TECHNISCHE UNIVERSITÄT DRESDEN

A Framework for Generating Query Language Code from OCL Invariants

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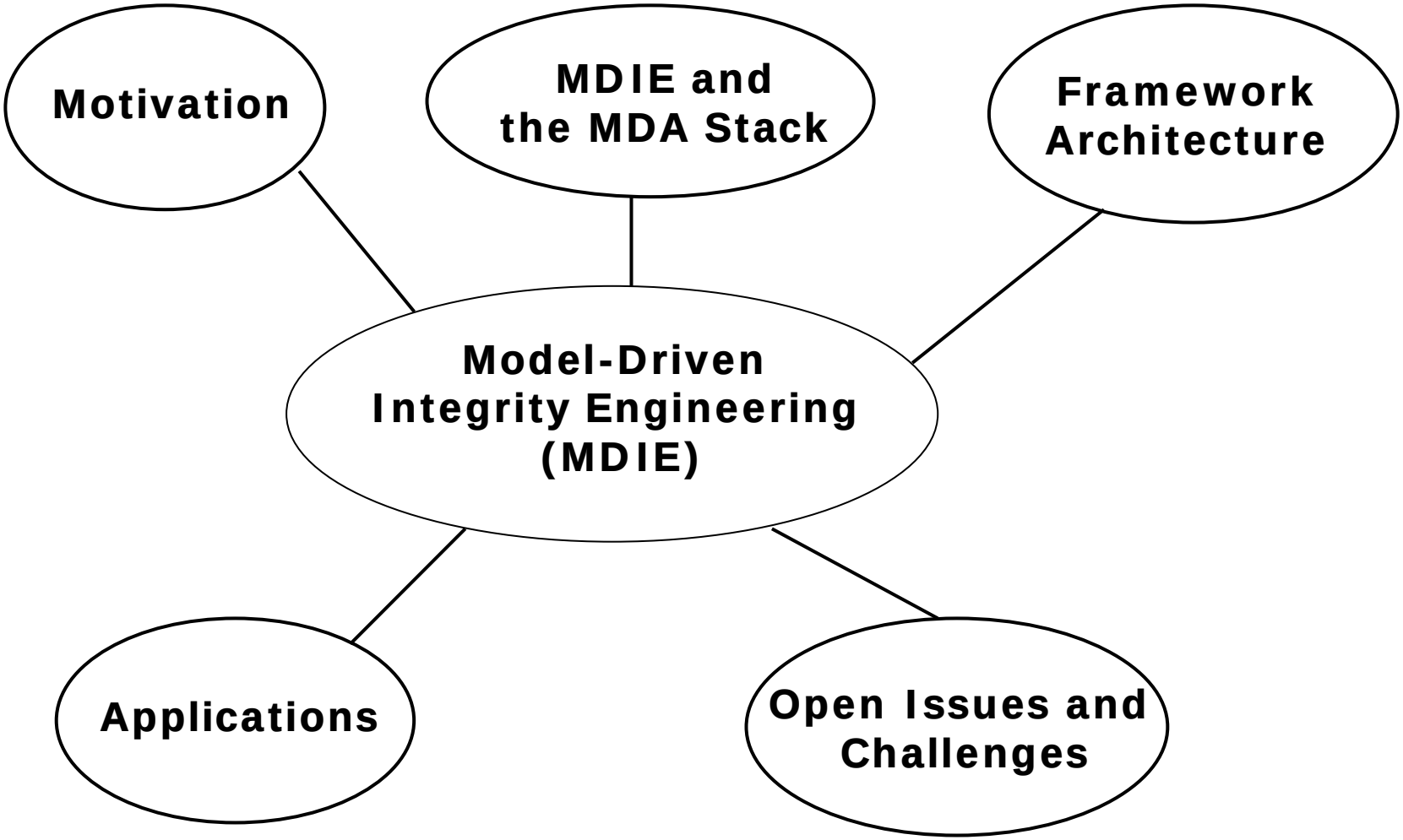
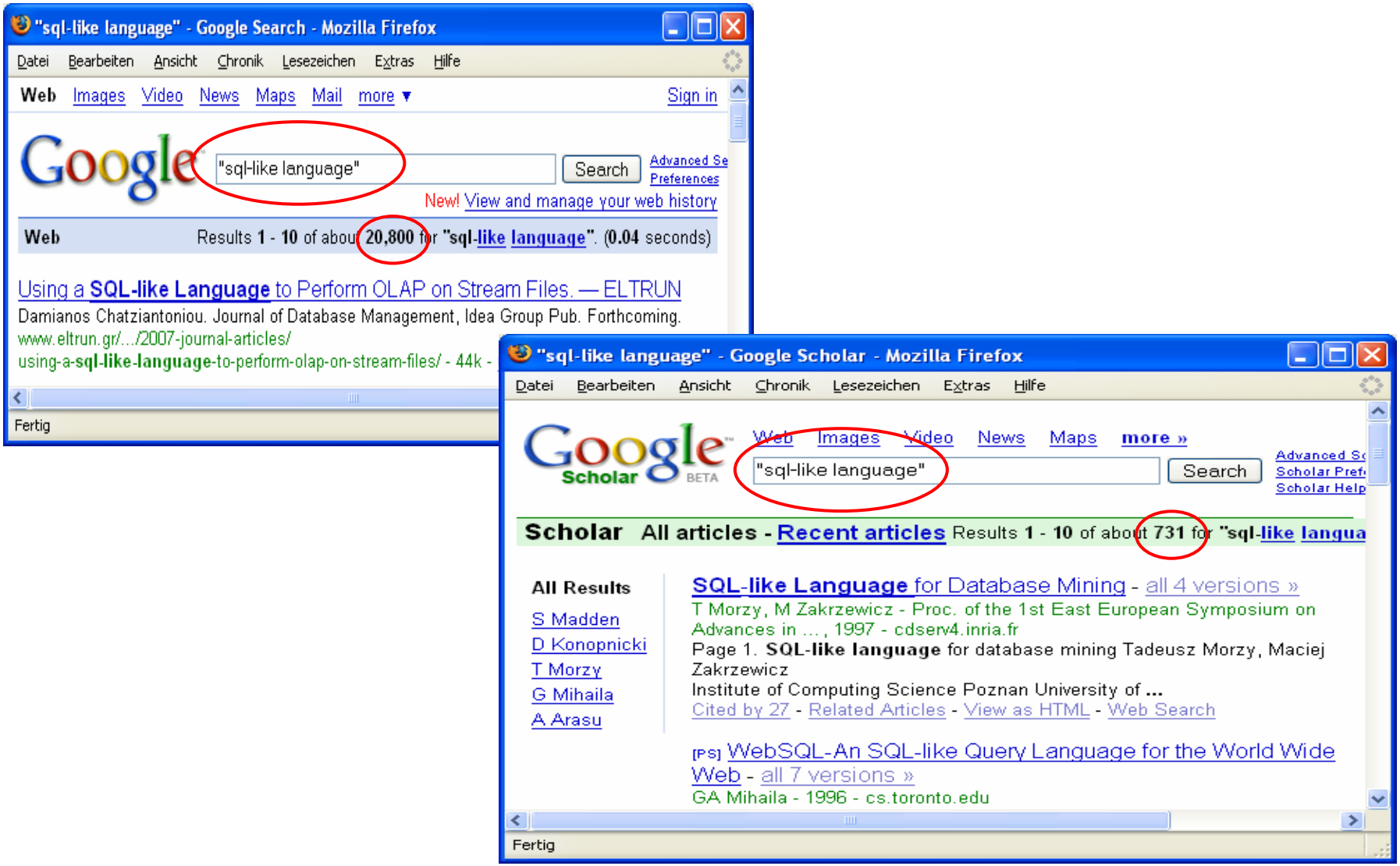

