Bidirectional Transformations & Triple Graph Grammars

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GRACE International Meeting on Bidirectional Transformations (14. – 18.12.2008)

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Model-Driven Software Development (Metamodeling & Model Transformations)

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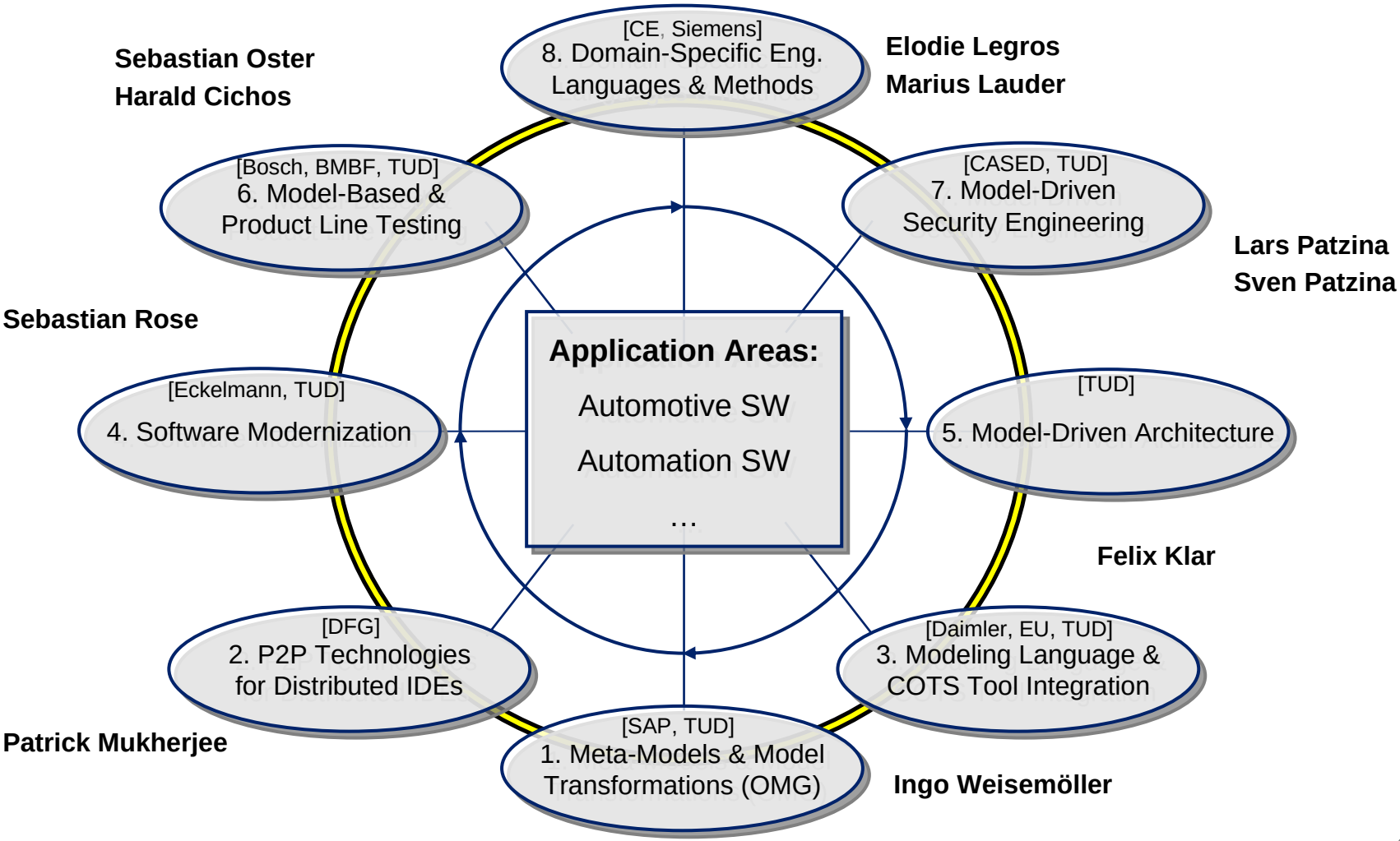

Model-Driven Software Development (Metamodeling & Model Transformations)

