Comparing BX Tools with Examples

FATBIT Workshop, Braga

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Motivation

- ***BX* Tools** comparisons are rare and lack **practical contexts**
- potential users need **common comparison criteria/scenarios**

assessment driven by **case studies**

=

pragmatic differentiation factor

Approach

- elaborate **case studies** (*Metamodel* + *Consistency Relation*)
- choose different ***BX* tools**
- assess tool **expressiveness** and **efficiency**
- assess transformations results against some **properties**

Some tools to assess

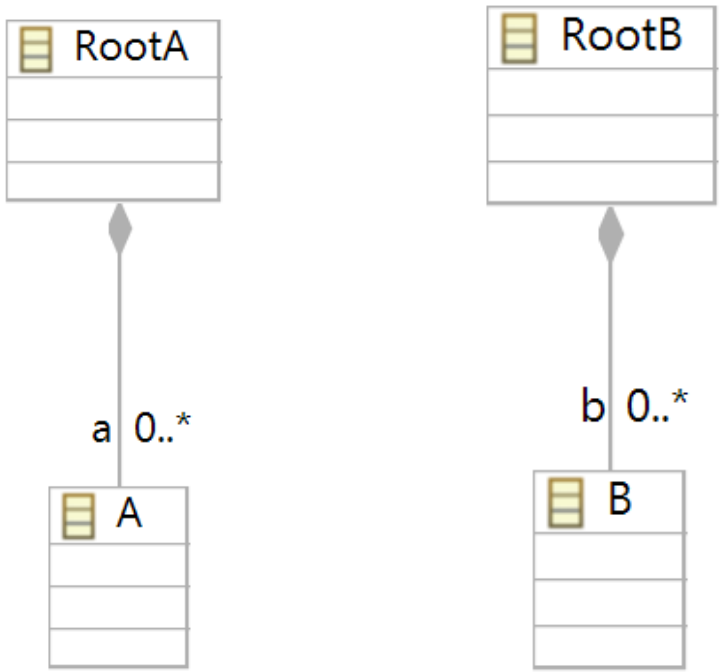
Tools

- ***eMoflon*** [4]
- ***echo*** [5]
- *GRoundTram* [6]
- *ModelMorf* [7]
- *Medini* [8]
- *focal* [9]

Properties

- ***correct*** [1] $\forall m \in M \ \forall n \in N \quad R(m, \overrightarrow{R}(m,n)) \ \wedge \ R(\overleftarrow{R}(m,n), n)$
- ***hippocratic*** [1] $\forall m \in M \ \forall n \in N \quad R(m,n) \implies \overrightarrow{R}(m,n) = n \ \wedge \ \overleftarrow{R}(m,n) = m$
- *undoable* [2]
- *history-ignorant* [2]
- *simply-matching* [2]
- *matching* [2]
- *least-change* [3]

Bijection - Metamodel



(a) M (b) N

Figure: Metamodels

Bijection - **Consistency Relation**

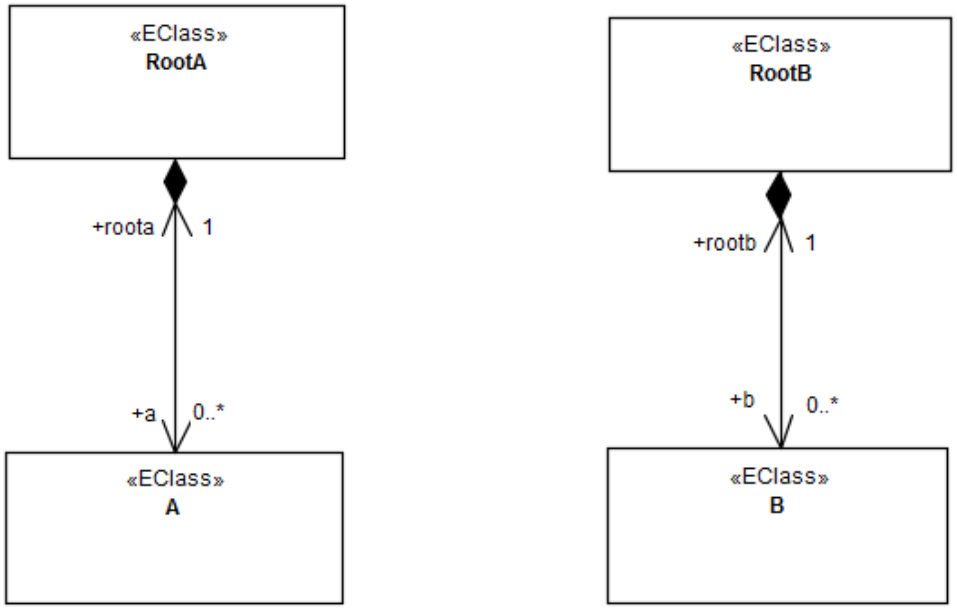
Type: Bijection (Total Deterministic (*TD*)) - *one* <> *one*
For every *M* instance there exists exactly one *N* instance such that both are related by *R* (and vice versa).

	injective	entire	simple	surjective
R	✓	✓	✓	✓

Definition
For every *A* in *RootA* there exists **exactly one** *B* in *RootB* (and vice versa).