Motivation
MDIE and the MDA Stack
Framework Architecture
Model-Driven Integrity Engineering (MDIE)
Applications
Open Issues and Challenges

- **Data-intensive applications** (business applications/information systems)

- **Database rules** versus Application rules
  - most of the integrity constraints should be an integral part of the database
  - role of integrity constraints is often underestimated in practice

- **Many proprietary dialects** of the (relational) SQL standard

- **Query / Declarative / SQL-like languages** in several technical spaces
  - Relational
  - Object-relational
  - Object-oriented
  - Navigational (XML and others)
  - ...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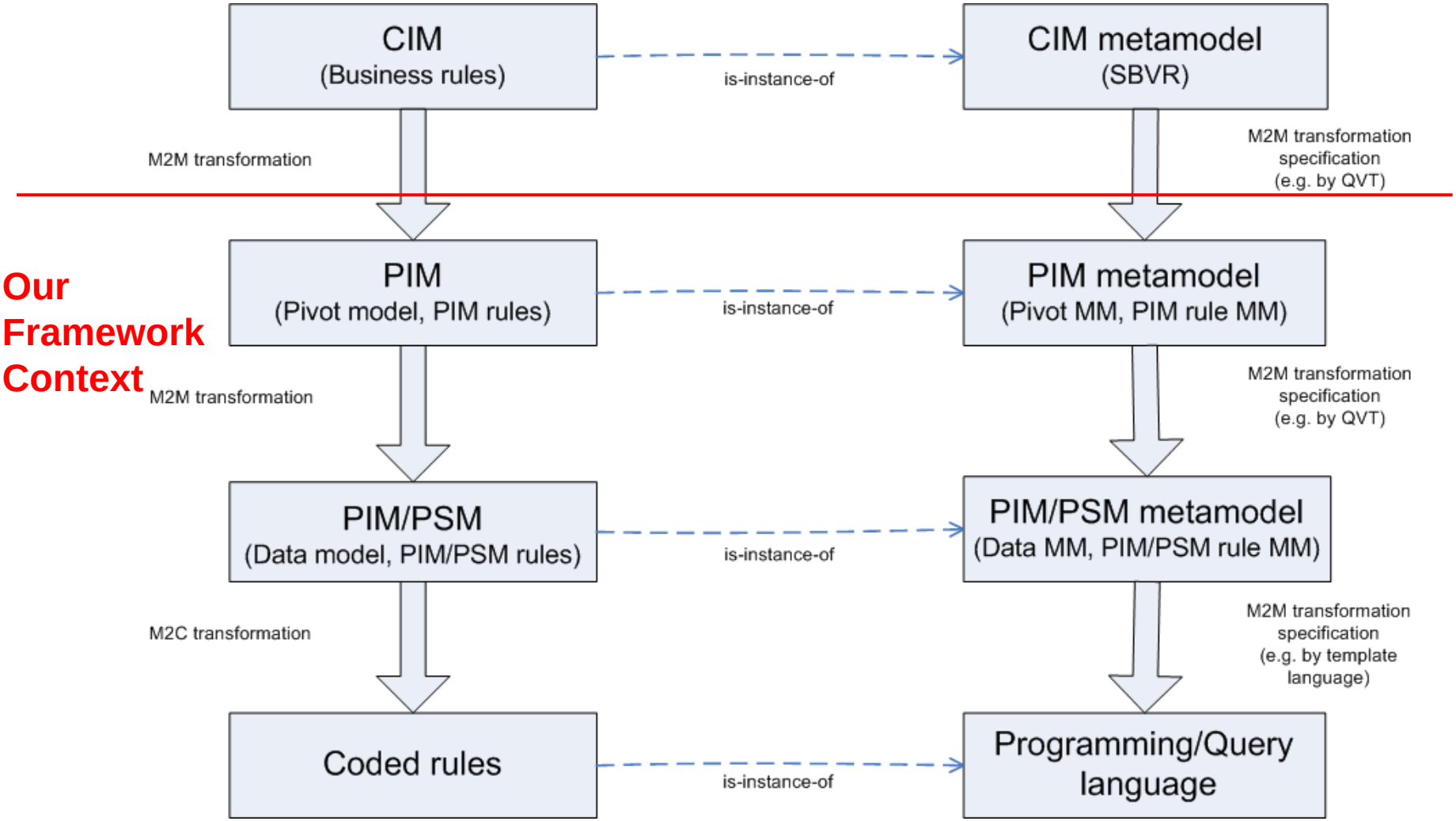
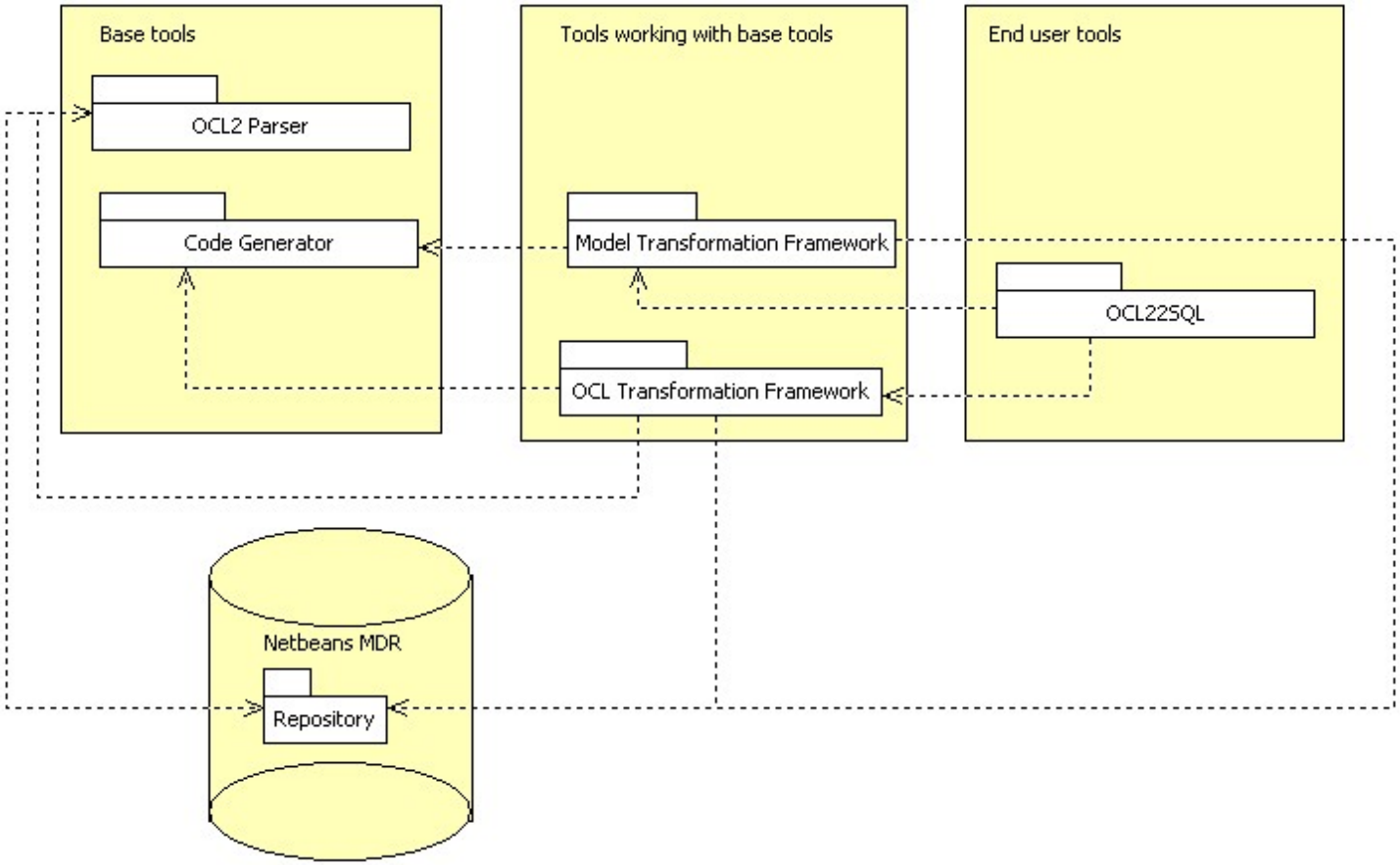
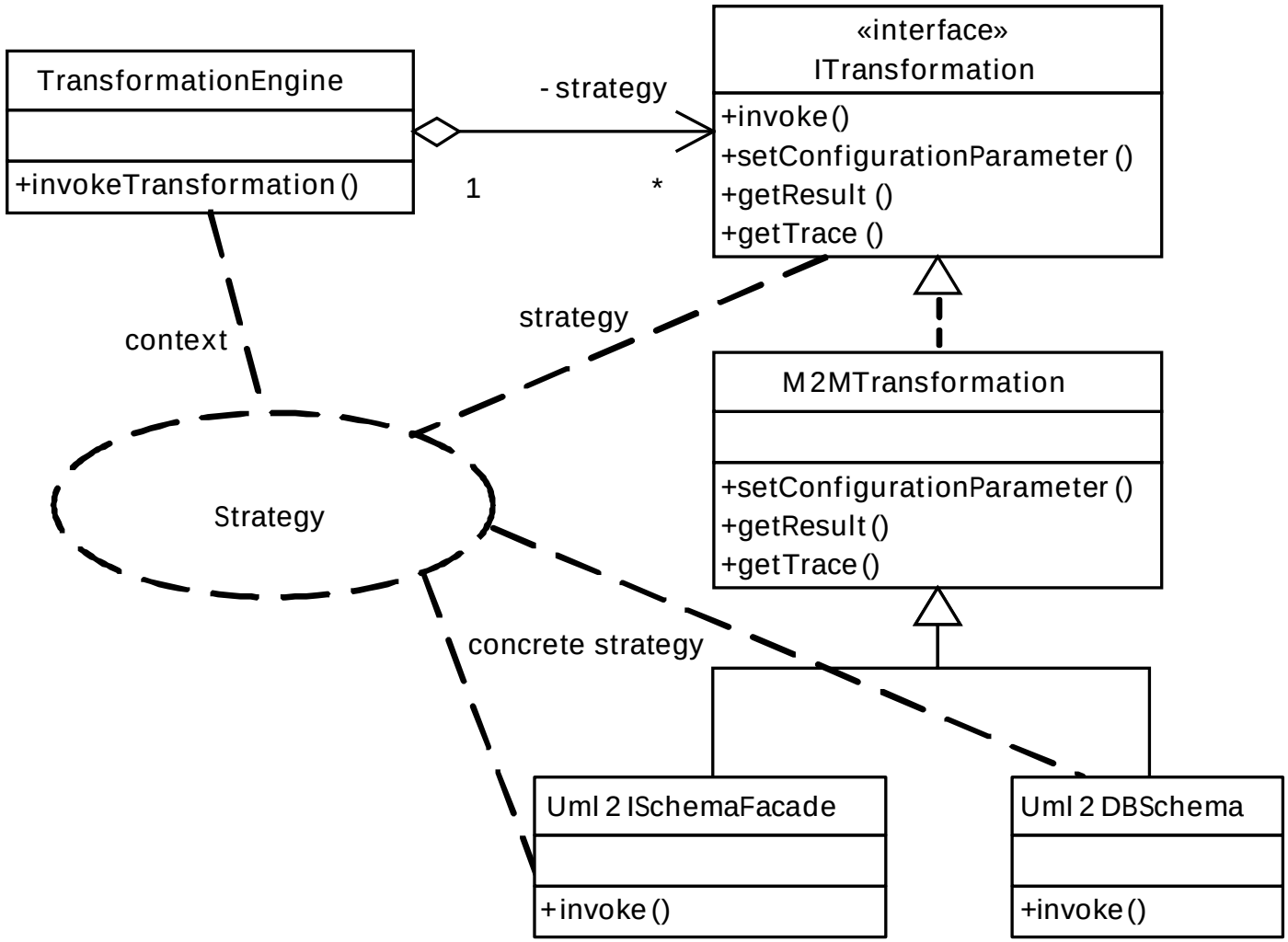
Business Rules Approach



