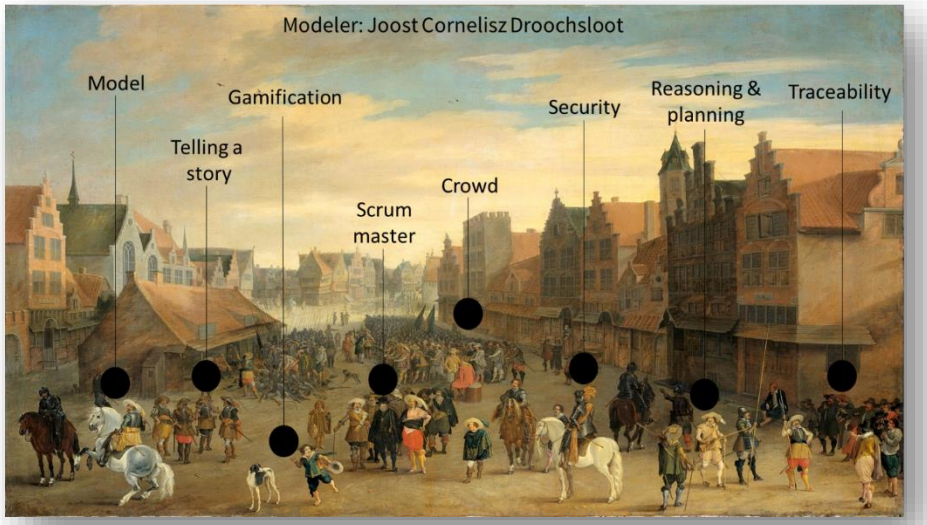
Research on NLP for RE at Utrecht University
A Report



Fabiano Dalpiaz and Sjaak Brinkkemper
Requirements Engineering Lab
Utrecht University, the Netherlands
March 18, 2019

