Karlsruhe Institute of Technology

CHILIES Project

Quality-Driven Stepwise Refinement of Component-Based Architectures

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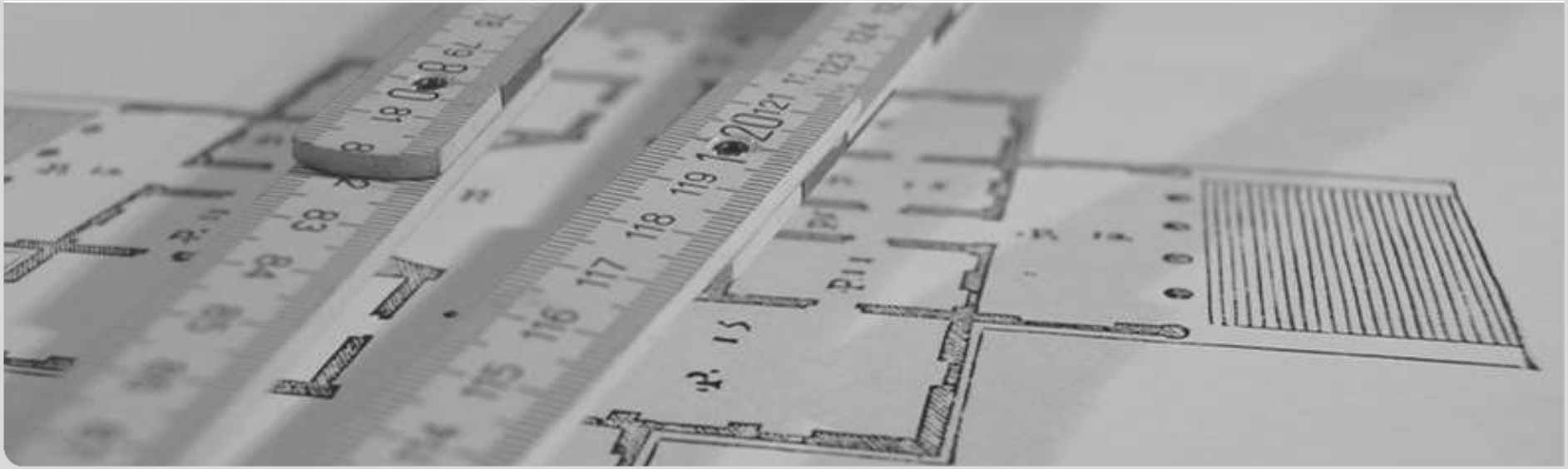
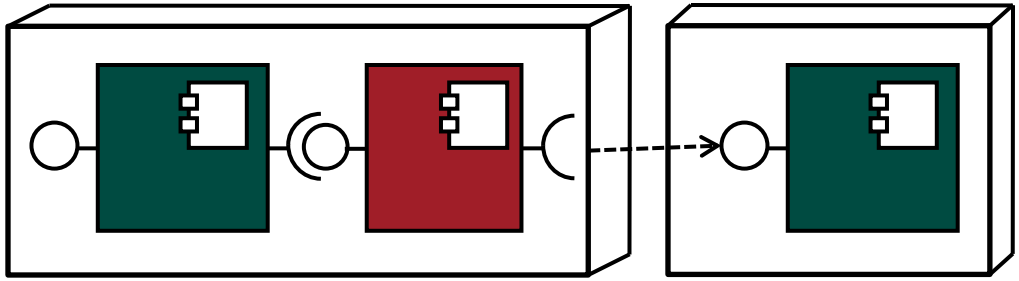


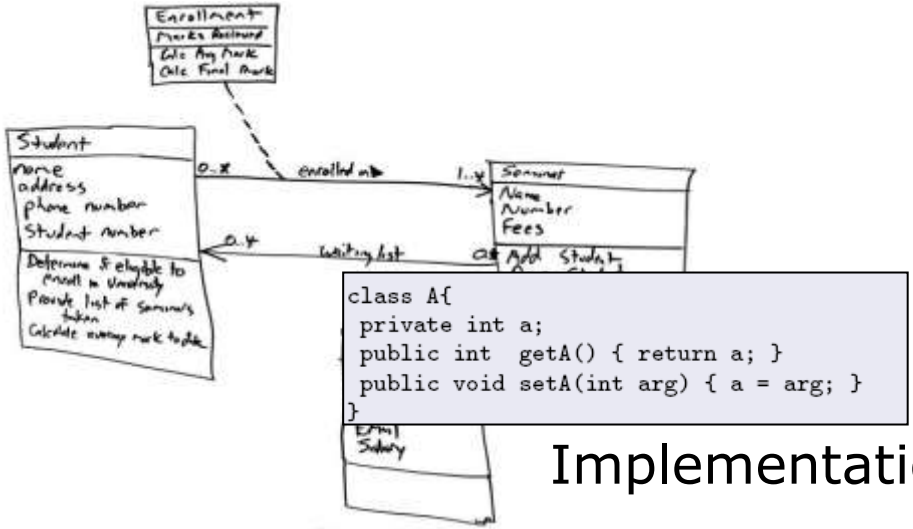
Motivation

Abstract Models



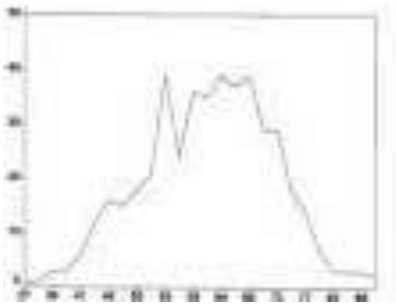
Prediction

?



Implementation

Measurements



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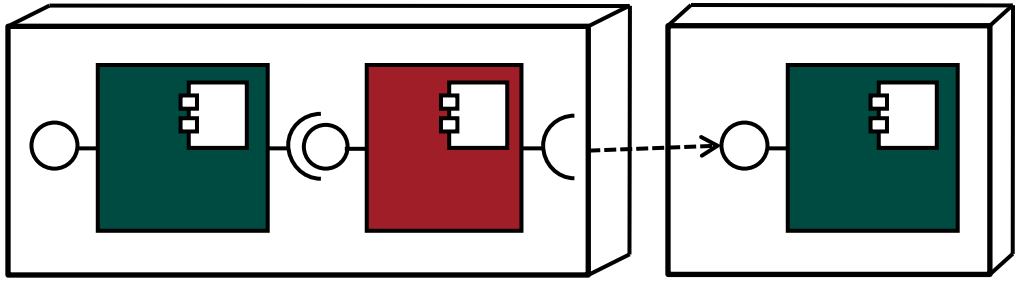
Abstract Models



