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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

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

SLM Method

- **Preparation:** Codes were derived iteratively through early snowballing rounds over candidate papers
- Measured Inter-coder agreement using Krippendorff'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

Inclusion Criteria	Exclusion Criteria
Has a significant component that deals with GORE	Does not significantly relate to GORE or
In conference, journal, or in/is a book, and	Is a thesis, workshop or regional conference, or
Is published in English, and	Is published in another language, or
Is more than 3 pages.	Is 3 pages or less.

Scope & Preliminaries: Paper Categories

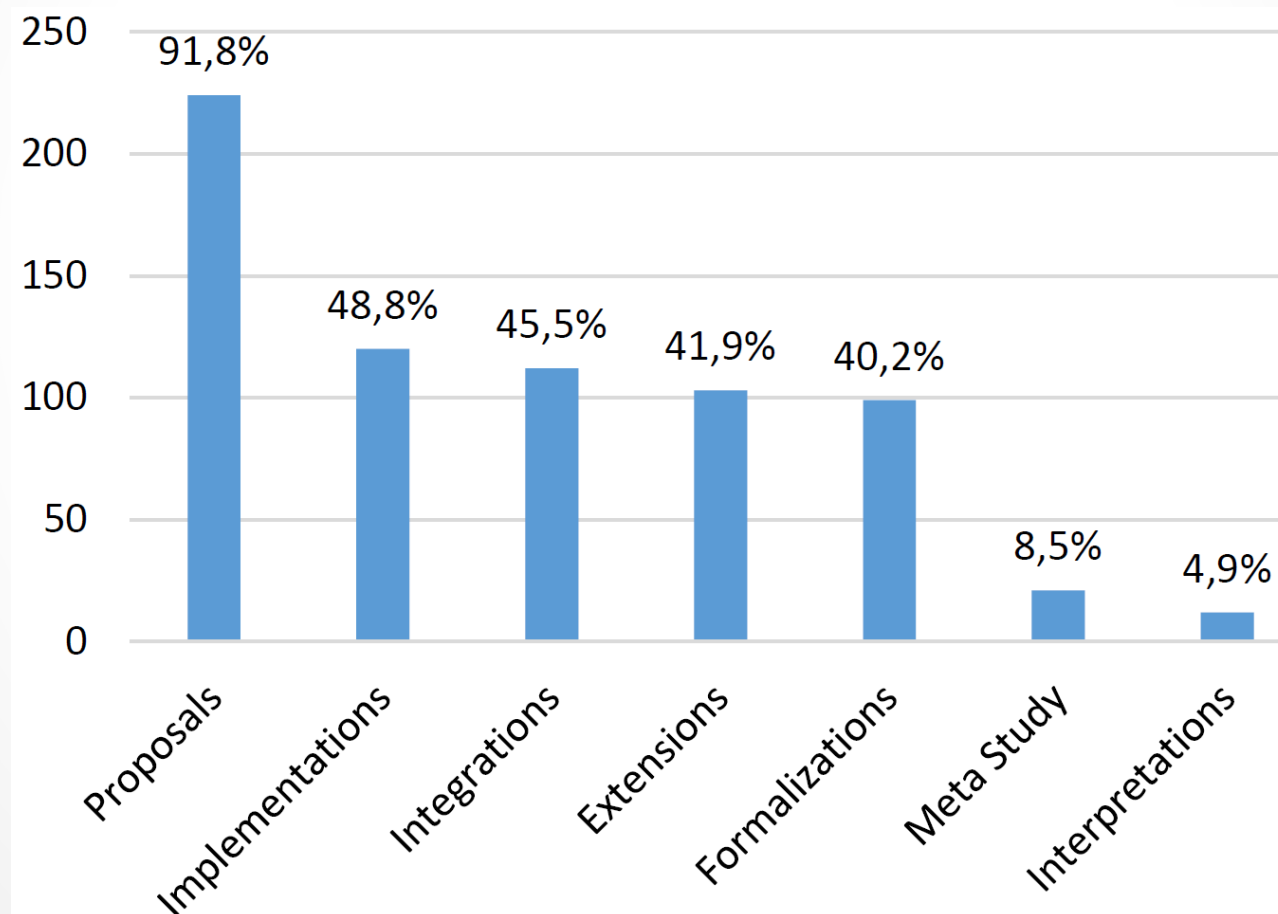
Paper Type	Paper Topic	
Formalization	Agents	Architecture
Meta Study	Aspects	Compliance (& Law)
Implementation	NFRs/Softgoals	Patterns
Integration/Transformation/Mapping	Conflicts	Agile
Extension	Requirements Engineering	Scenarios
(Ontological) Interpretation	Early Requirements Engineering	Systematic Reasoning
Evaluation (Benchmark)	Model Driven Development	Adaptation, Variability, & Evolution
Evaluation (Controlled Experiment)	Business Intelligence/Modeling	Privacy, Security, Trust, & Risk
Evaluation (Questionnaire)		
Evaluation (Case Study)		
Evaluation (Scalability)		

SLM RQs and Results

...

