Goal-Oriented Requirements Engineering: A Systematic Literature Map

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Motivation: Proliferation of GORE

- Goals in RE are used to elicit, model and analyse requirements, capturing alternatives and conflicts.
- The RE community has paid much attention to Goal-Oriented Requirements Engineering (GORE)
  - Informal impression: many past papers, increasing numbers...
- There is no general, broad systematic literature study of GORE.
- As a first step, we present a Systematic Literature Map (SLM)
  - As per Kitchenham et al. 2011 & Peterson et al. 2008.
# Background: Systematic Literature Map

<table>
<thead>
<tr>
<th>Systematic Literature Review (SLR)</th>
<th>Systematic Literature Map (SLM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematic to support repeatability</td>
<td>Systematic to support repeatability</td>
</tr>
<tr>
<td>Driven by Research Questions</td>
<td>Driven by Research Questions</td>
</tr>
<tr>
<td>Detailed coverage</td>
<td>Coverage at a high-level</td>
</tr>
<tr>
<td>All of each paper is read</td>
<td>Only certain sections read</td>
</tr>
<tr>
<td>Evaluates quality</td>
<td>Does not evaluate quality</td>
</tr>
<tr>
<td>Mostly textual analysis</td>
<td>Emphasis on visual results</td>
</tr>
<tr>
<td>Covers some papers</td>
<td>Covers many papers</td>
</tr>
</tbody>
</table>

GORE: Systematic Literature Map
SLM Method

- **Preparation:** Codes were derived iteratively through early snowballing rounds over candidate papers.
- Measured Inter-coder agreement using Krippendorf’s alpha:
  - Rounds of early iteration over sample paper subsets, codes and definitions until alpha score was satisfactory (approx. 0.67).
- Data collection supported by a database and web interface.
SLM Method

- **Systematic search**: Scopus (includes IEEE, Springer, ACM)
- ("goal-oriented" OR "goal model" OR "goal modeling" OR "goal modelling") AND "requirements" as of 2015-12-16 = 966 results
  - 394/966 papers, 41%, had 0 citations
  - Cut-off of 3 or more citations = 350 publications
- 6 coders, each paper assigned to 2 coders, disagreements discussed
- Read the title, abstract, introduction and conclusion
  - Could optionally flip through details when uncertain
- Found 104 papers out of scope, final inclusion: 246
### Scope & Preliminaries: Inclusion/Exclusion Criteria

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Has a significant component that deals with GORE</td>
<td>Does not significantly relate to GORE or</td>
</tr>
<tr>
<td>In conference, journal, or in/is a book, and</td>
<td>Is a thesis, workshop or regional conference, or</td>
</tr>
<tr>
<td>Is published in English, and</td>
<td>Is published in another language, or</td>
</tr>
<tr>
<td>Is more than 3 pages.</td>
<td>Is 3 pages or less.</td>
</tr>
</tbody>
</table>
## Scope & Preliminaries: Paper Categories

<table>
<thead>
<tr>
<th>Paper Type</th>
<th>Paper Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formalization</td>
<td>Architecture</td>
</tr>
<tr>
<td>Meta Study</td>
<td>Compliance (&amp; Law)</td>
</tr>
<tr>
<td>Implementation</td>
<td>Patterns</td>
</tr>
<tr>
<td>Integration/Transformation/Mapping</td>
<td>Agile</td>
</tr>
<tr>
<td>Extension</td>
<td>Scenarios</td>
</tr>
<tr>
<td>(Ontological) Interpretation</td>
<td>Systematic Reasoning</td>
</tr>
<tr>
<td>Evaluation (Benchmark)</td>
<td>Adaptation, Variability, &amp; Evolution</td>
</tr>
<tr>
<td>Evaluation (Controlled Experiment)</td>
<td>Privacy, Security, Trust, &amp; Risk</td>
</tr>
<tr>
<td>Evaluation (Questionnaire)</td>
<td>Business Intelligence/Modeling</td>
</tr>
<tr>
<td>Evaluation (Case Study)</td>
<td>GORE: Systematic Literature Map</td>
</tr>
<tr>
<td>Evaluation (Scalability)</td>
<td></td>
</tr>
</tbody>
</table>
SLM RQs and Results
Results: Classification (RQ1)

- **RQ1**: How can we classify the type of GORE approach?

![Bar chart showing classification percentages]
Results: Classification over Time (RQ1)

- **RQ1**: How has this changed over time?
Results: Evaluation (RQ2)

- **RQ2**: Do GORE publications contain evaluation? What type?
- 53% of the 246 papers contain a case study, 27% some evaluation of scalability, 7% a controlled experiment, 7% questionnaires, and 4% contain some type of benchmark.
- How has this evolved?
Results: Topics (RQ3)

- **RQ3**: What are the topics covered by GORE publications?
Results: Topics over Time (RQ3)

- **RQ3**: How have these topics evolved over time?
Results (RQ4)

- **RQ4**: What goal modeling frameworks have been used in the publications?

![Pie chart showing the distribution of goal modeling frameworks.]

- General: 21.54%
- Multiple: 7.32%
- KAOS: 12.60%
- i*: 13.41%
- NFR: 5.69%
- Tropos: 5.28%
- GRL: 2.44%
- URN: 2.44%
Results (RQ5)

- RQ5: In what journals or conferences do approaches appear?

- 211 Unique venues!
Results (RQ6)

- **RQ6**: What techniques are most widely cited? Are citations equally distributed? How do they vary per citation source?
**Results (RQ7)**

- **RQ7**: Is interest in GORE increasing or decreasing?
Summary & Discussion

• Some trends in topics, e.g., rise in adaptation/variability/evolution
  o Most of the topics seem to rise and fall with the number of papers
• The KAOS and i* Frameworks appear nearly equally
  o Majority of papers remaining noncommittal in regards to framework
• RE and REJ dominate, but we can see a wide variety of venues
• GORE has seen increased interest in recent years, possibly with a dip in interest recently
• About half of the publications have a case study
  o Scalability tests are still in use, while other forms of evaluation are rare
• Lots of new proposals
  o Slight rise in use of past approaches (implementations, integrations, extensions)
• Many papers with low citations
Summary & Discussion

• One hypothesis:
• Understanding and evaluating the socio-technical divide between complex human organizations and complex systems is a particularly hard problem
• The proliferation of proposal papers may be due to the complex nature of RE problems and the maturity of the field.
  o May be why the area of GORE research appears to have difficulty converging
• Or...
Recommendations

• For those planning on making future research contributions to GORE…

• 1) Due diligence is required to find related work.
  o Don’t just cite “usual suspects”: a more detailed literature search should be performed
  o make an effort to understand, adapt, extend and re-use what has been done

• 2) Plain clear wording in the title, abstract and keywords are important
  o For future Meta Studies, but also to help future readers more easily pick up on your work

• 3) It would be ideal to see an increased focus on evaluation of existing methods, rather than the introduction of new ones
Conclusions & Future Work

- Provided a first general overview of GORE via a SLM
- Provided possible explanations for some of the trends observed
- Several threats to validity (see paper)

- All data is publically available, we encourage reuse and further analysis
- Expanded data analysis
- Comparison to other RE areas?
- Follow-up SLR on key areas?