



# The Cha-Q Meta-Model: A Comprehensive, Change-Centric Software Representation

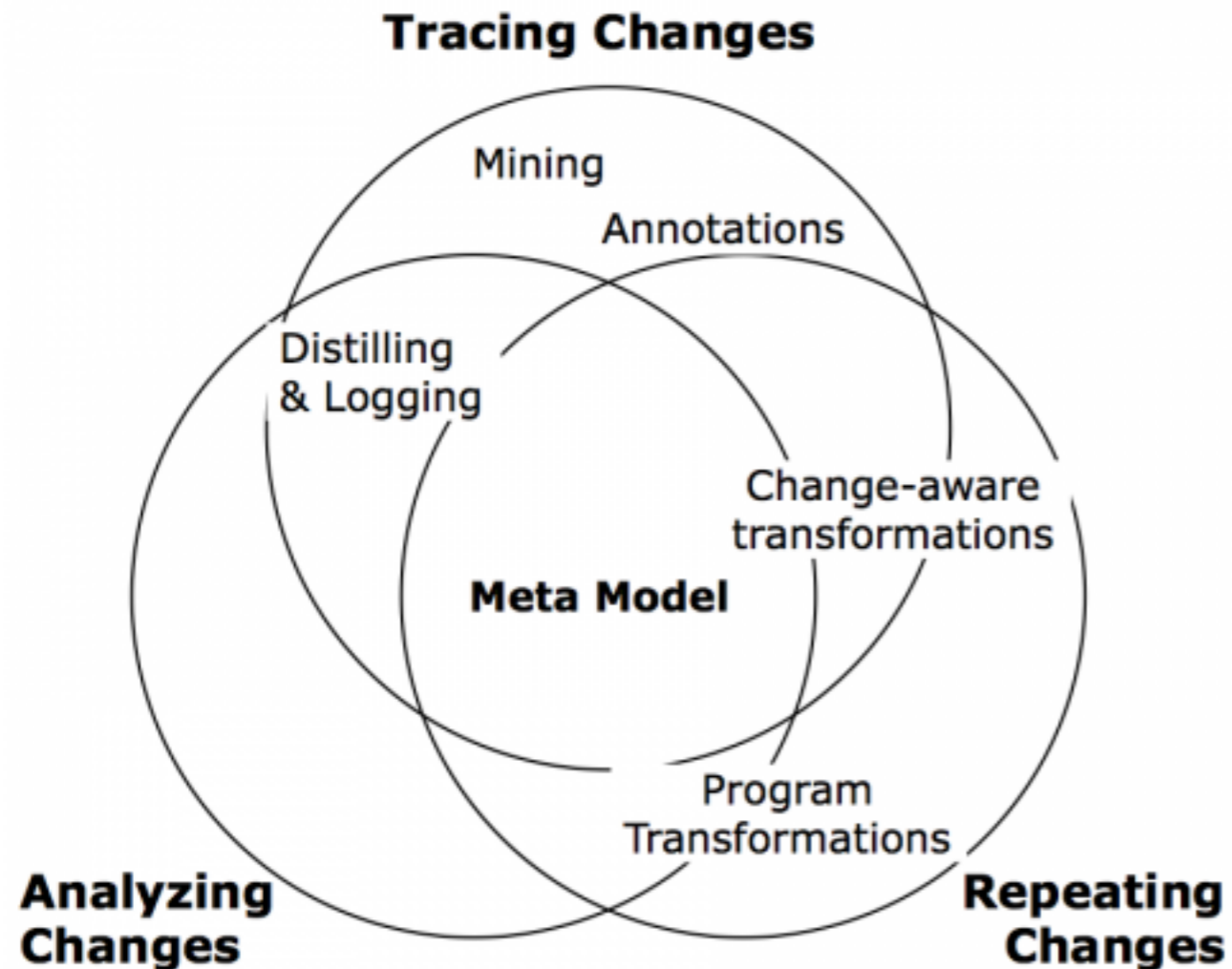
Presenter: Tim Molderez



The Implementation of the Cha-Q Meta-Model:  
A Comprehensive, Change-Centric Software Representation  
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Alessandro Murgia, Serge Demeyer  
Electronic Communication of European Association of Software Science  
and Technology, Volume 65 (2014)