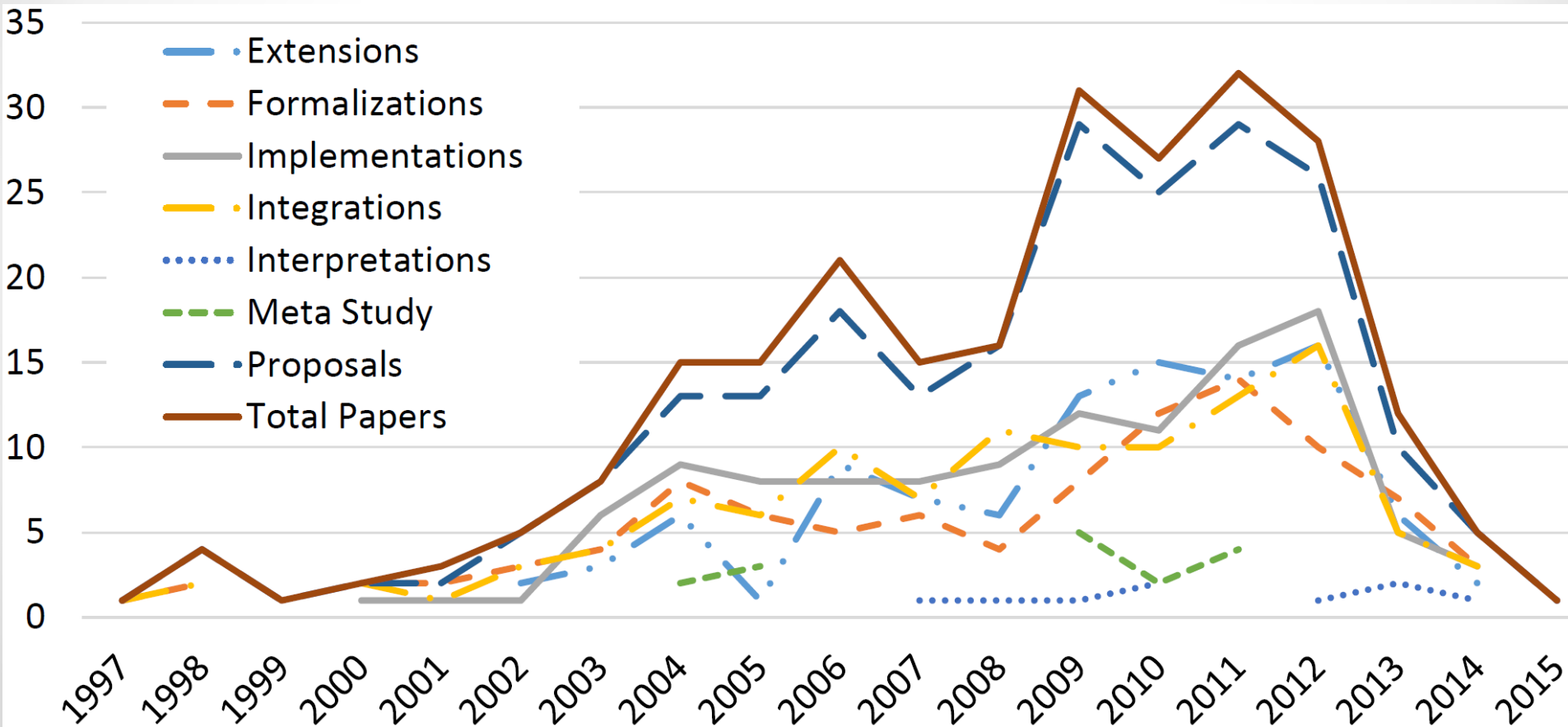
Results: Classification (RQ1)

