45. How to Synchronize Models with Triple Graph Grammars for Data Connection

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1) Triple Graph Grammars
2) TGG in MOFLON
3) Using TGG in MOFLON

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Literature

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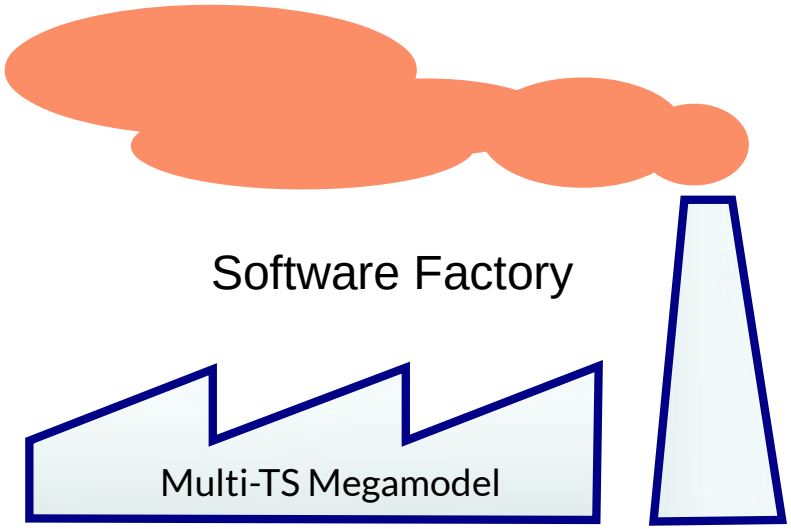
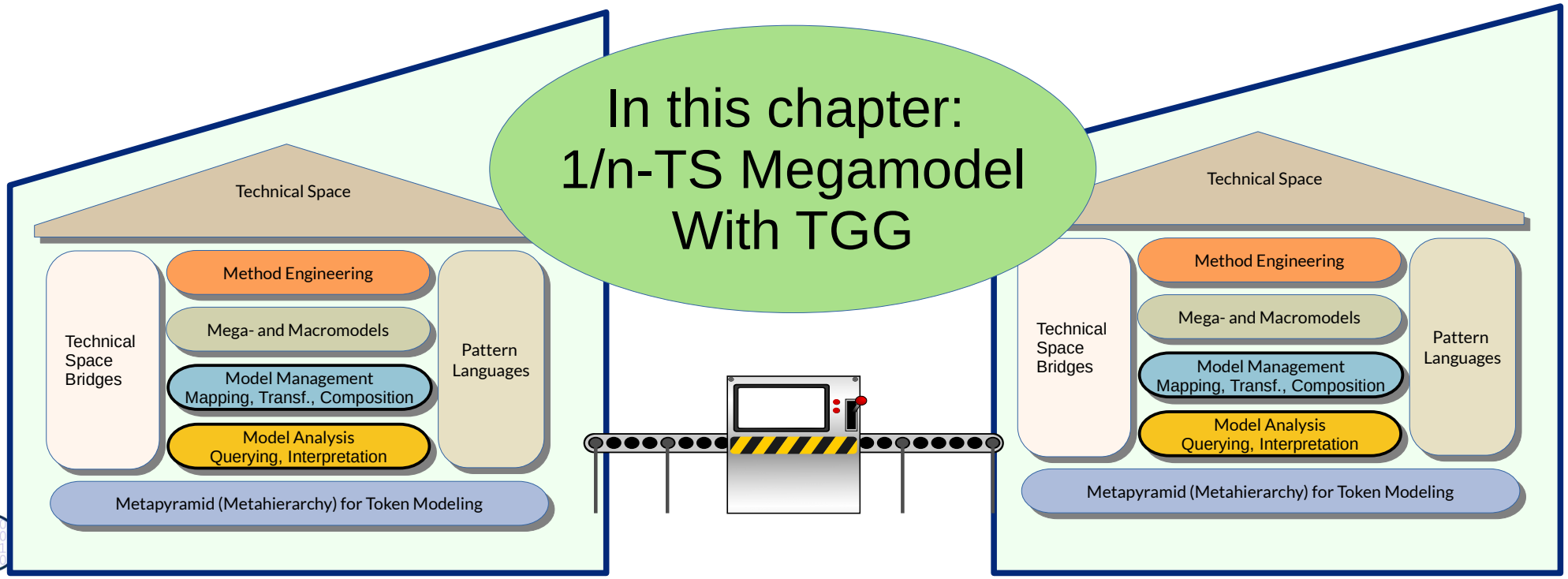
Q11: A Software Factory's Heart: the Multi-TS Megamodel



In this chapter:
1/n-TS Megamodel
With TGG



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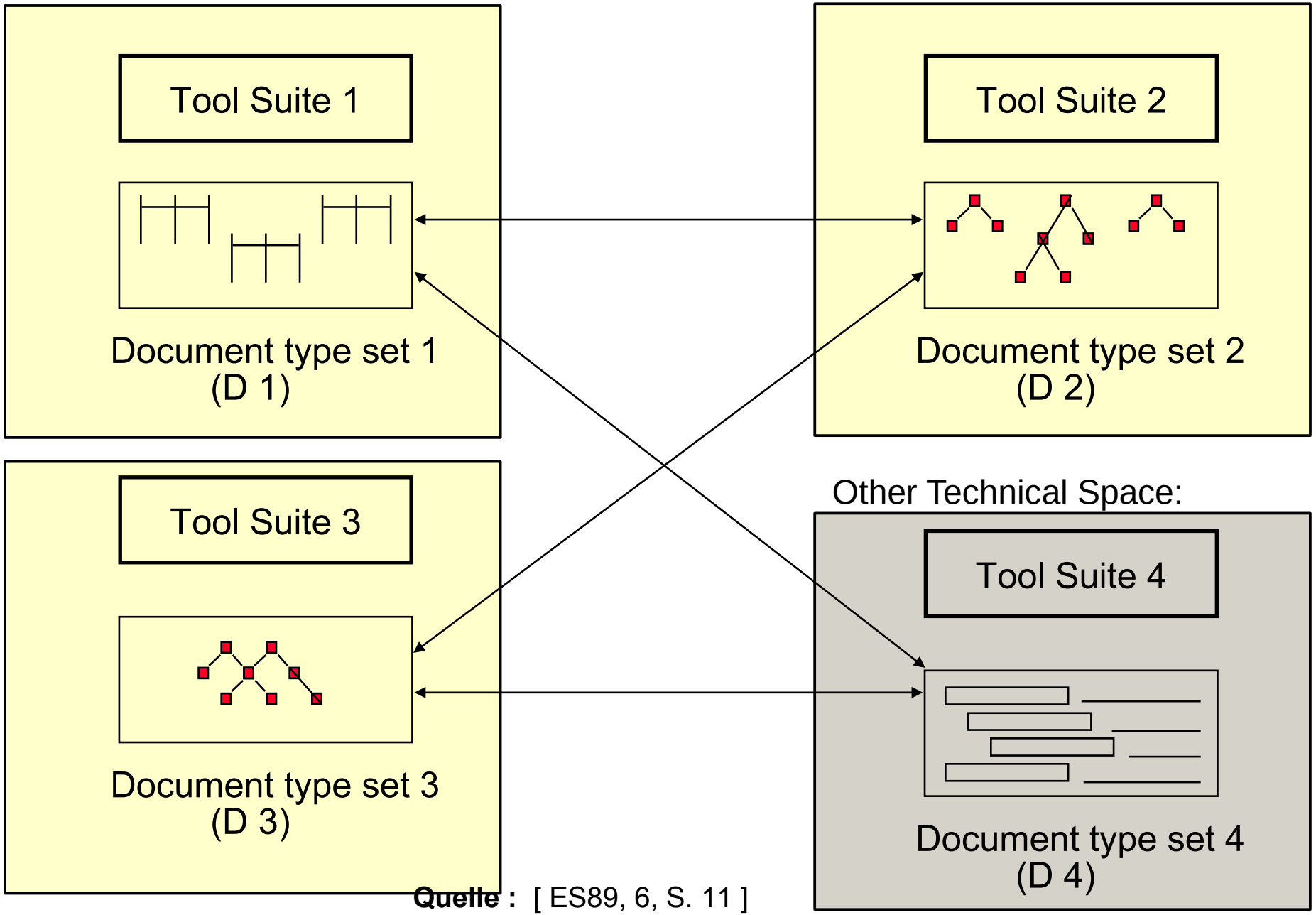
Integration of Tool Suites by Data Connection



Quelle : [ES89, 6, S. 11]

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45.1 „Synchronizing“ models with Triple Graph Grammars