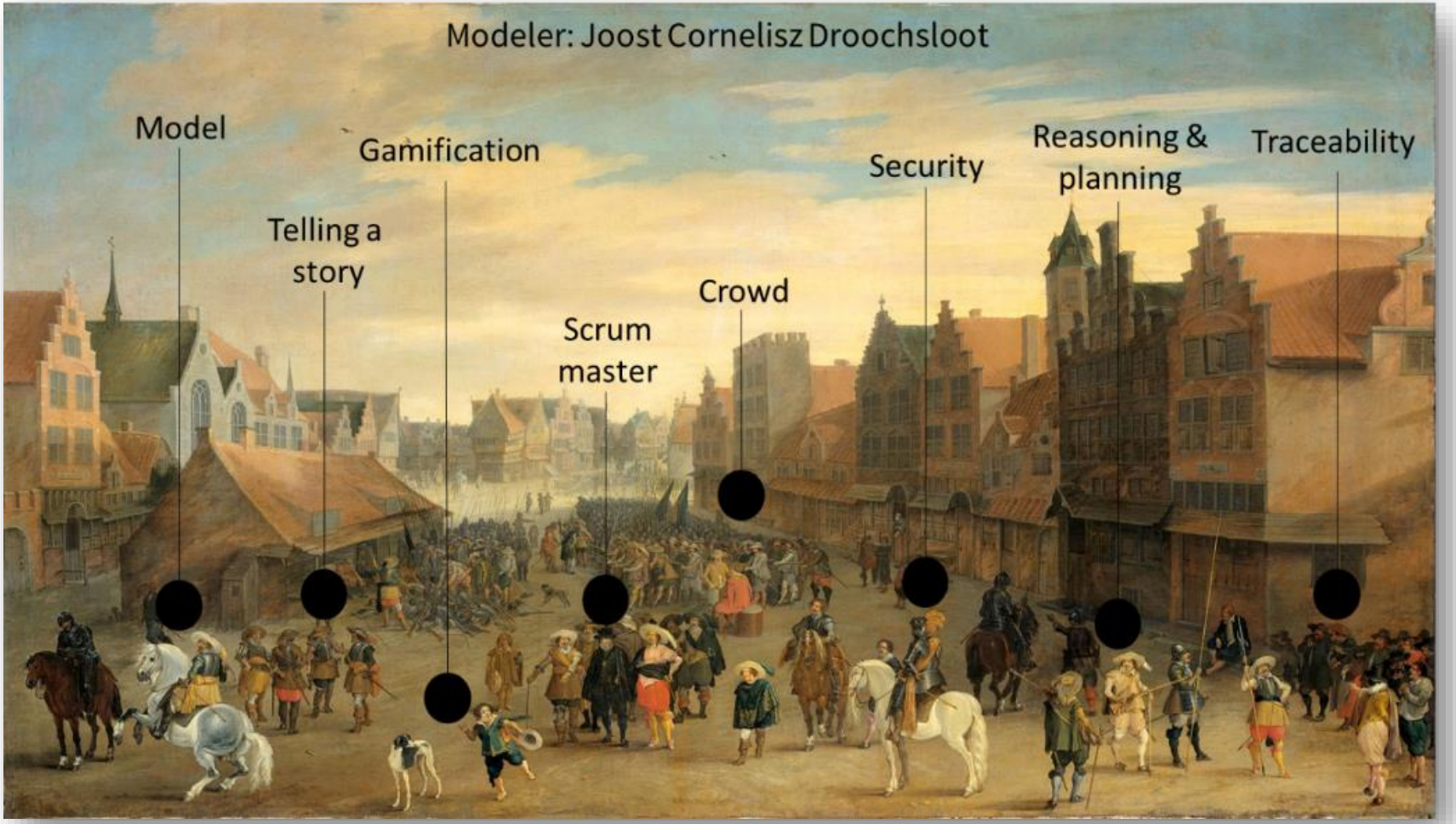
1. Team overview

Goal of the RE-Lab

Requirements Engineering

Requirements Engineering (RE) is the discipline that is concerned with understanding, modeling and specifying, analyzing and evolving the requirements of software systems. The Requirements Engineering Lab (RE-Lab) at Utrecht University is involved in several research directions with the common objective to **help people express better requirements** in order **to ultimately deliver better software.** Our recipe involves the use of state-of-the-art, innovative techniques from various disciplines (computer science, logics, artificial intelligence, computational linguistics, social sciences, psychology, etc.) and to apply them to solve real-world problems in the software industry.