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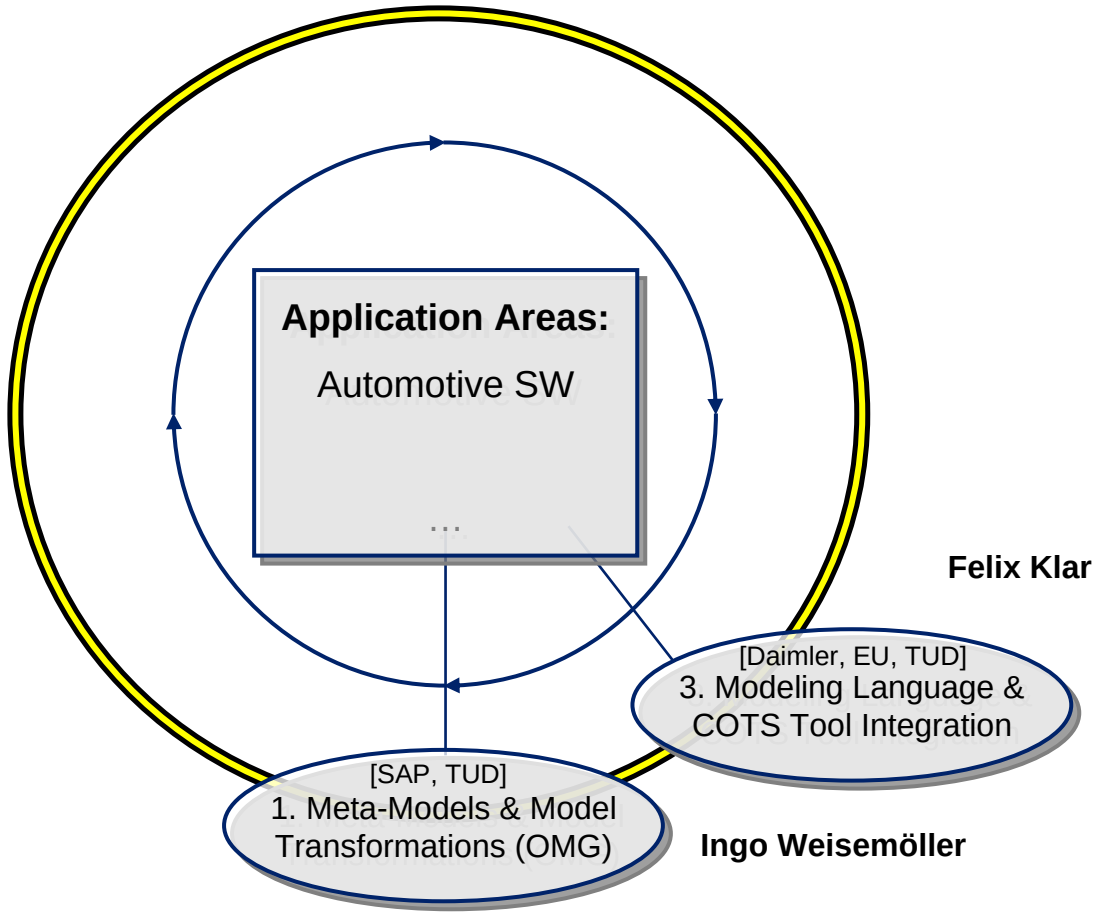