Our Framework Context

Query Code Transformation by the **Dresden OCL2 Toolkit**

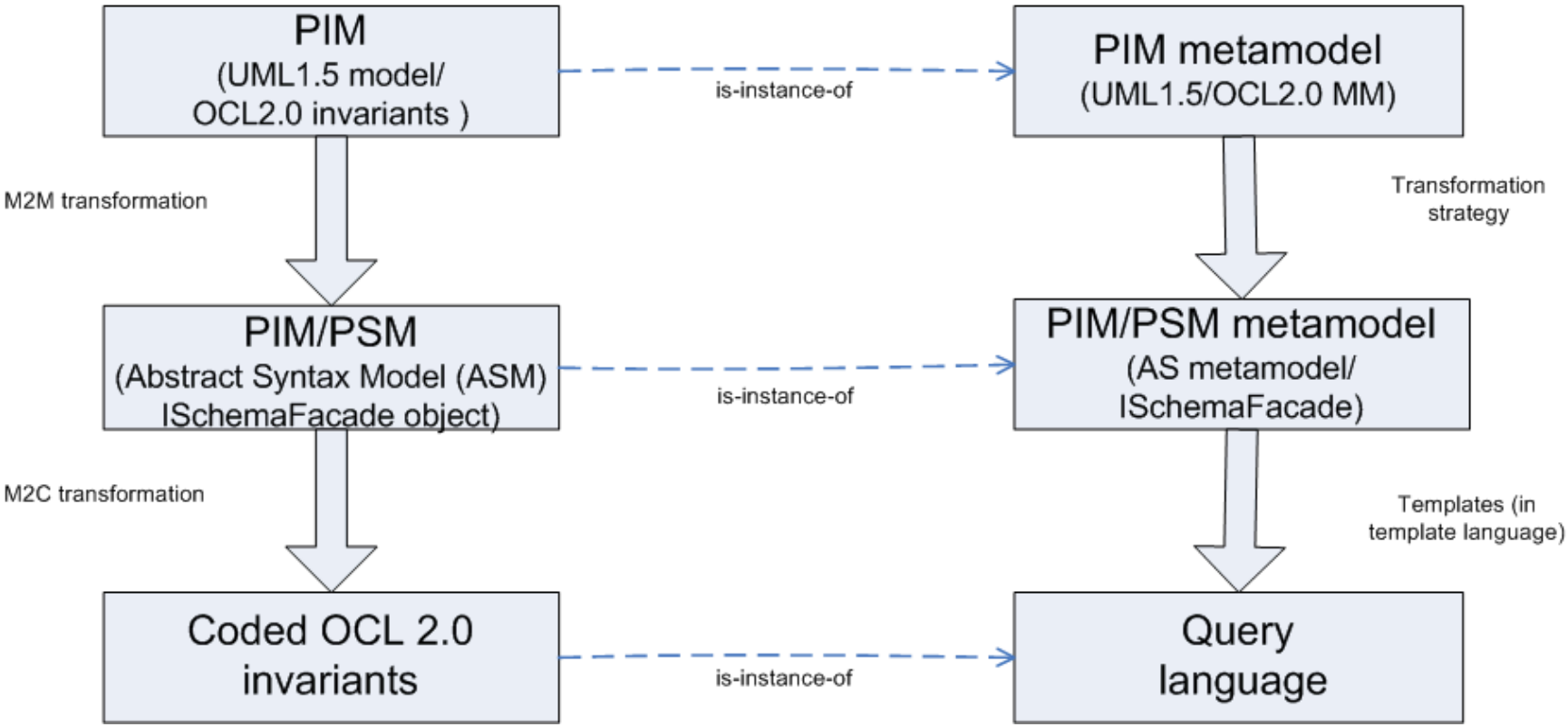


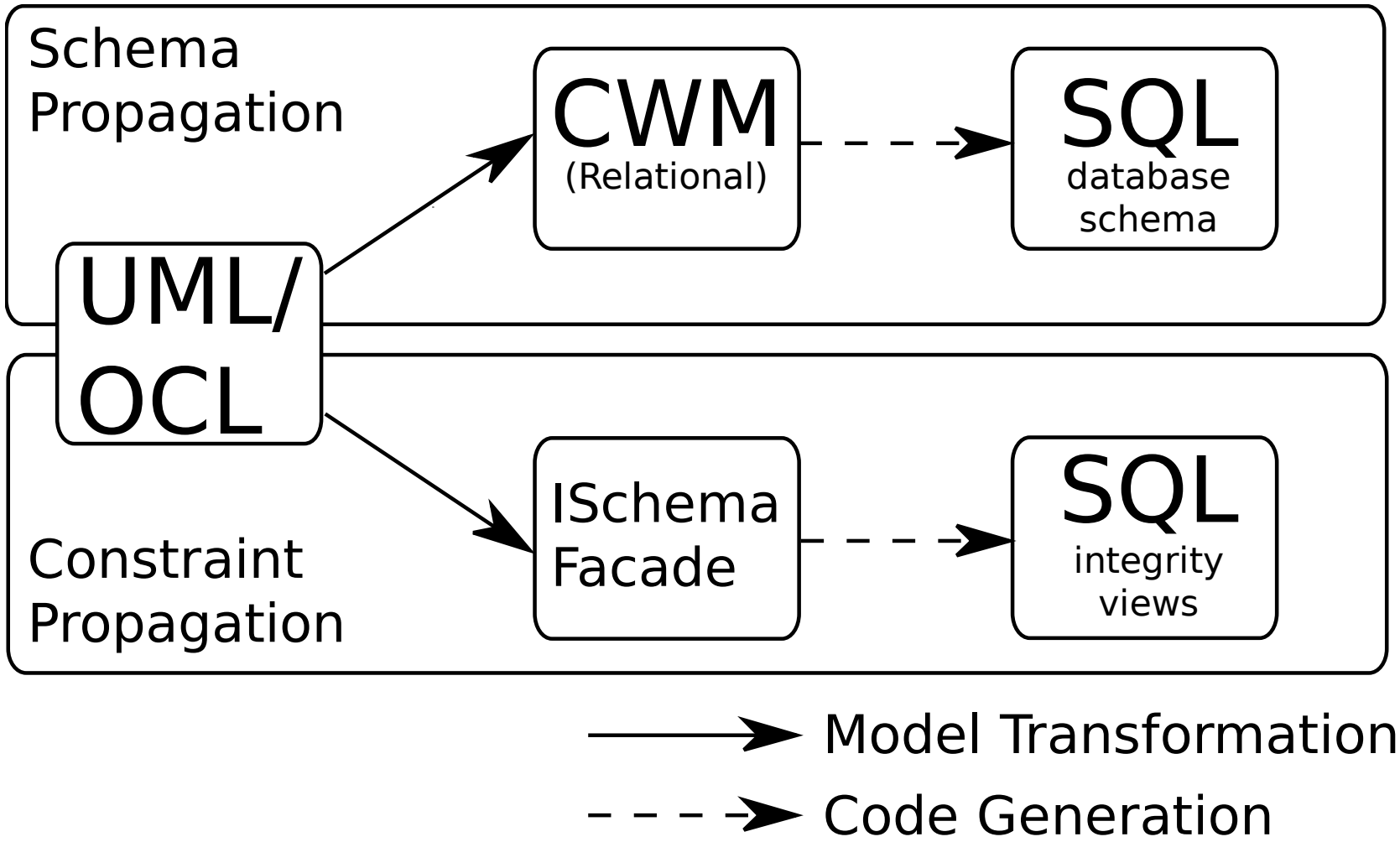

TransformationEngine
+invokeTransformation()
- strategy
1
*
«interface»
ITransformation
+invoke()
+setConfigurationParameter()