Research themes, illustrated



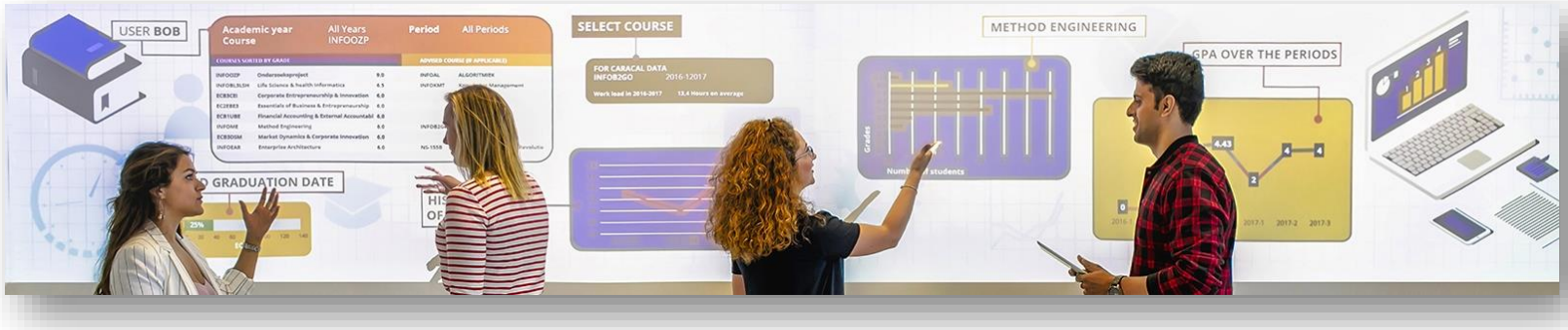
The RE-Lab team

Principal investigators

Researchers

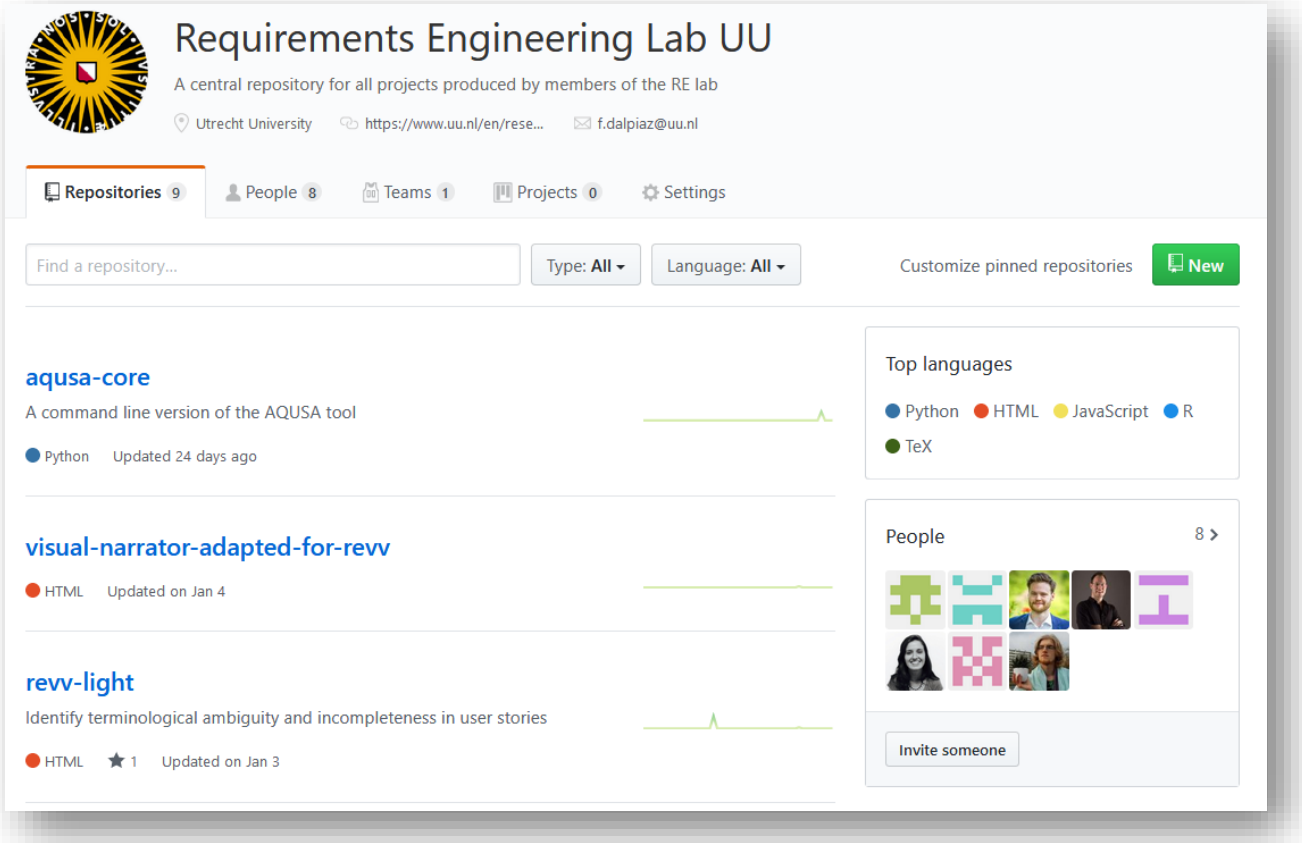
External members

Master's students

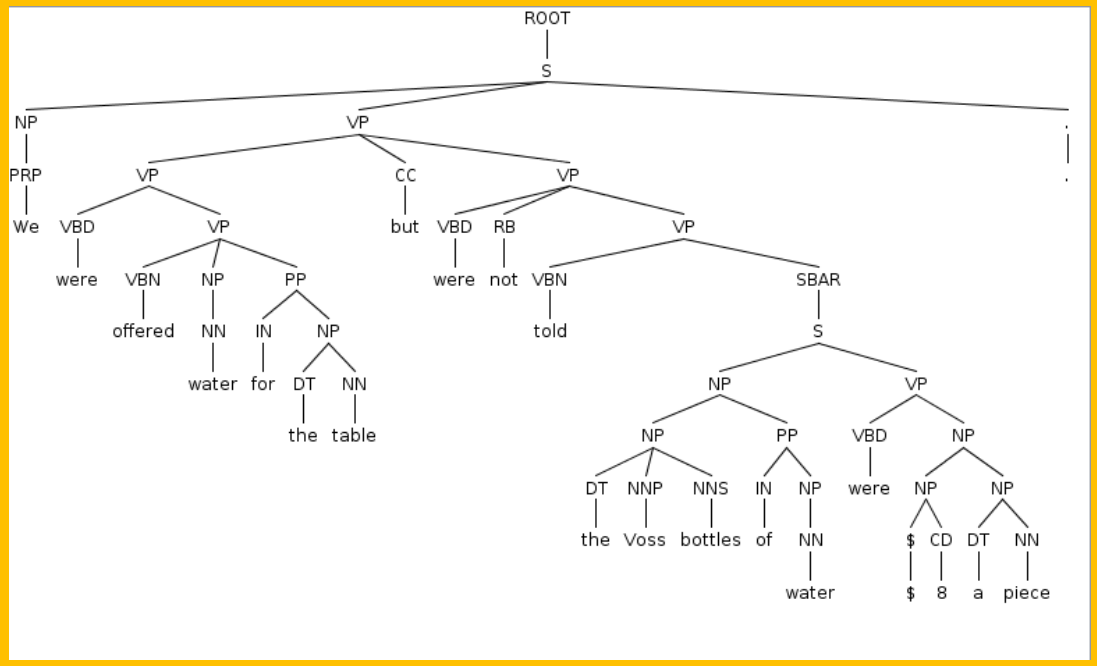


GitHub repository

https://github.com/RELabUU



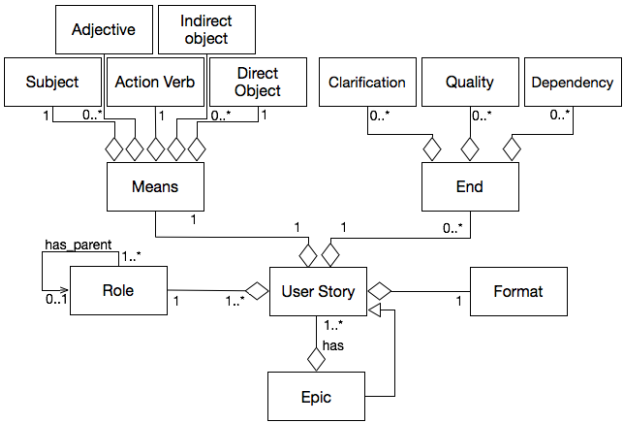
2. NLP research at the RE-Lab



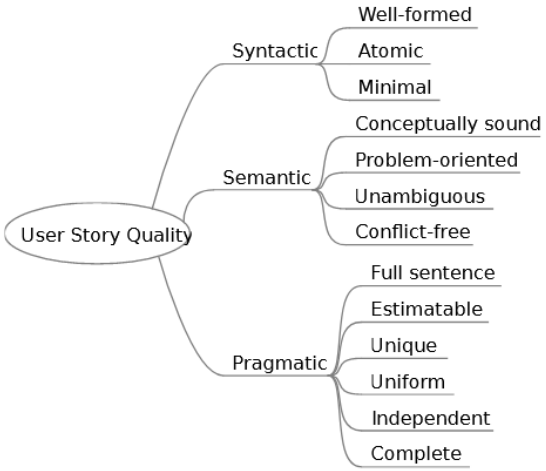
High-quality user stories with AQUSA

User story requirements:

As a NLP4RE attendee,
I want to see the presentations schedule,
so that I can skip Fabiano's talk