Automotive System Development

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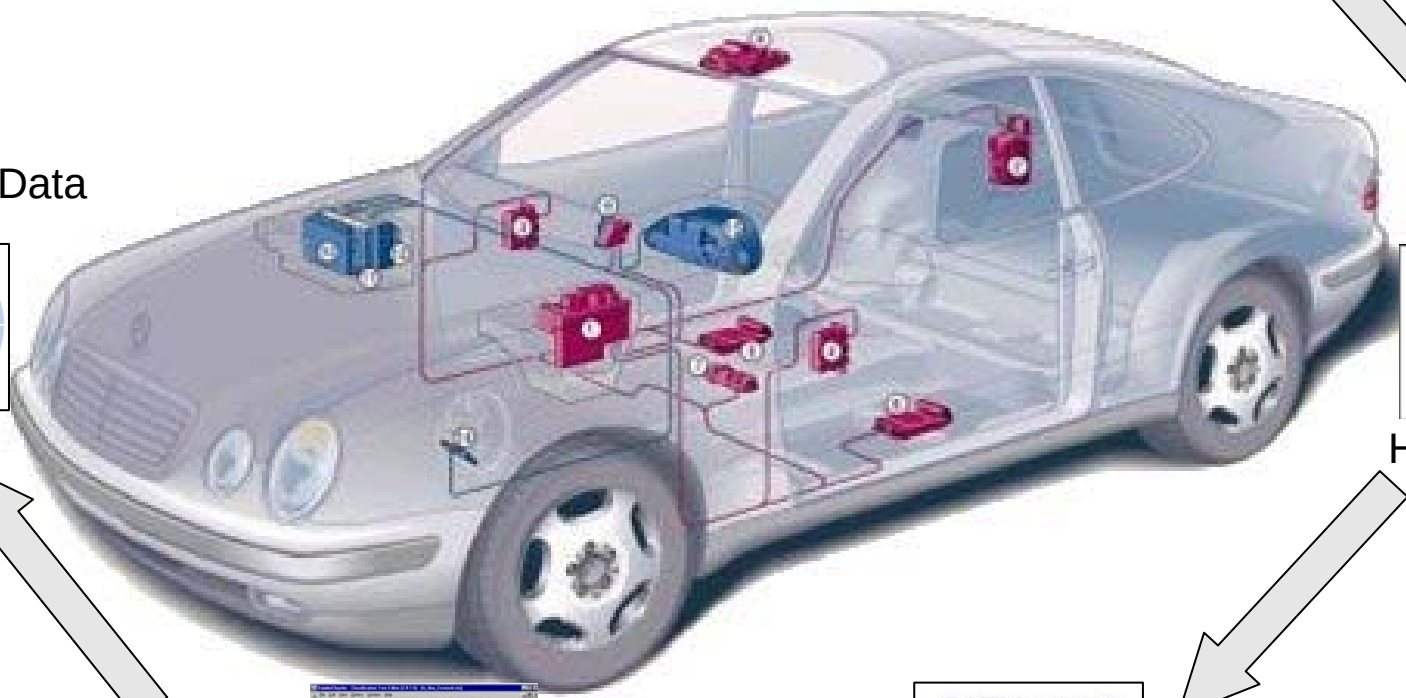
System Requirements (DOORS)

