitiveness: Level
qualityVariance: Level
cost: Level
Activity
name: String
description: String
ProductionTechnology
flexibility: Level
levelOfAutomation: Level
replacementCost: Level
IT
protectionOfInvest: Level
vendorDependance: Level
HumanResource
number: Integer
demand: Level
availability: Level
performance: Level
averageAge: Integer
motivation: Level
PrimaryActivity
name: String
description: String
SupportActivity
name: String
description: String
IT-Architecture
integration: Level
reuse: Level
Platform
number: Integer
dependency: Level
IT-Expertise
technicalSkills: SkillLevel
SDSkills: SkillLevel
businessSkills: SkillLevel
academicSkills: SkillLevel
SalesForce
softSkills: SkillLevel
productSkills:SkillLevel
RD-Expertise
analyticalSkills: SkillLevel
productSkills: SkillLevel
creativity: Level
Management
softSkills: SkillLevel
strategicSkills: SkillLevel
creativity: Level
productSkills: SkillLevel
academicSkill: SkillLevel
ProcessorClass
number: Integer
performance: Level
protOfInvestment: Level
Software
implLanguage: String
numOfLicenses: Integer
maturity: Level
dependency: Level
flexibility: Level
businessBenefit: Level
Component Diagram
Component
challenge: String
TopManagement
networks: Level
LineManagement
acceptance: Level
OS
challenge: String
IT Infrastructure Diagram
Middleware
standard: String
persistency: Boolean
OfficeApplication
productivity: Level
usability: Level
EnterpriseApplication
coverage: String
usability: Level
decisionSupport: Level
Interface
specification: XMLString
Organisation
BusinessProcess
name: String
isCore: Boolean
performance: Performance
Business Process Map
Business Process Diagram
Service
name: String
description: String
internal: Boolean
quality: Level
availability: Level
cost: Level
relevance: Level
SoftwareService
subsitutability: Level
SoftwareServiceContract
availabilityLevel: AvailLevel
protectionLevel: SecLevel
maintenance: String
Process
name: String
description: String
averageDuration: Time
minDuration: Time
maxDuration: Time
ServiceContract
precision: Level
adaptability: Level
SupportService
remote: Boolean
SupportServiceContract
availabilityLevel: AvailLevel
maxRespondTime: Time
OrganisationalUnit
staffUnit: Boolean
corporateRelevance: Affirmation
subjectOfOutsourcing: Affirmation
Organisational Chart
Position
averageSpan: Float
staff: Boolean
Class Diagram
Class
name: String
isAbstract: Boolean
Attribute
name: String
Param
name: String
Signature
name: String
Operation
code: String
Information System
part of
supports
competes with
generates
directed towards
serves to asses
focus on
takes
comprises
requires
aimed at
concretion of
concerns
measures
implemented by
provided by
supports
uses
runs on
depends on
provides
concretion of
relates to
foundation of
in charge of
responsible for
class of
returns object of
represents
includes
obtainable feature
intrinsic feature

The Essential Conflict of Designing DSML



Method Engineering

- rationalist assumption: method approach of choice for addressing complex problems
- given set of methods not sufficient
- however: creating and validating methods require substantial expertise and effort
- hence, need for guiding the construction of methods

What is a method?