Bijection - **Metamodel** - ***eMoflon***

Specification environment: *Enterprise Architect*



(a) *M* (b) *N*

Figure: Metamodels modelled as *EA Ecore Diagrams*

Bijection - **Consistency Relation** - *eMoflon*

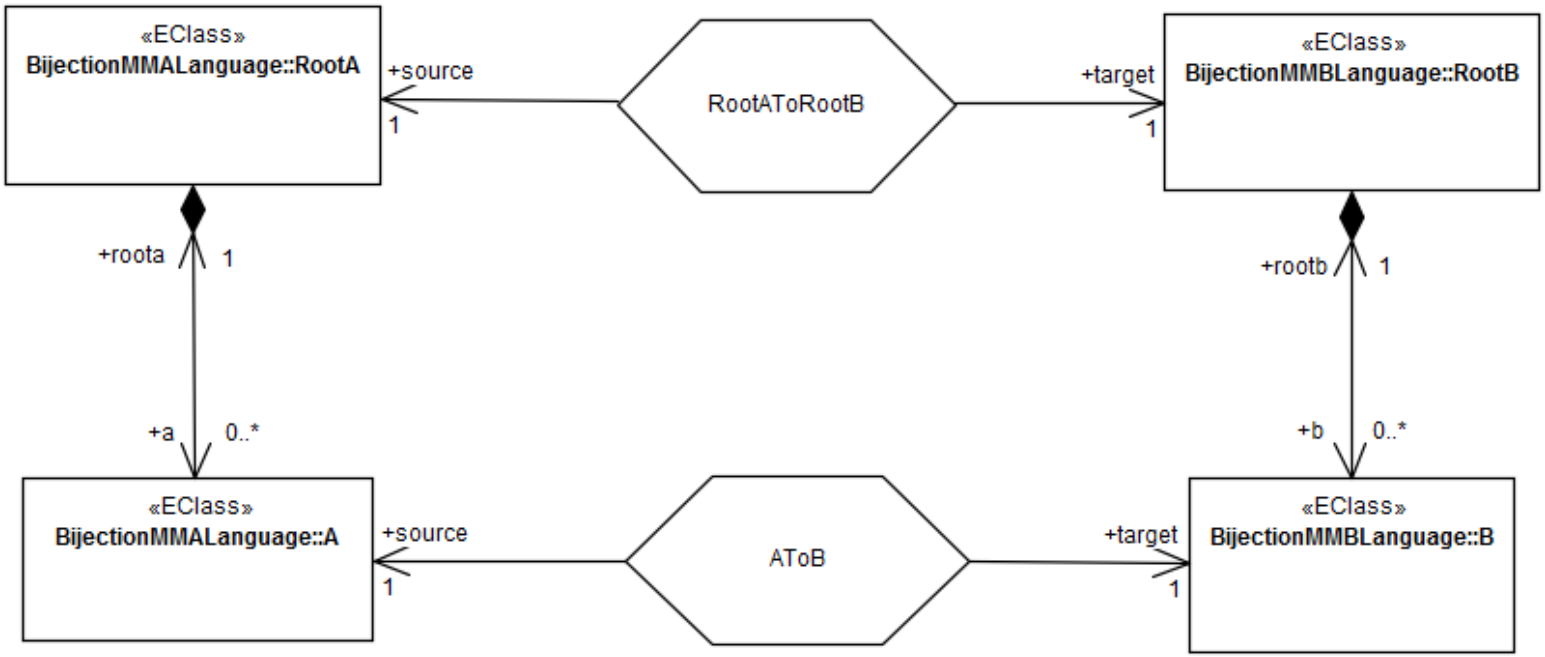


Figure: *TGG Schema Diagram*