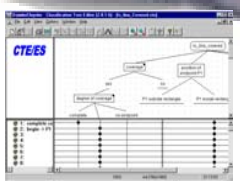
SW-Functionality

Product Data



HW-Design

ECU-Housing



Function Test

Tool Integration

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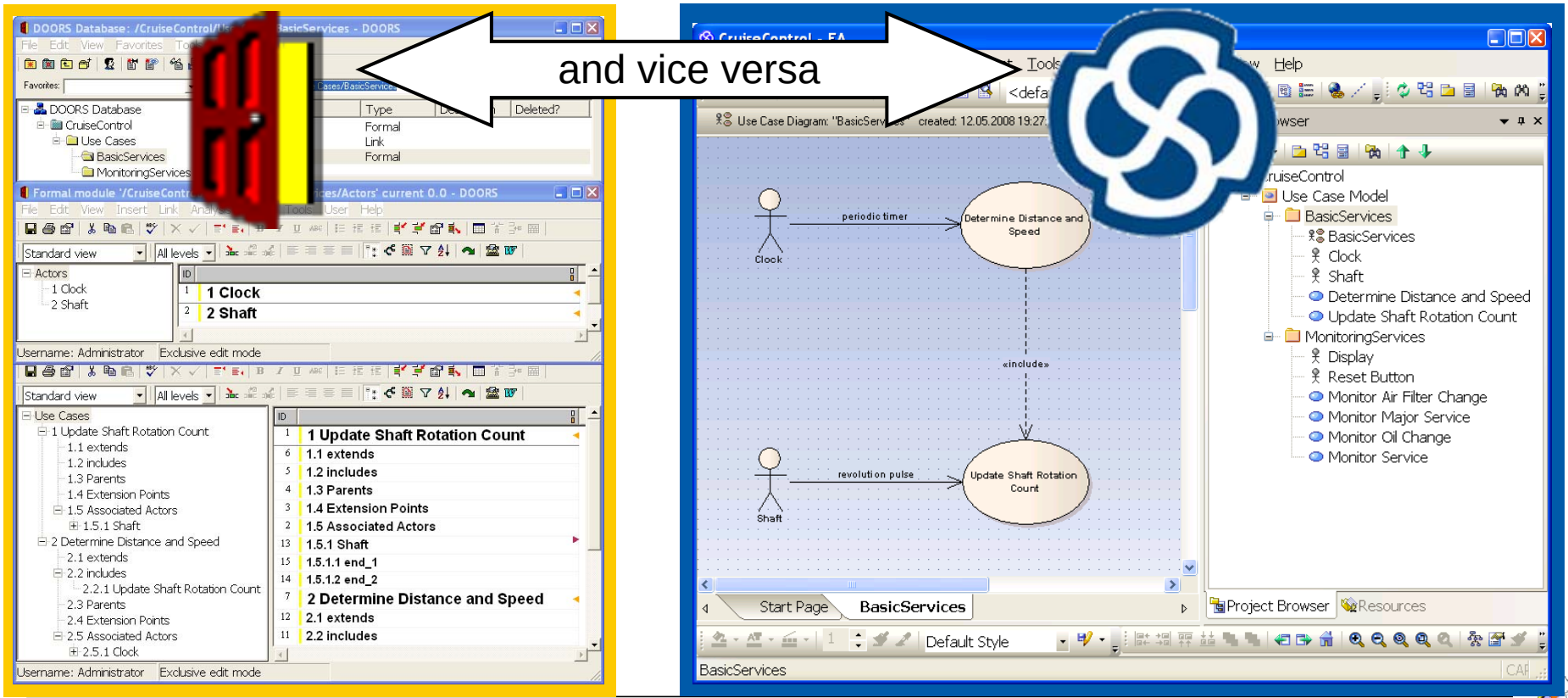
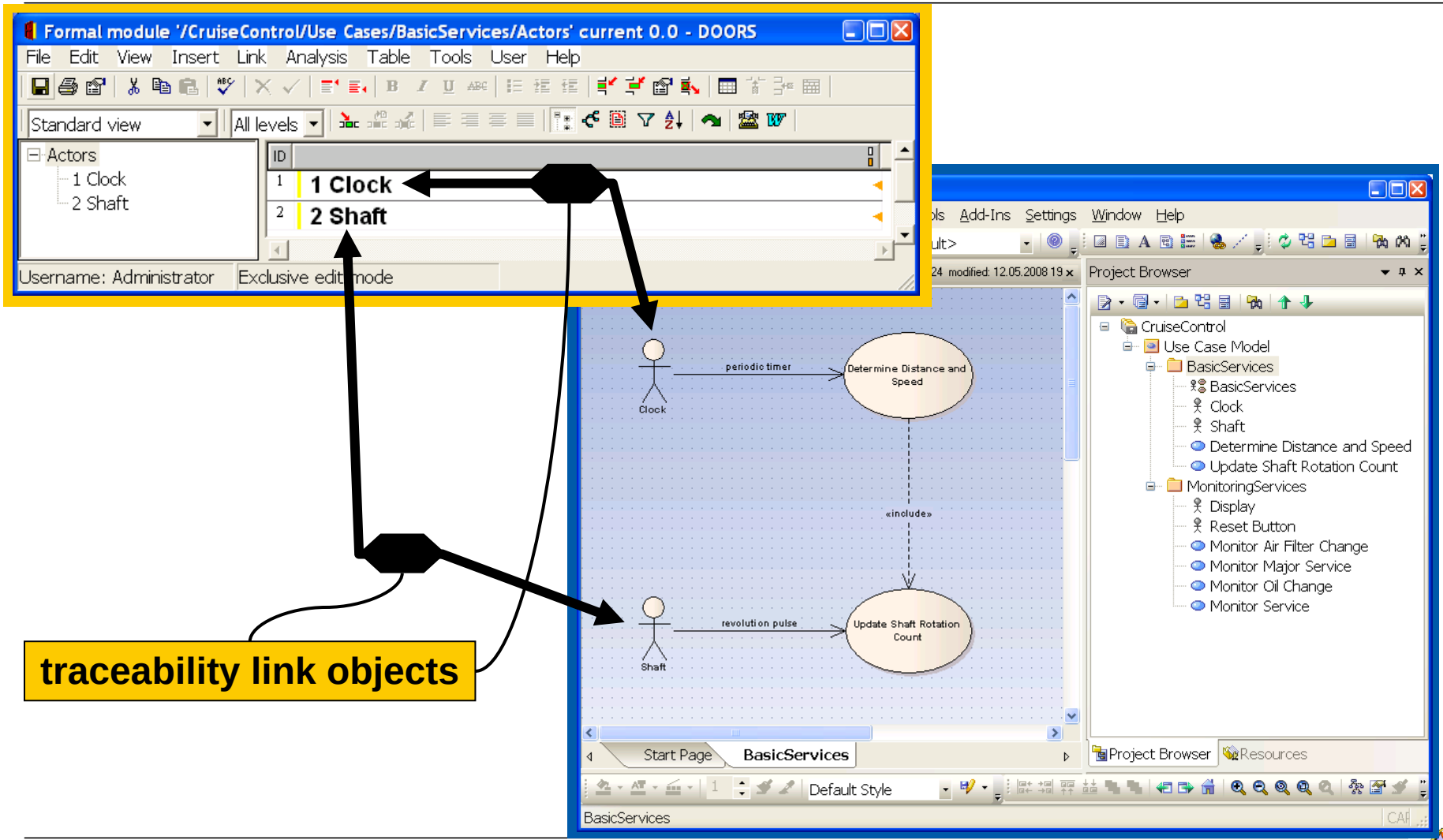
textual use case specification
in Telelogic DOORS ...