Mapping graphs to other graphs

Specification of mappings with mapping rules

Incremental transformation

Traceability

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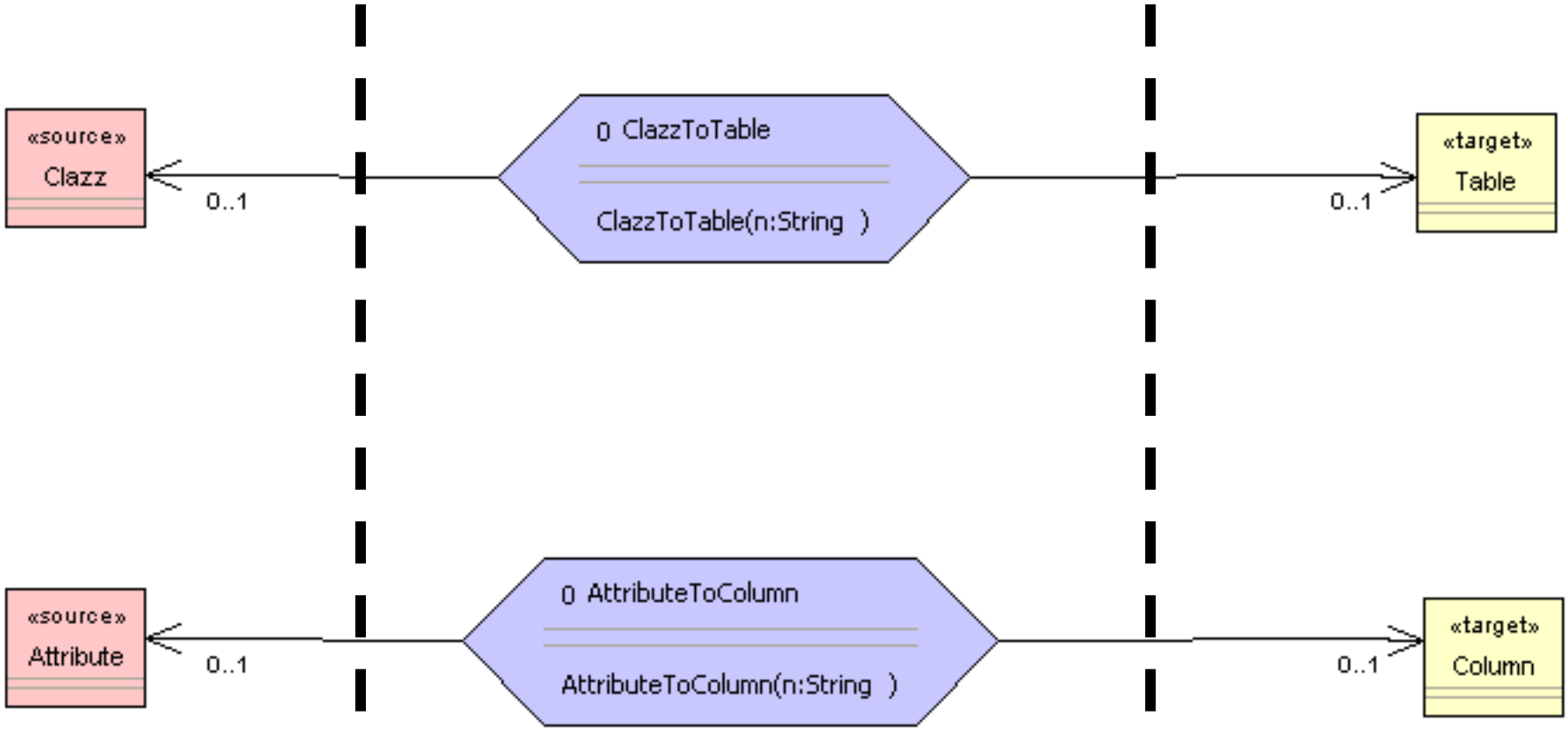
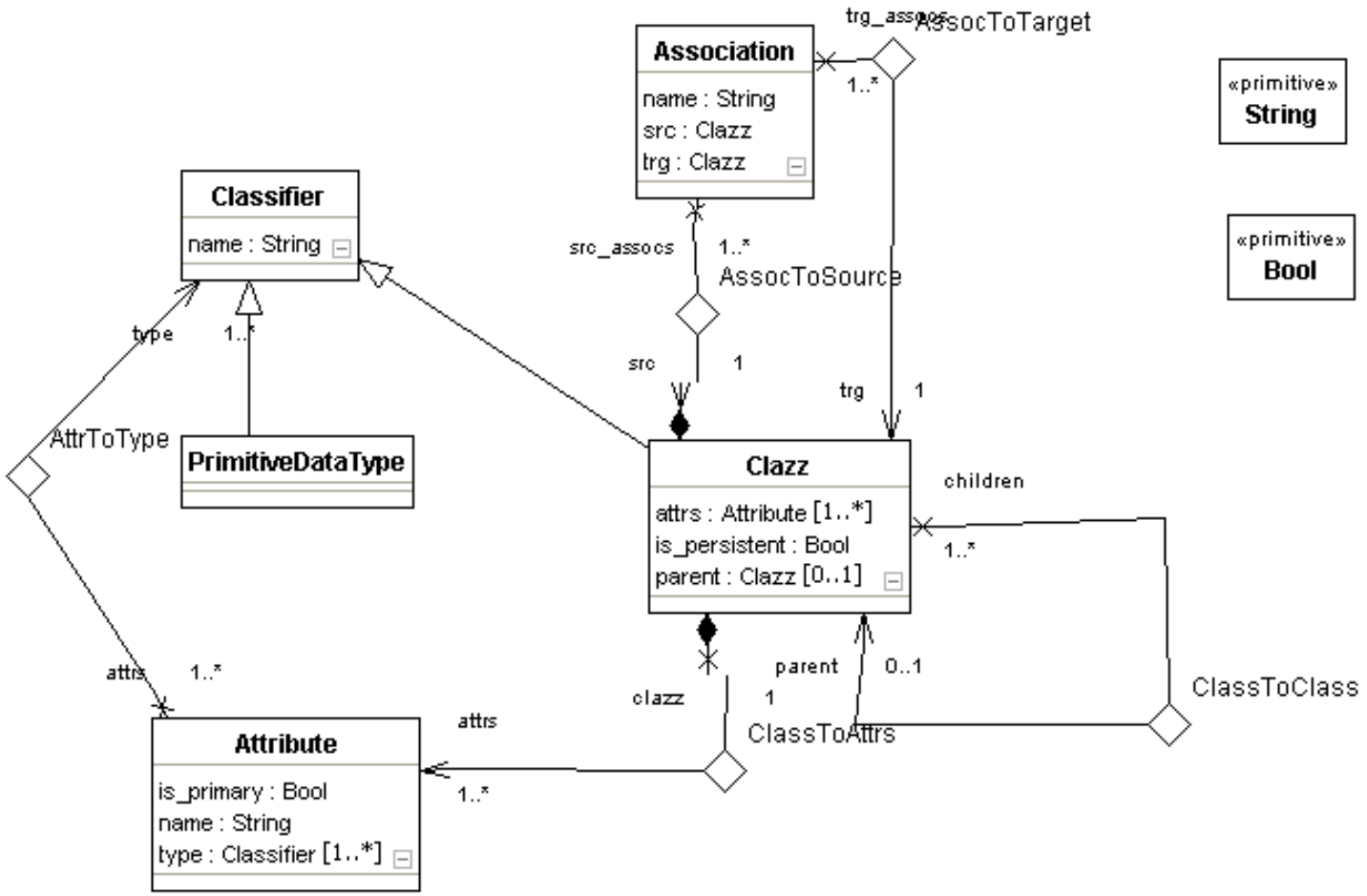
Triple Graph Grammars – Moflon Example

- A T**riple Graph Grammar (TGG)** is a mapping-oriented transformation system, consisting of rules with three „areas“ (better called **metamodel mapping grammars**)
  - Left side: (source) graph pattern 1 in (source) graph 1
  - Right side: (target) graph pattern 2 in (target) graph 2
  - Middle: relational expression (net) relating graph pattern 1 and 2 (trace model)



Triple Graph Grammars – Class Diagram Metamodel (CD)

- Synchronize Class-Diagram-metamodel (CD) with a relational schema (RS): object-relational mapping (ORM)



