

## Template Based MDE

Matthieu Allon

Motivation

Model reuse :  
Main issues

State-of-the-art

Model reuse in MDE  
Sharing models for reuse

Team  
Contributions

Aspectual Template

Proposition  
Template Based MDE  
Planning

Questions

# Template Based MDE

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First year PHD Student - CAMEL Team

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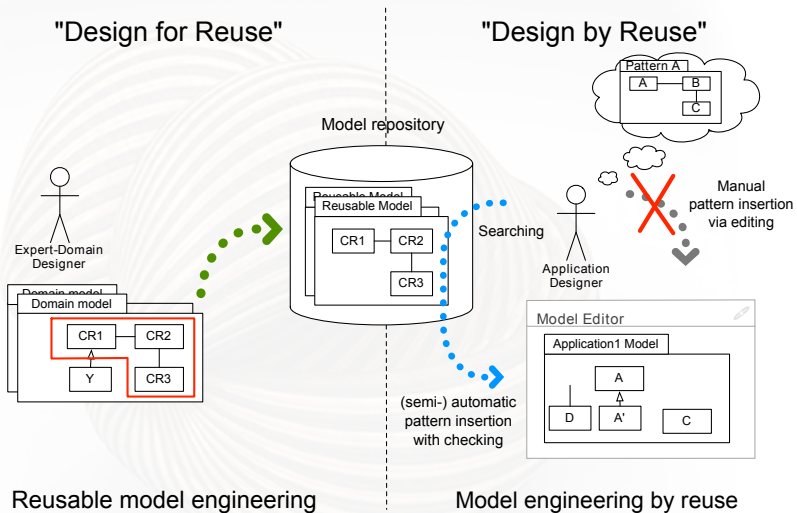
Reuse is a main challenge of software engineering :

- Mainly investigated for code reuse and binary components
- Also a challenge in MDE :
  - Models as “components”
  - System design by model assembly

Objectives of model reuse :

- Improve productivity and reliability during design
- Capitalization of business know-how, software knowledge (patterns)...
- Allow collaborative modeling

# Model reuse



# Model reuse : Main issues

- How to design reusable models ?
  - Specific forms, ingredients ?
- How to use reusable models ?
  - Which operators for their adaptation, composition ?
- How to share these models ?
  - Libraries, Models “off-the-shelf”, Repositories
- How to find these models efficiently ?

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# Reuse in MDE

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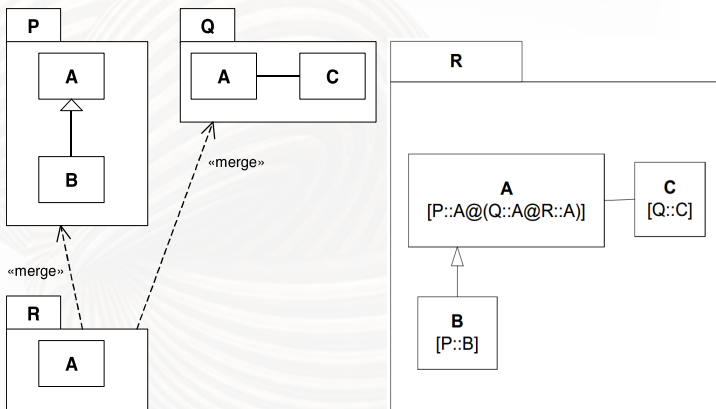
Questions

- Relationships / Operators for reusing models
- Reusable models through parameterization
- Reusable model transformations

# Model reuse in UML

Several relationships for reusing complete or partial package content :

- Merge, import and combine :



# Model reuse in existing works

Lot of works on model composition and extension :

- Composition operators... :
  - “join” [dsouza98],
  - “merge” with renaming [bernstein03], [melnik04], [brunet06], [mosser10], [clark03],
  - “override” [clark03],
  - “weaving” [bézivin06],
  - ...
- ... And their properties : Idempotency, Commutativity, Associativity ...
- On various kinds of models : Class, Activity, Sequence diagrams, ...