... should be translated into
graphical use case diagrams
in SparxSystems Enterprise Architect



Correspondence of Tool Elements



Integration Scenario Examples (1)

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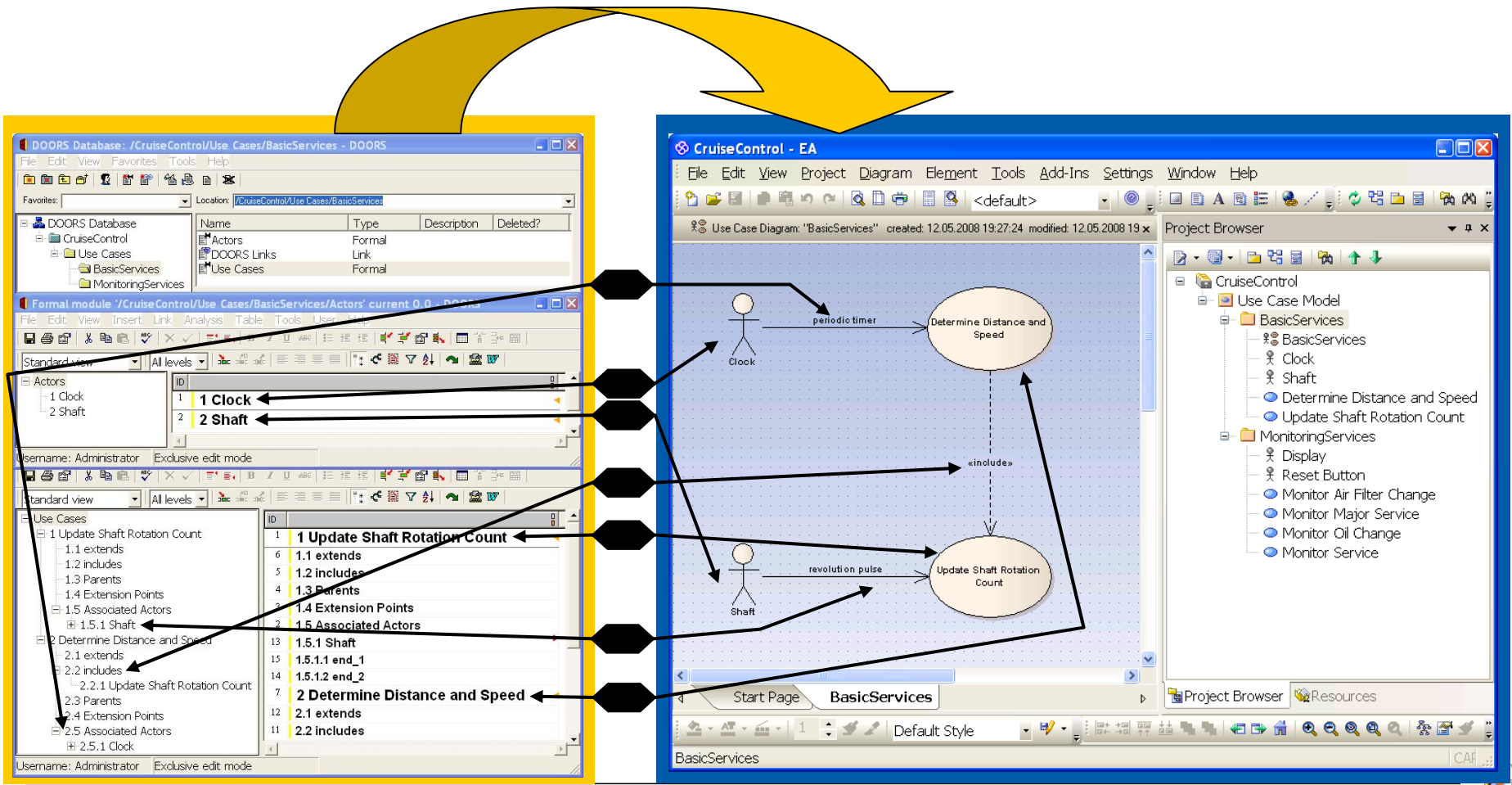
Forward Translation (DOORS → EA)