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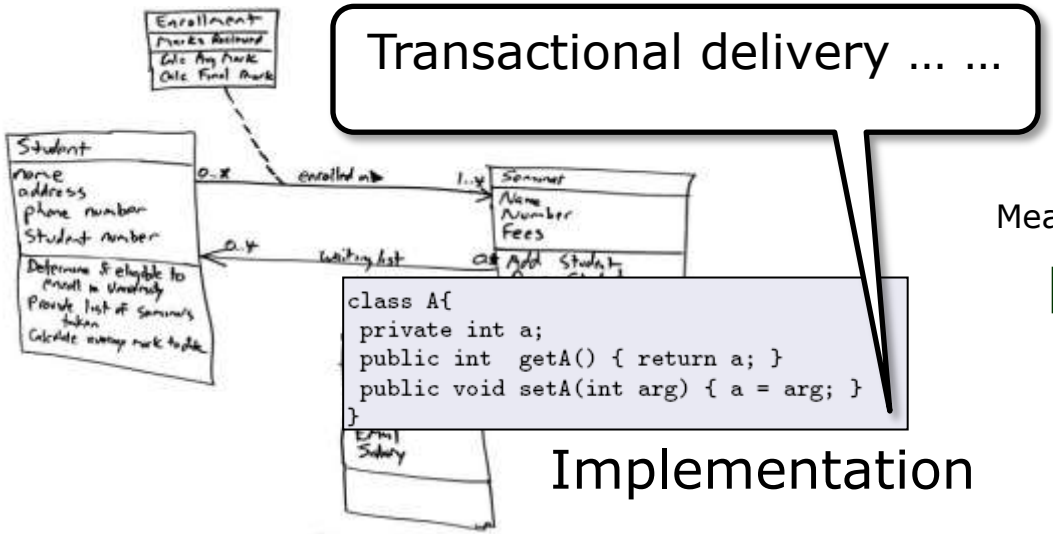
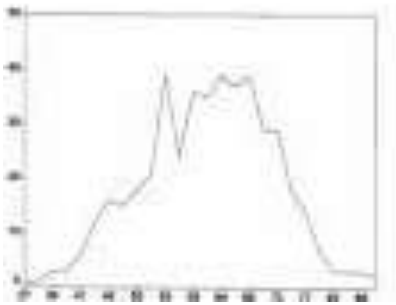


Implementation

Low-level details!

Measurements



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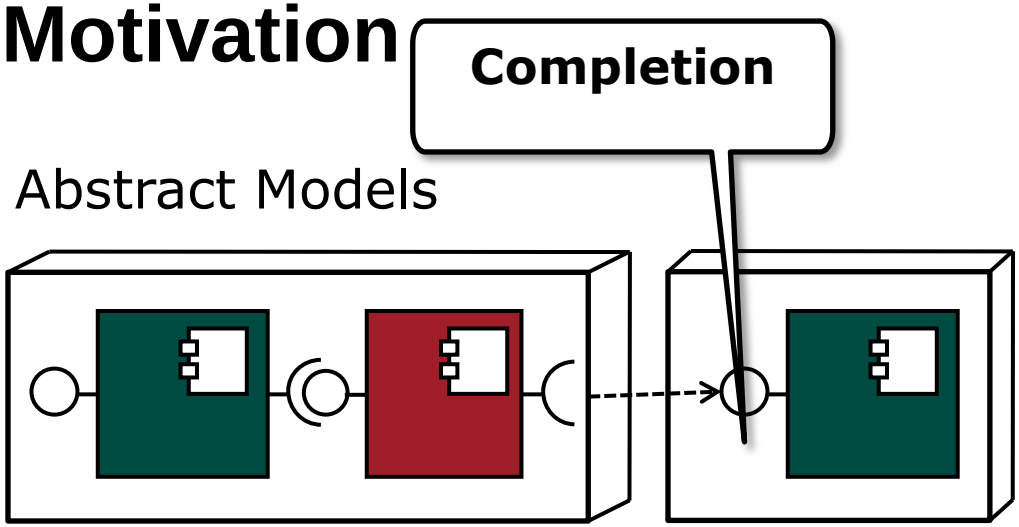
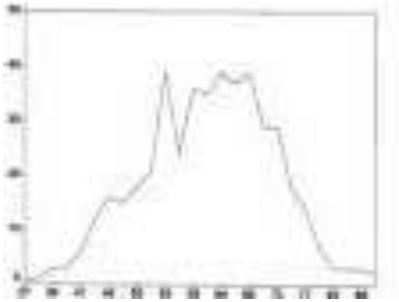
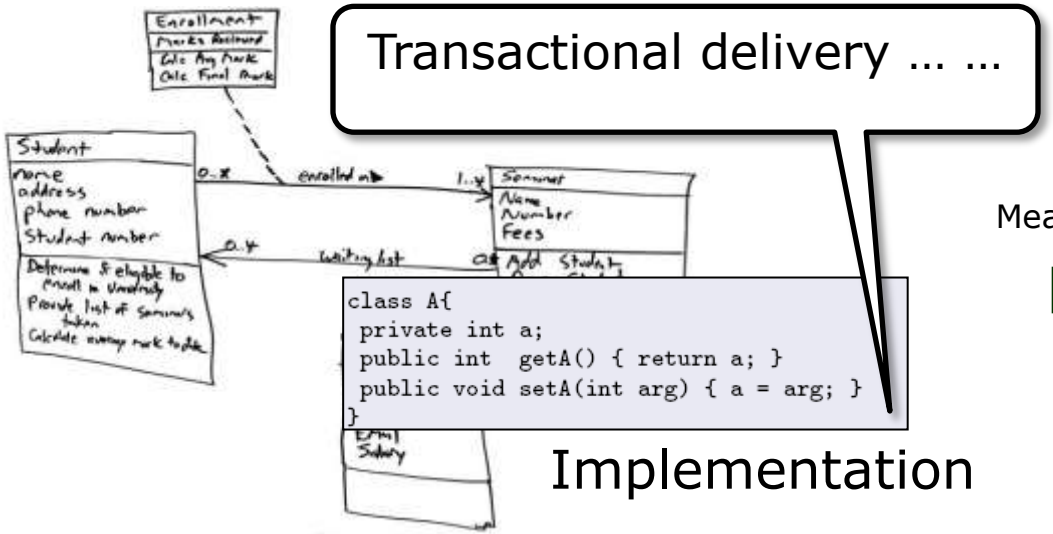