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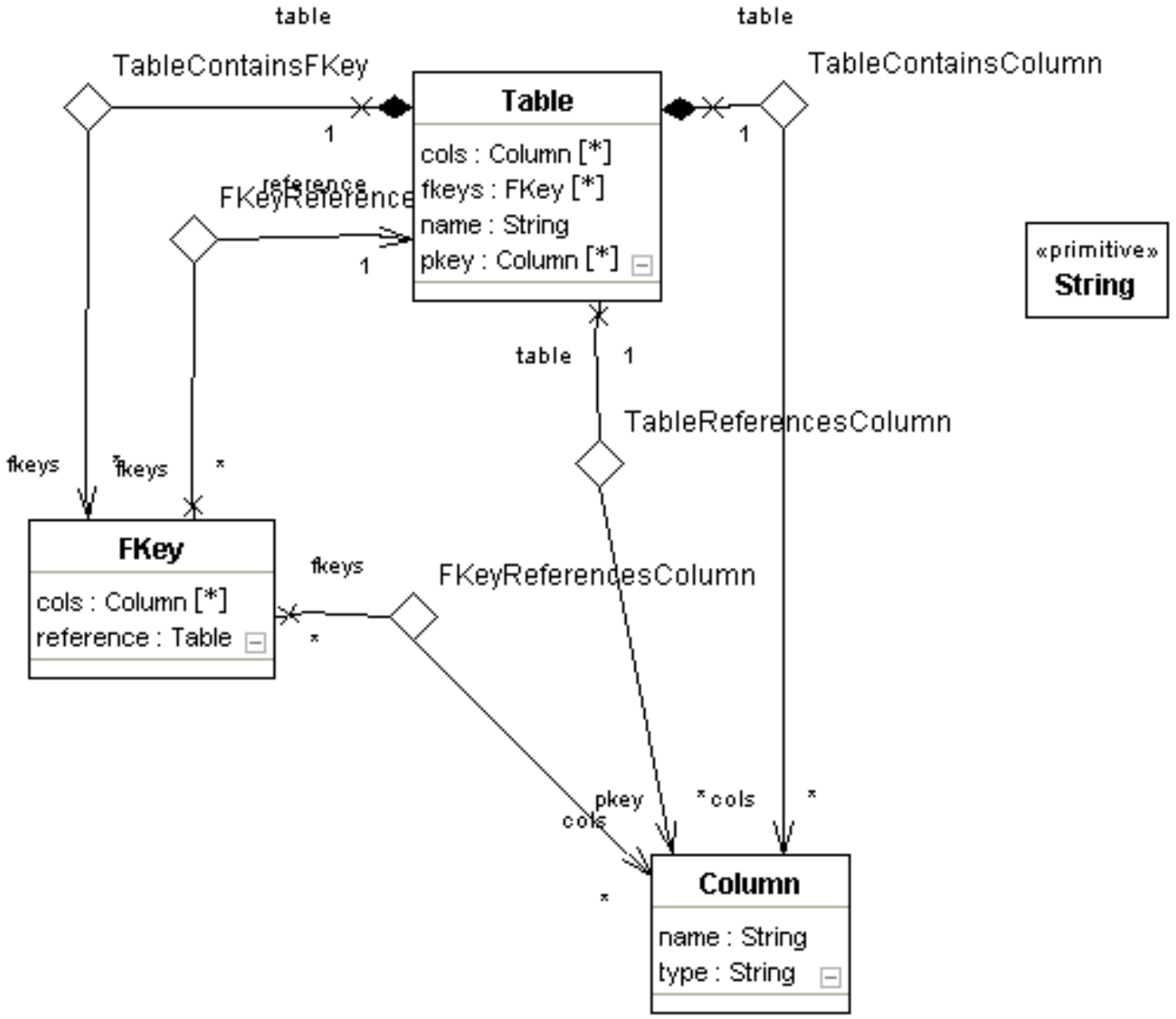
Relational Metamodel (DB, relational schema)



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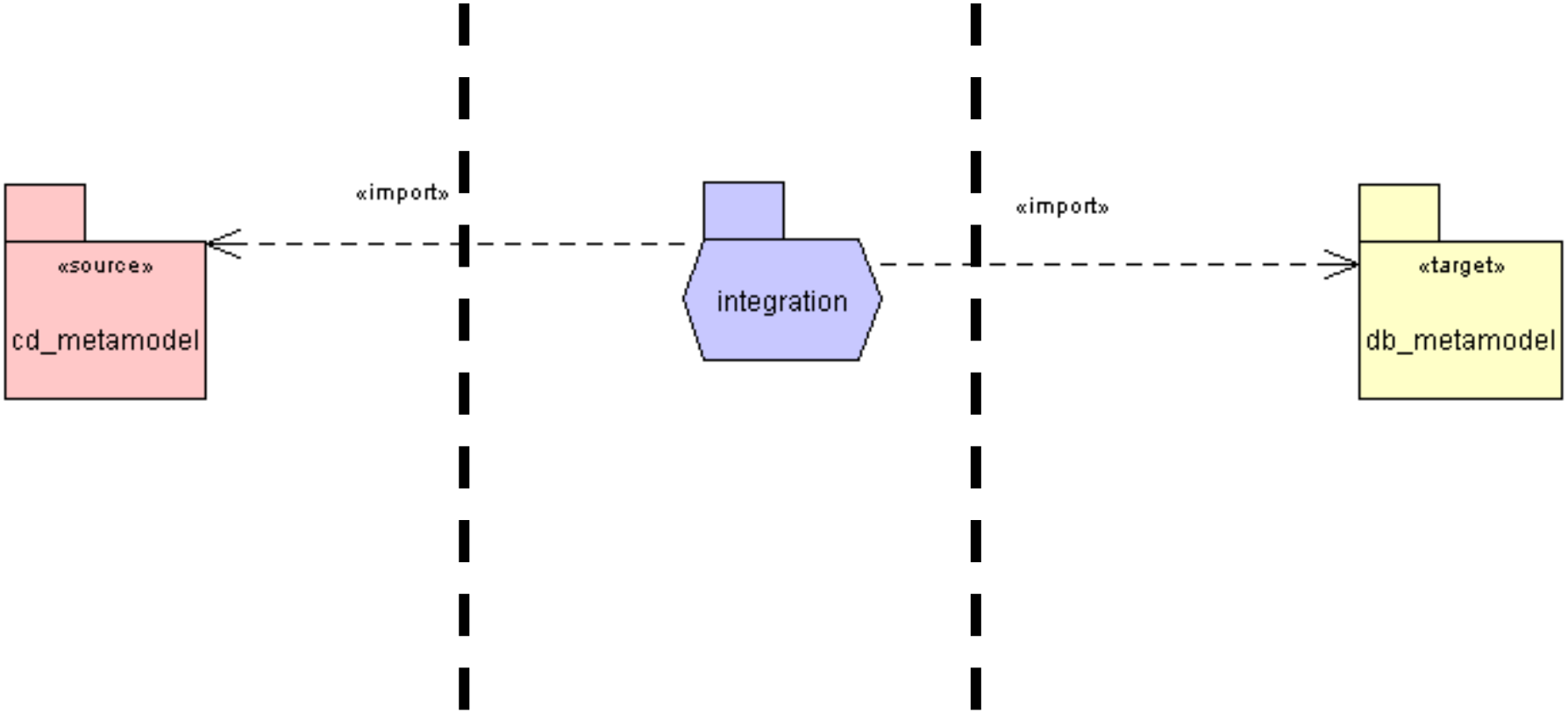
Triple Graph Grammars – Example

- The metamodel mapping grammar of a TGG has a top rule (start rule) which describes the relationship of the graphs on topmost level



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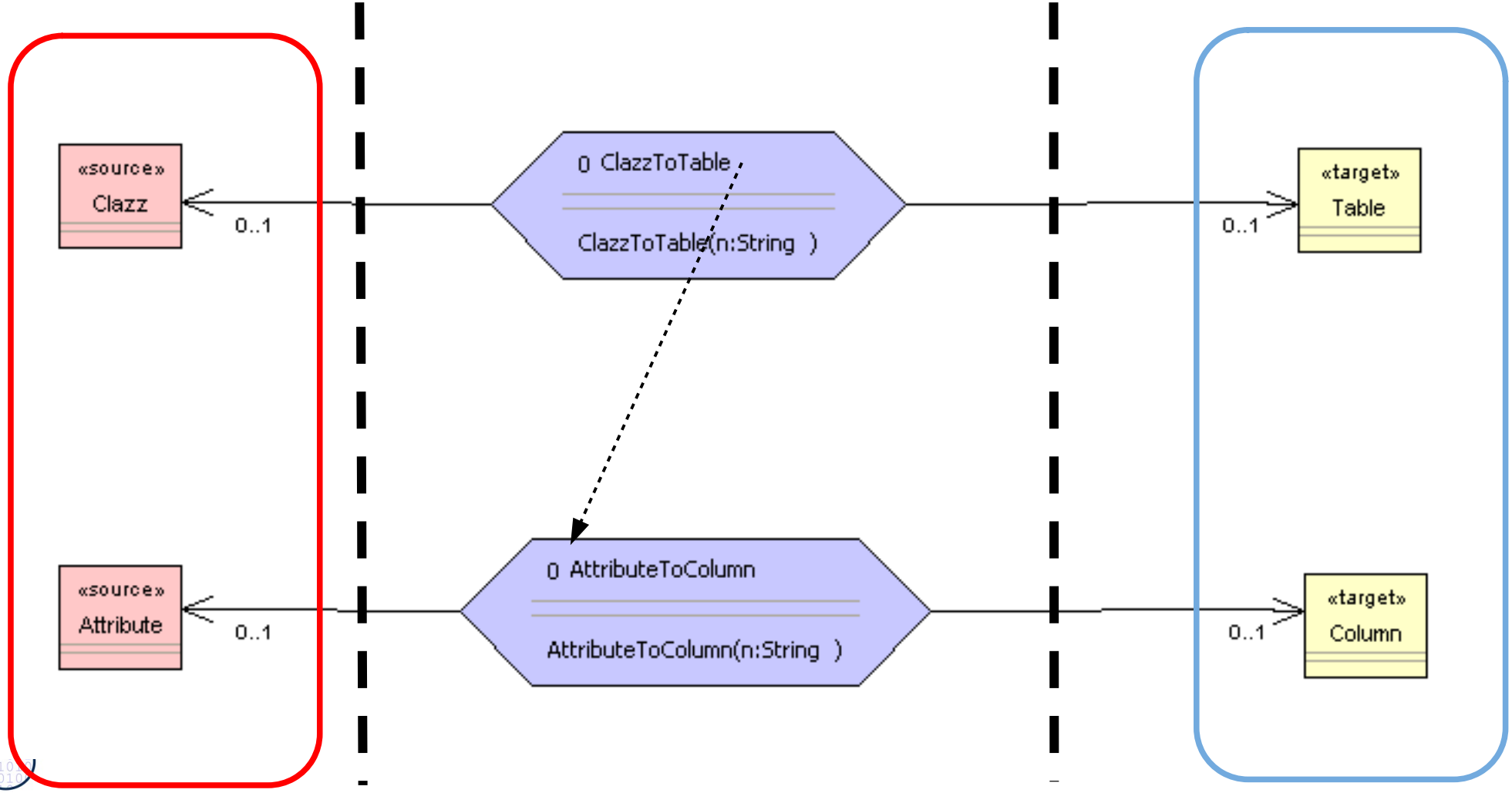
Triple Graph Grammars – Example

- From the top-rule, other TGG rules are associated („called“)
- In this case, the TGG only checks (black color – TEST)
- What happens, if both sides are in different Technical Spaces?