# Parameterized models

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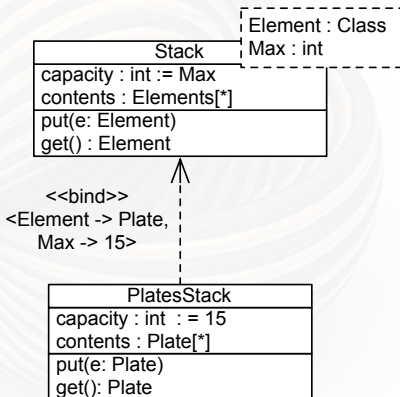
- Kinds of models with ingredients representing variation points (parameters)
- Mechanism for deriving new models by setting variation points
- Existing parameterized models :
  - Variable model : [clauss07], [tessier08]
  - Models with roles : [bottoni10], [tombelle12]
  - **Templates (Genericity)**



# Templates in UML

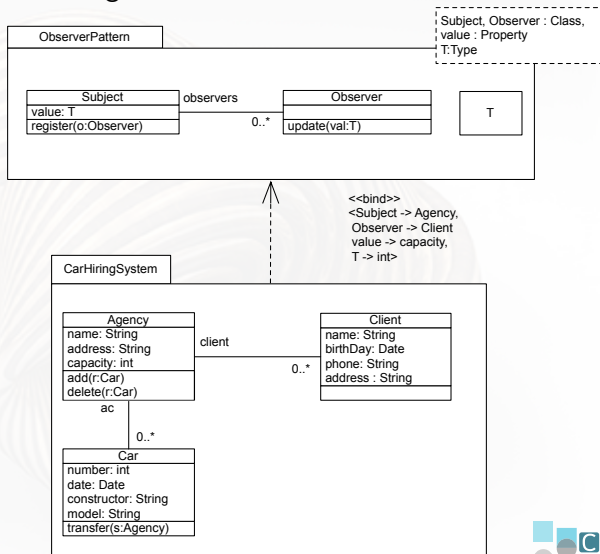
- Generic construct for package, class, collaboration ...
- “bind” relationship to apply templates through substitutions :

Generative usage (C++ template, generics in Java...)



# Templates in UML

## Aspectual usage



# Templates in existing works

- Two main kinds of usages :
  - Generative usages  
*Ecore*, [dsouza98], [bigot09], [cucurru09],  
[delara10],[bergmayr13]
  - Aspectual usages  
[clark02], [clarke03], [muller05], [france06], [whittle09],  
[kienzle10], [berg13], [vanwormhoudt15]
- Variations :
  - Allowed parameters,
  - Model kinds,
  - Modeling level,
  - UML template compliance
  - Parameter granularity

# Sharing models for reuse

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Two activities for the users :

- Model base constitution :
  - Populating, Structuring
- Model base exploitation :
  - Searching, Browsing

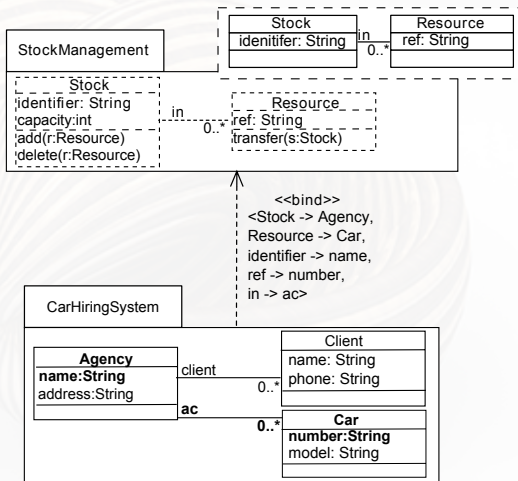
# Sharing models for reuse

## Existing works :

- Model libraries  
*[bézivin07], [salay09], [zaytsev14]*
- Model repositories  
*[mocko04], [ayala07], [koegel10]*
- ... and more generally, works on model spaces
  - “Macromodel”, “Megamodel”  
*[reiter05], [vogel11], [hebig12], [vignaga13]*