linguistic structure of domain + **process**

Technical terminology

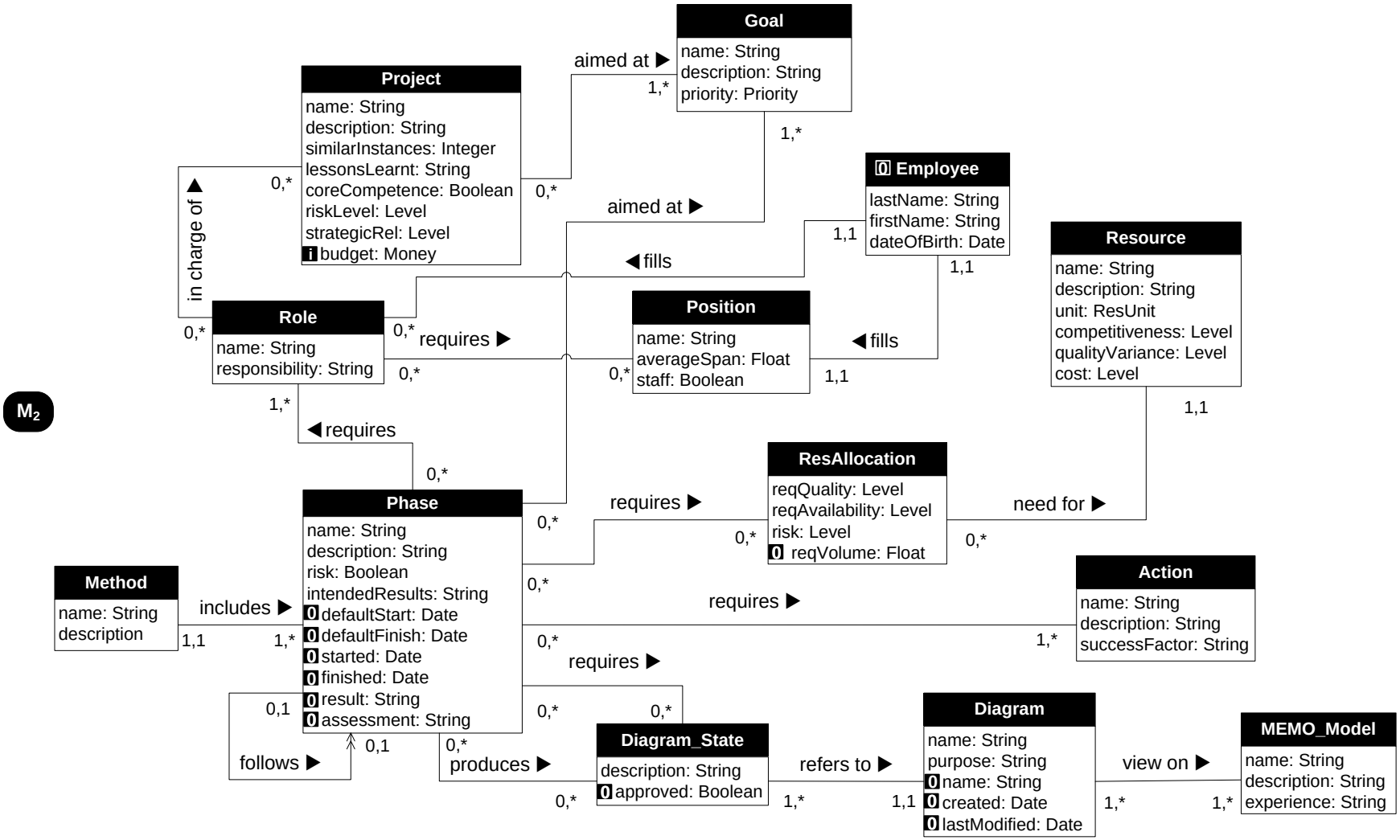
DSML

Enterprise Modelling as a Foundation of ME

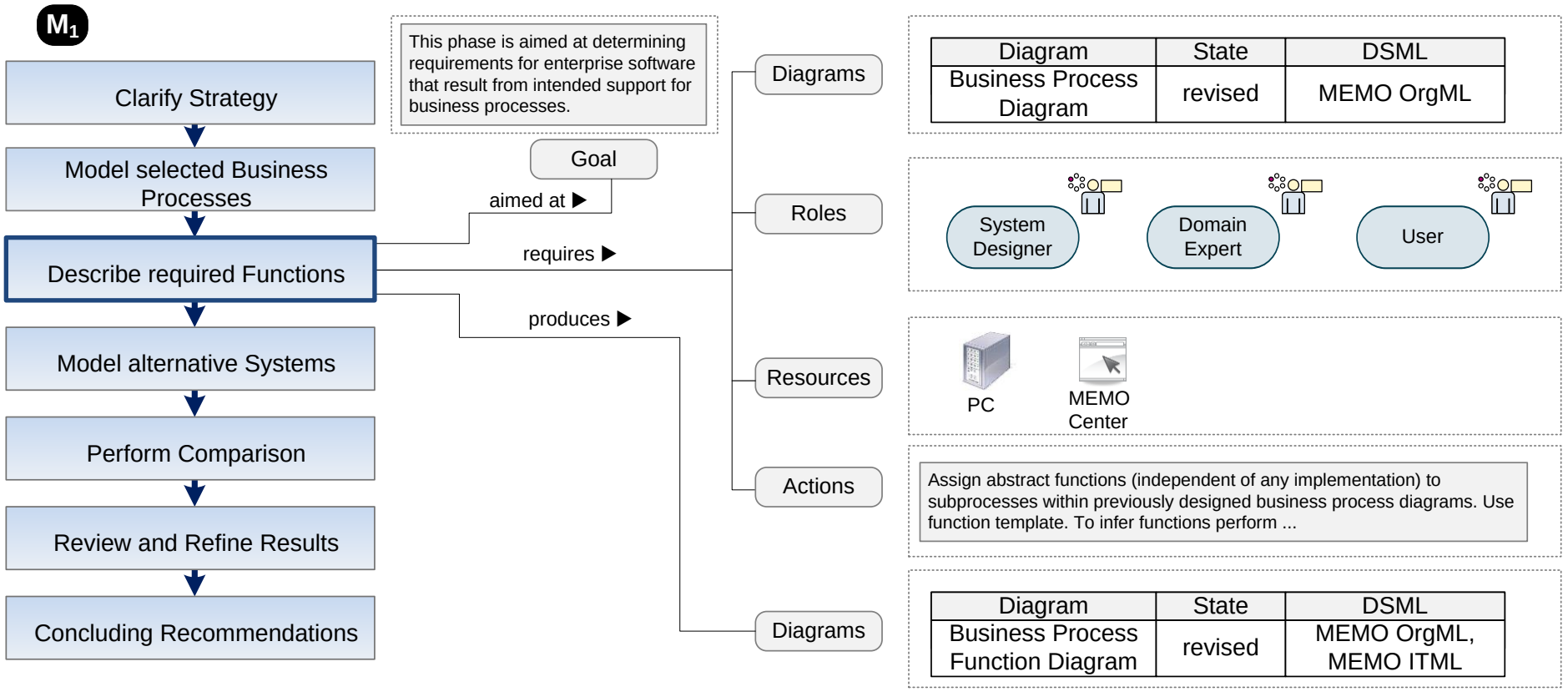
- Enterprise models enable elaborate, purposeful representations of problem domains in enterprises.
  - on the level of reference models
  - … or on the level of DSML
- Supplementing them with abstractions of processes/projects provides conceptual foundation for modelling (engineering) methods.
- Existing modelling tools can be extended to support project monitoring and support.