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



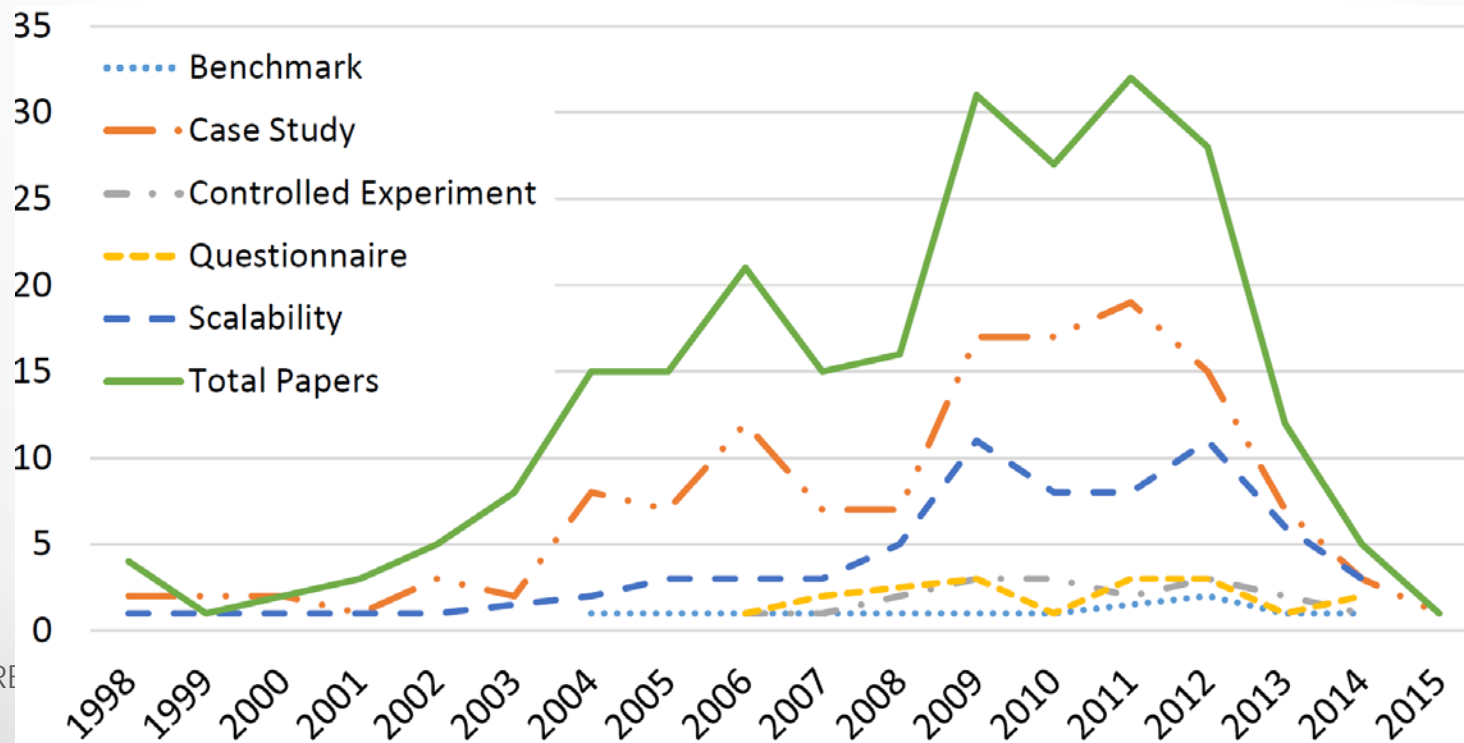
Results: Classification over Time (RQ1)

- RQ1: How has this changed over time?



