Naming the Pain in Requirements Engineering

Globally distributed, yearly replicated family of surveys

Methodik AG
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Joint work with
Stefan Wagner, University of Stuttgart
Current State of Evidence-based Research in RE
Current State of Evidence-based RE Research

- Most investigations in RE remain isolated
- Available surveys beyond RE are not reliable / reproducible / detailed enough (e.g., Chaos report)
  ➡ Generalisations difficult as no empirical (grounded) survey basis available
Current State of Evidence-based RE Research

Implications

• Practically relevant problems and goals not sufficiently understood
• Weak transfer of (practical and basic) RE research results to practice

“Close enough. Let’s go.”
Why a **Family of Surveys in RE?**

Establishment of an **open and generalisable** survey basis for RE

1. Support for problem-driven RE research
2. Long-term investigations of current state of RE practices

**First step**

Family of RE surveys on practical status quo and problems.

**Long-term view**

- What matters to practical RE?
- What are practically relevant problems?
- What is RE of high quality?

- How / what to measure in RE quality?
- How to improve RE?
- ...
Objectives

Establishment of an open and generalisable survey basis for RE

„Naming the Pain in Requirements Engineering“ (NaPiRE)

- Expectations and status quo in RE
- Problems and needs in RE

Approach: Structured family of surveys

1. Yearly collaborative instrument design
2. Yearly independent surveys in different countries
3. Yearly collaborative synthesis and publication

Principles

- Openness and transparency
- Anonymity, but closed
- Instrument (and continuously adapted) based on theory and expectations
Goals of the Talk

Give an Overview of...

- Design of NaPiRE
- NaPiRE results (Germany)
- Next steps
Agenda

1. Overview Design
2. Overview Results
3. Summary Results and Interpretation
4. Future Work / Strategy
Our approach

- Preparation:
  - Conceptualisation of research questions
  - Initial creation of questionnaire

- Validation:
  - Internal validation
  - Implementation / correction
  - Online Survey
  - Industrial pilot

- Preparation:
  - External validation
  - Conceptualisation of research questions

- Initiation:
  - Creation distribution list
  - Invitation
  - First interpretation
  - Data analysis & interpretation
  - Final reporting

- Synthesis & reporting
  - Dissemination
  - Planning

International Communities:
- Presentation & discussions at communities
- ISERN '12 EESSMod (MoDELS '12)
- EASE '13 Replication Report
- PROMISE Repository

International Replication:
- 1. Replication (Netherlands)
- Baseline Report
- Yearly RE Community Report
  - Creation distribution list
  - Invitation
  - Data analysis & interpretation
  - Survey Report
  - Final reporting

- Global Replication
  - Creation distribution list
  - Invitation
  - Data analysis & interpretation
  - Synthesis & reporting
Our approach

1. First results from Germany
2. Replication ongoing in NL
3. Process and community “adjusted”

Naming the Pain in Requirements Engineering (NaPiRE) - Globally distributed, yearly replicated family of surveys -

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Background and Goals
- RE Survey with the idea of continuous joint replications via ISERN
- Establish an empirical basis for problem-driven RE research

Principles
- Openness and transparency
- Anonymity, but closed
- Instrument based on theory

Current Status
- Instrument established within ISERN community
- Infrastructure set up and hosted
- First Survey in Germany completed & published
- First replication currently ongoing in the Netherlands

Goals of the Workshop
- Get overview at background and current results
- Re-adjust instrument
- Plan replication projects
- Join!

We are here...
Infrastructure for NaPiRE

NaPiRE

Naming the Pain in Requirements Engineering

Requirements Engineering Survey 2012

Technische Universität München
Universität Stuttgart

Dear Survey Participant,

thank you very much for sparing 15-30 minutes of your valuable time by answering this questionnaire!

The Requirements Engineering Survey 2012 is conducted by the Technische Universität München and the University of Stuttgart and shall help us getting a better understanding about general industrial trends in Requirements Engineering (RE).

Goal of the survey: We are interested in your personal expectations and experiences on Requirements Engineering to understand the status quo of expectations in practical Requirements Engineering process definitions, their improvement, and their application in projects – all relying on your personal expert opinion. This shall give you insights into industrial trends in RE and lay the foundation to steer academic and industrial research in problem-driven manner, i.e. it shall help detect practically relevant problems and goals in Requirements Engineering.

Structure of the survey: The Requirements Engineering Survey includes (at most) 35 questions, structured into 5 categories:

1. General information about you and your company:
   a. Your personal expectations on a good RE
   b. Status quo in RE at your company
   c. Status quo in RE improvement at your company
   d. Controversial problems experienced in RE and how these problems manifest themselves in the process
   e. Please answer the questions as accurately as possible.
2. At the end of the survey, you will be asked to enter your email address. In case you agree to post your email-address, we will provide you with a overview of the survey results. In any case, please be assured that the survey follows a high academic standard and is conducted anonymously. We will not associate your email address with your answers and exclusively use the addresses for purpose of providing you with the survey results.
3. For further information / questions, please contact:
   Dr. Daniel Mendez
   Technische Universität München - Software & Systems Engineering
   Tel: +49 89 289 17096
   http://www.tum.de/~mendez/

Continue

Enterprise Feedback Suite

Website

www.re-survey.org
Instrument for NaPiRE - 2013

Research questions

1. What are the expectations on a good RE?
2. How is RE defined, applied, and controlled?
3. How is RE continuously improved?
4. Which contemporary problems exist in RE, and how do they manifest themselves in the process?
5. Are there observable patterns of expectations, status quo, and problems in RE?