need for abstractions that cover a (wide) range of problem classes

Metamodel

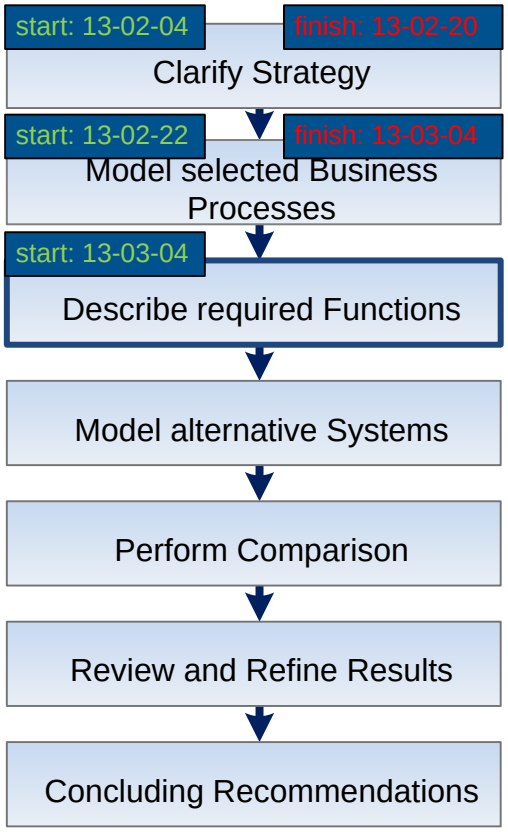


Example Method

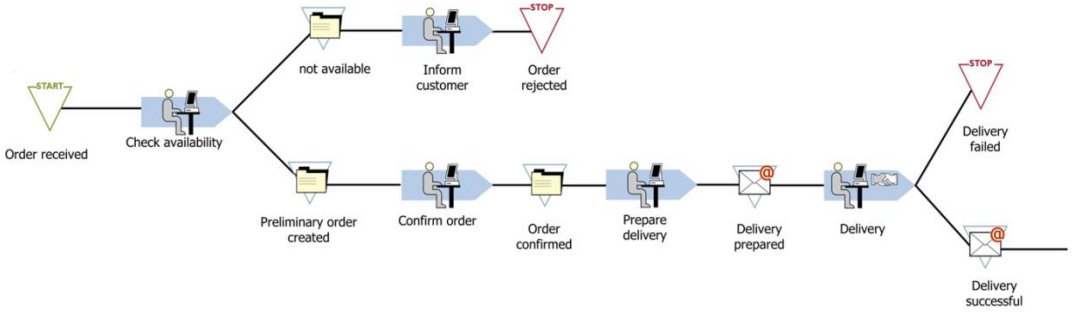


Example Execution of Method (Project)

200



M_0



Self-Referential Enteprise Systems: Motivation

- currently, (enterprise) modelling widely restricted to analysis and design phase
- use of enterprise software widely restricted to retrieving, manipulating and aggregating instance-level (M0) data
  - difficult to understand the system for users
  - almost impossible to modify it
- Enterprise software lacks representation of relevant context.

Integrating enterprise modelling environments with enterprise software seems promising.

Conception of Self-Referential Enterprise System

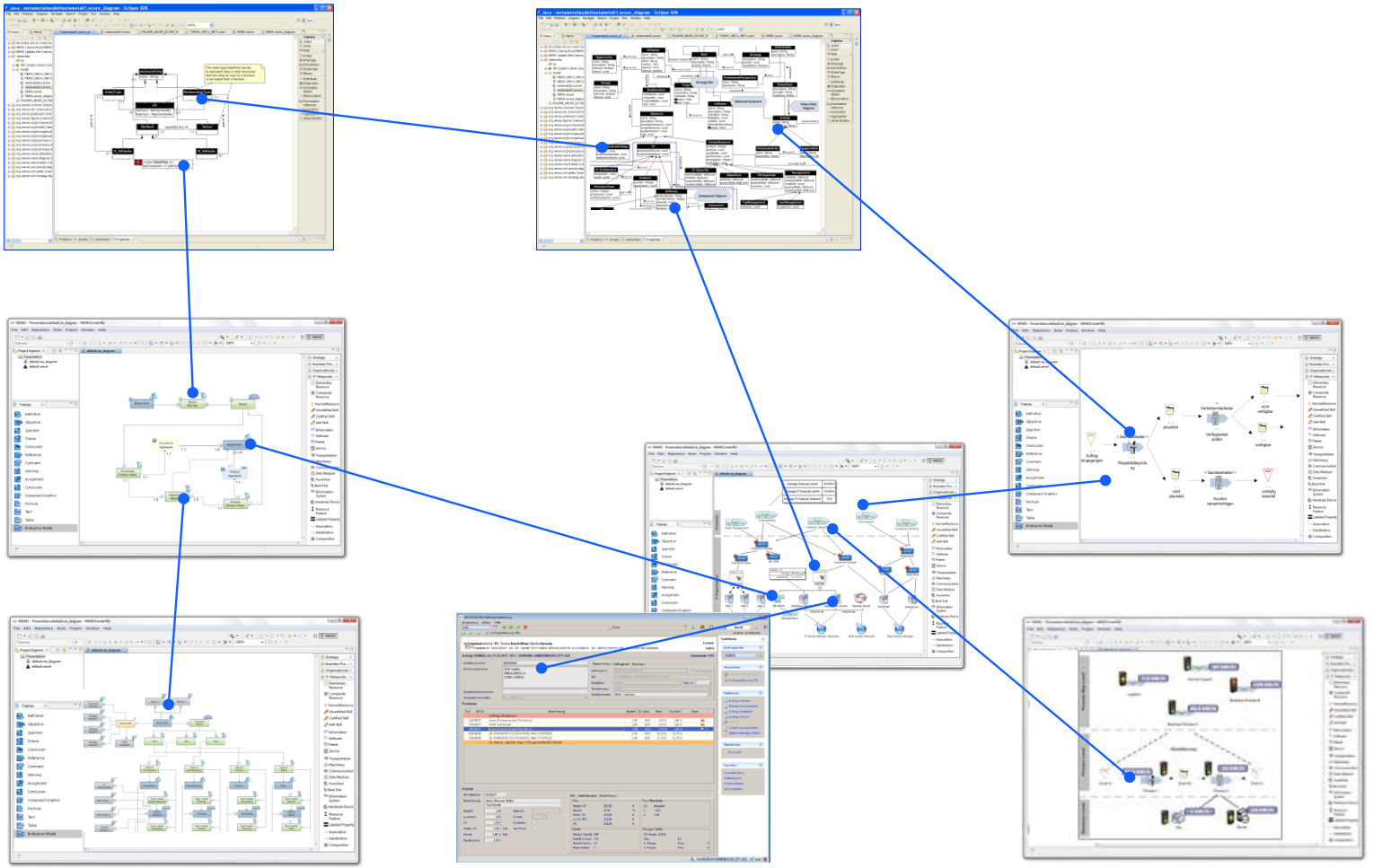
- integrates traditional enterprise systems (e.g. ERP systems) with corresponding enterprise model
  - enterprise model used at **run time**
  - supplements application system not only with conceptual model of itself, but also with model of its surroundings and purpose (goal system)
  - enrich models with access to components/data of corresponding enterprise system
- enables self-management and monitoring
- provides users with multiple navigation/analysis capabilities on different levels of abstraction
- enables advanced users to adapt a system by modifying models