Bijection - **Consistency Relation** - *eMoflon*

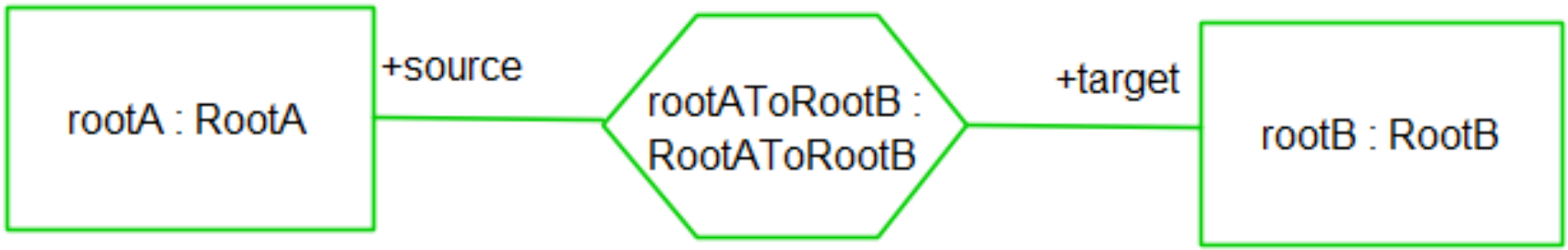


Figure: *TGG Rule Diagram* - RootAToRootB

Bijection - **Consistency Relation** - *eMoflon*

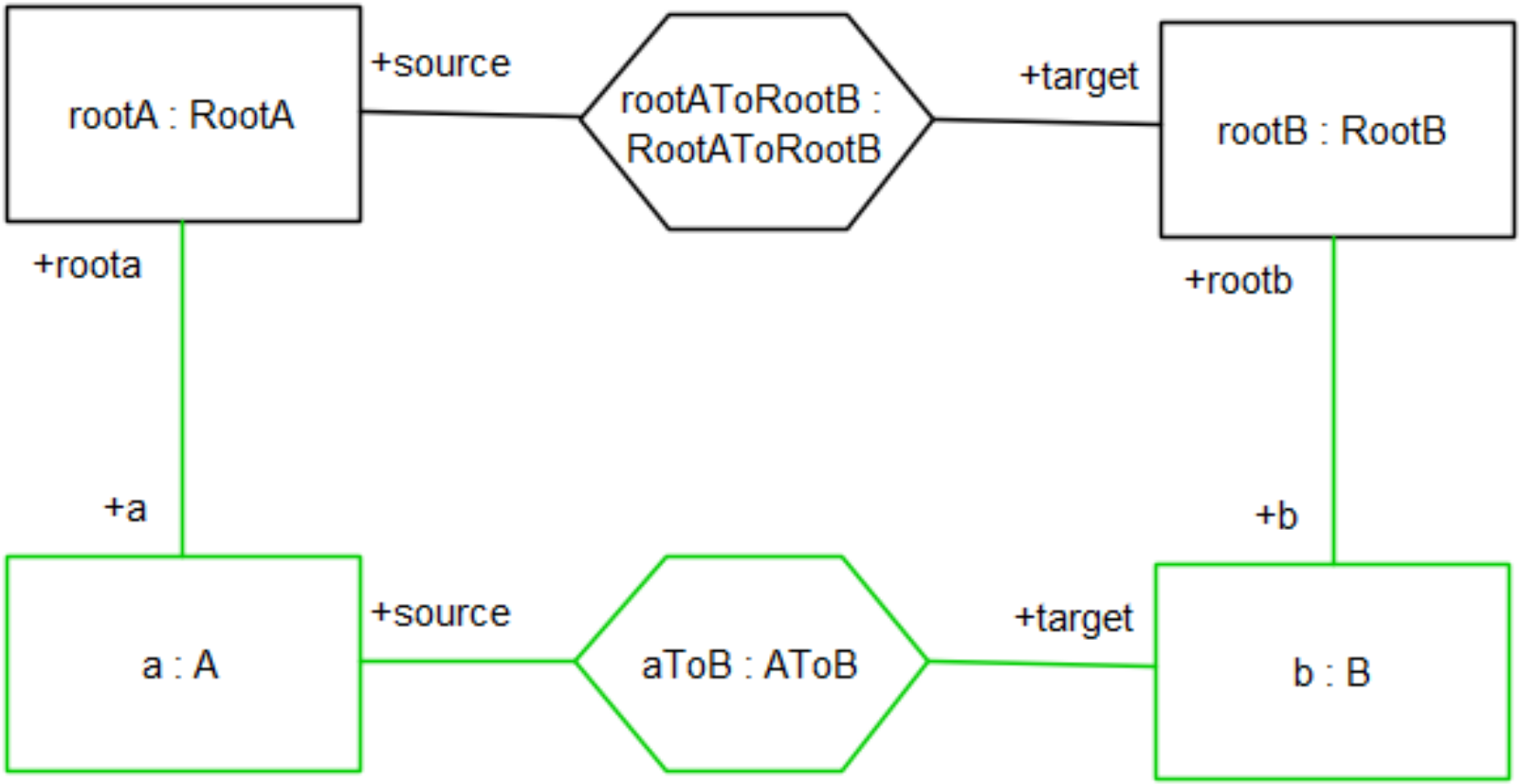
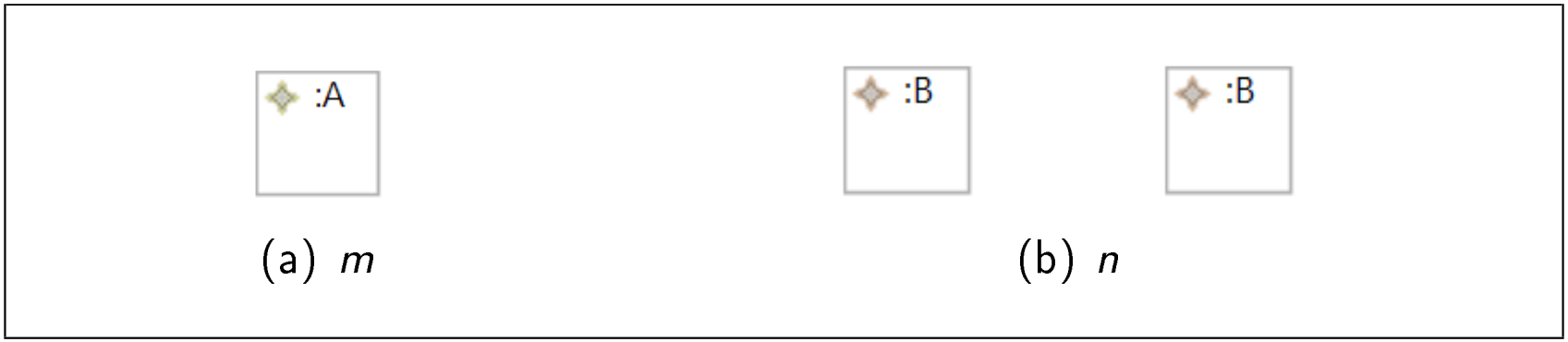


