An Empirical Investigation of Scenarios Gained and Lost in Architecture Evaluation Meetings

Dietmar Winkler¹, Stefan Biffl¹, Muhammad Ali Babar²

¹Institute of Software Technology and Interactive Systems
Vienna University of Technology, Austria

²Lero, University of Limerick, Irland
Motivation & Background

- Software architecture is a **success-critical issue** in software projects.
- **Defects and Changes** can have a major impact on quality of delivered system, project duration, and cost.
- Issues related to **Quality Attributes** and **Non-Functional Requirements** (such as modifiability, performance, and maintainability) should be addressed early.

**Basic Idea:**
- Using benefits of **Software Inspection Processes** to identify **Scenarios** for **Architecture Evaluation**.
  - **Scenarios** can be used to address these Non-Functional Requirements.
  - **Architecture evaluation** supports project managers to consider quality sensitive scenarios in early software architecture decisions based on architecture evaluation processes like ATAM.
  - Process from **Software Inspection**: (a) Individual Scenario Brainstorming and (b) Team Meeting.
Research Questions & Study Process

- **Empirical study** (controlled experiment) on a scenario elicitation workshop with focus on team meeting effectiveness.

- **Key research questions**:  
  - How do guidance with change categories influence scenario brainstorming supported by these categories (top-down)?  
  - What is the effect of scenario brainstorming performance of real and nominal teams regarding scenario gain and lost.

- **Study Process:**
  - SRS for a system  
  - Process Instructions  
  - Support material  
  - Develop Individual Scenarios  
  - Individual Scenarios Submitted  
  - Individual Score  
  - Develop Team Scenarios  
  - Team Scenarios  
  - Team Score
Study Material:

- **Requirements Specification** for a Web-Based Distributed Collaboration tool.
- **Quality Attribute**: Modifiability (over three years).
- **6 Software Change Categories** provided to the treatment group (e.g., UI changes, communication tool changes, etc).

Variables:

- **Independent Variables**: Domain specific change categories of software changes.
- **Dependent Variables**: Frequency of scenarios: (a) individual, (b) real 3-person teams, (c) nominal (non-communicating) 3-person teams.

- **Randomized balanced design / Randomized group assignment**.
- Treatment group: change categories provided (12 participants), 4 teams.
- Control group: change categories not provided (12 participants), 4 teams.
Execution & Threats to Validity

Experiment Execution:
- **Selection** of participants, **group assignment** (treatment and control group) and (real) **team composition**.
- **Briefing session** (30 min).
- **Experiment Execution - individual** - team.
- **Frequency-Based Scenario Classification**.

Validity Considerations:
- **Internal validity**: randomized subject assignment, Scoring schemes (frequency-based), Subject experience (students).
- **External validity**: classroom setting, similar background of participants, possible limited experience on the domain, short software requirements specification might not be typical in industry setting.
Scenario Reports by Real Teams

- **Real 3- Person Teams** (collaborative team meeting).

- **Up to 90% more scenarios compared to individuals.**

- Notable differences for all scenario classes of control and treatment group members:
  - More critical scenarios (class A)
  - Less class B and C scenarios

- But no significant differences.

- **Top down scenario method** (change categories provided) might provide a better guidance for critical scenarios.

### Table: Scenario Category Mean and Std. Dev.

<table>
<thead>
<tr>
<th>Scenario Category</th>
<th>Control Group Mean</th>
<th>Control Group Std.Dev.</th>
<th>Treatment Group Mean</th>
<th>Treatment Group Std.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>5.8</td>
<td>4.79</td>
<td>9.8</td>
<td>1.26</td>
</tr>
<tr>
<td>Class B</td>
<td>6.8</td>
<td>3.10</td>
<td>5.3</td>
<td>2.87</td>
</tr>
<tr>
<td>Class C</td>
<td>2.8</td>
<td>4.27</td>
<td>1.5</td>
<td>1.29</td>
</tr>
</tbody>
</table>

Real Teams
Gain / Loss of Scenarios

- Comparison of 3 person teams (similar team members): real vs. nominal teams

- Average total number of scenarios found:
  - Real Teams: 15 scenarios.
  - Nominal Teams: 22 scenarios.

- Scenario gained / lost in team meetings:
  - Class A/B: more lost than gained.
  - Class C: similar number of gained/lost scenarios.

- Nominal teams
  - are more effective.
  - require less effort (no team meeting)
  - These results indicate that real team meetings hinder scenario elicitation.
Conclusions and Future Work

- **Impact of Change Categories**
  - Change categories are used to guide reviewers in the scenario brainstorming process (top-down approach).
  - Results show a significant improvement of identified critical (class A) scenarios.

- **Scenario Gain / Loss in Team Meetings.**
  - **Less effort** because there is no real team meeting.
  - Results show a **higher number of scenario losses** in a real team meeting for **critical and important** scenarios and a **comparable number** of gains/losses for **less important** scenarios.
  - Real team meetings seems to be questionable regarding the team meeting conducted in this study.

→ **Future work** is an ongoing analysis of impact factors on team meetings.
→ **Replication of the study** to achieve a deeper insight in team meeting processes.