Requirements-Oriented Problems While Architecting: An Empirical Study

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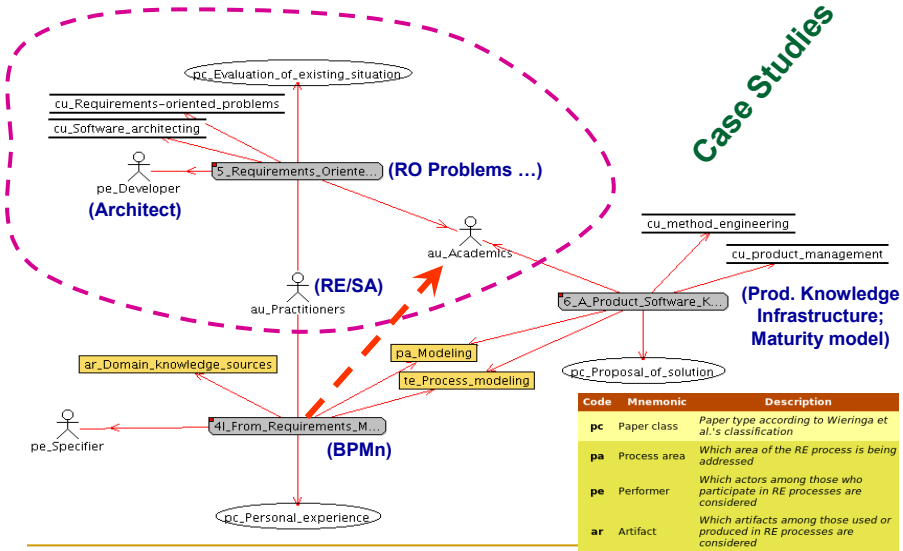
Requirements-Oriented Problems …



Introduction

We ask a rarely posed question:

- "What kinds of requirements-oriented (RO) problems are being experienced while architecting a software system?"

Purpose of Study

- Motivation for this question is rooted in its significance for both the software architecting (SA) and the requirements engineering (RE) fields.
- Answering the question could help in improving RE/SA practice and technologies.

Study Overview

- **16 teams**, *each* architecting from the same set of requirements.
- **Results**: Found several different types of RO problems.

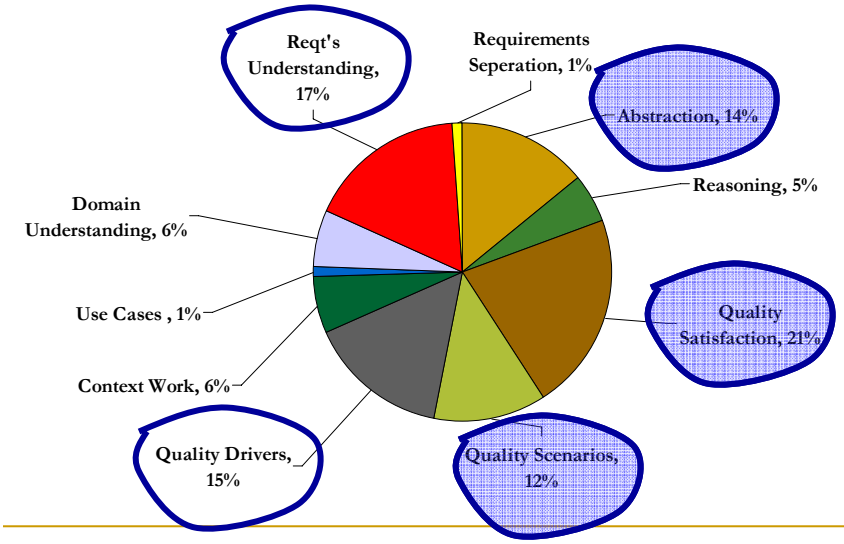
More study details later.

RO problem spread

Team #	Mild	Moderate	Severe
1	9	4	1
2	1	2	0
3	10	8	1
4	4	1	2
5	6	6	2
6	18	10	4
7	3	9	0
8	6	7	0
9	7	9	0
10	4	1	1
11	8	4	1
12	11	3	0
13	4	13	2
14	21	21	8
15	12	9	2
16	10	12	1

- Problem spread:
  - All teams had problems
  - Mild, Moderate or Severe
- **35%** of all problems were RO
  - This suggested the need for further analysis.

RO Problematic Areas



Quality Satisfaction – 21%

- **DEFINITION:** The ability to discern whether the architectural solution would, or did, meet the quality requirements.
- **INTERPRETATION:** Most of the problems seem to lie with *performance* and *availability* requirements.
  - *Security* and *modifiability* (also of high priority) were generally implemented and reasoned with relative ease.

Quality Satisfaction – ../contd.

- This suggests that certain types of requirements property make it simpler (or harder) to relate the requirements to an architecture.
- For example, *security* requirements will often suggest, tangible, concrete functions involved, whereas *performance* requirements may not readily suggest specific, implementable elements except perhaps those involving specific physical elements.

