Artefact-based Requirements Engineering Improvement

Dr. Daniel Méndez

01-06-2012
Software Engineering II
University of Stuttgart
Agenda

- Background: Artefact-based Requirements Engineering
- Artefact-based Requirements Engineering Improvement
- Implications for Research Design
What is Artefact Orientation? *

**Activity Orientation**

**Principle**
Focus on methods and dependencies

**Problems (condensed)**
- Results and dependencies out of scope
- No awareness of syntactically consistent artefacts

**Artefact Orientation**

**Principle**
Focus on artefacts and dependencies

**Expected advantages (condensed)**
- Syntactically consistent result structures
- Flexibility in the process

---

* Mendez et al.. A Meta Model for Artefact Orientation: Fundamentals and Lessons Learned in Requirements Engineering (MoDELS 2010).
Different Views on Artefacts (Simplified) *

Artefacts
- Documents
- Data models

Structure
- Package / document hierarchy

Content
- Concept Models
- Ontologies
- Checklists
- ...

Representation
- Diagrams / Models
- Natural Text
- ...

* Mendez et al., A Meta Model for Artefact Orientation: Fundamentals and Lessons Learned in Requirements Engineering (MoDELS 2010).
Artefact-based Requirements Engineering

- Idea of artefact orientation not new (see, e.g., V-Modell XT)
- Relevance of artefacts to RE recognised (see e.g., IEEE Std. 830-1998)

Challenge
- Artefact Orientation still a philosophy (compared to, e.g., Method Eng.)

Questions
- What are the basic concepts of artefact orientation?
- How can the artefact-based philosophy be used in RE?
- What are the benefits and limitations?
Research on Artefact-based Requirements Engineering *

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Step</th>
<th>Contribution</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Problem Analysis</td>
<td>Field Study on RE</td>
<td>EASE’10, IST’12</td>
</tr>
<tr>
<td>2</td>
<td>Foundation Analysis</td>
<td>Meta Model for Artefact Orientation</td>
<td>MODELS’10</td>
</tr>
<tr>
<td>3</td>
<td>Domain-specific Implementation</td>
<td>Quasar Requirements (Capgemini Technology Services)</td>
<td>Technical Report (TUM)</td>
</tr>
<tr>
<td>4</td>
<td>Empirical Evaluation</td>
<td>Case Study (Siemens)</td>
<td>EASE’11</td>
</tr>
</tbody>
</table>

Artefact-based RE: Current state of Art

Available contributions

- Plenty of methods for RE (maybe enough…)
- First concepts of artefact-based RE (integrating those methods)
- First field and case studies, first controlled (student) experiments

Open Questions

- Extension of Concepts (dynamic tailoring, controlling & QA, tool-support, etc.) and studies (new ones & replications)

Generalisation and abstraction: How can we use artefact orientation to systematically improve Requirements Engineering?
Agenda

- Background: Artefact-based Requirements Engineering
- Artefact-based Requirements Engineering Improvement
- Implications for Research Design
Setting: Continuous (RE) Process Improvement

Analyse

Integrate

Conceptualise

Realise
RE Process Improvement Today

Process improvement as it should be …

These are our project-specific needs. How can we satisfy them?
RE Process Improvement Today

Process improvement as it should be …

These are our project-specific needs. How can we satisfy them?

These are some best practices. How can we justify and implement them?

… and as it often is …
Research Objective and Challenges

- Todays approaches are mostly of prescriptive nature (assessment / rating of RE against external process reference model)
- We have already shown selected benefits of artefact orientation for
  - Analysing processes (qualitatively)
  - Improving the RE process in an inductive manner

Challenges

- Little known about..
  - General strengths and limitations of artefact orientation in RE
  - How to use artefact orientation to systematically improve RE processes using the concepts of SPI
Goal: Artefact-based RE Improvement Approach

Planning of Improvement

RE Analysis

Improvement Realisation
  (Solution Exploration & validation)

Dissemination
  (Integration & Evaluation)
Goal: Artefact-based RE Improvement Approach

How can we systematise an artefact-based RE improvement?
RQ 1: What is the value of artefact orientation to RE, both from an analytical and an engineering perspective?
RQ 2: What are the basic SPI concepts important to RE and how can they be synthesised with the basic concepts of artefact orientation?
RQ 3: How can an artefact-based Requirements Engineering improvement approach be effectively disseminated and evaluated?
Research Agenda 2012: Focus on Foundations