Integration Scenario Examples (2)

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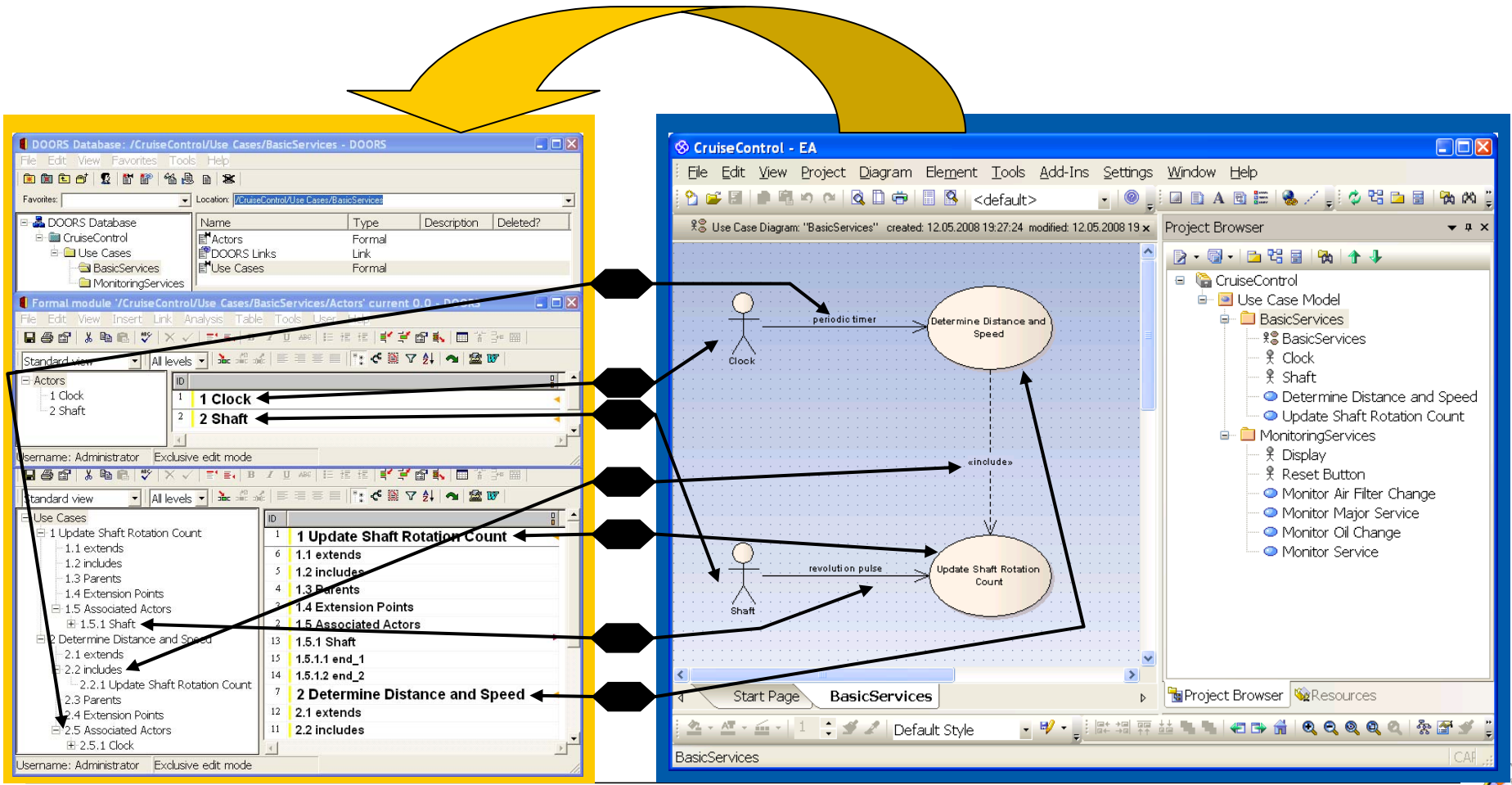
Backward Translation (DOORS ← EA)