TGG Specify Transformation Bridges Between Roles and Technical Spaces

- TGG can also be used to synchronize Material roles
  - between two material objects
  - in different repositories
  - even in different technical spaces
- Only assumption: 1:1 mappings of model elements

TGG are a fine technique to build *transformation bridges for data connection* between tools, even in different technical spaces.

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45.2. Triple Graph Grammars in MOFLON

- MOFLON in MOF Technical Space
- eMOFLON in EMOF TS

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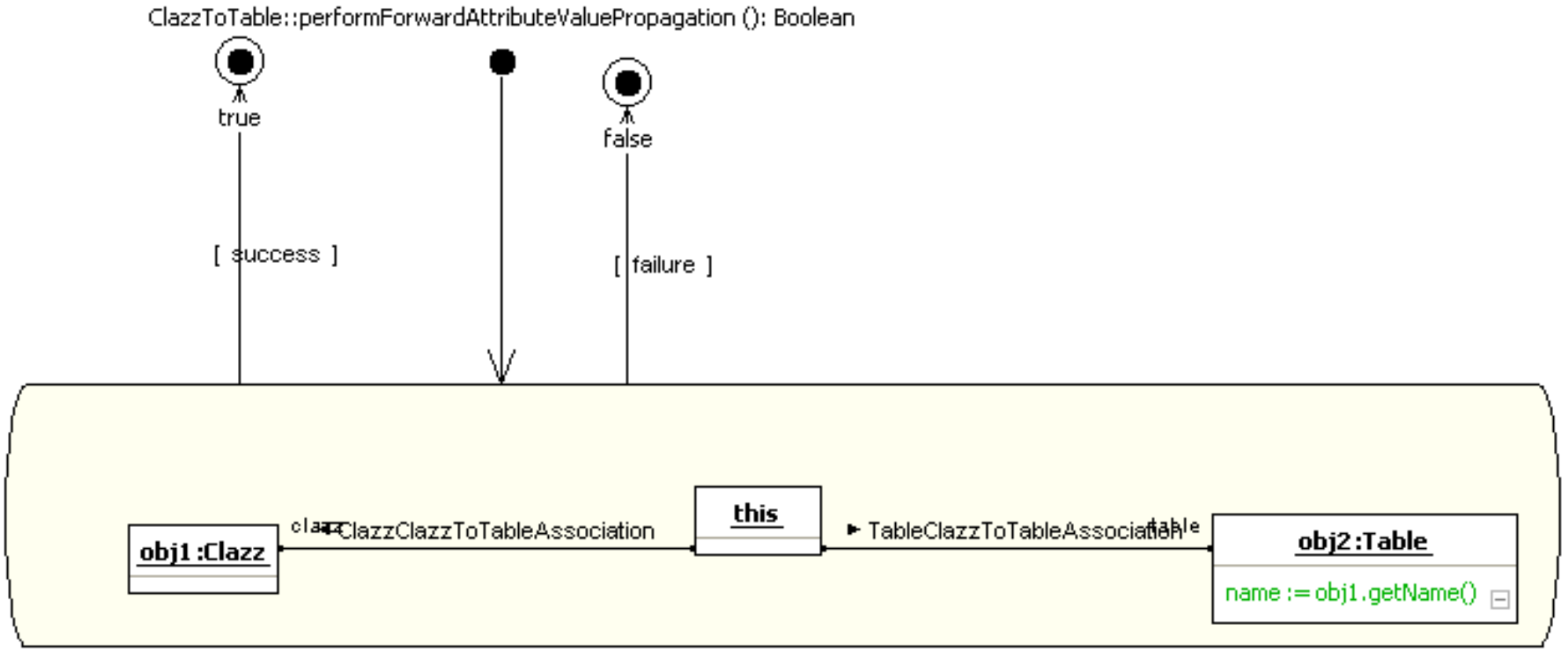
Triple Graph Grammars – Moflon Example

- Because they are named, TGG rules can be started by Fujaba Storyboards



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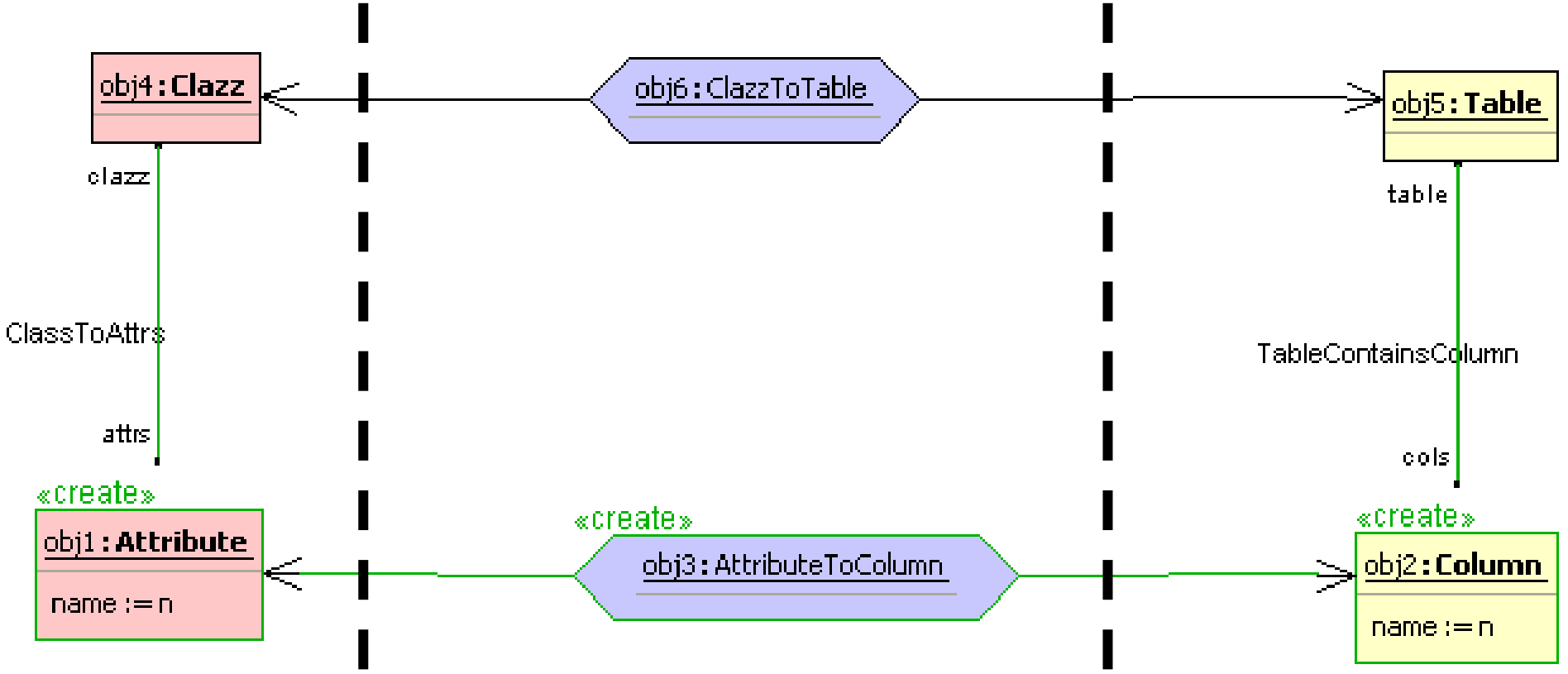
Triple Graph Grammars – Moflon Example

- Pairwise correspondance of model elements on both sides
- Here, objects on the lower level are created anew



