

# 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** [3]
- **echo** [4]
- GRoundTram [5]
- *ModelMorf* [6]
- *Medini* [7]
- *focal* [8]

### Properties

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

# Bijection - Metamodel

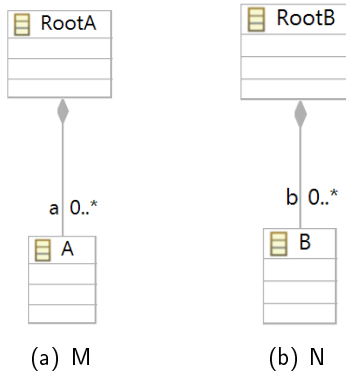


Figure: Metamodels

## Bijection - Consistency Relation

**Type:**  $TD$  (Bijection)

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*

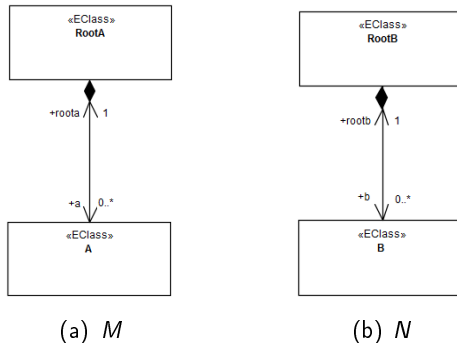


Figure: Metamodels modelled as *EA Ecore Diagrams*

## Bijection - Consistency Relation - *eMoflon*

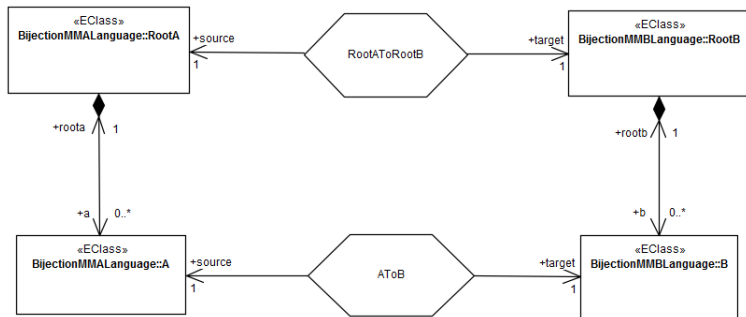


Figure: TGG Schema Diagram



## Bijection - Consistency Relation - *eMoflon*

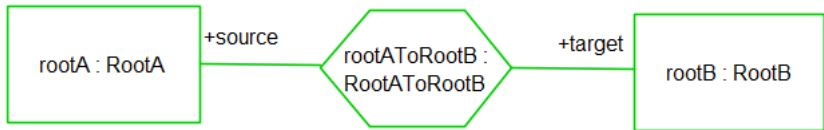


Figure: *TGG Rule Diagram - RootAToRootB*

## Bijection - Consistency Relation - *eMoflon*

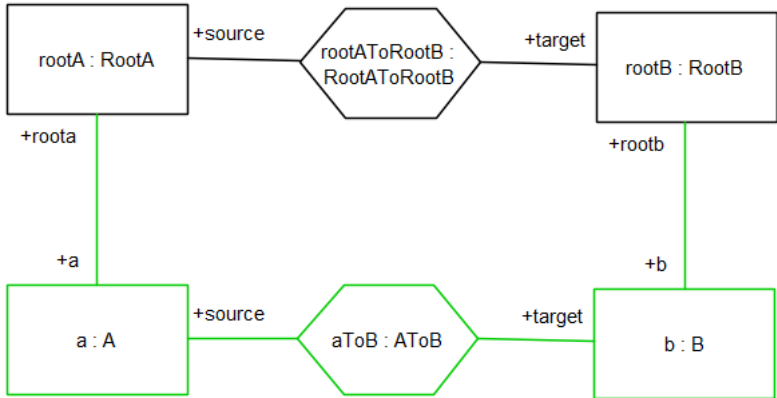


Figure: TGG Rule Diagram - AToB

# Bijection - Transformations - *eMoflon*



(a)  $m$



(b)  $n$

$\vec{R}$



(c)  $m$



(d)  $n$

## Bijection - Transformations - *eMoflon*



(e)  $m$



(f)  $n$

$\overleftarrow{R}$



(g)  $m$



(h)  $n$

# Bijection - Transformations - *eMoflon*



(i)  $m$



(j)  $n$



$\vec{R}$



(k)  $m$



(l)  $n$



# Bijection - Transformations - *eMoflon*



(m)  $m$

(n)  $n$

$\xrightarrow{R}$



(o)  $m$



(p)  $n$

# Bijection - Transformations - *eMoflon*

(q)  $m$

(r)  $n$

$\xrightarrow{R}$

(s)  $m$

(t)  $n$

# Bijection - **Assessment** - *eMoflon*

correct	✓
hippocratic	✓



## Bijection - Metamodel - *echo*

*Specification environment: Eclipse Modeling Tools*

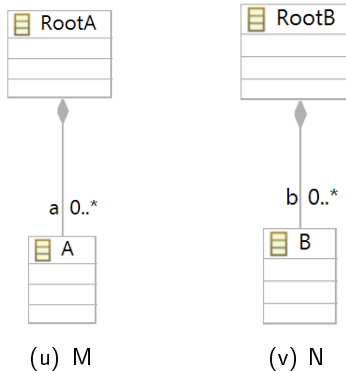


Figure: Metamodels

# 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 standard QVT
  }
}
```

# Bijection - Transformations - *echo*

*same results*

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

correct	✓