Illustration

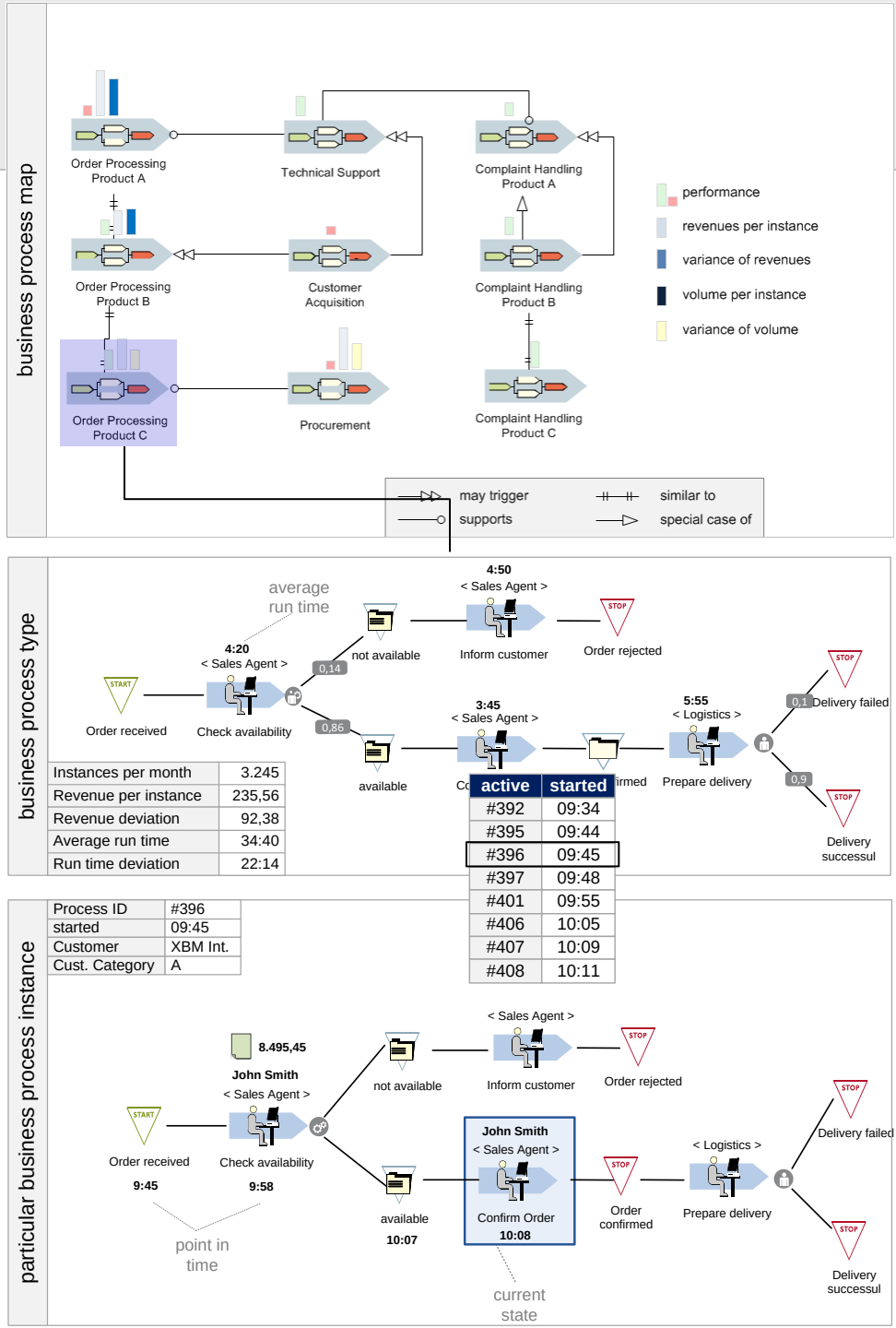
M2

M1

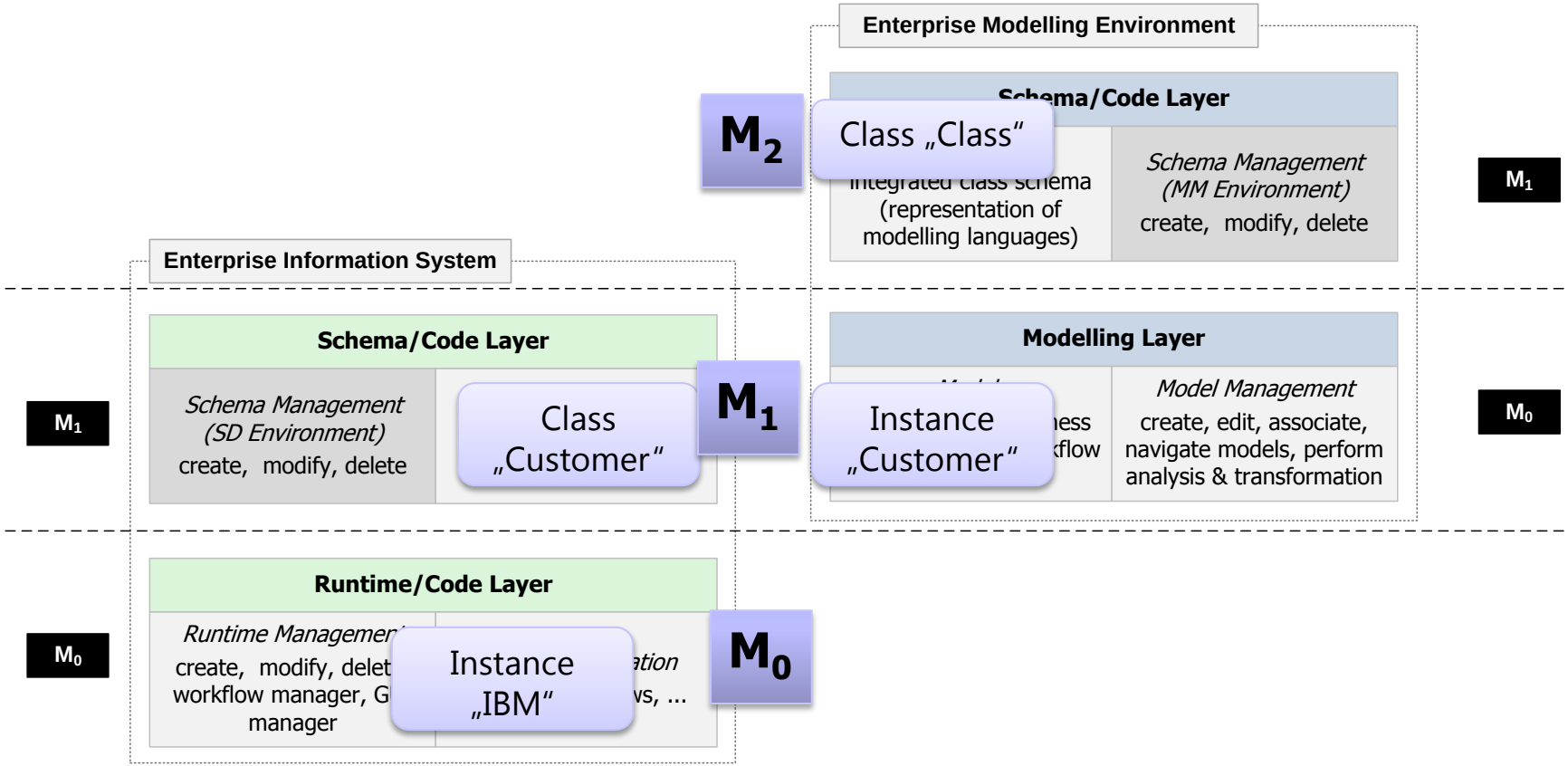
M0



Example Navigation