+getResult()
+getTrace()
context
strategy
M2MTransformation
+setConfigurationParameter()
+getResult()
+getTrace()
Strategy
concrete strategy
Uml2ISchemaFacade
+invoke()
Uml2DBSchema
+invoke()

Data schema access:

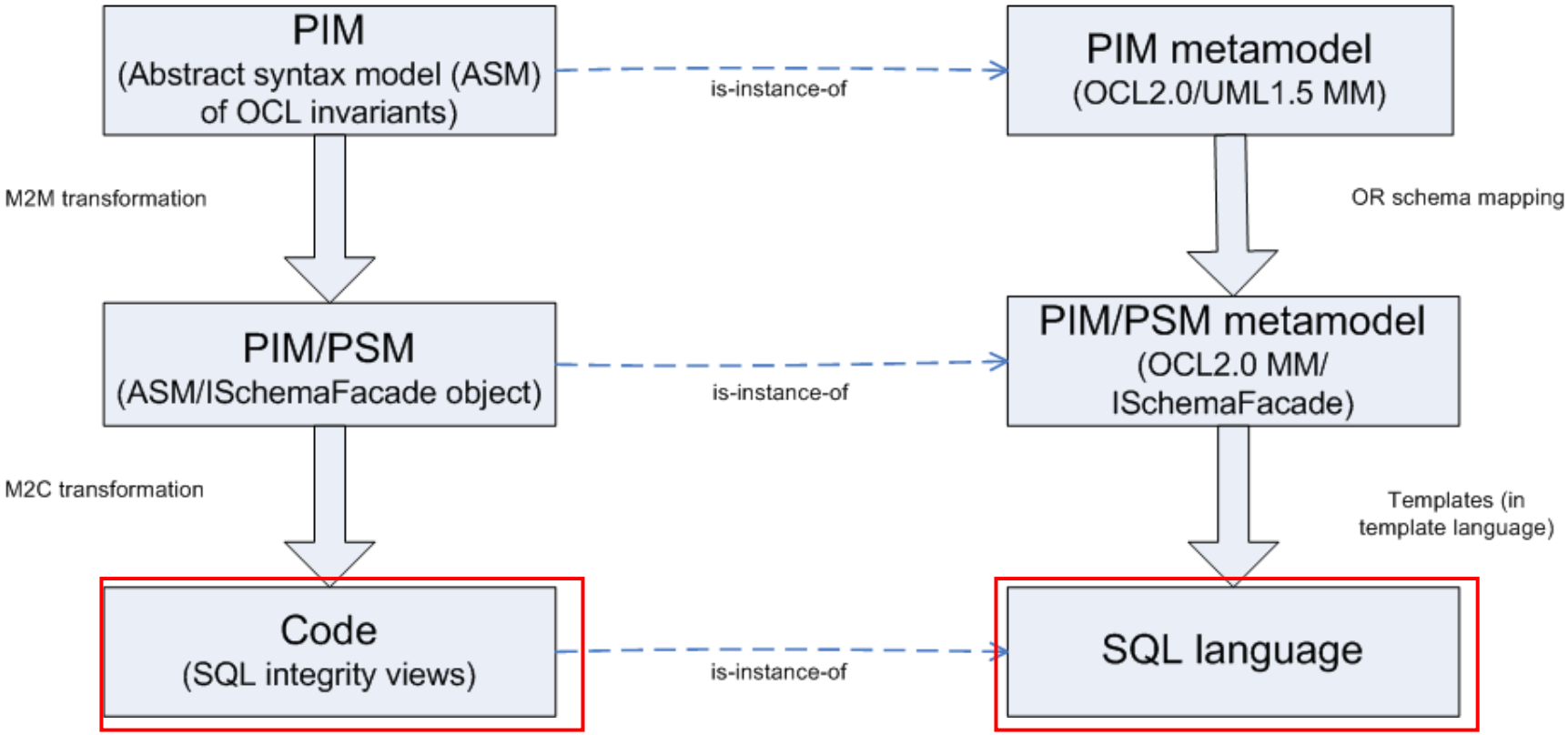
String-Template for SQL92 Code Generation:

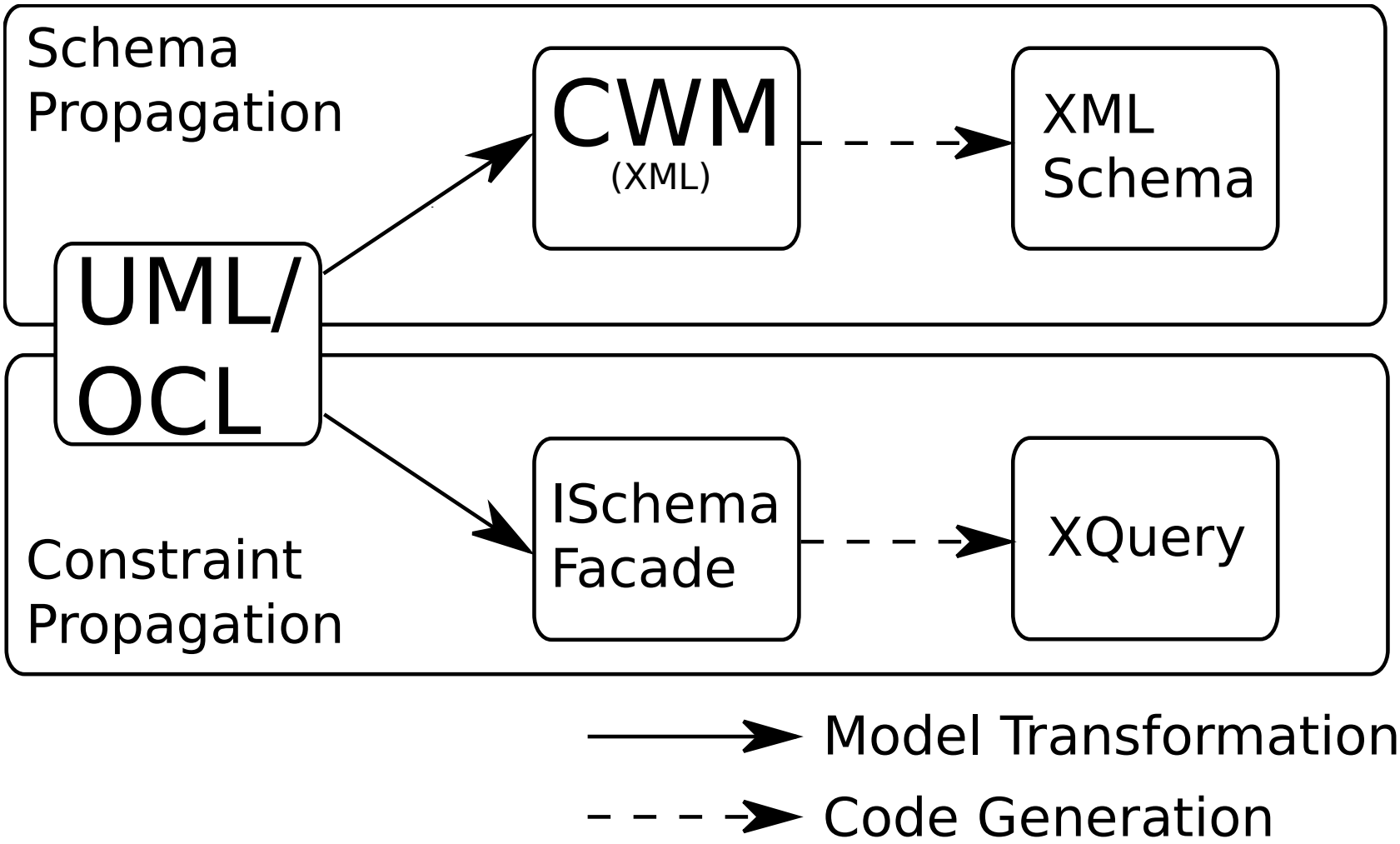
```
constraint_body(
constraint_name,context,context_alias,expression)
::= <<
create view $constraint_name$ as
(select * from $context$ as $context_alias$
where not ($expression$))
>>
```