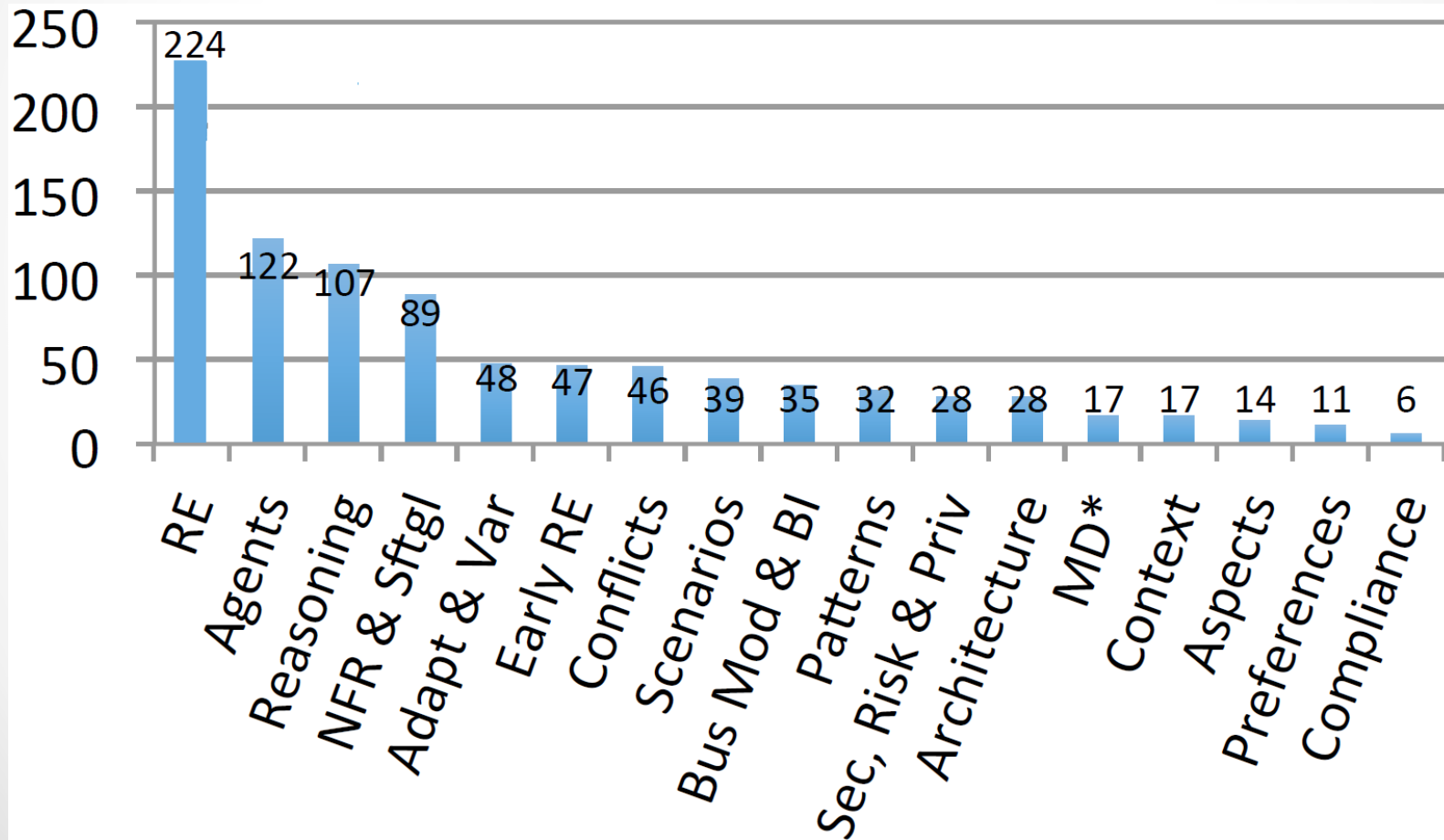
Results: Evaluation (RQ2)

- **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?