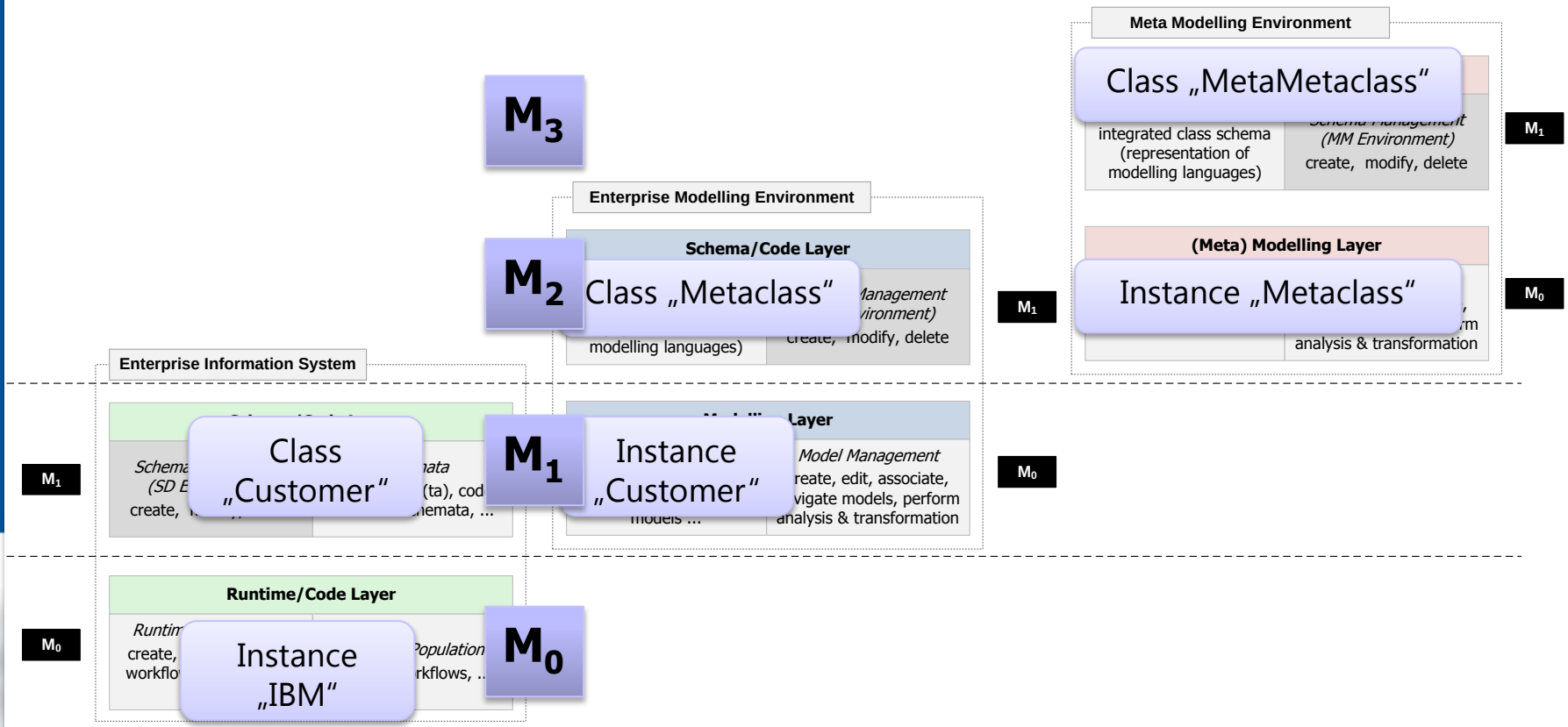


Challenge: Mismatch of Abstraction Levels



Implied by limitations of prevalent