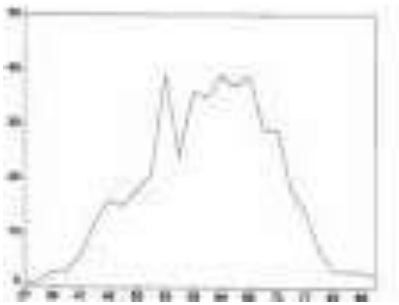
Prediction





Implementation

Measurements



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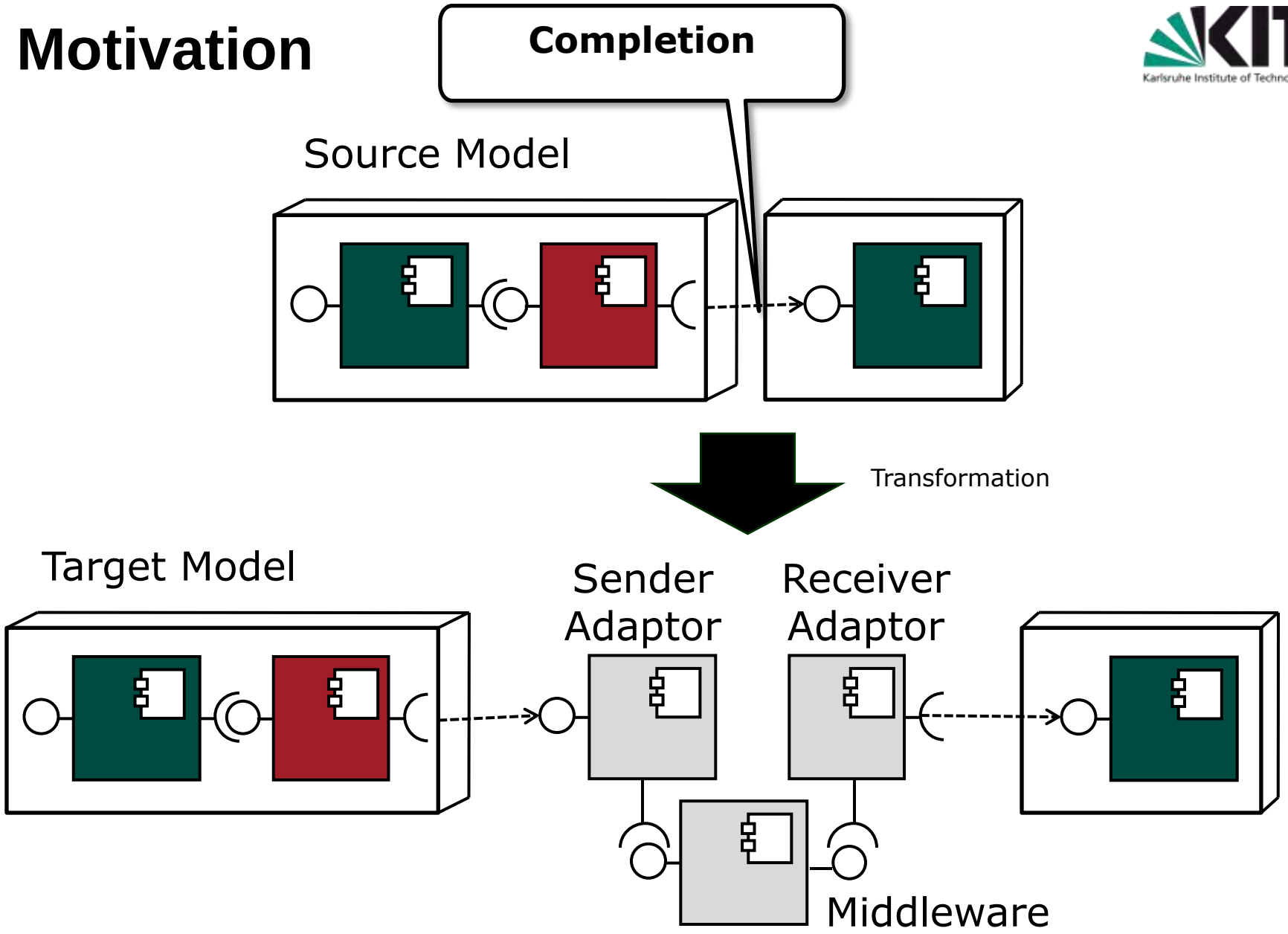


Previous Work

Woodside, ICSE 2007: The future of software performance engineering

- Motivation for performance completions

Happe, WOSP 2008: A pattern-based performance completion for Message-Oriented Middleware

- Process of completion development based on measurements
- Message-oriented Middleware

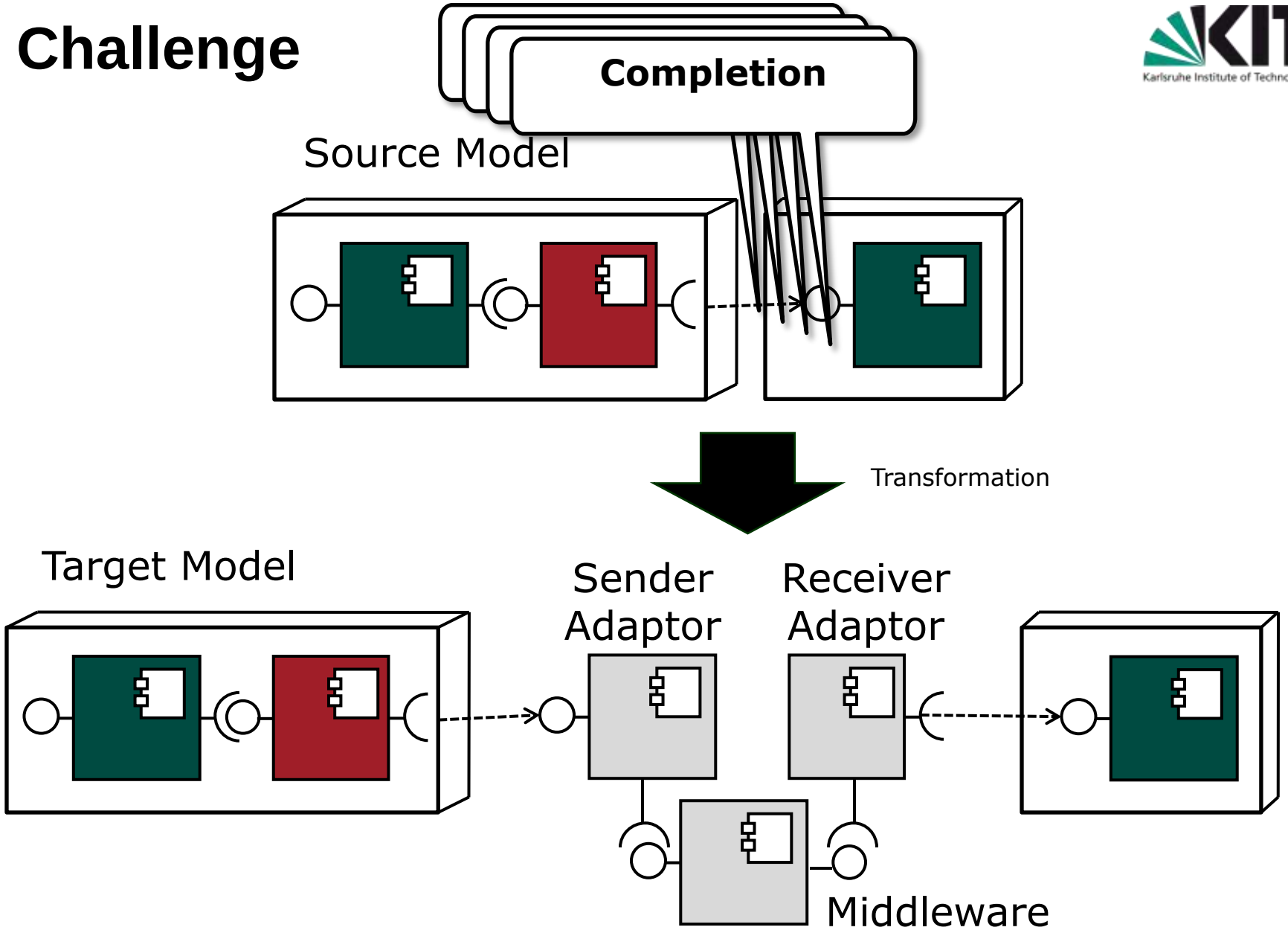
Kapova, EUROMICRO 2009: Automated feature model-based generation of refinement transformations