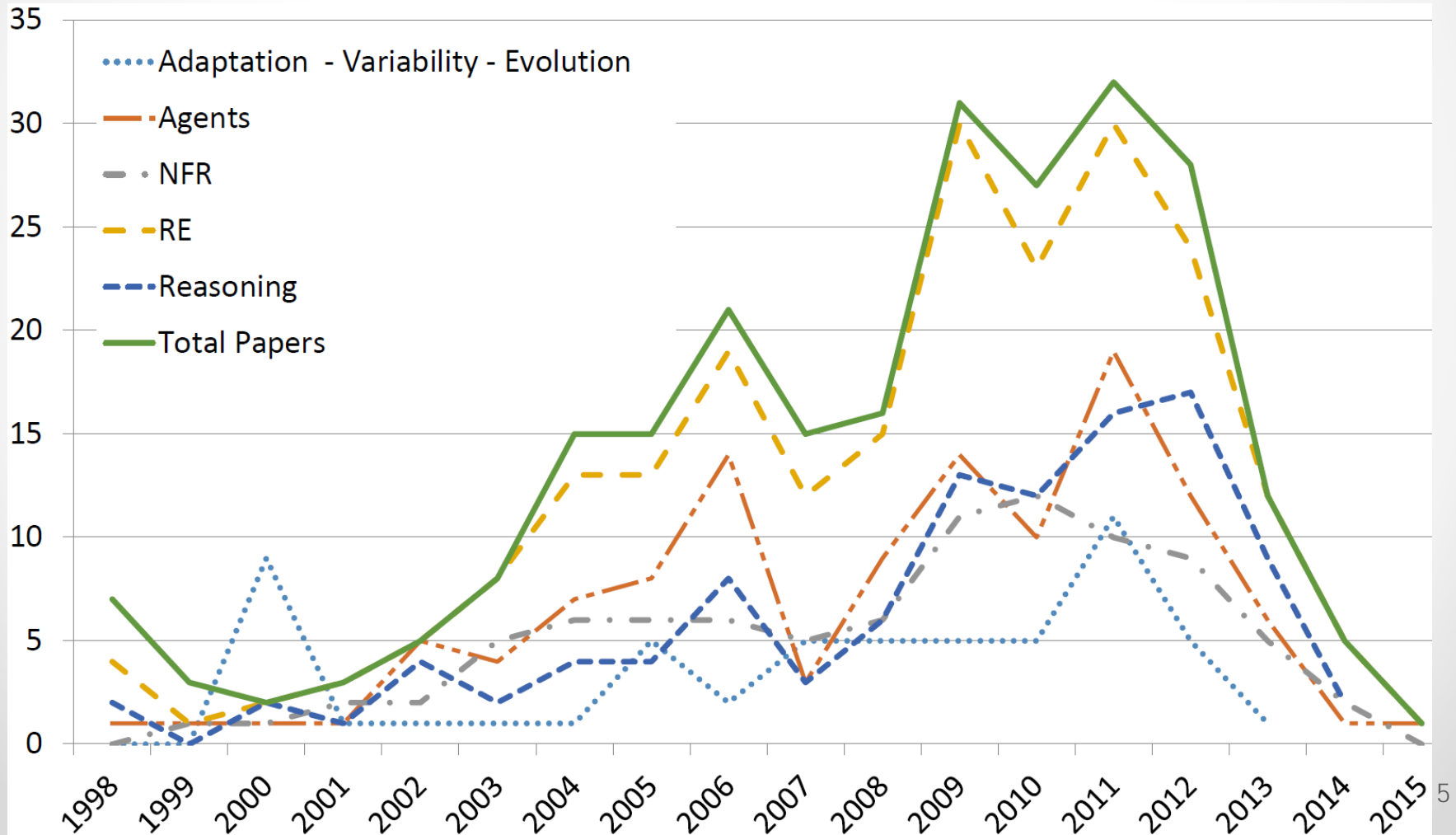
Results: Topics (RQ3)

- **RQ3:** What are the topics covered by GORE publications?



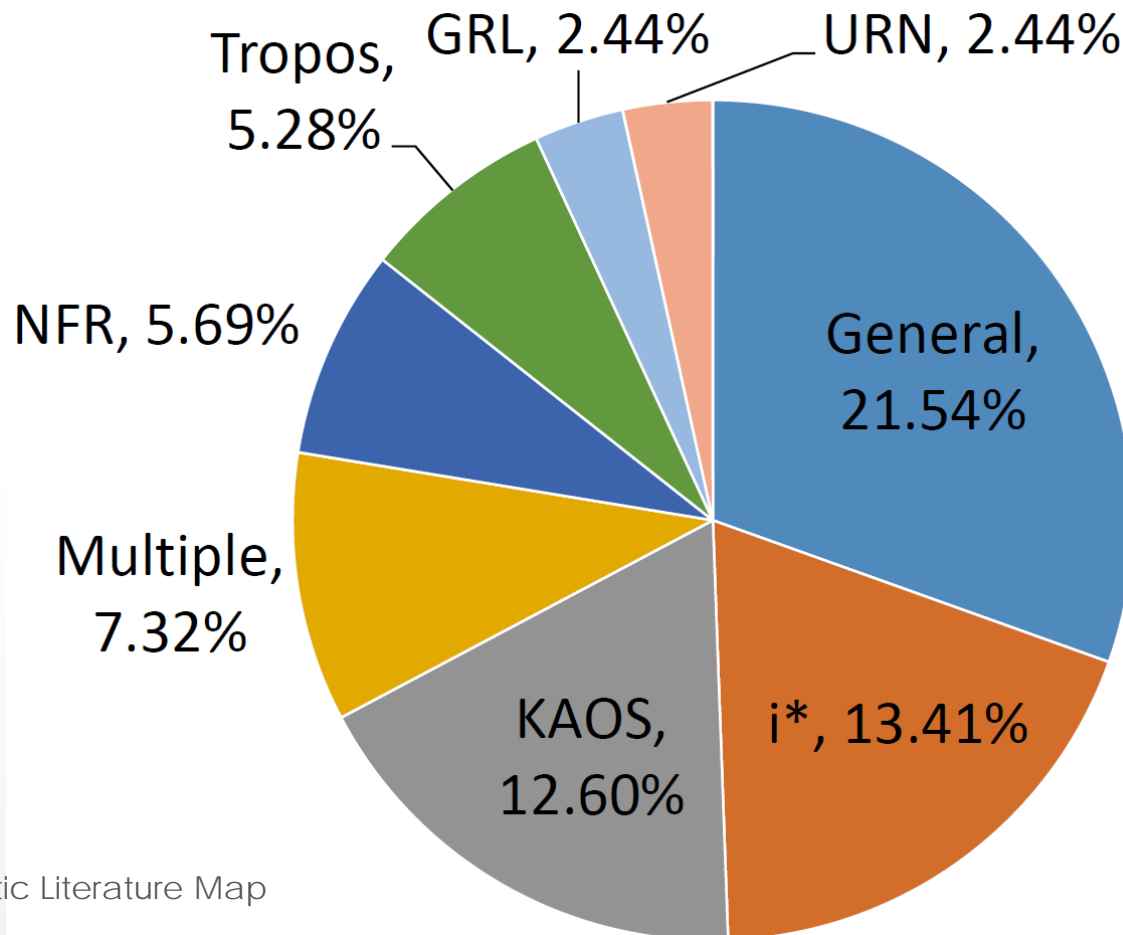
Results: Topics over Time (RQ3)