programming languages.

… even worse



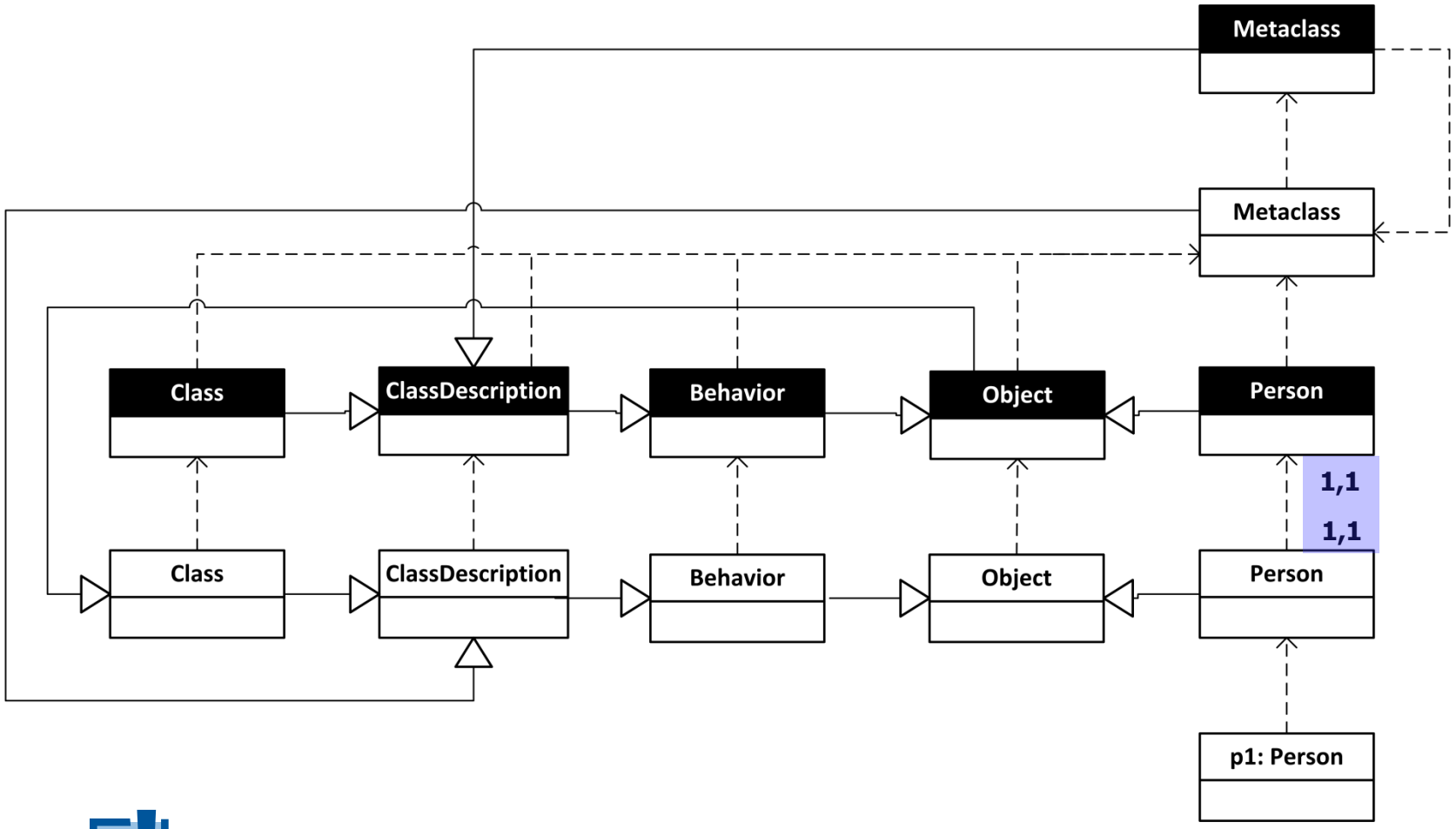
Synchronization of model and code hardly possible!