PIM
(UML1.5 model/
OCL2.0 invariants)
is-instance-of
PIM metamodel
(UML1.5/OCL2.0 MM)
M2M transformation
Transformation
strategy
PIM/PSM
(Abstract Syntax Model (ASM)
ISchemaFacade object)
is-instance-of
PIM/PSM metamodel
(AS metamodel/
ISchemaFacade)
M2C transformation
Templates (in
template language)
Coded OCL 2.0
invariants
is-instance-of
Query
language


Schema Propagation
CWM
(Relational)
SQL
database schema
UML/ OCL
Constraint Propagation
ISchema Facade
SQL
integrity views
Model Transformation
Code Generation

MDIE and the MDA Stack
Application Example




Schema Propagation
CWM
(XML)
XML Schema
UML/ OCL
Constraint Propagation
ISchema Facade
XQuery
Model Transformation
Code Generation

Open Issues

From the theoretical/conceptual viewpoint:

- No proof that our approach works for all declarative/SQL-like languages
- Declarative/SQL-like languages not formalized
- No pattern for arbitrarily complex iterate expressions (OCL-to-SQL)
- Are data models/rules PIM or PSM models/rules?

From the implementation-technical viewpoint:

- Current model transformation approaches (QVT) not considered
- OCL2XQuery not yet implemented
- Not yet migrated to the new architecture of the Dresden OCL2 Toolkit

1. Increase the role of database rules in every day applications such as Web applications or information systems!

2. Is OCL resp. OCL as core language of production rules (PRR) the adequate language for automating of business rules?
   - power of the language
   - paradigm of the language

1. Idea of model- and database driven development of business rules that we call **Model-Driven Integrity Engineering.** Sharing the database by all applications, it
   - reduces development costs
   - improves the quality of data bases

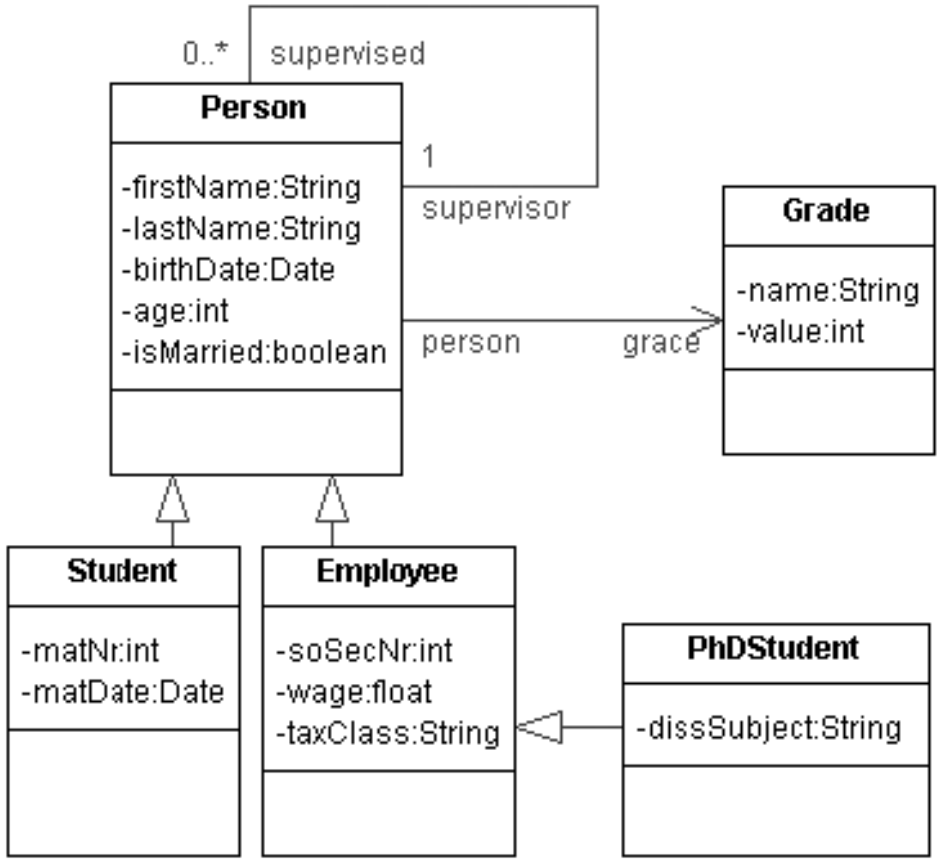
2. **Query Code Generation Framework** to transform OCL-based rules to a manifold of platforms and their corresponding query language code

3. Running **OCL22SQL application**

Questions / Comments?

```
context Person
inv inv1: self.grade.value > 0
```

```
select VALUE
from GRADE
where PKG in (
   select GRADE_PK
   from PERSON
   where PKP = SELF.PKP)
```



Template definition

```
arithmetic_expression_plus(operand1,operand2) ::= <<
($operand1$ + $operand2$)
>>
```

Use in code generation

```
StringTemplate template =
templateEngine.getInstanceOf("arithmetic_expression_plus");
template.setAttribute("operand1", "1");
template.setAttribute("operand2", "2");
```