- **RQ3:** How have these topics evolved over time?



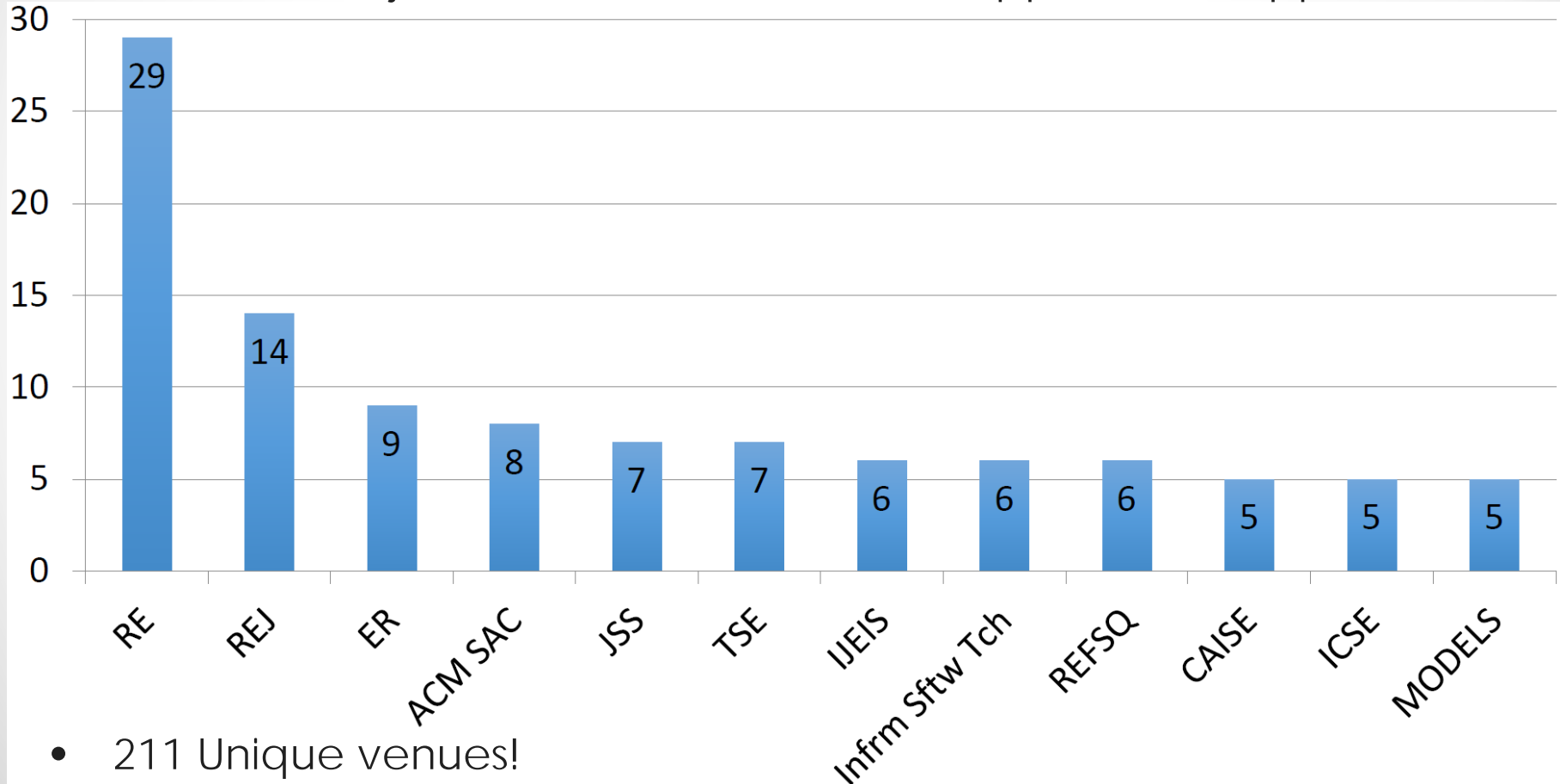
Results (RQ4)