Characteristics of an Ideal Solution

- **common representation** of model and code
  - no need for code generation
  - Modifications become immediately effective.
- arbitrary number of classification levels possible
- beyond strict separation of classification levels as proposed by MOF
  - concepts on different classification levels in one model
  - implementation of deferred instantiation („intrinsic features“, „clabjects“, „powertypes“ etc.)

Prevalent programming languages no option.

Smalltalk as a Solution?



unfortunately not suited

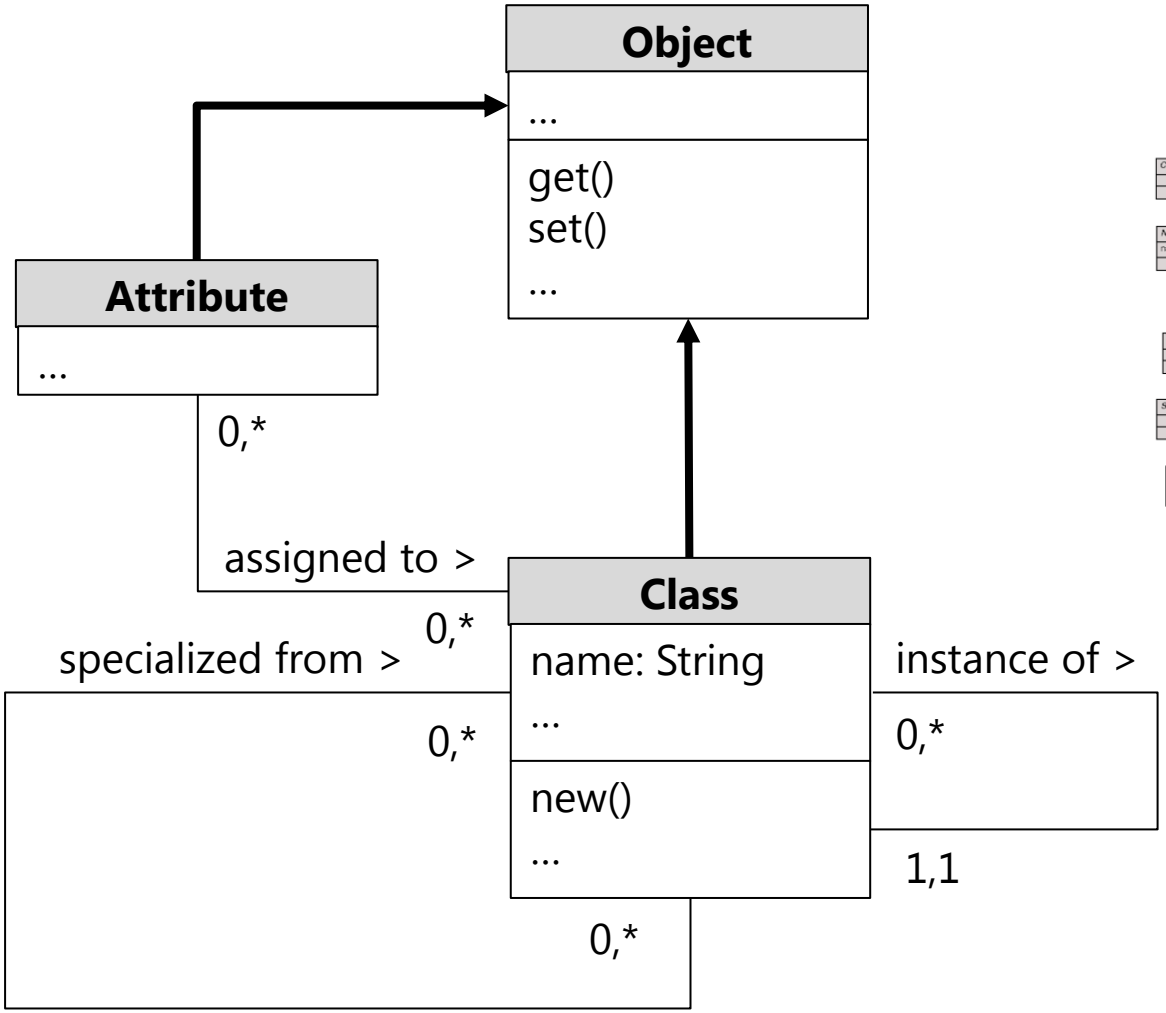
XMF: eXtensible Metamodelling Facility

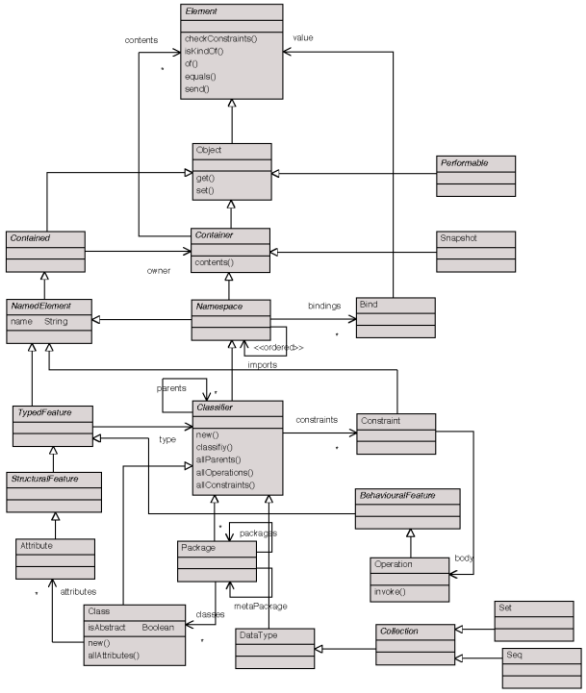
- meta programming language
- based on „golden braid“ architecture
- allows for arbitrary number of classification levels
- all (meta) classes are objects
- Classes have access to their instances at run-time – et vice versa.
- supplemented by (meta) modelling environment (Xmodeler)

Clark, T.; Sammut, P. et al.: Applied Metamodelling: A Foundation for Language Driven Development. 2008