# Why do we need this meta-model?



various kinds of software entities:

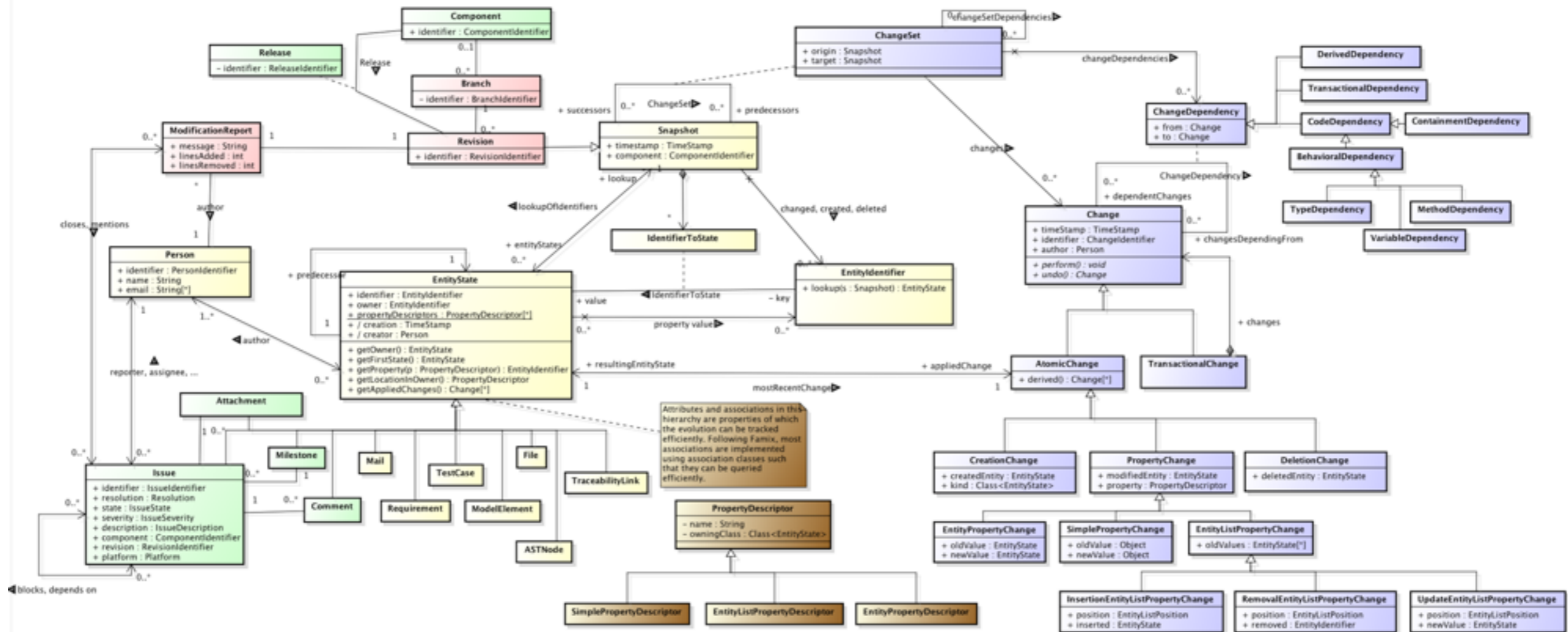
- source code
- bug reports
- configuration files
- versioning information
- changes
- ...