<table>
<thead>
<tr>
<th>RQ</th>
<th>Planned Contribution</th>
<th>Current State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Notes on KPIs / Goals, Controlled Experiment with Meta Models</td>
<td>Searching for industry partners</td>
</tr>
</tbody>
</table>

- **Integration into teaching**
  - Student work: guided research, BSc/Msc theses, …
  - Courses: Foundations in Empirical Software Engineering
- **Establishment of collaborations / joint work:**
  - Bilateral collaborations / research projects
  - Research communities (ISERN, conferences, workshops, …)
Summary

- Requirements Engineering offers enough space for research!
- Current research challenges in Requirements Engineering:
  - Formalisation and application of artefact orientation in RE
  - Empirical studies on RE
  - Interdisciplinary transfer
- The “softer” the investigated discipline, the higher the need for empirically sound research
Agenda

- Background: Artefact-based Requirements Engineering
- Artefact-based Requirements Engineering Improvement
- Implications for Research Design

Discussion
Major Pitfalls in Research on Methods and Processes

- Problem not appropriately justified
  - “What is the problem and its relevance?"
  - “Yet another method” / “One size fits it all”
Major Pitfalls in Research on Methods and Processes

- Problem not appropriately justified
  - “What is the problem and its relevance?"
  - “Yet another method” / “One size fits it all”
- Contributions not accurately evaluated
  - Toy example does not reflect reality (context)
  - Reality does not reflect reality (generalisation, side-effects, …)
  - Missing linkage to problem statement
Major Pitfalls in Research on Methods and Processes

- Problem not appropriately justified
  - “What is the problem and its relevance?
    → “Yet another method” / “One size fits it all”
- Contributions not accurately evaluated
  - Toy example does not reflect reality (context)
  - Reality does not reflect reality (generalisation, side-effects, …)
    → Missing linkage to problem statement

→ Use empirical methods to
  - Understand the problem (field)
  - Increase the validity and credibility of your contributions
Empirically sound Research

- Field / Case Studies
  - Literature Reviews
  - Surveys
  - …

Problem Research

- Surveys / Reviews
  - Workshops
  - …

Evaluation

Solution Exploration

- (Meta) Modelling
  - Prototyping
  - …

Solution Validation

* R. Wieringa, Engineering Life Cycle

Challenge 1: Small Samples / Data Population

- Finite number of observations hamper…
  - … generalisations
  - … precise trends / predictions
- “Prediction is very difficult, especially about the future” – Niels Bohr

* http://xkcd.com/
However...

“[Even if] one swallow does not make a summer, one swallow does…

- ... prove the existence of swallows
- ... provide a great deal of reliable information about swallow anatomy” *

→ Focus on qualitative data analyses rather than on quantitative ones (e.g., observational / exploratory studies & interviews) **

→ Be careful when discussing the threats to validity (e.g., implications on generalisation)

→ Collaborate and make use of further data sources (research communities & research projects)
  - Extension of data population
  - Relation to existing evidence?
  - (Replication of studies)

Challenge 2: Context-sensitive Studies

- The context of software processes is very sensitive
- Processes & methods are always accompanied by expectations
- Variables in software processes are often hard to measure

However...

- Minimise **side-effects** (questionnaire wording/interviewer effects/action research)
- Carefully outline the **threats to validity** before executing the study
- Formulate your research questions in an “**explorative**” manner
  - “To what extent does the application of [insert method here] impact [insert variable(s) of problem statement here]” rather than
  - “Is [insert your method here] better than [insert “enemy” method here]”
- Be **unbiased** and observe **cases and subjects**
- Make use of **triangulation**
- Explain the **design** in detail (make your study reproducible to others)
- Carefully study and explain the **context**
- **Correlation** does not imply **causation**
- Show **relation to evidence**, do not interpret speculatively
Thank you.

Contact:

mendezfe@in.tum.de
http://www4.in.tum.de/~mendezfe/
Further Reading

- C. Wohlin et al. Experimentation in software engineering: an introduction.
- P. Runeson et al. Guidelines for conducting and reporting case study research in software engineering.
- B. Kitchenham et al. Guidelines for performing systematic literature reviews in software engineering.
- D. Huff. How to lie with statistics.
- D. Méndez et al. Pattern-based guideline to empirically analyse software development processes.