Figure: *TGG Rule Diagram* - AToB

Bijection - **Transformations** - *eMoflon*

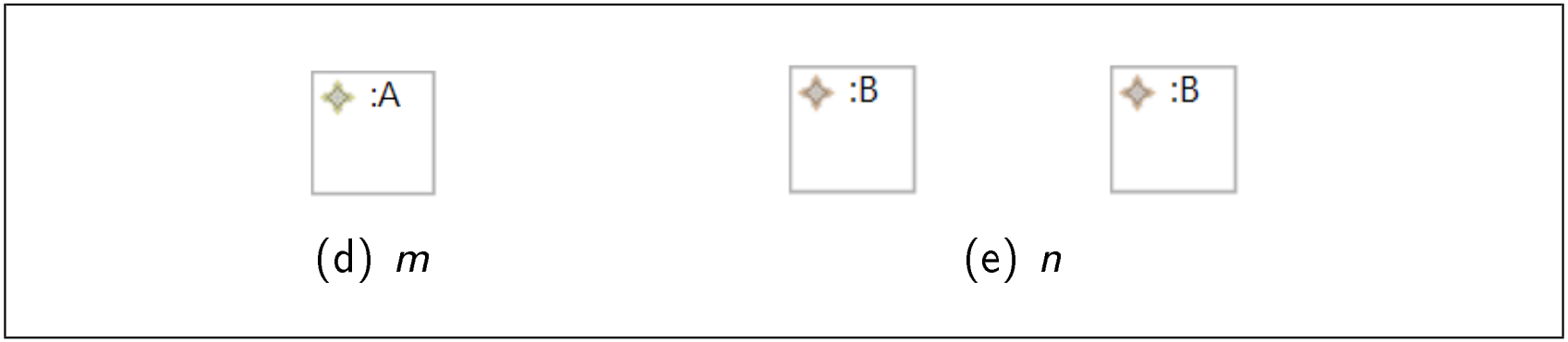


(a) m (b) n

$\overrightarrow{R}$

(c) n'

Bijection - Transformations - *eMoflon*



(d) m (e) n

$\overleftarrow{R}$

(f) m'

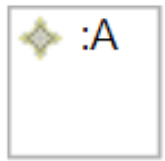
Bijection - **Transformations** - *eMoflon*

(g) m (h) n

$\overrightarrow{R}$

(i) n'

Bijection - **Transformations** - *eMoflon*

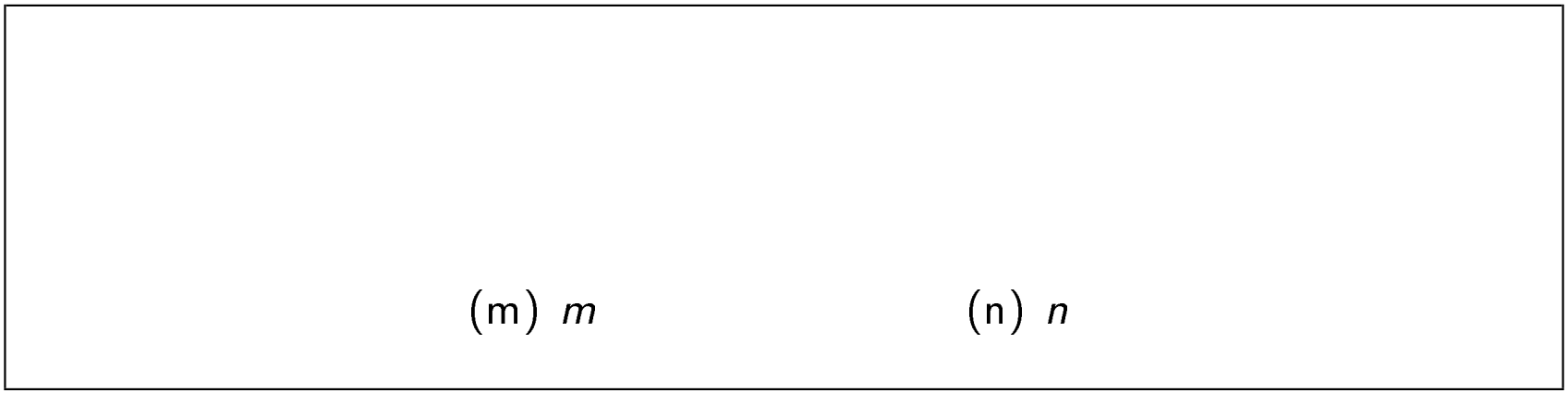


(j) m (k) n

$\overrightarrow{R}$

(l) n'

Bijection - **Transformations** - *eMoflon*



$\overrightarrow{R}$

(o) n'

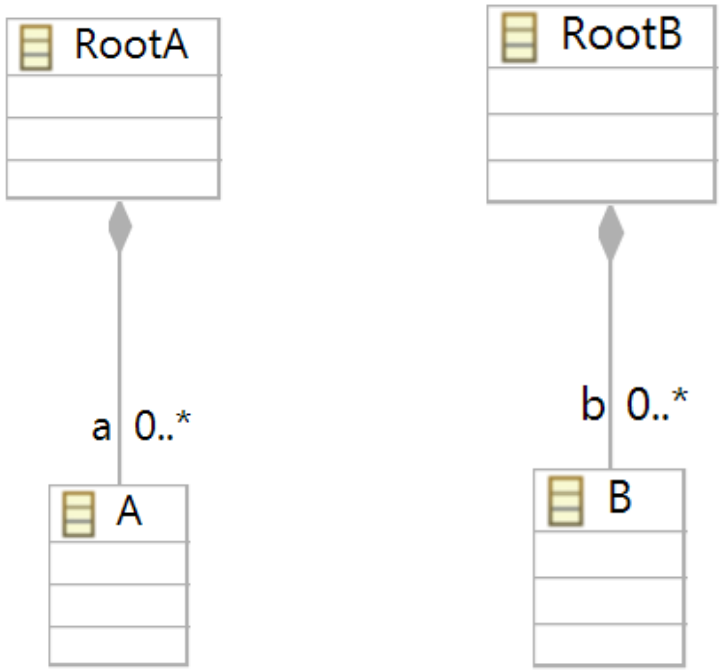
Bijection - **Assessment** - *eMoflon*

For **the previous test instances in particular** the tool was:

correct	✓
hippocratic	✓

Bijection - **Metamodel** - ***echo***

Specification environment: *Eclipse Modeling Tools*



(p) M (q) N

Figure: Metamodels

Bijection - Consistency Relation - *echo*

```
transformation a2b (as : A, bs : B) {
  top relation R2R {
    domain as ra:RootA {};
    domain bs rb:RootB {};
    where { ra.as->size() = rb.bs->size(); } // not suitable QVT
  }
}
```

Bijection - **Transformations** - ***echo***

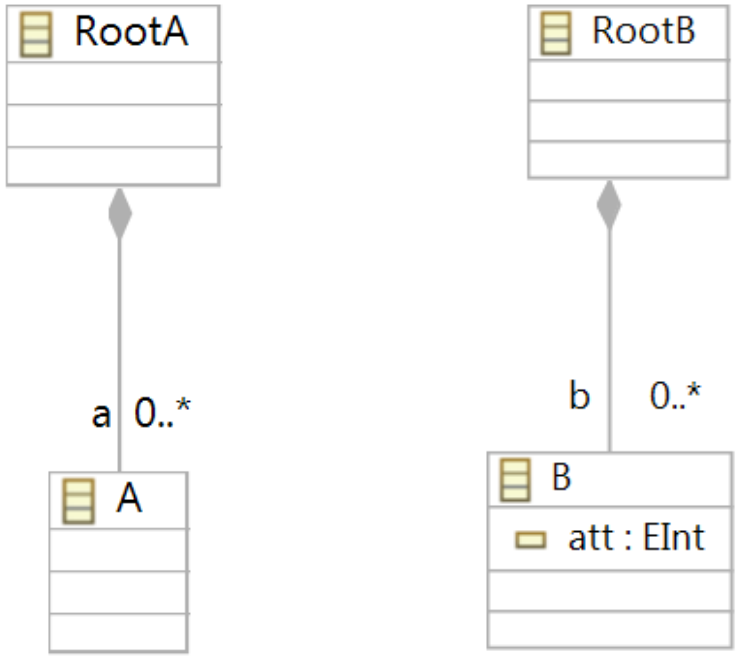
same results as with eMoflon

Bijection - **Assessment** - ***echo***

For **the previous test instances in particular** the tool was:

correct	✓
hippocratic	✓

uniNDTotal - Metamodel



(a) M (b) N

Figure: Metamodels

uniNDTotal - **Consistency Relation**

Type: *Non Deterministic (only unidirectionally) Total (uniNDTotal) - one <> some*

For every M instance there exists **one** N instance such that both are related by R;
For every N instance there exists **exactly one** M instance such that both are related by R.

	injective	entire	simple	surjective
R	✓	✓	X	✓

Definition

For every A in *RootA* there exists **one** B in *RootB*;
For every B in *RootB* there exists **exactly one** A in *RootA*.

uniNDTotal - **Metamodel** - *eMoflon*

Specification environment: *Enterprise Architect*

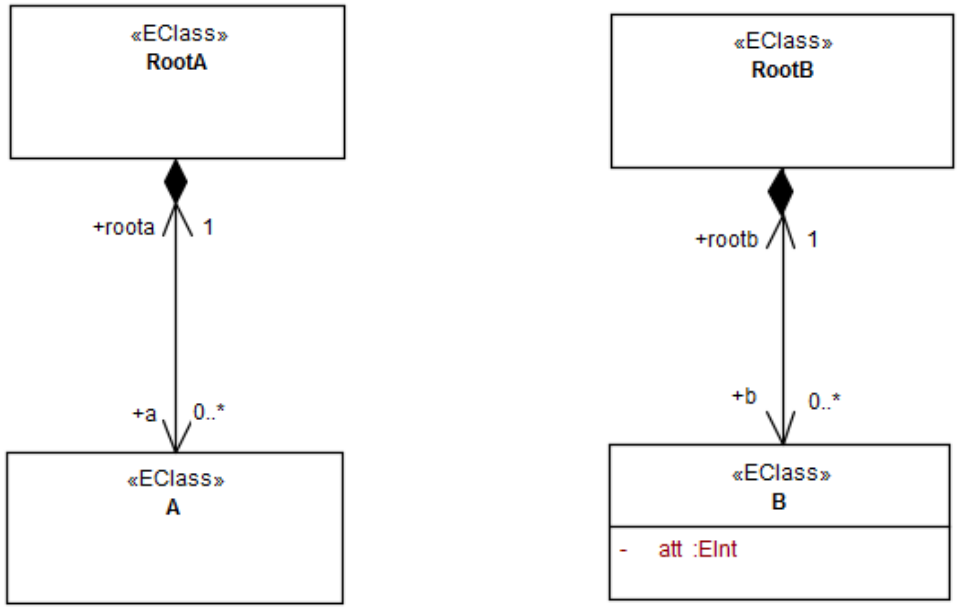


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Figure: Metamodels modelled as *EA Ecore Diagrams*