# Team Contributions - Aspectual Template

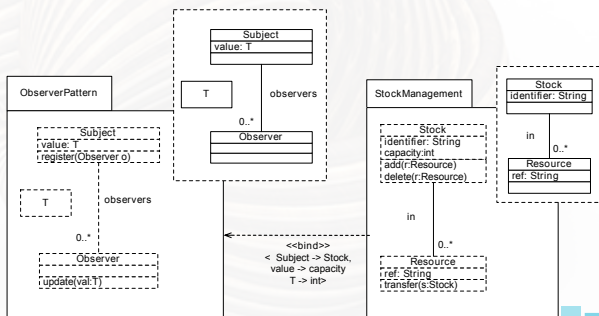
Generalization of UML Templates with parameters as a model  
[vanwormhoudt15]



# Aspectual Template

UML semantic refinement due to “parameters as a model” requirement :

- Consistency of parameters
- (Partial) Binding conformance
- Template composition
  - Parameter propagation



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# Aspectual Template

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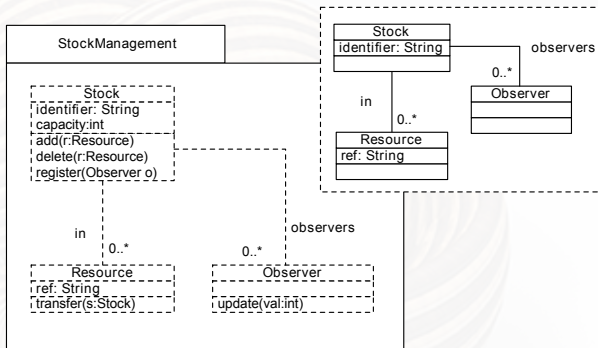
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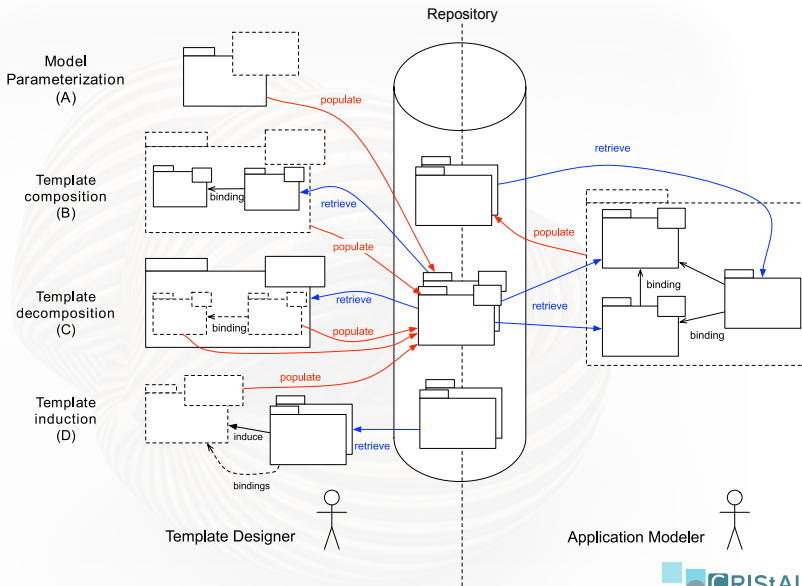
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## Template Based MDE



- Main studies
  - Template constituents and relationships
  - Template hierarchy
  - Template operations
- Software development
  - Reusable technology in Eclipse :
    - Core engine for template consistency and comparison
    - Rich set of template operators
    - Facilities for template searching in model repositories
    - Plugin based and compatible with existing plugins (EMF, CDO/EMF-Store, OCL and UML)

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# Team contribution

## Parameterized models :

Gilles VANWORMHOUDT, Olivier CARON et Bernard CARRÉ.

“Aspectual templates in UML : Enhancing the semantics of UML templates in OCL”. en. In : *Software & Systems Modeling* (avr. 2015)

Alexis MULLER et al. “On some properties of parameterized model application”. In : *Model Driven Architecture—Foundations and Applications*. Springer, 2005, p. 130–144

## Submodels :

Bernard CARRÉ, Gilles VANWORMHOUDT et Olivier CARON. “From subsets of model elements to submodels : A characterization of submodels and their properties”. en. In : *Software & Systems Modeling* (avr. 2013)