- Automated integration of completions based on M2M Transformation
- Generation of transformation variants

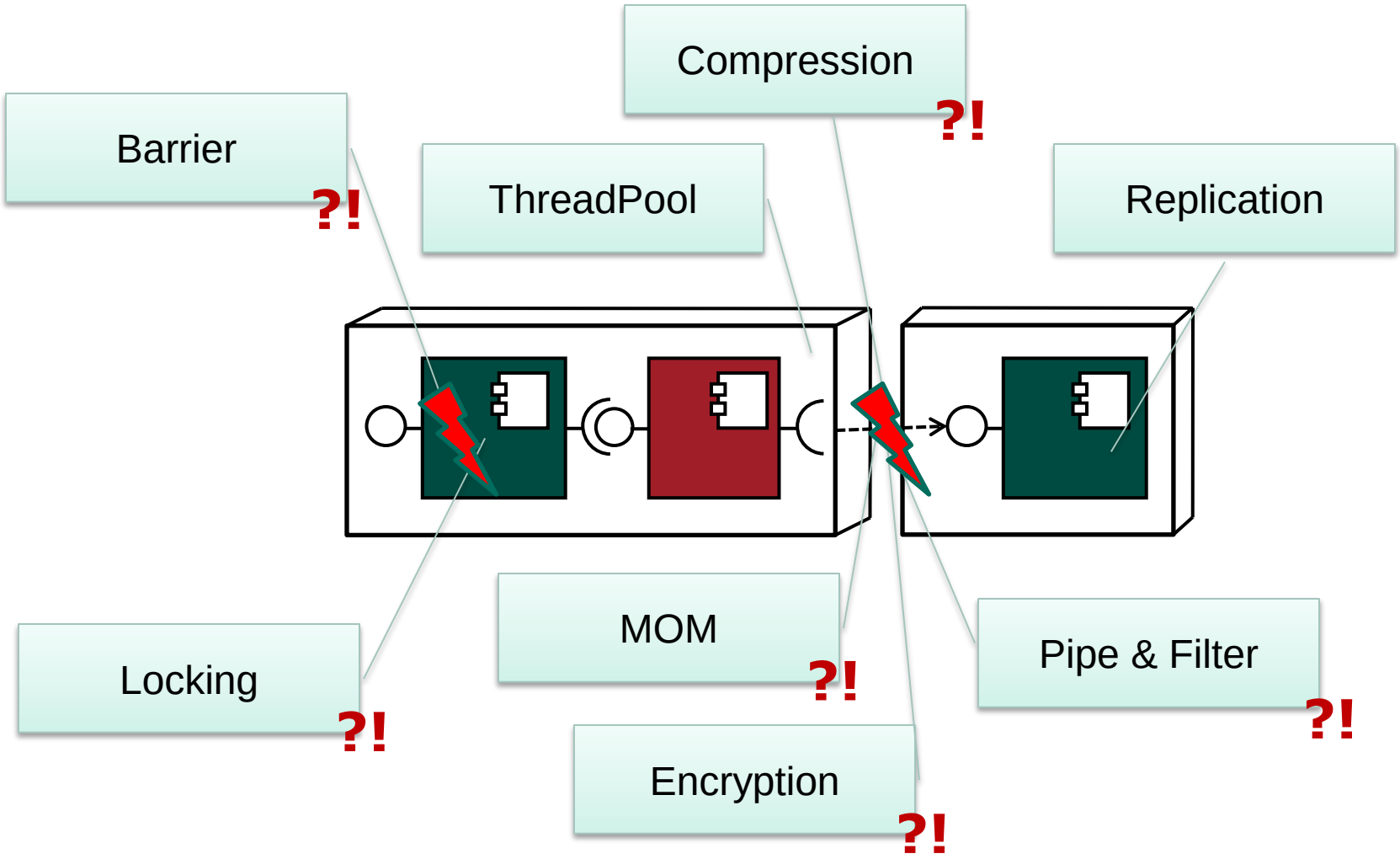
Kapova, FESCA 2010: Systematic refinement of performance models for concurrent component-based systems

- Categorization and analysis of completions for concurrent component-based systems
- Identification of their interdependencies

Challenge

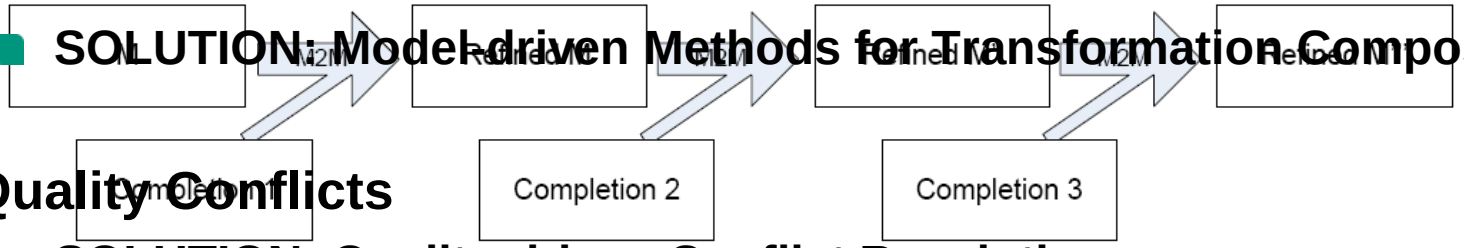


Completion Library



Completion Chain

- **Structural Conflicts**
  - **SOLUTION: Model-driven Methods for Transformation Composition**
- **Quality Conflicts**
  - **SOLUTION: Quality-driven Conflict Resolution**