OMG Standards + Graph Transformation (Metamodeling Language Family + Tools)

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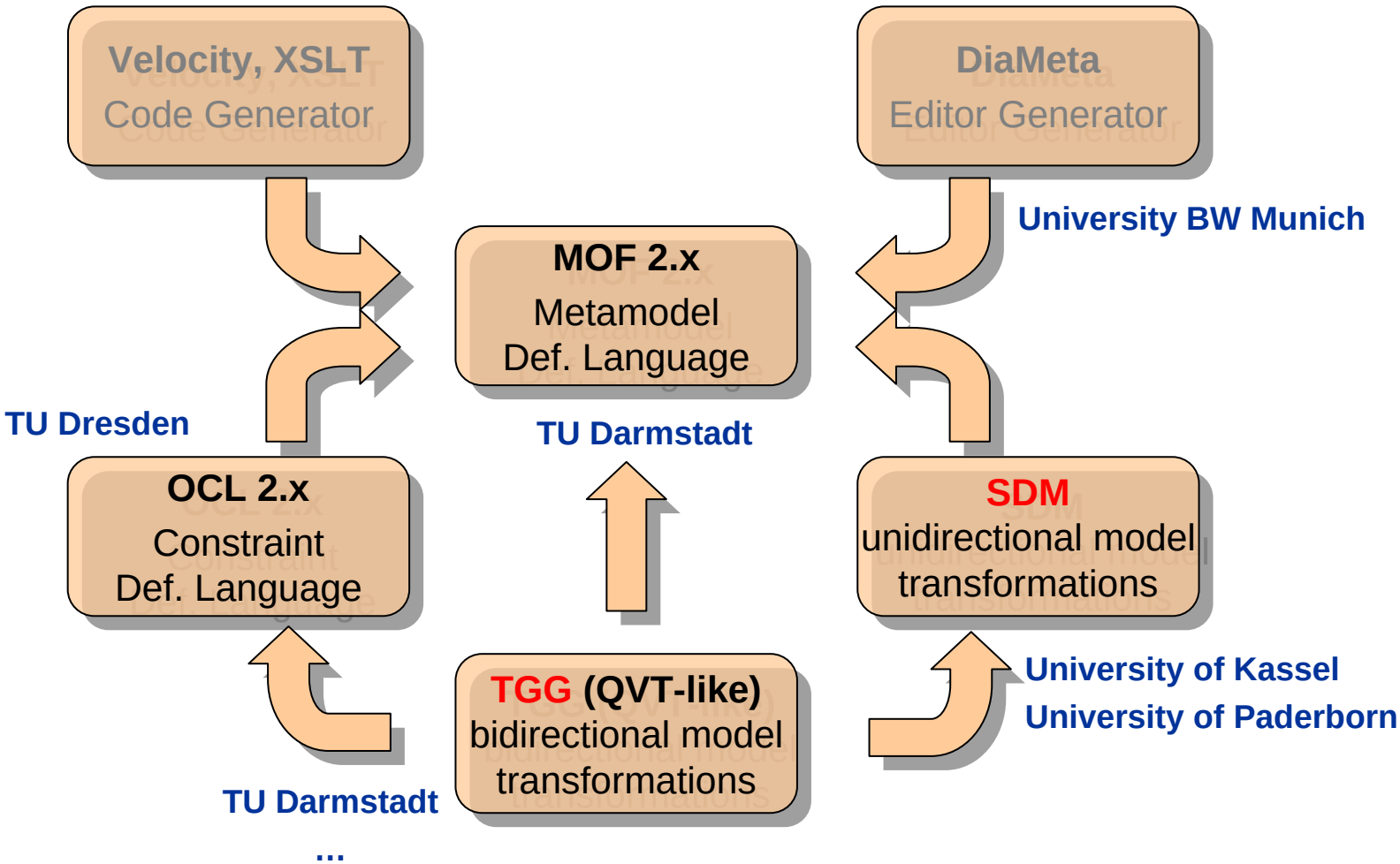