• Based on theory of expectations (inferred from available surveys)
• Questionnaire with 35 questions
  • Closed and open questions
  • Implemented via the Enterprise Feedback Suite
  • Available at www.re-survey.org
• Invitation of participants from existing research co-operations
Data Analysis
Statistical Analysis (RQ 1-3)

Research questions

1. What are the expectations on a good RE?
2. How is RE defined, applied, and controlled?
3. How is RE continuously improved?
4. Which contemporary problems exist in RE, and how do they manifest themselves in the process?
5. Are there observable patterns of expectations, status quo, and problems in RE?

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<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 16-a</td>
<td>Requirements are elicited via workshops.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Q 16-b</td>
<td>Requirements are elicited change requests.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Q 18</td>
<td>Requirements engineering standards are defined due to company-specific demands.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Q 19-a</td>
<td>The standard does not rely on an architecture model with different levels of abstraction.</td>
<td>0.6074</td>
</tr>
<tr>
<td>Q 19-b</td>
<td>The standard does not include a differentiated view on different requirements classes and dependencies.</td>
<td>0.4625</td>
</tr>
<tr>
<td>Q 19-c</td>
<td>The standard includes a differentiated view on different requirements classes, but no dependencies.</td>
<td>0.9969</td>
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<tr>
<td>Q 19-d</td>
<td>The standard does not includes tracing relationships among the contents.</td>
<td>0.2397</td>
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<tr>
<td>Q 19-e</td>
<td>The standard does not include a differentiated view on non-functional requirements.</td>
<td>0.7982</td>
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<tr>
<td>Q 20</td>
<td>A requirements change management is established after formally accepting a requirements specification.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Q 21</td>
<td>Each project can decide whether to use the company standard.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Q 22</td>
<td>The company standard is tailored at the beginning of a project by the project lead based on experiences.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Q 23</td>
<td>The application of the RE standard is controlled via analytical quality assurance.</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>
Data Analysis
Grounded Theory (RQ 4)

Research questions
1. What are the expectations on a good RE?
2. How is RE defined, applied, and controlled?
3. How is RE continuously improved?
4. Which contemporary problems exist in RE, and how do they manifest themselves in the process?
5. Are there observable patterns of expectations, status quo, and problems in RE?
Data Analysis

Correlation Analysis (RQ 5)

Research questions

1. What are the expectations on a good RE?
2. How is RE defined, applied, and controlled?
3. How is RE continuously improved?
4. Which contemporary problems exist in RE, and how do they manifest themselves in the process?
5. Are there observable patterns of expectations, status quo, and problems in RE?
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First NaPiRE results from Germany

Study population

- German companies only
- Response rate: 55% (105 invitations, 73 participants, 58 completed questionnaires)

General characteristics

- Most respondents in large enterprises (median: 251-500 employees)
- Most respondents work in globally distributed settings (97 %)
- 80 % of respondents with more than 3 years of experience
- 19 % customer role, 47 % role of contractor, 38 % product development

Main business area

<table>
<thead>
<tr>
<th>Service</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Custom software development</td>
<td>36 %</td>
</tr>
<tr>
<td>IT consulting</td>
<td>36 %</td>
</tr>
<tr>
<td>Project management consulting</td>
<td>35 %</td>
</tr>
<tr>
<td>Software process consulting</td>
<td>31 %</td>
</tr>
<tr>
<td>Standard software development</td>
<td>28 %</td>
</tr>
<tr>
<td>Embedded software development</td>
<td>7 %</td>
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</tbody>
</table>
**First NaPiRE results from Germany**

**RQ 1: Expectations on good RE (Excerpt)**

What do you see as a barrier for an RE reference model?

<table>
<thead>
<tr>
<th>I disagree</th>
<th>Neutral</th>
<th>I agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing willingness for change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher process complexity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher communication demand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing possibility for standardisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower efficiency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Selected results from follow-up questions**

- RE improvement considered as most beneficial and most challenging
- Biggest motivation for RE reference model: QA of artefacts
- Important for RE reference model: Support for agility and guidance for tailoring
First NaPiRE results from Germany

RQ 2: Status quo in RE (Excerpt)

Selected results from follow-up questions

- Motivation for current RE reference model: Company-specific demands (64%)
- Status quo in RE reference model:
  - 33% use no RE reference model or the one predefined by the software process model
  - 45% state their RE reference model to include a (vague) description of the RE artefacts
  - 44% state their RE reference model to include a description of roles and responsibilities
- Application and tailoring: By project lead based on experiences (62%)
- Control: Constructive quality assurance (53%)
First NaPiRE results from Germany