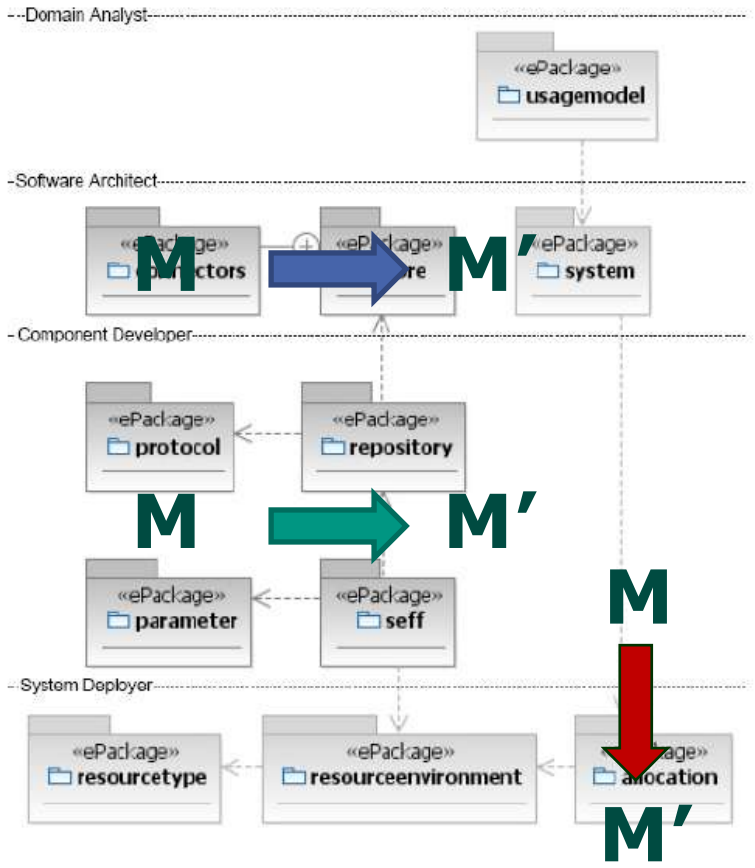
Completion 1 ➡ **Completion 2** ➡ **M_{12}** **RT:500ms**

Completion 2 ➡ **Completion 1** ➡ **M_{21}** **RT:1500ms**

Structural Conflicts: Transformation Composition

Conflict Reduction:

- Metamodel clustering
- Sequential composition



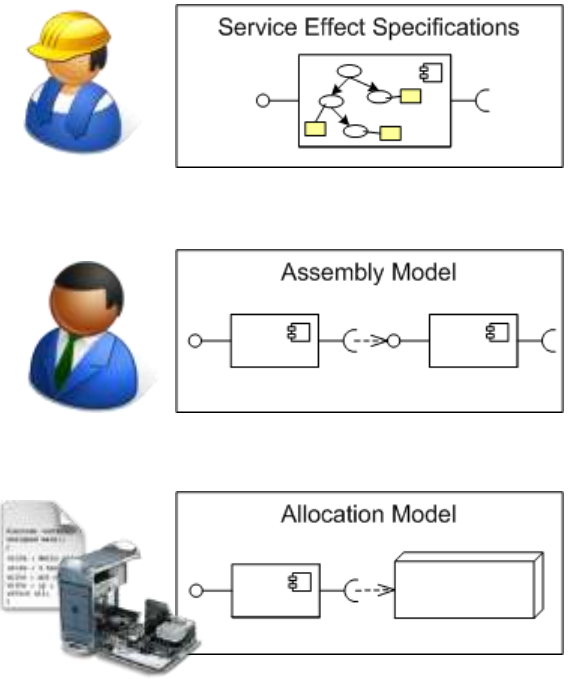
Structural Conflicts: Completion Conflicts Reduction

	Event-based communication	Synchronisation	Concurrency	Message-oriented communication
 P_{CD}: Component Developer (Thread-safe Components)		Scoped Locking Strategized Locking Thread-safe Interface Double-Checked Locking Optimisation Rendezvous (Barrier)	Thread-specific Storage Monitor Object	Messaging Endpoints
 P_{SA}: Software Architect (Component interaction)	Asynchronous Completion Token		Replication	Message Channels Message Routing Message Endpoints
 P_{SD}: System Deployer (Infrastructure)	Reactor Proactor Acceptor-Connector		Active Object Half-Sync/ Half-Async Leader-Followers Thread Pool	Message Bus