hippocratic	✓

## uniNDTotal - Metamodel

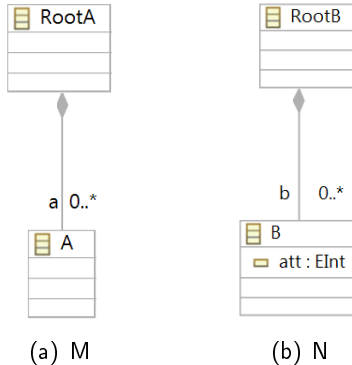


Figure: Metamodels

## uniNDTotal - Consistency Relation

**Type:** *uniNDTotal*,  $one \leftrightarrow some$

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*

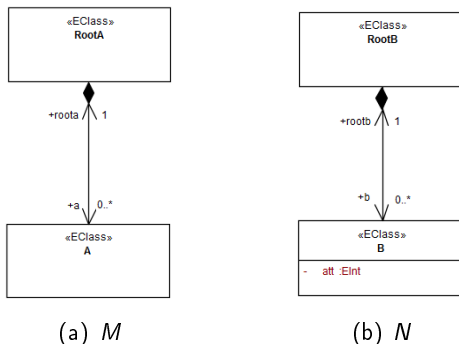


Figure: Metamodels modelled as *EA Ecore Diagrams*

## uniNDTotal - Consistency Relation - *eMoflon*

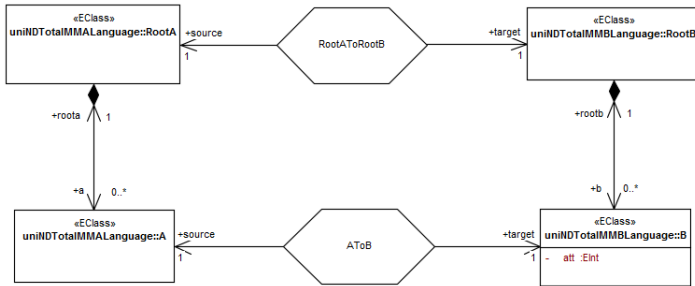


Figure: TGG Schema Diagram



## uniNDTotal - Consistency Relation - *eMoflon*

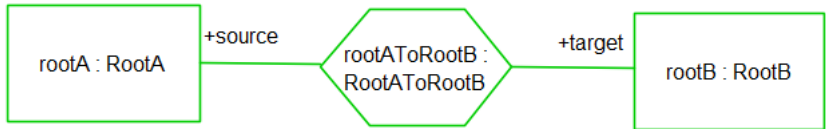


Figure: *TGG Rule Diagram - RootAToRootB*

## uniNDTotal - Consistency Relation - *eMoflon*

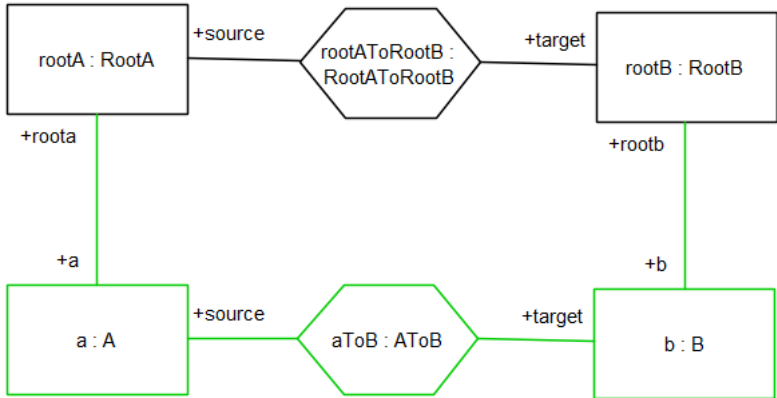


Figure: TGG Rule Diagram - AToB

# uniNDTotal - Transformations - *eMoflon*



(a)  $m$



(b)  $n$

$\xrightarrow{R}$



(c)  $m$



(d)  $n$

# uniNDTotal - Transformations - *eMoflon*

(e)  $m$



(f)  $n$

$\xleftarrow{R}$



(g)  $m$



(h)  $n$

# uniNDTotal - Transformations - *eMoflon*



(i)  $m$



(j)  $n$

$\xrightarrow{R}$



(k)  $m$



(l)  $n$

# uniNDTotal - **Assessment** - *eMoflon*

correct	✓
hippocratic	X

## uniNDTotal - Metamodel - *echo*

*Specification environment: Eclipse Modeling Tools*

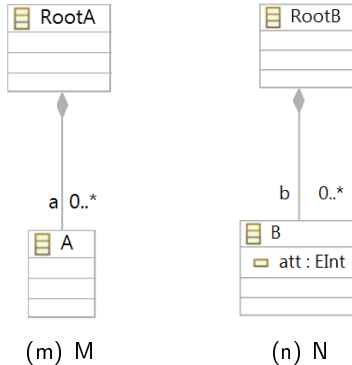


Figure: Metamodels

## uniNDTotal - 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(); }  
  }  
}
```



# uniNDTotal - Transformations - *echo*



(a)  $m$



(b)  $n$

$\xrightarrow{R}$



(c)  $m$



(d)  $n$

# uniNDTotal - Transformations - *echo*

(e)  $m$



(f)  $n$

$\overleftarrow{R}$



(g)  $m$



(h)  $n$

# uniNDTotal - Transformations - *echo*



(i)  $m$



(j)  $n$

$\xrightarrow{R}$



(k)  $m$



(l)  $n$

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

correct	✓
hippocratic	✓

## References



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/>