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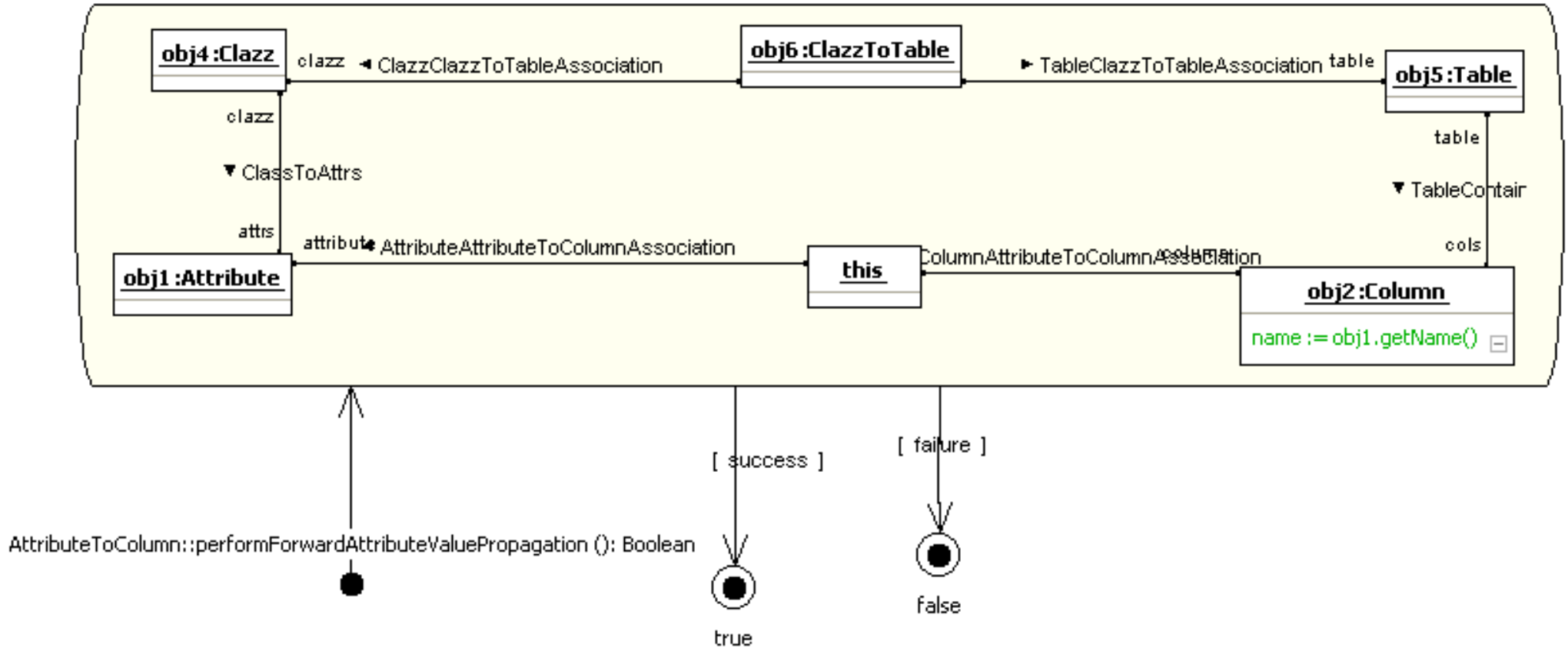
Triple Graph Grammars – Moflon Example



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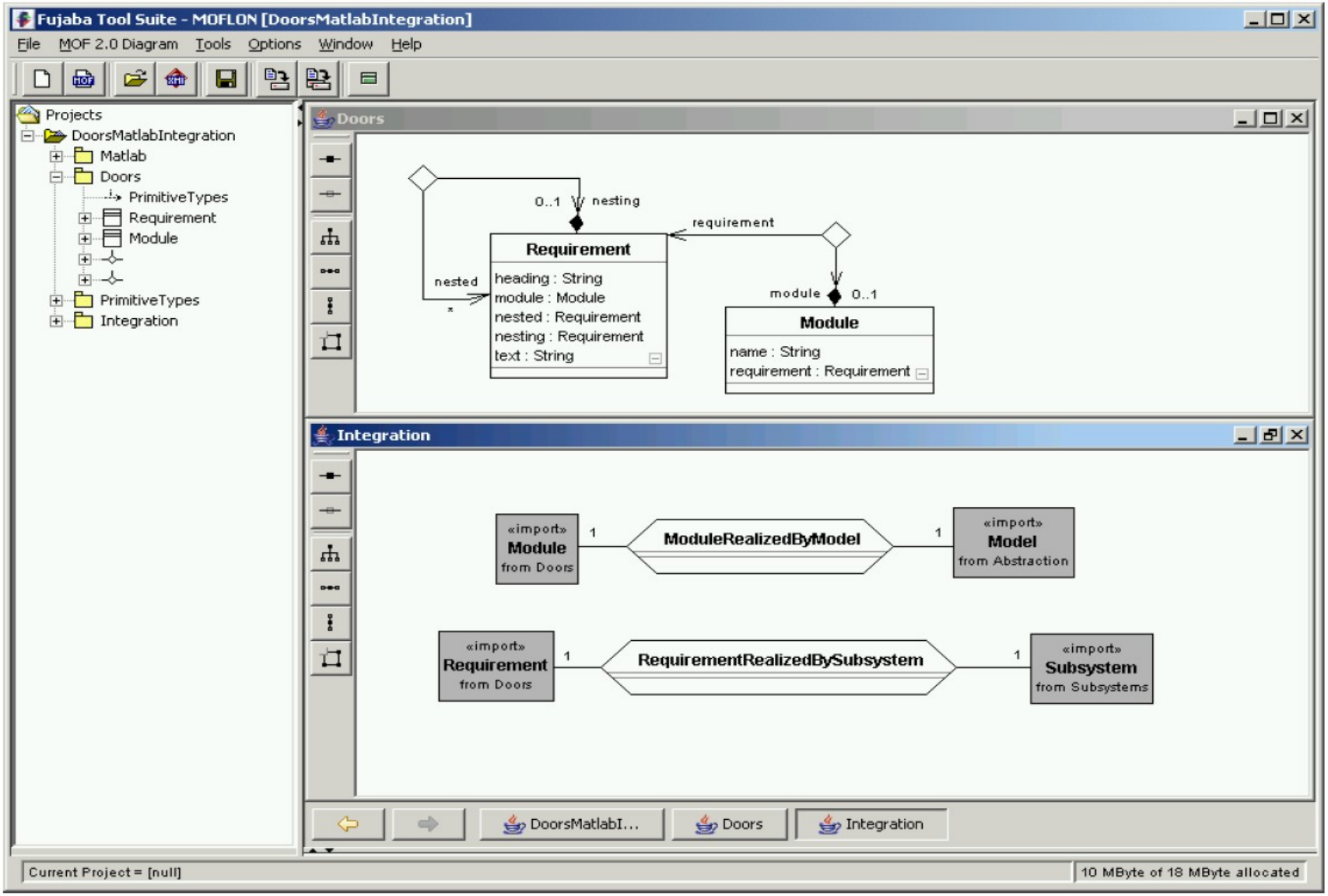
Ex. 2: TGG Coupling of Requirements Specification and Design



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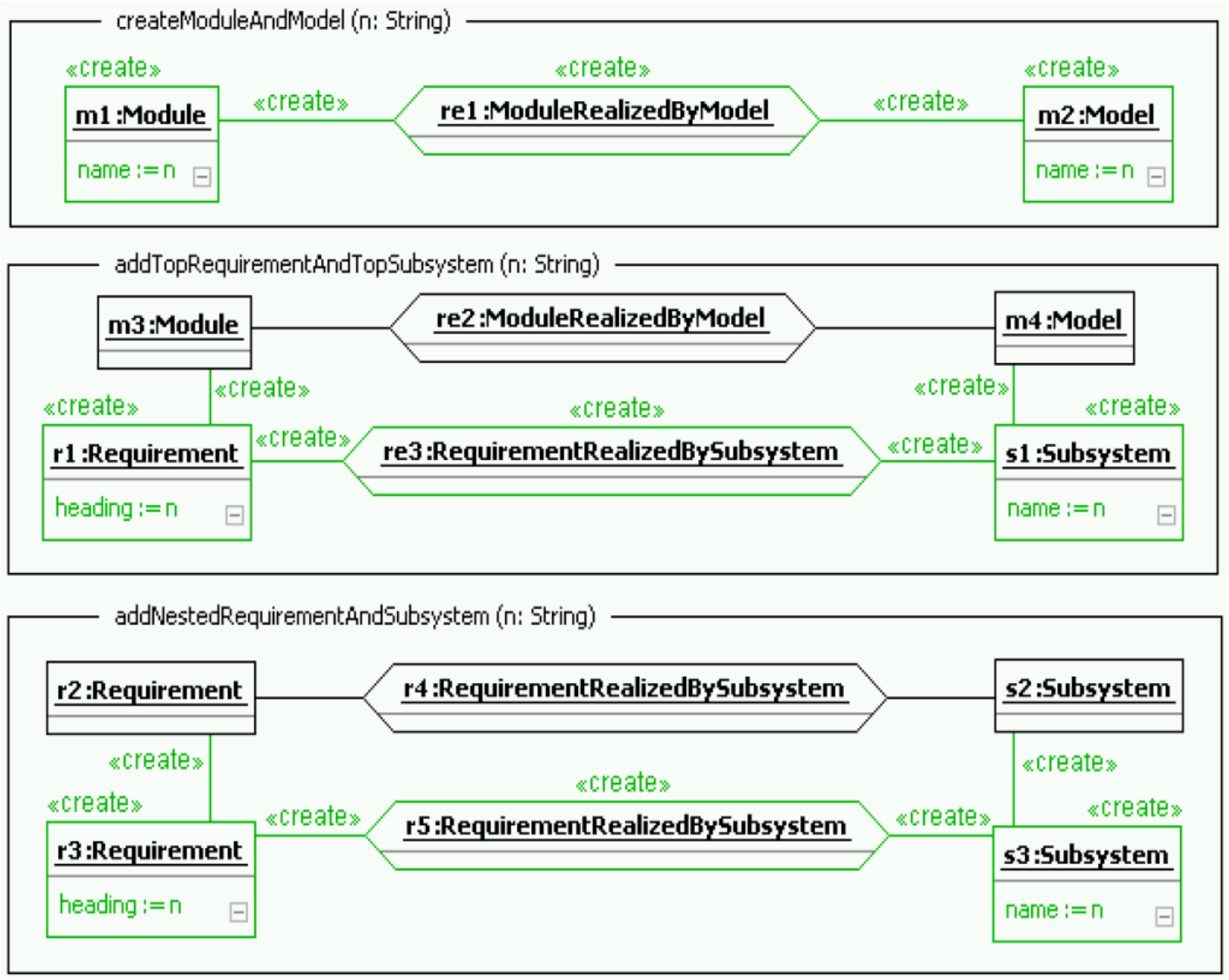
TGG Coupling Requirements Specification and Design