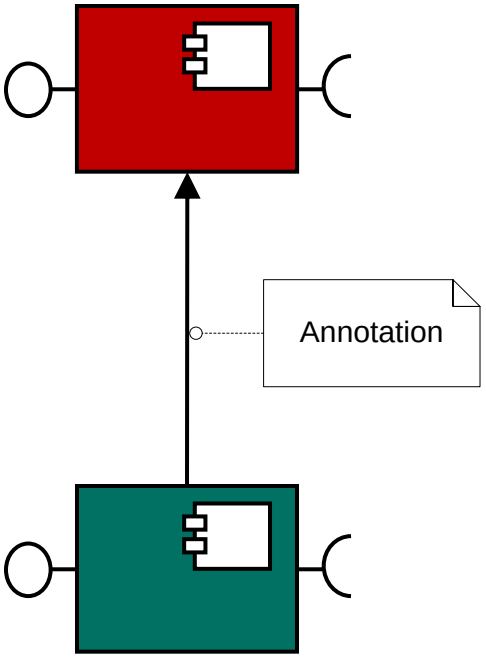
Quality Conflicts: Lessons Learned

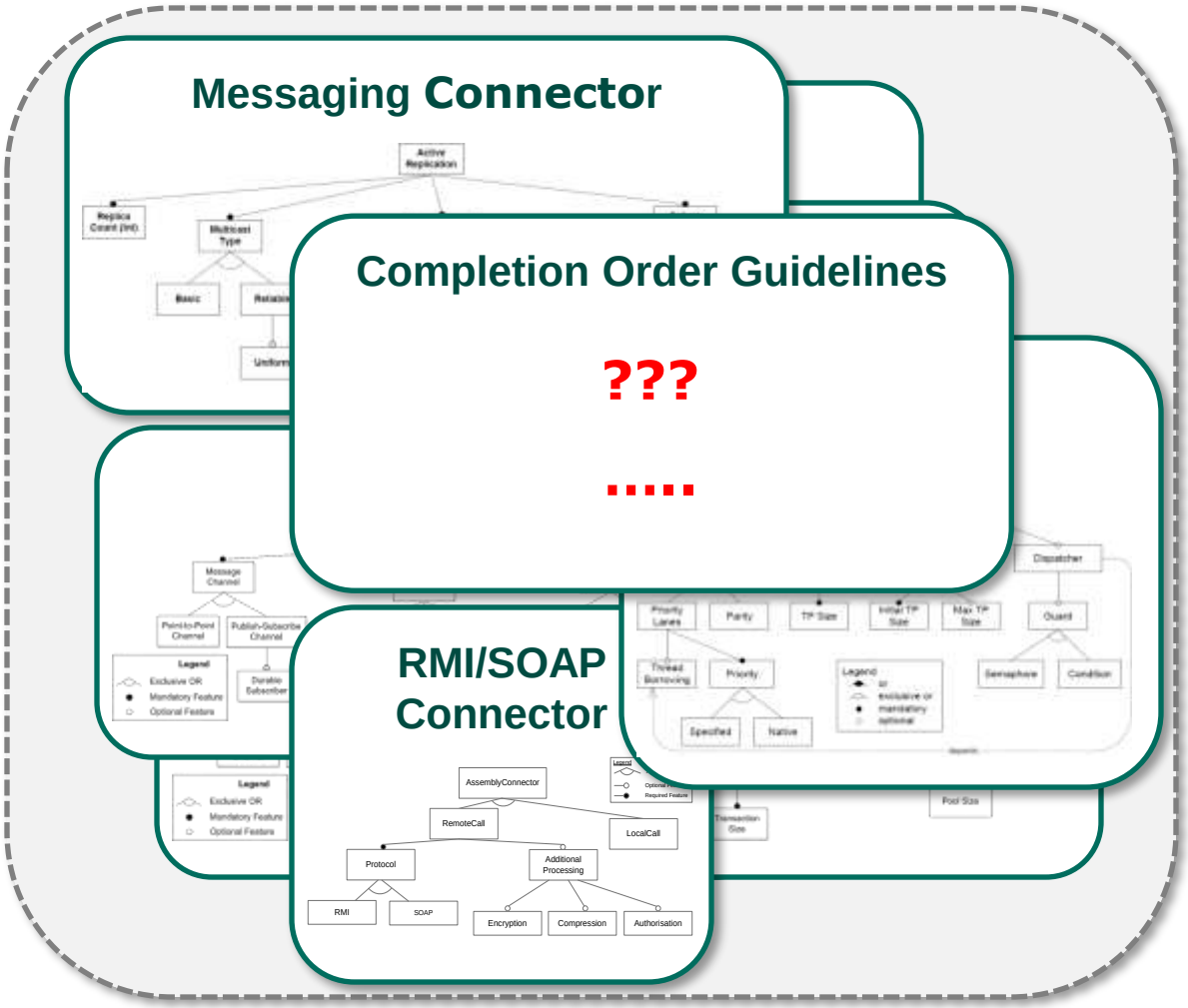
- **Palladio Component Model (PCM) was used to implement our approach**

- **Three levels of Completion-based Refinement**
  - **Components**
  - **Connectors**
  - **Infrastructure**