Linguistic analysis



Quality framework (QUS)

AQUSA

NLP to check part of QUS automatically

AQUSA: examples

I

As a user,
I want to be able to select different types of recyclable waste,
so I have and get a list of facilities that accept each type and their opening hours, so that I can find an optimal route and schedule.

Not Minimal

As a Publisher,
I want to know if this site has a pricing plan and what the prices are,
so that I can work out what …

Not Atomic

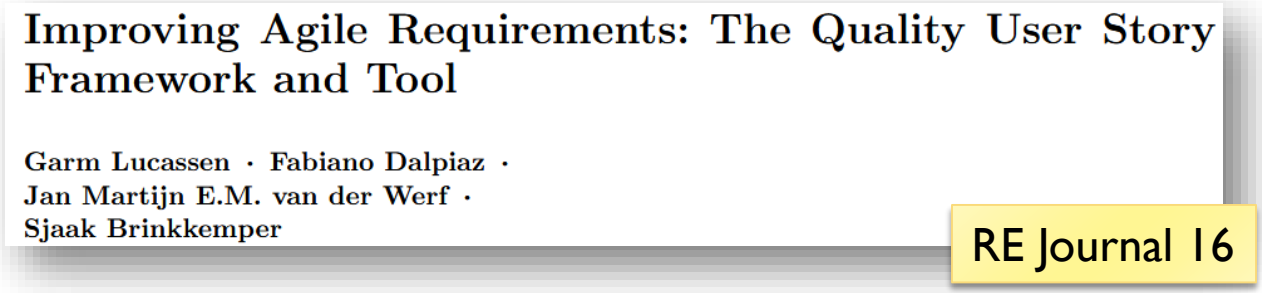
I want to print a report,
so that my customers consider me a professional consultant.