uniNDTotal - **Consistency Relation** - *eMoflon*

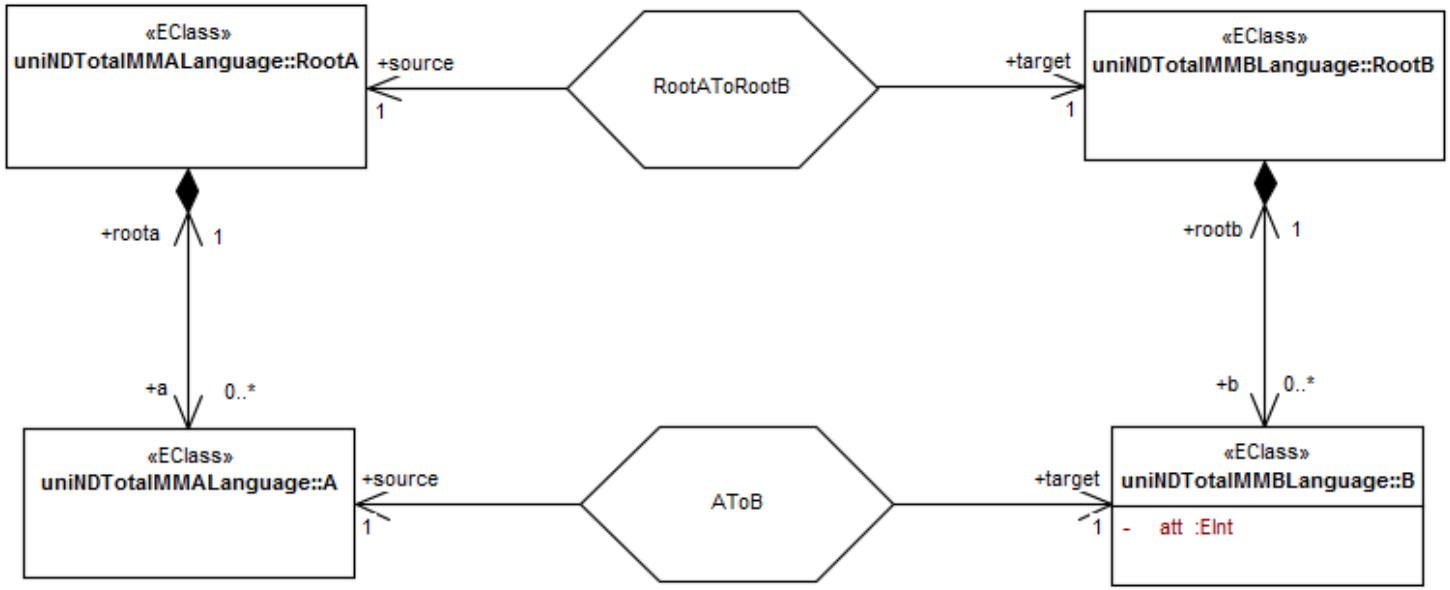
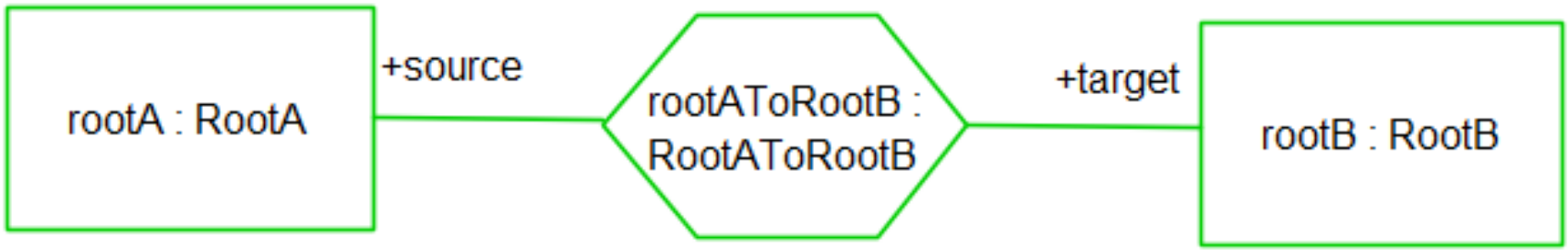


Figure: *TGG Schema Diagram*

uniNDTotal - **Consistency Relation** - *eMoflon*



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uniNDTotal - **Consistency Relation** - *eMoflon*