Terminology for Bidirectional Transformations

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Definition 1: Model Relations and Translations (adopted from P. Stevens, but simplified for this presentation)

M, N are sets of models representing all legal instances of related metamodels mm_M, mm_N.

1. $R \subset MxN$ is a model relation (mapping; declarative bidirectional TGG / QVT model transformation specification) with $(m,n) \in R$ representing pairs of consistent models

2. $\vec{R}: M \rightarrow N$ is a forward translation that implements R in one direction (transform; partial function implementing TGG / QVT spec.)
3. $\overleftarrow{R}: N \rightarrow M$ is a backward translation that implements R in one direction (transform; partial function implementing TGG / QVT spec.)

Characterization of Bidirectional …

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Useful properties (introd)used by

- Perdita Stevens
- Nate Foster
- Michal Antkiewicz & Krzysytof Czarnecki
- Juan de Lara
- Gabi Taentzer & Hartmut Ehrig
- …

of model relations (mappings) and translations (transforms)

- correctness (consistency)
- hippocraticness, undoability, invertibility
- totality, acceptability, stability, forgetfulness, bijectivity, …
- …

Definition of Correctness and … ?

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Definition 2: Correctness of Model Translations

A pair of model translations $\vec{R}: M \rightarrow N$ and $\overleftarrow{R}: N \rightarrow M$

is correct w.r.t. a given model relation $R \subset MxN$ iff

1. $\forall m \in M, n \in N: \vec{R}(m) = n \Rightarrow (m,n) \in R$
2. $\forall m \in M, n \in N: \overleftarrow{R}(n) = m \Rightarrow (m,n) \in R$

Definition 3: „Useless“ Completeness of Model Translations

A pair of model translations $\vec{R}: M \rightarrow N$ and $\overleftarrow{R}: N \rightarrow M$

is complete w.r.t. a given model relation $R \subset MxN$ iff :

1. $\forall m \in M, \forall n \in N: (m,n) \in R \Rightarrow \vec{R}(m) = n$
2. $\forall m \in M, \forall n \in N: (m,n) \in R \Rightarrow \overleftarrow{R}(n) = m$

Observations & Questions

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- How does a reasonable completeness definition of forward/backward translations look like?
- So far we have different candidates in mind!
- All TGG implementations are incomplete in the following sense: they are not always able to translate models with consistent counterparts!
- Are we able to characterize subsets of TGGs with complete forward/backward translation algorithms
- Do QVT implementations (and other declarative model transformation approaches) have similar drawbacks?

My Offers for this Workshop

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- **Tutorial (any length):**

  Triple Graph Grammars in a Nutshell

- **Presentation (as input for bidirectional transformation properties discussion):**

  Completeness of Model Relation Implementation (Completeness of Model Mapping Transforms)

  Guess: „our“ definition of „useful“ completeness
  definitions closely related to quotient lenses