satisfies all requirements.

Illustration of "Golden Braid" Architecture

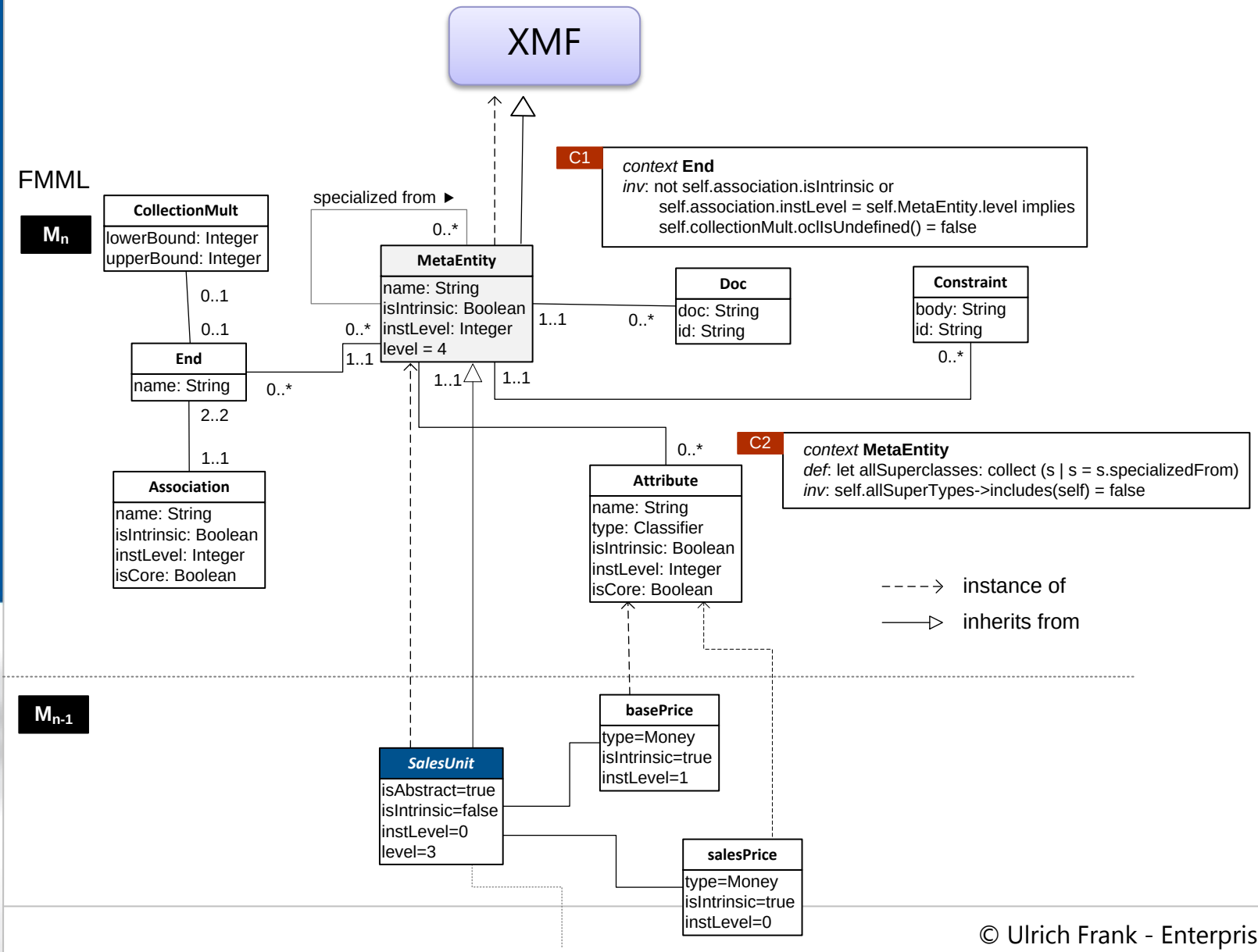




The Solution

- new MEMO language architecture based on „golden braid“ model
- extends XMF meta model
- allows for representing all levels of abstraction/classification in one system
- various update policies available, e.g.
  - modification of class results in modification of all its instances
  - modification of class results in modification of future instances only
  - access to „deleted“ features permitted or not

MEMO Flexible Meta Modelling Language



Current State and Perspectives

- prototypical implementation of SRES successful
- focus on business process models and respective process instances
- also: support for multi-level modelling
- creation and integration of new languages effectively supported by tools for generating editors from metamodels and specifications of concrete syntax
- XMF requires highly qualified programmers.
- governance recommended to avoid pitfalls
- joint project with Tony Clark to further develop the Xmodeler