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



Results (RQ5)

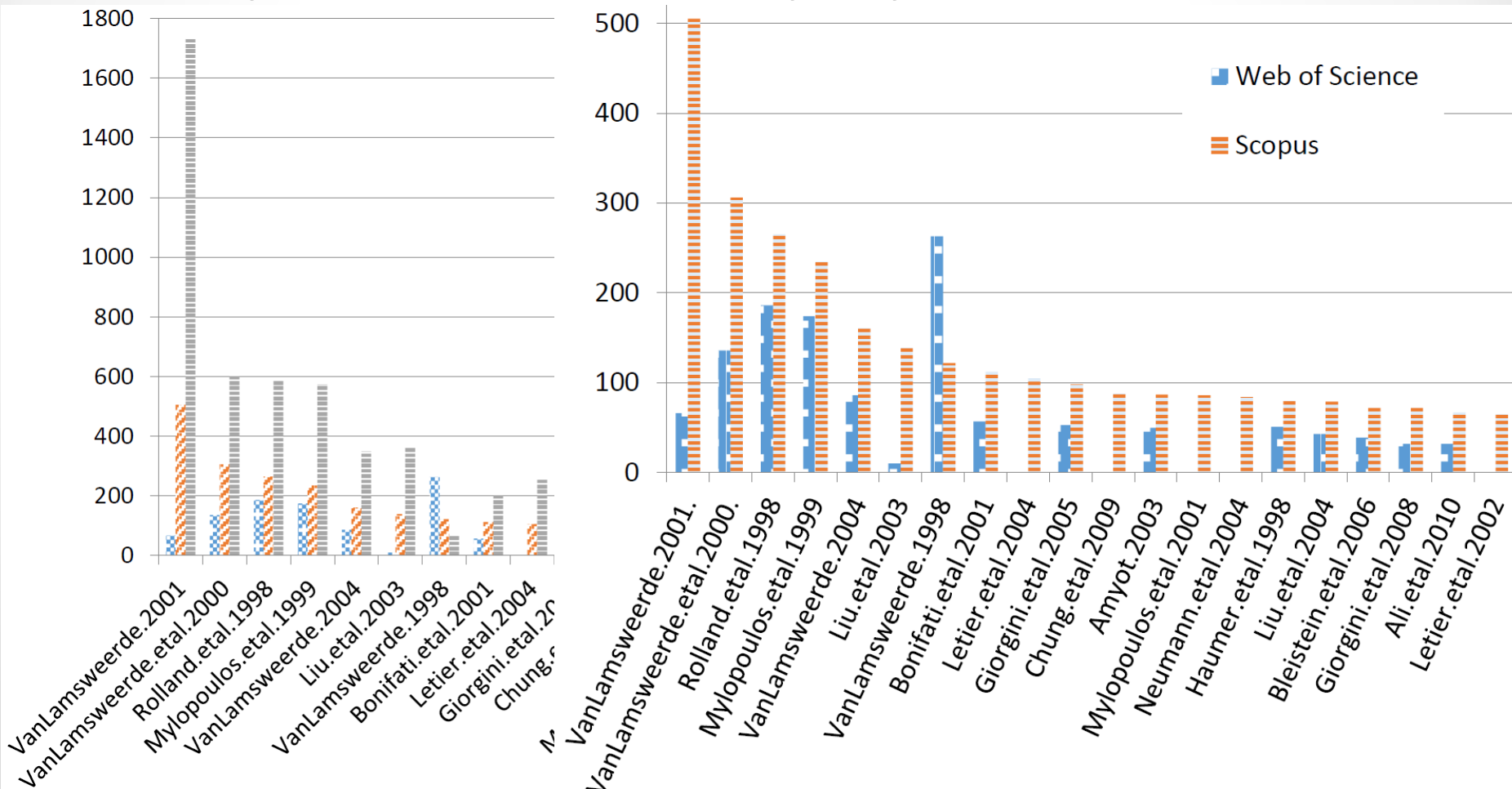
- RQ5: In what journals or conferences do approaches appear?