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45.3. Using Triple Graph Grammars in MOFLON

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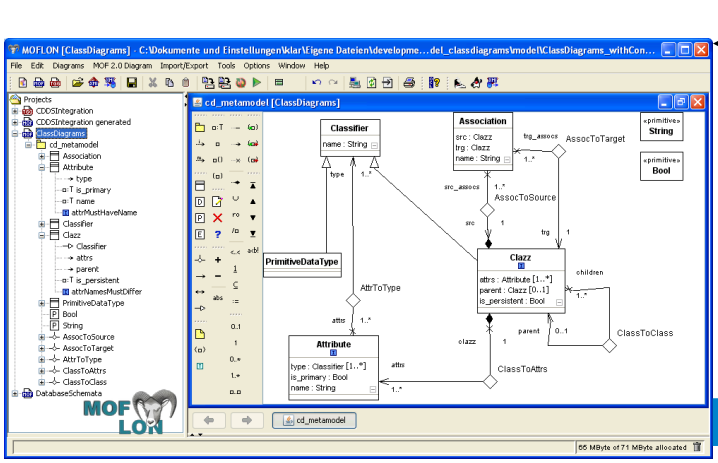
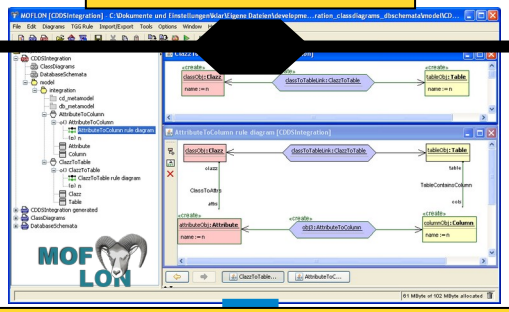
Example: Tool Integration Scenario TiE-CD-DB: (ClassDiagrams / DatabaseSchema)

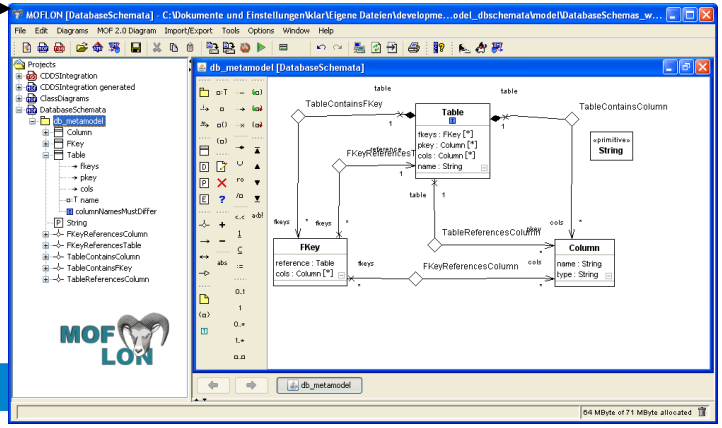
Class Diagrams Metamodel

TGGs relate

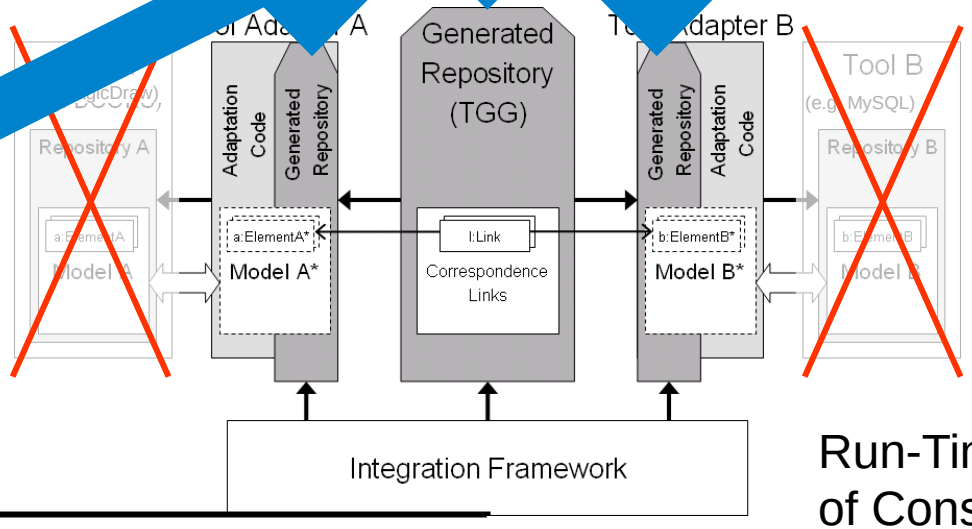
Database Schemata Metamodel







MOFLON generates



integration rule code

Run-Time Verification of Constraints

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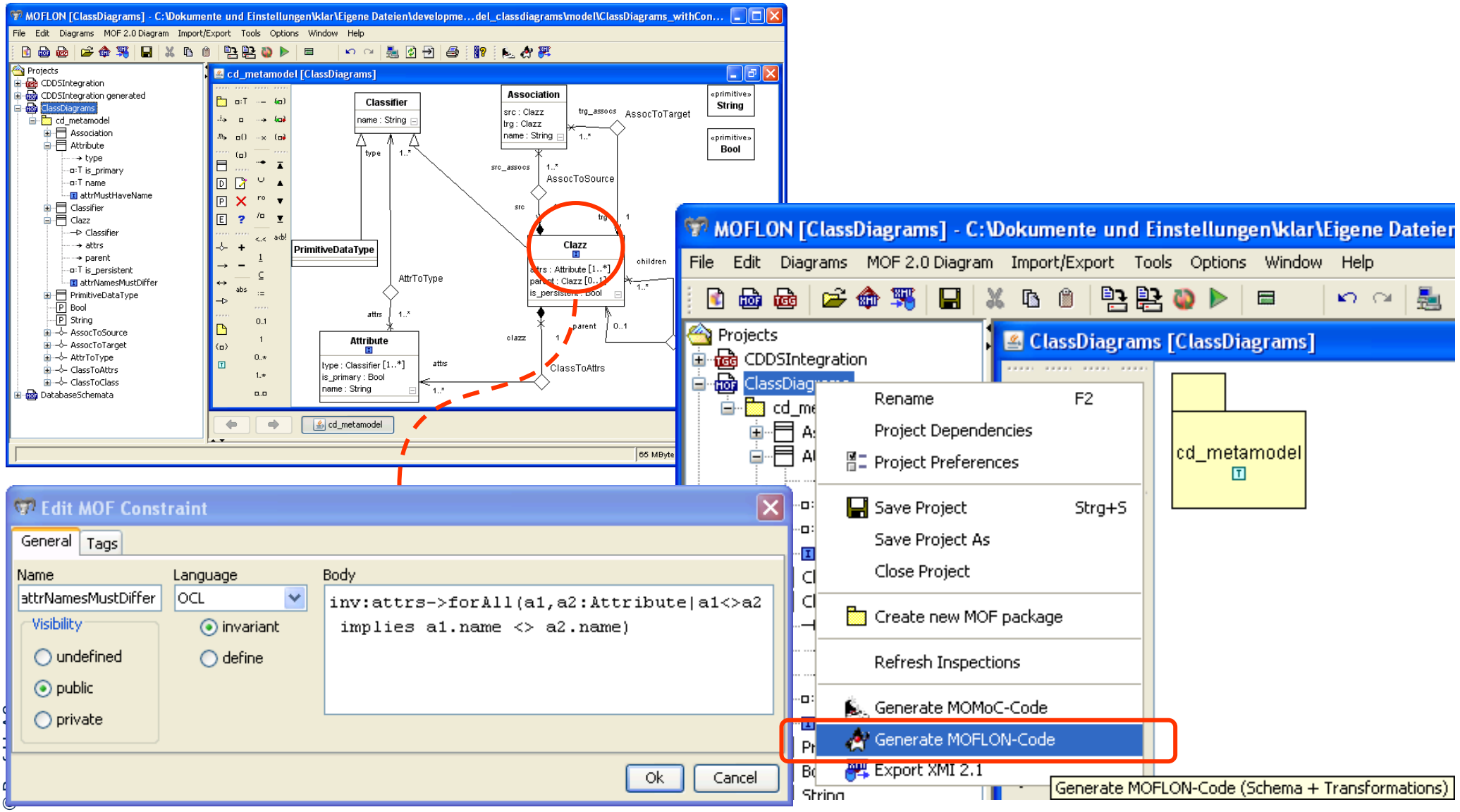
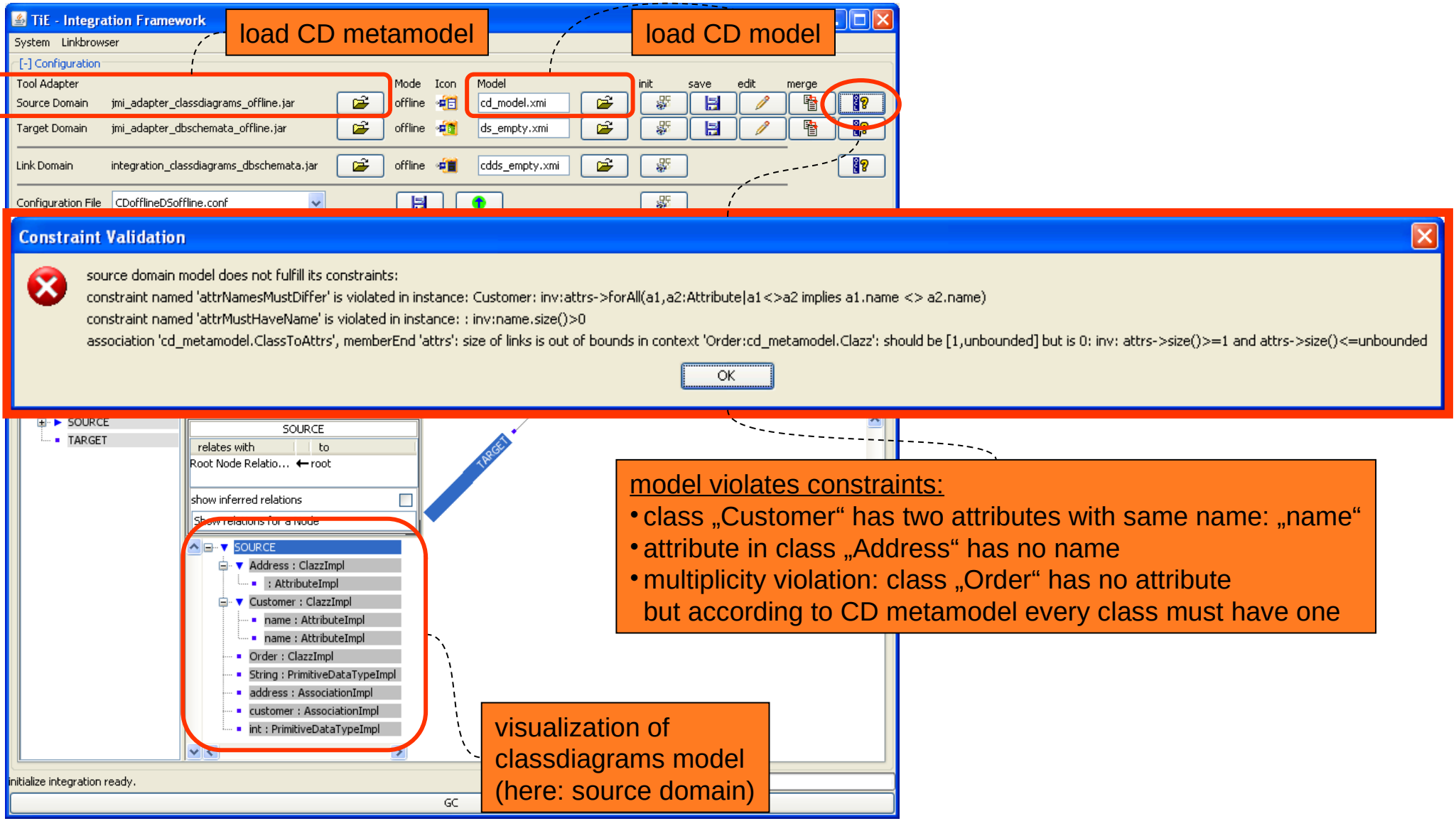
TiE-CD-DB – Constraints in Class Diagrams (1)
Generate Code from MOF model (CD metamodel)