# Cha-Q meta-model

first interconnected representation of:

- ✓ state & evolution of the different entities of a software system
- ✓ each change to an entity that results in a new entity state
- ✓ system snapshots in a version control system

# Cha-Q meta-model



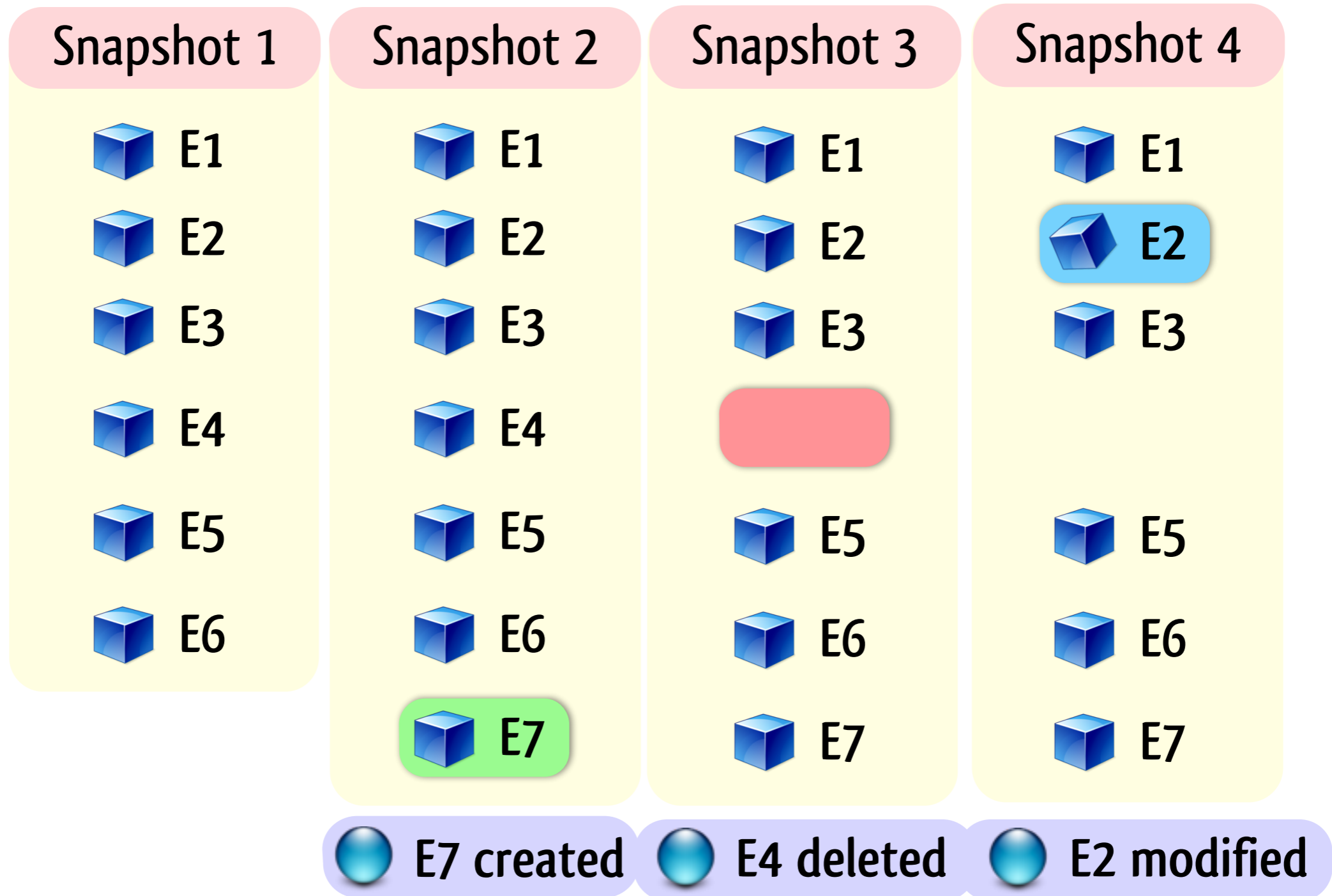
state & evolution

change

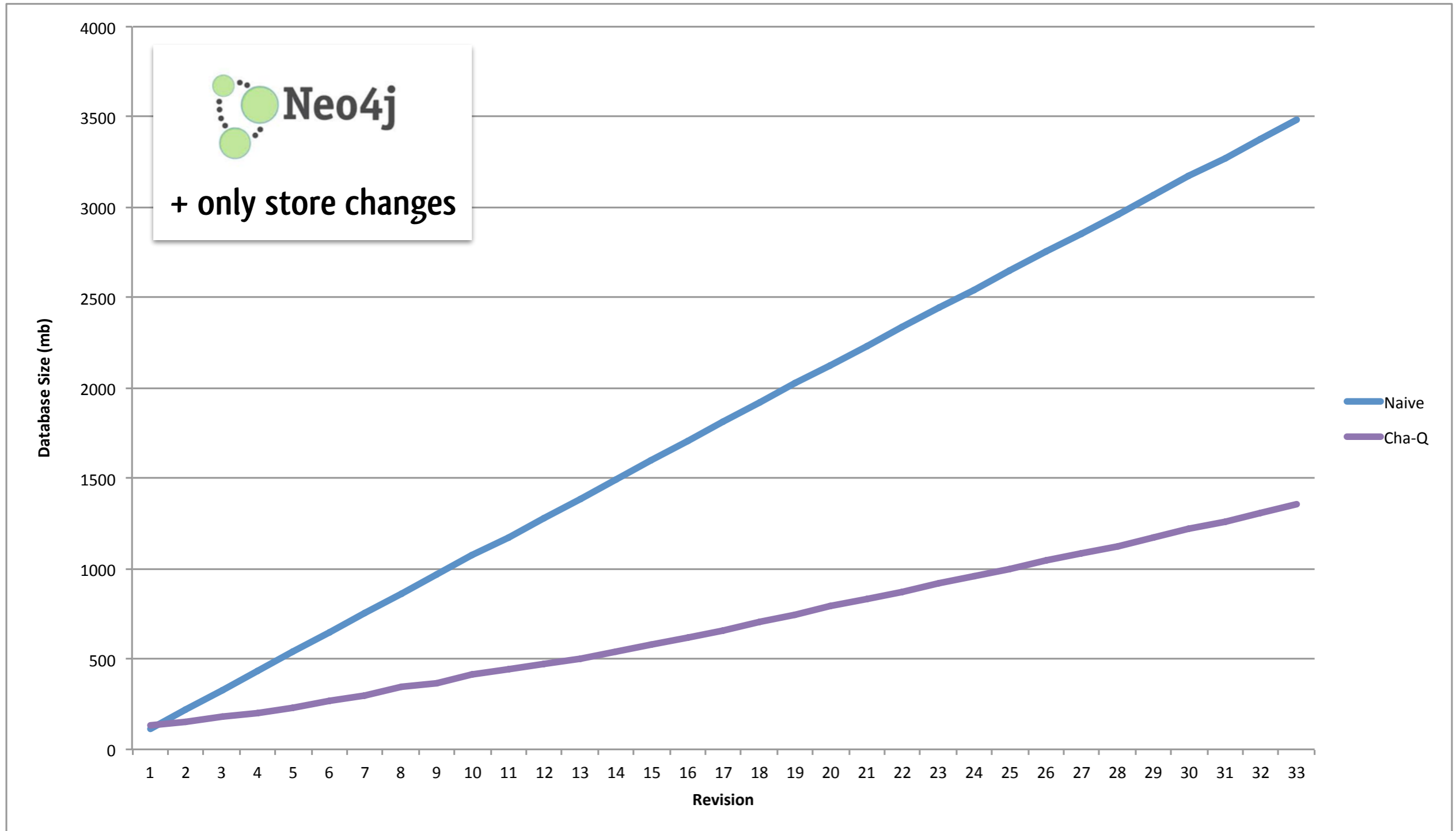
versioning

# How does it work?

time →



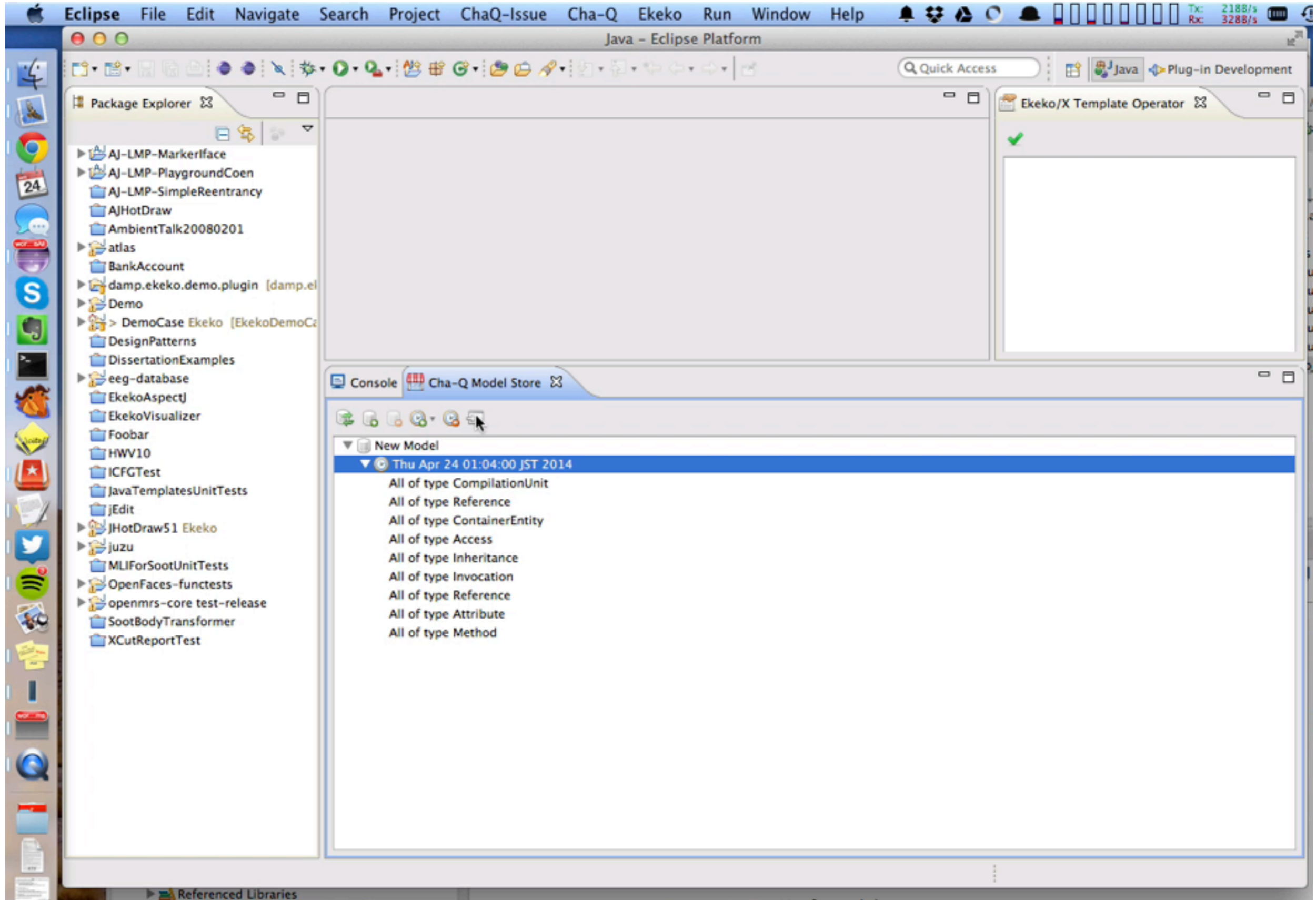
# Implementation highlight: scalability



evolution of Exapus project

single revision: 194149 nodes, 223979 properties, and 194147 relationships of 32 distinct types  
on average: 22,5 files per revision changed