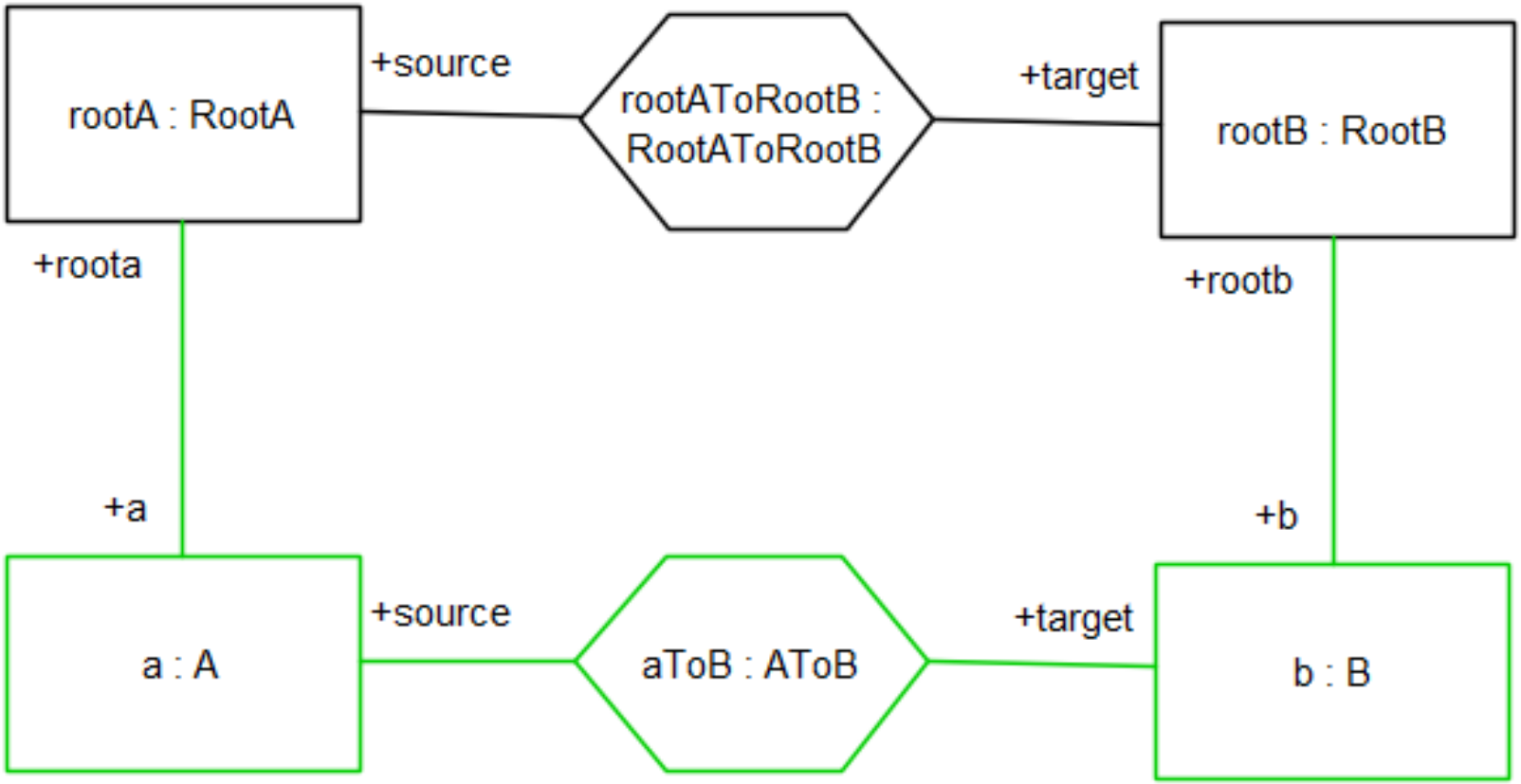
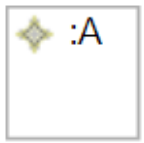


Figure: *TGG Rule Diagram* - AToB

uniNDTotal - **Transformations** - *eMoflon*



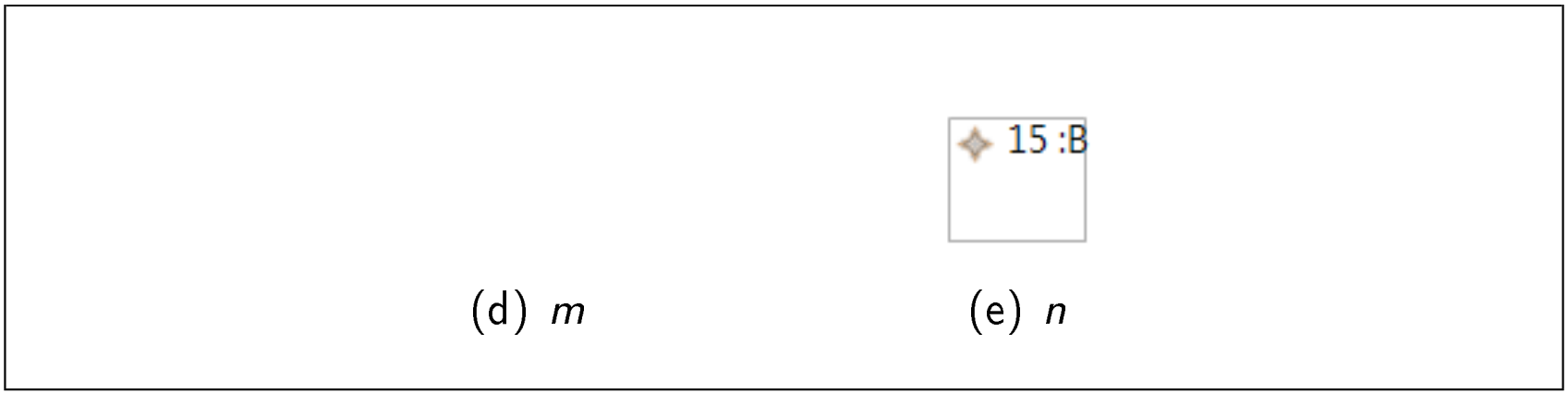
(a) m

(b) n

$\overrightarrow{R}$

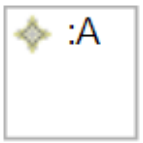
(c) n'

uniNDTotal - **Transformations** - *eMoflon*



(d) m (e) n

$\overleftarrow{R}$



(f) m'

uniNDTotal - **Transformations** - *eMoflon*

(g) m (h) n

$\overrightarrow{R}$

(i) n'

uniNDTotal - **Assessment** - *eMoflon*

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uniNDTotal - **Metamodel** - ***echo***