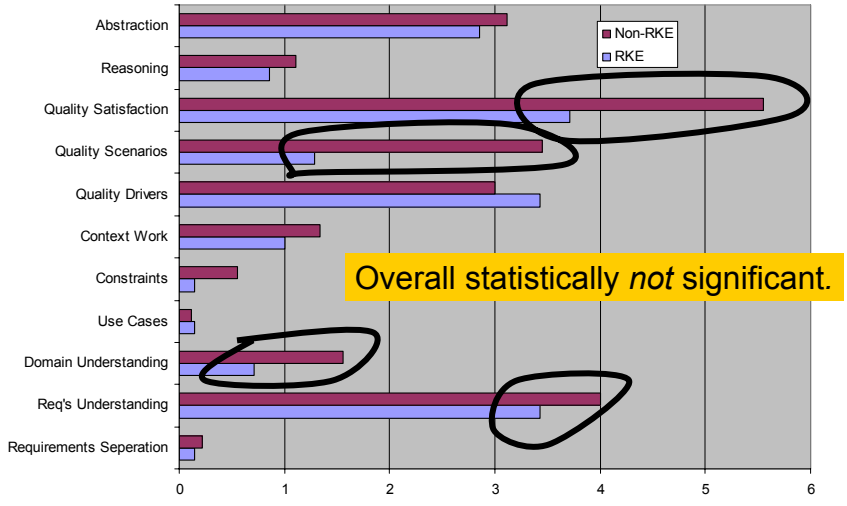
Modelling Quality Requirements – 12%

- **DEFINITION:** *Modelling quality requirements* involves, amongst other things, a stimulus and a response to the stimulus.
  - The resultant scenarios help understand, specify and prioritise desirable system qualities.
  - They are a trigger for architectural design and
  - They provide a means to check that the architecture satisfies the intended quality attributes.
- **INTERPRETATION:** It seems that theory is ahead of practice in this area at the moment.
  - Should motivate Tech. Transfer and more studies.

Abstraction – 14%

- **DEFINITION:** This has to do with varying (subjective) levels of abstraction of the different requirements.
- **INTERPRETATION:** This seems to cause mapping problems between requirements and component hierarchies in the architecture.
  - Begs the question whether requirements have been documented at a consistent level of abstraction (e.g., from the point of view of system functionality) and, if not, whether they should be regrouped or decomposed so as to simplify mapping on to architectural components.

RE vs. non-RE Architecting Teams



Study Details

- Study design
- Participants
- Requirements document
- The architecting project
- Data collection
- Data analysis

Study Design

- *Multi-case* (16) study design [Creswell 2003]
- *Exploratory* study (no initial hypothesis on RO problems).
  - There wasn't much background literature related to the posed research question.

Participants

- Used availability (or *convenience*) sampling [Creswell, 2003]
- Participants: final year *Software Architecture* course at the University of Western Ontario (UWO).
- Each of the 16 architecting teams comprised of 4 members.

Requirements Document

- Application domain: banking.
- About 85 high-level requirements.
- Architects were briefed about the project and requirements were explained.

The Architecting Project

- Each of the 16 teams developed an architecture from the same requirements using the ADD method [Bass, et al. 2003]
- Architectures were documented and their process data was captured in defined templates
- Each team had the freedom to seek help on any difficulties they faced during their project. We termed these “feedback” sessions. ➔

Data Collection

- *Process* data gathered:
  - intra-team email communications,
  - data templates and
  - feedback sessions (over 50 hours recorded).
- Ethnographic methods were used such as participant observation and semi-structured interviews.

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Data Analysis

- *Content analysis* [Creswell, 2003] was performed on the transcribed data. (QSR NUD*IST 4.0 Tool used)
- The frequency of the various types of feedback (i.e., severity of RO problems, and technical activity in the architecting process) was counted.
- The technical activities were identified before appropriate categories were formed ➔

Summary – 1/4

- **Which quality features are addressed by the paper?**
  - Quality Satisfaction
  - Modelling quality requirements (scenarios)
  - Quality drivers determination
- **What is the main novelty/contribution of the paper?**
  - The study identifies specific RO problem areas discussed (see pie chart).
  - To our knowledge, the first study of its kind.

Summary – 2/4

- **How will this novelty/contribution improve RE practice or RE research?**
  - RE Practice:
    - Feedback: Awareness of the RO problem areas for architects.
    - To take special care when documenting requirements.
    - To ensure problematic areas are dealt with care when transferring over RE documents and knowledge to SA.
  - Research:
    - Call for more studies!
    - Need for improved RE tools to aid e.g.:
      - Quality driver determination
      - Quality scenario modelling
      - Consistent level of abstraction

Summary – 3/4

- **What are the main problems with the novelty/contribution and/or with the paper?**
  - Threat to generalisability of the results to the software industry due to:
    - the use of student subjects,
    - academic environment, and
    - relatively small size of requirements set considered.

Summary – 4/4

- **Can the proposed approach be expected to scale to real-life problems?**
  - As far as the results are concerned, where there is smoke there might be fire. So, we believe the study to be an important precursor for specific case studies in industry.
  - Such a study should be possible, in principle, in industry.
  - The “control” (RE vs. non-RE architects) might be very difficult to achieve in industry.

The End