The Completions Library Guidelines



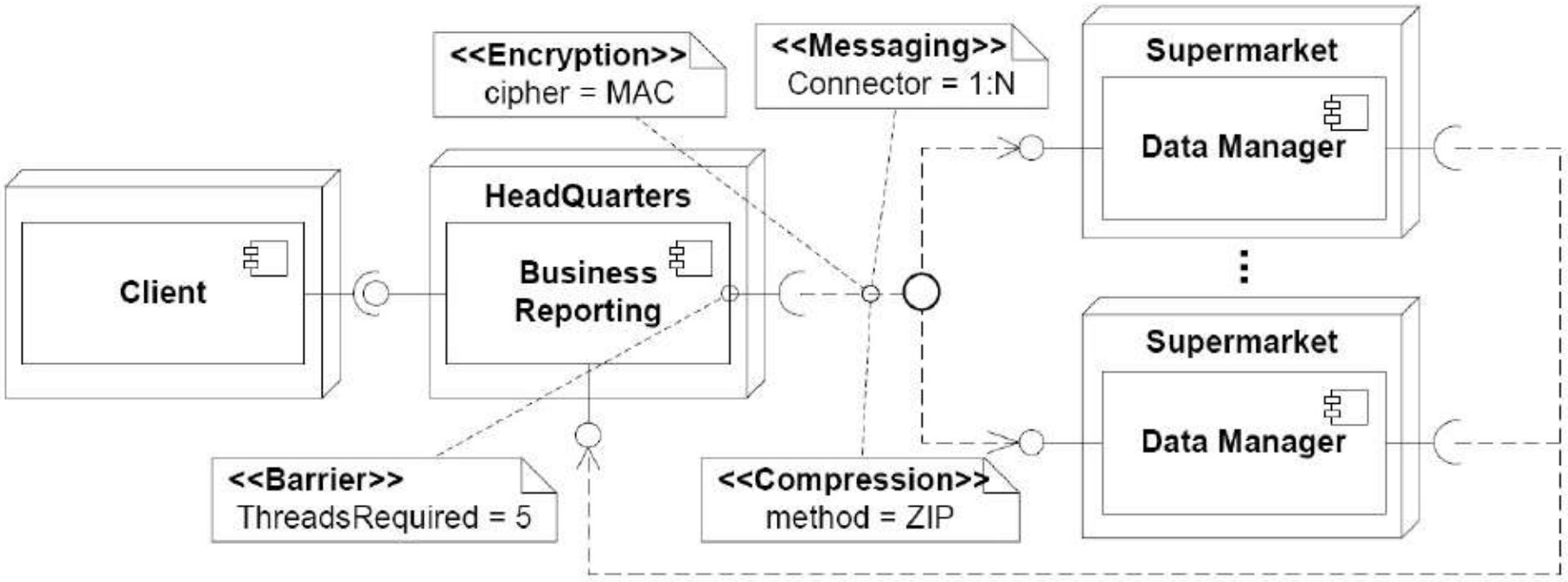


Quality Conflicts: Conflicts Resolution Heuristics

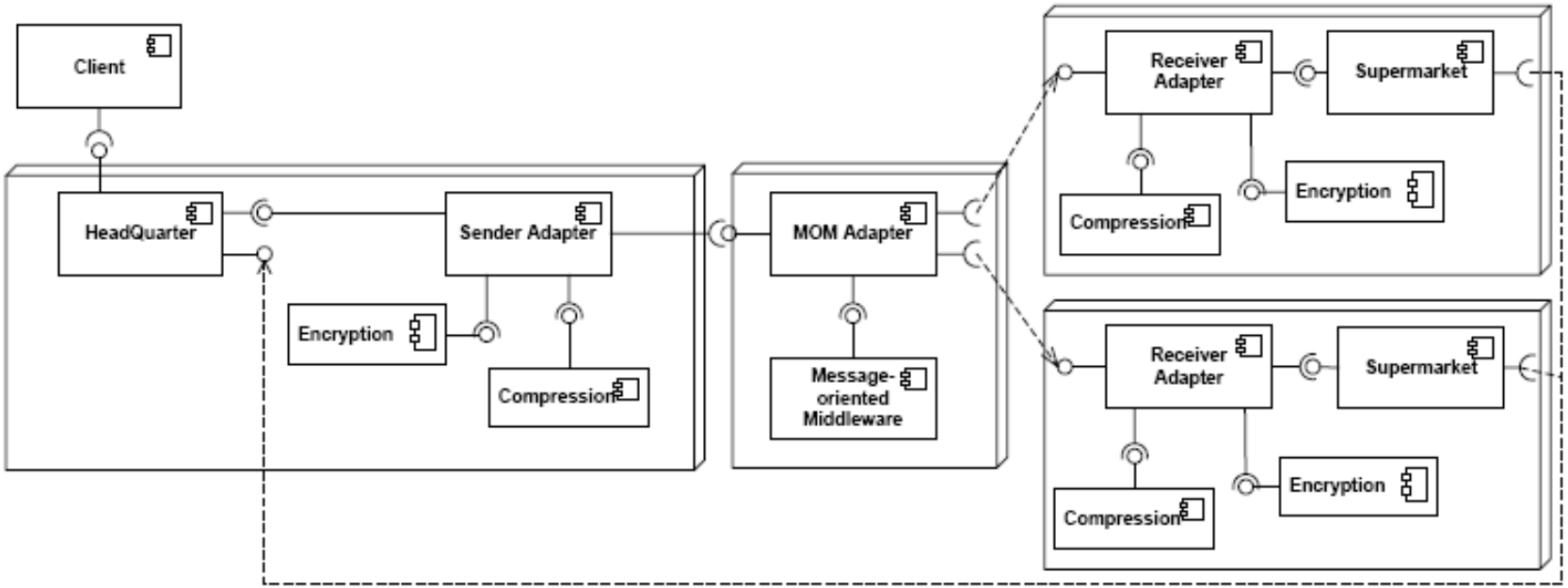
- **Components** $Q(e) = \sum_{s_i \in S} \frac{rt(s_i)}{thp(s_i)}$
- **Connectors** $Q(e) = \frac{rt(e)}{thp(link)}$
- **Infrastructure** $Q(e) = \sum_{r_i \in R} ut(r_i)$

Suggested Candidate: Completion Chain with minimal *Q(e).*

Case Study

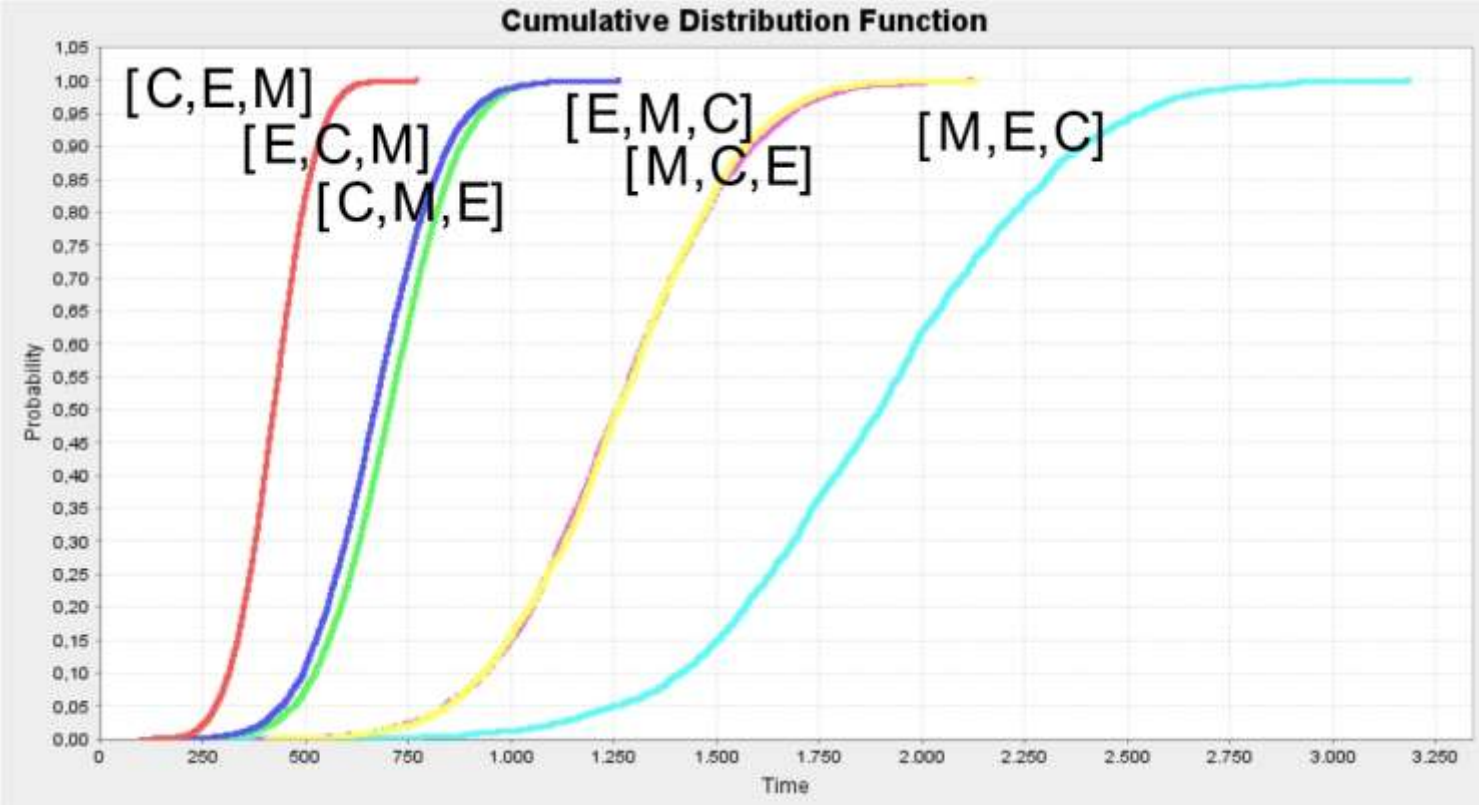


Case Study



	$[C,E,M]$	$[E,C,M]$	$[E,M,C]$	$[C,M,E]$	$[M,C,E]$	$[M,E,C]$
$rt(link)$	496 ms	653 ms	1137 ms	676 ms	1130 ms	1574 ms
$thp(link)$	115 msg/s	72.5 msg/s	39 msg/s	70 msg/s	39 msg/s	26 msg/s
$Q(e)$	4.3	9.0	29.1	9.6	28.9	60.5