TiE-CD-DB – Constraints in Class Diagrams (2) Integration Framework



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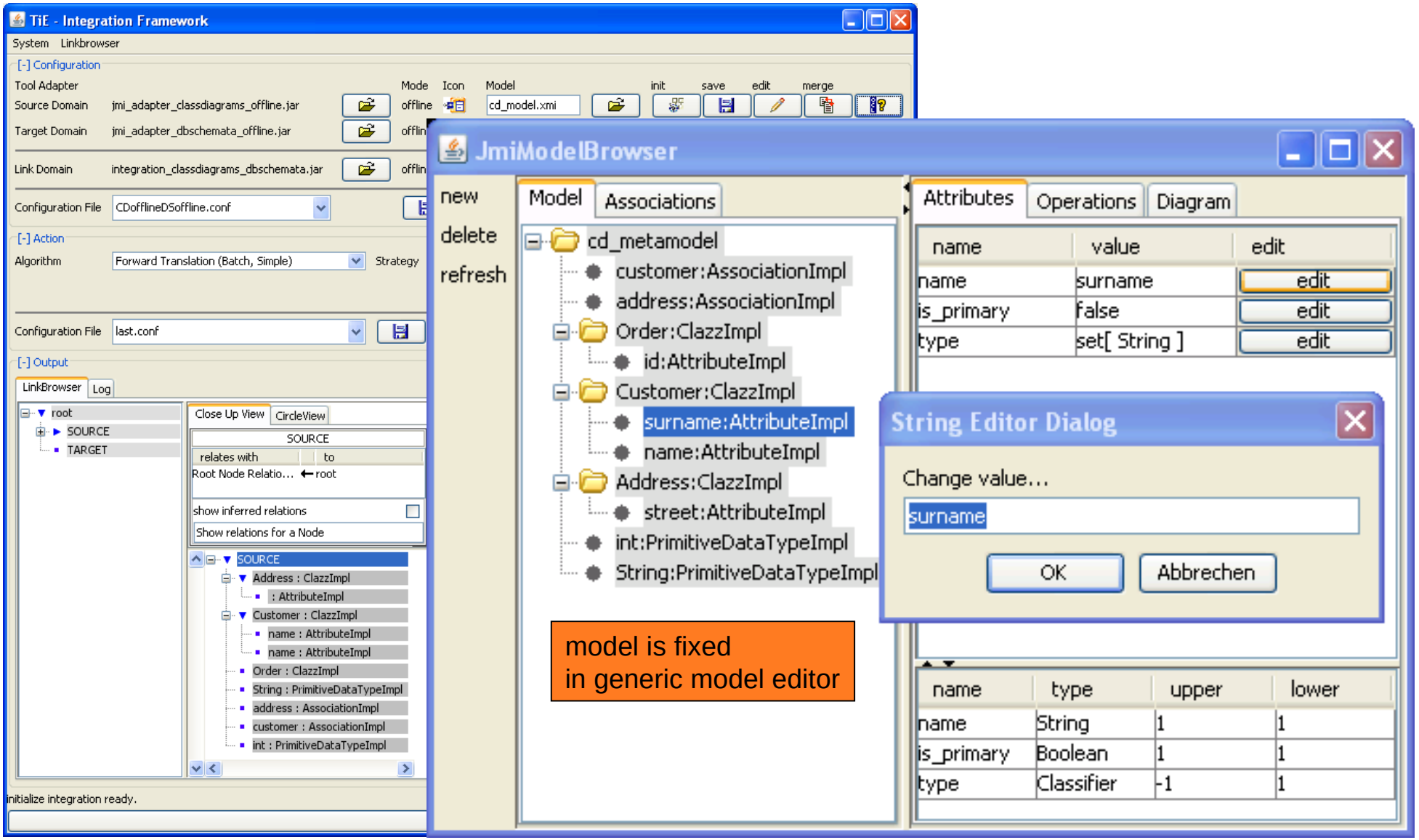
TiE-CD-DB – Constraints in Class Diagrams (3) Model Browser