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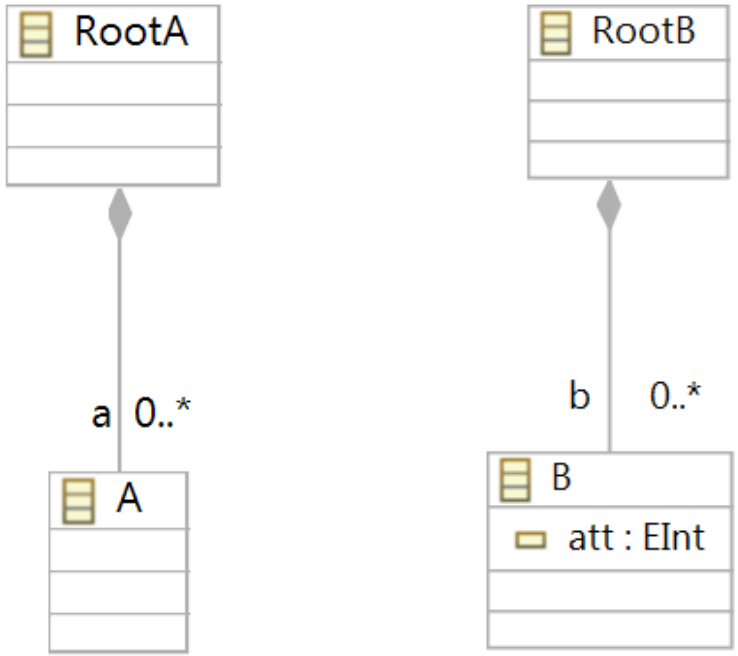

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Figure: Metamodels

uniNDTotal - Consistency Relation - *echo*

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  }
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```

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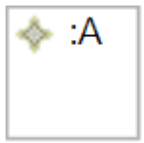


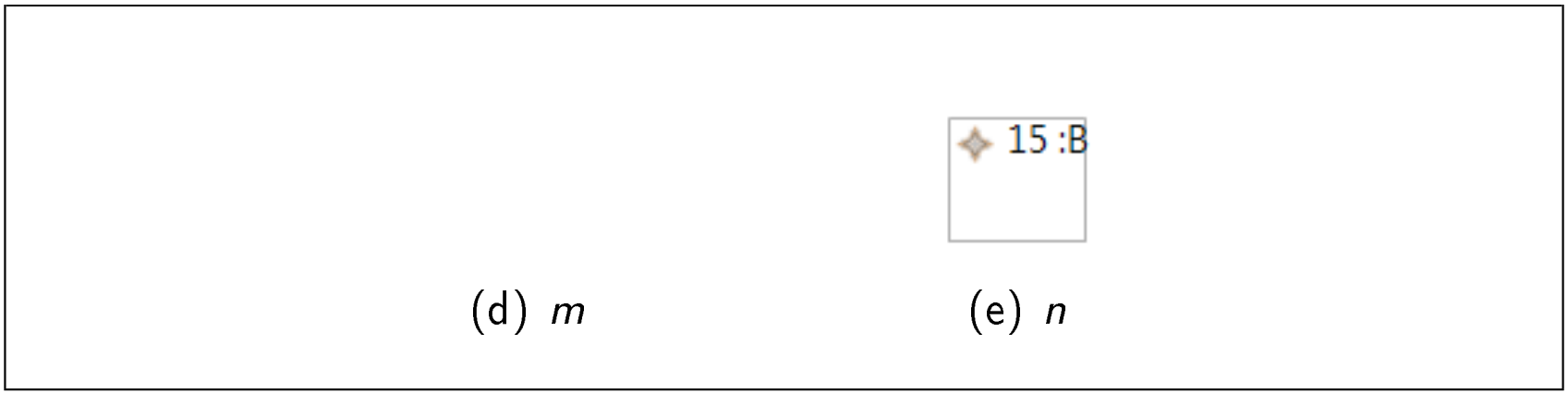
(a) m

(b) n

$\overrightarrow{R}$

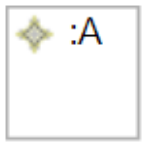
(c) n'

uniNDTotal - **Transformations** - *echo*



(d) m (e) n

$\overleftarrow{R}$



(f) m'

uniNDTotal - **Transformations** - *echo*

(g) m (h) n

$\overrightarrow{R}$

(i) n'

uniNDTotal - **Assessment** - ***echo***

For **the previous test instances in particular** the tool was:

correct	✓
hippocratic	✓

References

Stevens, Perdita. "Bidirectional model transformations in QVT: Semantic issues and open questions." Model Driven Engineering Languages and Systems. Springer Berlin Heidelberg, 2007. 1-15.

Stevens, Perdita. "Observations relating to the equivalences induced on model sets by bidirectional transformations." Electronic Communications of the EASST 49 (2012).

Macedo, Nuno, and Alcino Cunha. "Implementing QVT-R bidirectional model transformations using Alloy." Fundamental Approaches to Software Engineering. Springer Berlin Heidelberg, 2013. 297-311.

eMoflon - `http://www.moflon.org/`

echo - `https://github.com/haslab/echo`

GRoundTram - `http://www.biglab.org/`

ModelMorf - `http://www.tcs-trddc.com/`

medini QVT - `http://projects.ikv.de/qvt`

focal - `https://alliance.seas.upenn.edu/~harmony/old/`