RQ 3: Status quo in RE improvement (Excerpt)

General attitude on RE improvement

• 80% state to improve their RE

• Responsibility for Improvement:
  – Own business unit / role: 55% (in case of large companies; as part of general SPI?)
  – No systematic improvement: 29%

• Perceived value for external improvement norms: “I am not convinced of the benefits”

Motivation for an RE improvement

- Detecting weaknesses
- Expected by customers
- Demanded by regulations

Improvement methods (assessment & evaluation)

- Qualitative analyses
- Metrics
First NaPiRE results from Germany

RQ 4: Contemporary problems in projects (Excerpt)

Interpretation: Need for flexibility and / or agility?

Interpretation: Need for artefact definition and QA?
First NaPiRE results from Germany

RQ 4: Manifestation of problems in process (Excerpt)

Implications of Problems
(Grounded Theory)
First NaPiRE results from Germany

RQ 5: Observable patterns (Excerpt)

• No systematic RE improvement in domain of custom software development.

• Who rates the RE standard as too complex, rates the content/guidance at the same time as too abstract.

• Who rates the RE standard to not sufficiently guide the creation of precise requirements specifications, rates it as not sufficiently defining terminology (and vice-versa)

• Who rates the RE standard as too heavy-weight, ...
  – ... rates it to not sufficiently defining roles and responsibility
  – ... rates it not flexible enough

• Who states to be confronted with a discrepancy between high degree of innovation and need for formal acceptance of RE artefacts, also states to have problems with time boxing.
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Summary of Results
Making things we are preaching anyway explicit...

• RE Governance & RE Improvement (if performed)
  – Systematic RE improvement considered important, but challenging
  – No / weak systematic management or improvement of RE reference models at organisational levels
  – General reluctance against prescriptive (external) improvement norms
  – RE improvement needs to rely on qualitative methods (considering own goals and problems)

• RE Reference Models & Awareness at project level
  – Biggest motivation for RE reference model: QA of artefacts
  – Reference models seen as too abstract w/o giving guidance on contents and terminology, unclear roles, and not sufficiently integrated into surrounding disciplines
  – Respondents state to need more guidance on how to create precise artefacts
  – Tailoring of RE reference model based on experiences of project lead (not even by a requirements engineer)
  – Quality assurance done in a constructive manner although artefact templates rated as too vague

• RE Problems
  – 21 given problems (without considering grounded theory results) including problems in terminology, artefacts quality, or roles and responsibilities
  – Manifestation in projects:
    • Problems occurred 221 times leading 80 times to project failures (36%)
    • Further consequences: change requests, re-planning and communication, stagnation, time and cost overrun
What does that mean for RE Research?

Topics

• RE Improvement Research
  – Transfer and application of empirical methods for a problem-driven RE improvement
  – Focus on artefacts, roles and responsibilities, tailoring profiles / adaptability

• Artefact Orientation...
  – Value supported by respondents (“guidance”, “precision”, “terminology”, “flexibility”, ...) as it offers means to tackle many (stated) problems in RE, but needs further investigation
  – Needs to be established in a company-specific/problem-driven way (reflecting organisational culture w.r.t. artefacts, terminology, roles, process integration)

• Traceability still an unsolved issue

• Systematic quality assurance...
  – Efficient techniques for constructive quality assurance
  – Finding appropriate (goal-driven) measures for analytical quality assurance

• Further topics that need (further) investigation
  – Role of RE at organisational level
  – Economical impacts of discovered problems and technical debt in context of RE
Threats to Validity (Simplified)

- First results from one country
- Theory “calibrated” and extended

⇒ We need further replications!
  - Synthesis w/ results from other countries
  - Saturation of hypotheses in theory
Agenda

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Short-term plan

Next steps within the research group

Internally use results for experimental research in RE

• Value of *artefact orientation*: Validate criteria used in previous case studies in RE, optionally launch new experiments
• Use for experiments and case studies on *quality management in RE*

Operationalise & disseminate results

• Reflect on *essence* of survey results and reasoning based on previous case studies (Potential submission to *IEEE Software*)
• Establish guideline on qualitative analyses: Potential (ABC) chapter on *Analyzing Software Data*
• Maintain website [www.re-survey.org](http://www.re-survey.org)
  (*Sophist blog already relies on our results…. although not a measurement of success… ;-)*)

Extend the survey

• Re-calibrate the questionnaire according to results (e.g. more focus on status quo in artefacts, problems, and technical debt)
• Coordinate replications
Long-term plan
NaPiRE went under the umbrella of ISERN!

1. Synthesis with results from NL and publication
2. Begin replications within ISERN under our lead
The new team within ISERN

- Canada
- USA
- Brazil
- Spain
- Netherlands
- Germany
- Finland
- Norway
- Estonia
- Luxembourg
- China
Thank you!

Special thanks for the support during the design:

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