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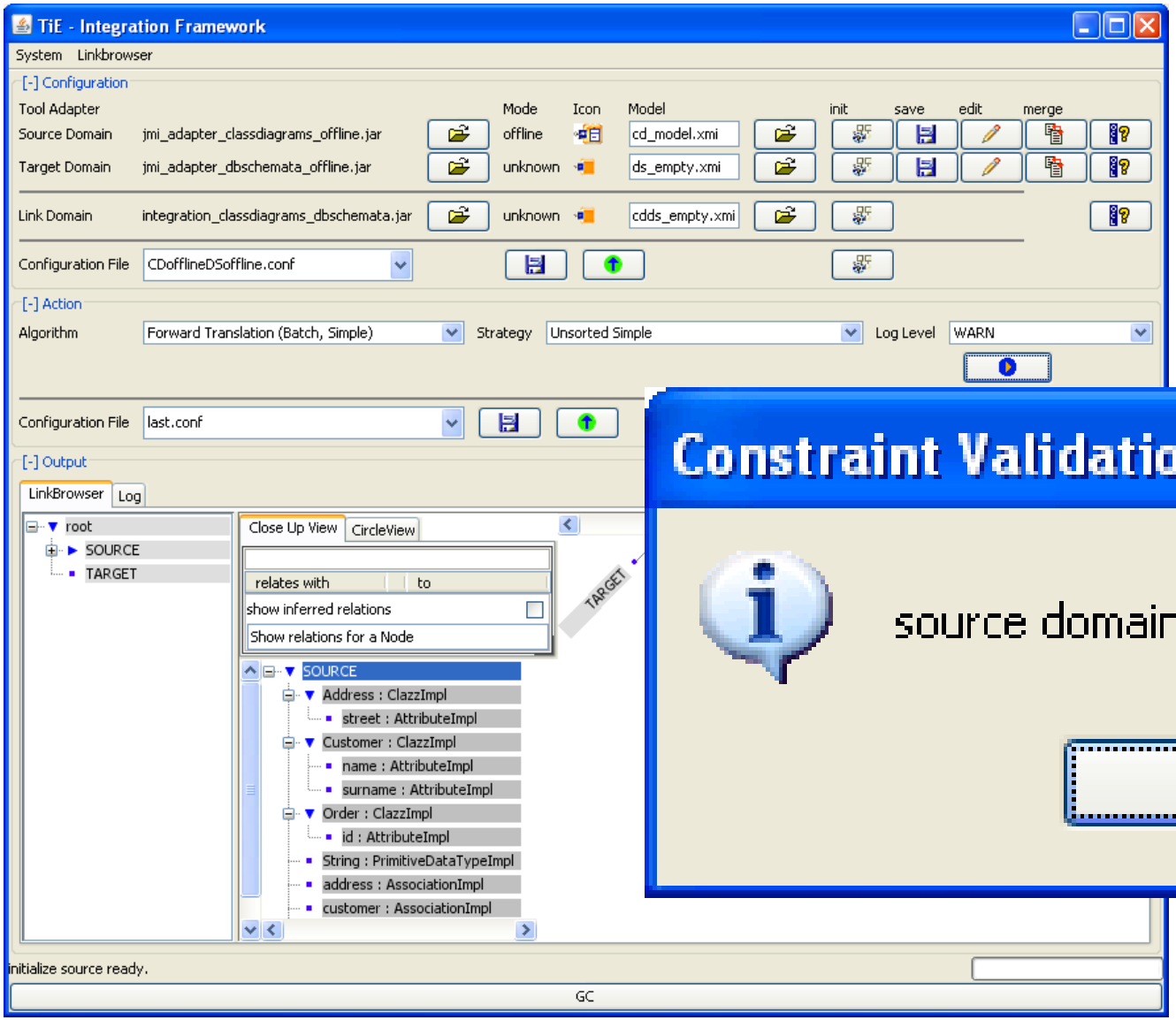
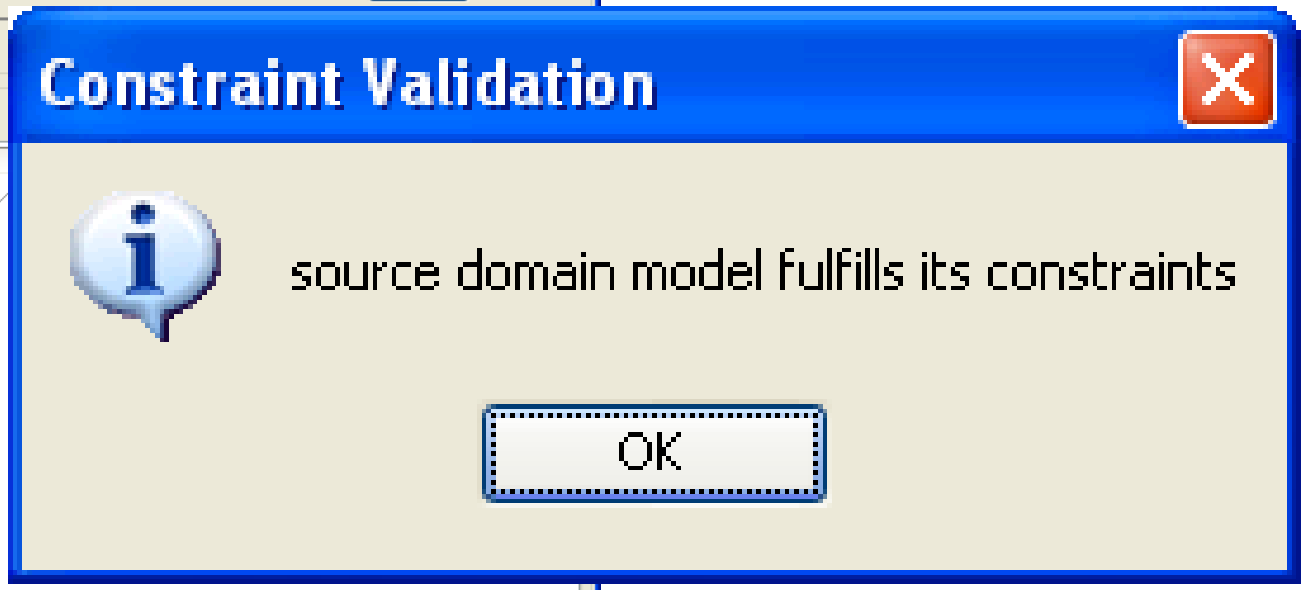
TiE-CD-DB – Constraints in Class Diagrams (4) Integration Framework



translation process may start now…



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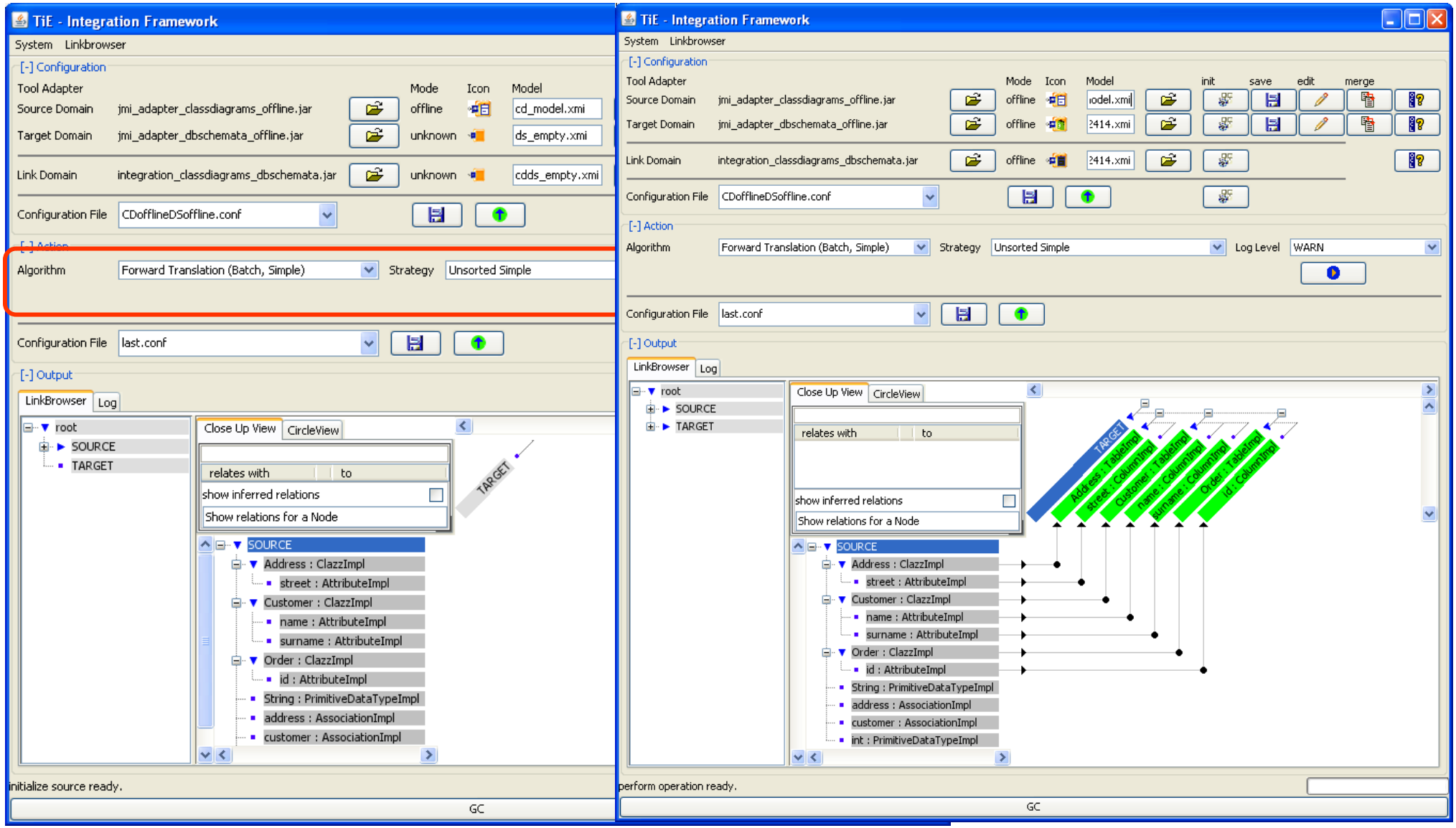
TiE-CD-DB – Constraints in Class Diagrams (5)
Forward Translation to DB representation



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Other Software Engineering Applications of Model Synchronization

- Mapping a PIM to a PSM in Model-Driven Architecture
- Graph Structurings (see course ST-II)
- Refactorings (see Course DPF)
- Semantic refinements
- Round-Trip Engineering (RTE)

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The End: What Have We Learned

- Graph rewrite systems are tools to transform graph-based models and graph-based program representations
- MOFLON supports OCL queries and constraints
- TGG enable to bidirectionally map models and synchronize them
- Why can a TGG also be called a *metamodel mapping grammar*?

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