Not well-formed

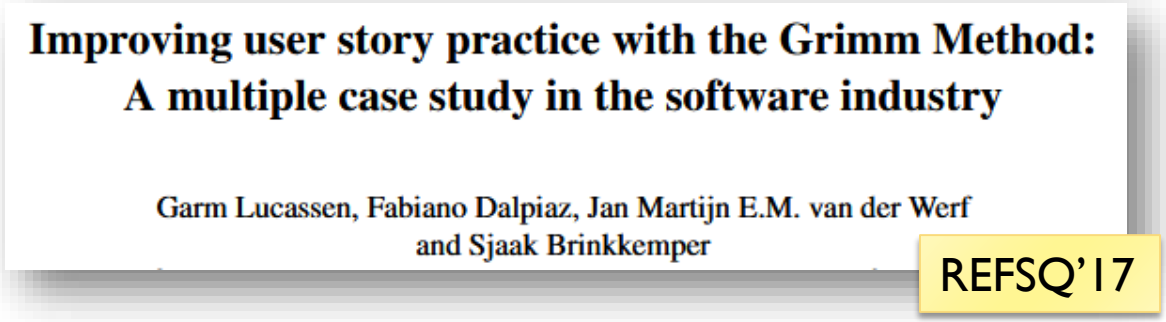
AQUSA: evaluation

I

- Five criteria implemented
  - Precision 72%,
  - Recall 93%
  - **Original goal: 100% recall**



- Longitudinal study in three companies for two months
  - Better user stories
  - No improvements of project mgmt. metrics



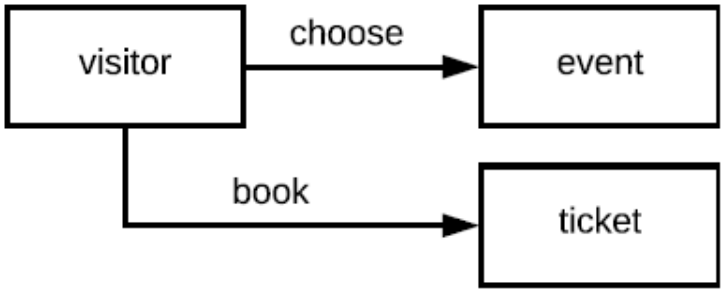
Extraction of conceptual models

2

As a $\langle$visitor$\rangle_{ent}$,

$\langle$I$\rangle_{=visitor}$ ~~want to~~ $\langle$choose$\rangle_{rel}$ ~~an~~ $\langle$event$\rangle_{ent}$

so that $\langle$I$\rangle_{=visitor}$ ~~can~~ $\langle$book$\rangle_{rel}$ a $\langle$ticket$\rangle_{ent}$ for that $\langle$event$\rangle_{ent}$



Extraction of conceptual models

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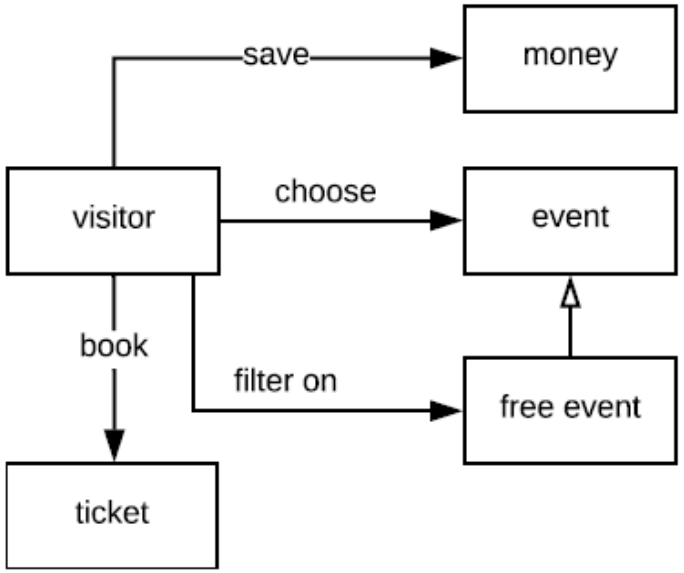
As a visitor,