- 211 Unique venues!

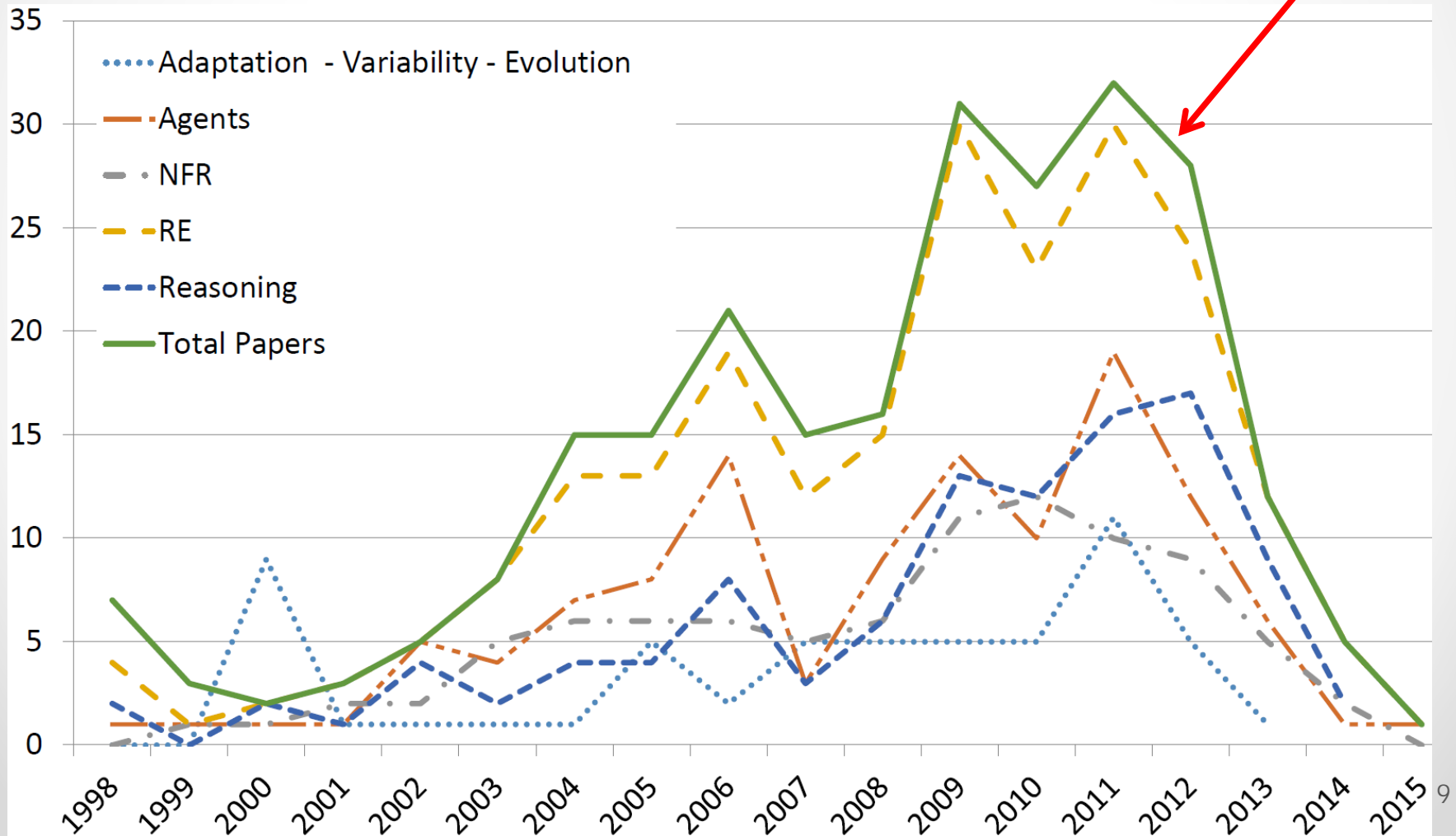
Results (RQ6)

- 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
 - Most of the topics seem to rise and fall with the number of papers
- The KAOS and i* Frameworks appear nearly equally
 - 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
 - Scalability tests are still in use, while other forms of evaluation are rare
- Lots of new proposals
 - 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.
 - 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.
 - Don't just cite "usual suspects": a more detailed literature search should be performed
 - 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
 - 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?