Case Study



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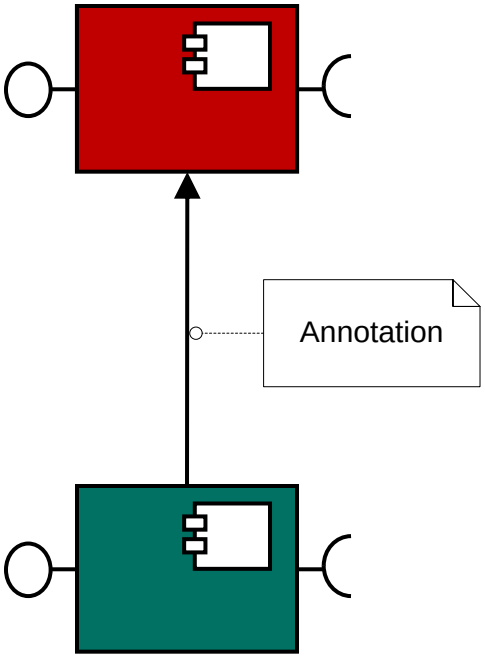

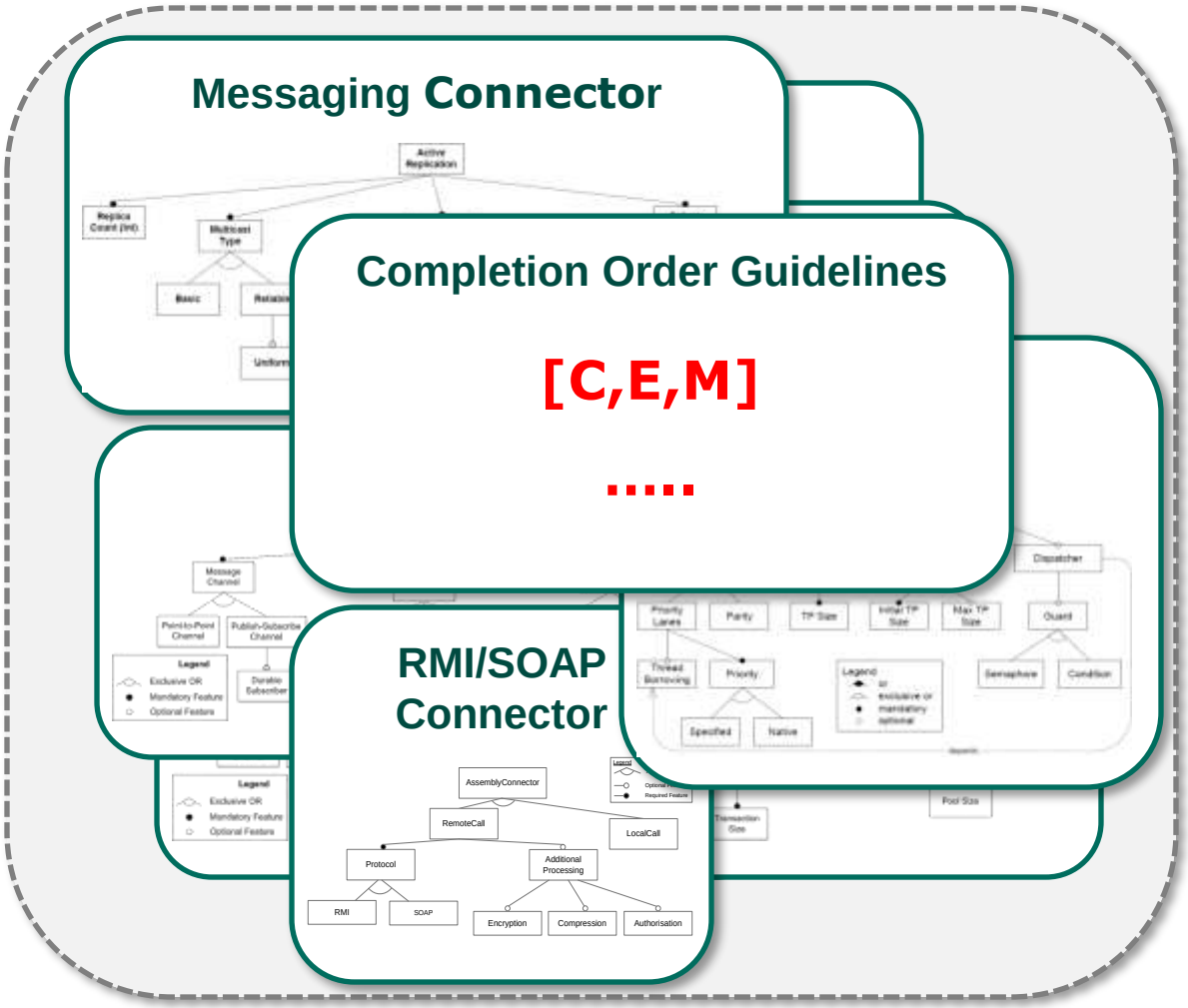

Conclusion and Future Work

Evaluation

- Implementation Prototype: **http://sdqweb.ipd.kit.edu/wiki/Chilies**
- Case Study (ThreadPool, MOM, Replication, Pub-Sub Configurations, etc.).

Contributions

- Inclusion of implementation details required for absolutely correct prediction.
- Localisation, reduction and resolution of completion conflicts.
- Completion library with order guidelines.

Future Work

- Many MDD research questions arise during use of MDD:
  - Structuring, composition and maintainability of transformations
  - Rule-based composition of transformations (vertical composition)
- How to deal with implementation details which are not so easy to decide on during design time?
- Cyclic component interdependencies should be further researched.
- Composition of complex subsystems for connector completions.

http://sdqweb.ipd.kit.edu/wiki/Chilies

!?

Thanks!

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http://sdq.ipd.uka.de