# Cha-Q model browser: importing a project



# Cha-Q model browser: CompilationUnit entities

The screenshot displays the Eclipse IDE interface with the following components:

- Package Explorer:** Lists various projects and packages, including 'DemoCase Ekeko' and 'EkekoVisualizer'.
- Console:** Shows the 'Cha-Q Model Store' with a tree view under 'New Model' containing a timestamp 'Thu Apr 24 01:04:00 JST 2014' and a list of entities:
  - All of type CompilationUnit (highlighted)
  - All of type Reference
  - All of type ContainerEntity
  - All of type Access
  - All of type Inheritance
  - All of type Invocation
  - All of type Reference
  - All of type Attribute
  - All of type Method
- Ekeko/X Template Operator:** Shows a green checkmark, indicating a successful operation.
- Bottom Status Bar:** Displays 'Referenced Libraries' and a message: 'end (17/19): Command.java added 15 entities'.



# Cha-Q model browser: Inheritance entities

The screenshot displays the Eclipse IDE interface. The Package Explorer on the left shows a project structure with various packages. The main editor area is currently empty. The Console window at the bottom is titled 'Cha-Q Model Store' and shows a tree view of model entities. The 'All of type Inheritance' entry is highlighted in blue. The status bar at the bottom indicates 'end (17/19): Command.java added 15 entities'.

Package Explorer:

- AJ-LMP-MarkerIface
- AJ-LMP-PlaygroundCoen
- AJ-LMP-SimpleReentrancy
- AJHotDraw
- AmbientTalk20080201
- atlas
- BankAccount
- damp.ekeko.demo.plugin [damp.el
- Demo
- > DemoCase Ekeko [EkekoDemoCo
- DesignPatterns
- DissertationExamples
- eeg-database
- EkekoAspectJ
- EkekoVisualizer
- Foobar
- HWV10
- ICFGTest
- JavaTemplatesUnitTests
- JEdit
- JHotDraw51 Ekeko
- juzu
- MLIForSootUnitTests
- OpenFaces-functests
- openmrs-core test-release
- SootBodyTransformer
- XCUTReportTest

Console: Cha-Q Model Store

- New Model
  - Thu Apr 24 01:04:00 JST 2014
    - All of type CompilationUnit
    - All of type Reference
    - All of type ContainerEntity
    - All of type Access
    - All of type Inheritance**
    - All of type Invocation
    - All of type Reference
    - All of type Attribute
    - All of type Method

# Cha-Q meta-model applications

analysing changes

Change logger

Change distiller

automating repeated changes

Overview LHS Change Subjects RHS Change Actions

Ekeko Query Results

Query Variables

Mark Results

Query Stats

?FieldDeclaration17600	?fieldType	?annoType
yProperty(value=Javadoc.class) private EntityIdentifier javadoc;	EntityIdentifier	Javadoc
yProperty(value=Name.class) private EntityIdentifier qualifier;	EntityIdentifier	Name
yProperty(value=Type.class) private EntityIdentifier bound;	EntityIdentifier	Type
yProperty(value=Statement.class) private EntityIdentifier elseStatement;	EntityIdentifier	Statement
yProperty(value=Expression.class) private EntityIdentifier expression;	EntityIdentifier	Expression
vProperty(value=Expression.class) private EntityIdentifier expression;	EntityIdentifier	Expression

Cha-Qeko/X

maintaining traceability links

Link View

!	Source	Link status	Target
↔	s-do-compare	--->	test.ResourceWebService.getCompare()
↔	s-do-merge	--->	test.ResourceWebService.getMergeUR...
↔	s-revert	-X->	
↔	s-get-repos	-X->	
↔	s-get-workspace-name	-X->	

# Conclusion

defines the first interconnected representation of:

- ✓ state & evolution of the different entities of a software system
- ✓ each change to an entity that results in a new entity state
- ✓ system snapshots in a version control system

implementation highlights:

- ✓ memory-efficient
- ✓ familiar OO API for tool builders