I want to filter on free events

so that I can save money

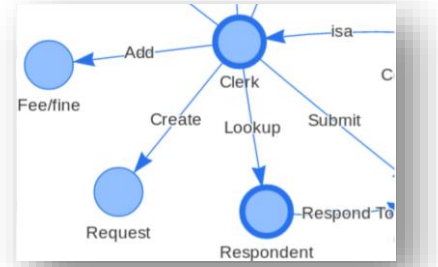


Support tool: Visual Narrator

2

User story requirements

Visual Narrator



Conceptual model

- Conflicts
- Duplicates
- Incompleteness
- …

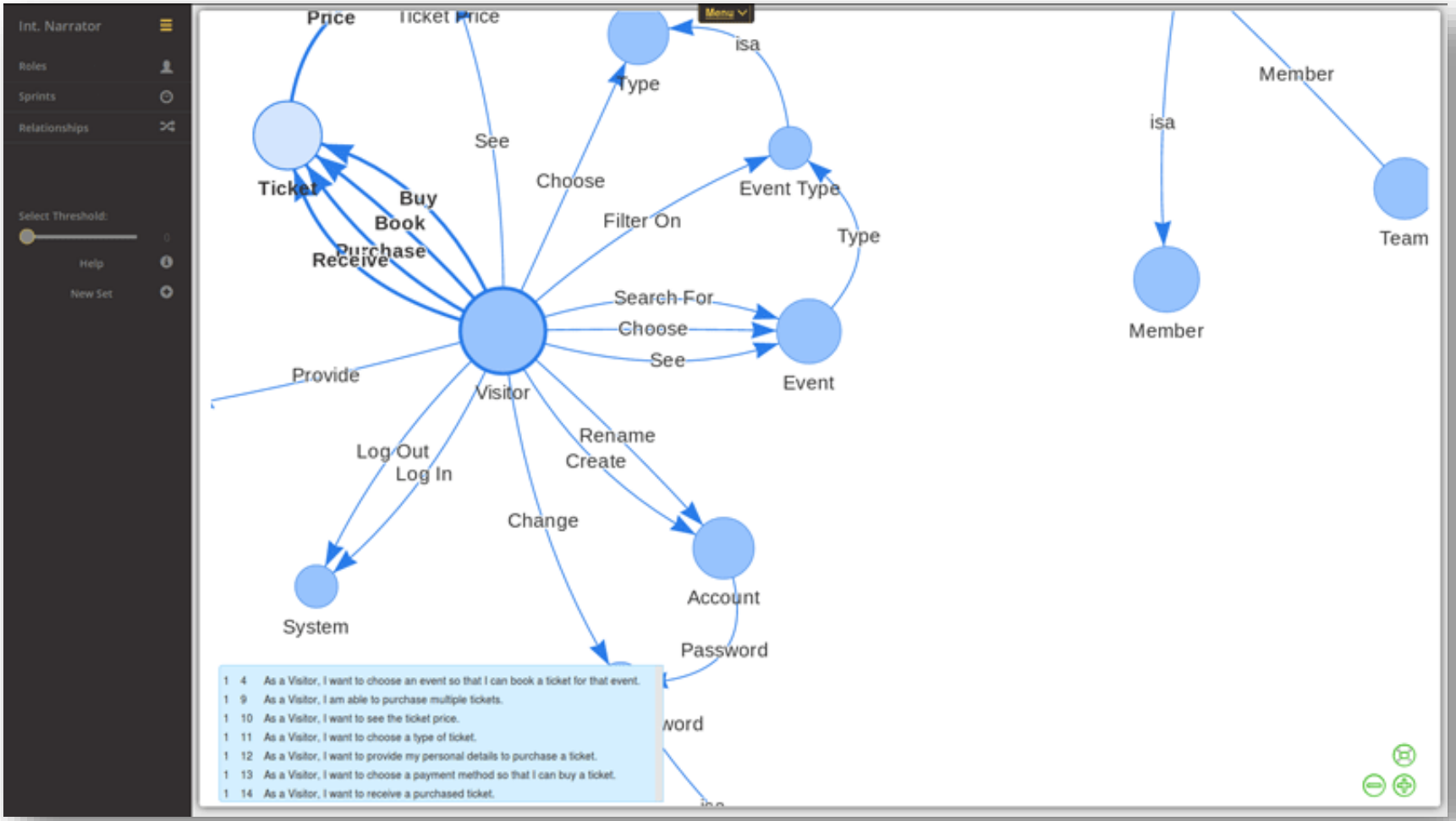
Extracting Conceptual Models from User Stories with Visual Narrator

Garm Lucassen · Marcel Robeer · Fabiano Dalpiaz · Jan Martijn E.M. van der Werf · Sjaak Brinkkemper

RE Journal 17

Interactive Narrator (a rendering engine for the Visual Narrator)

2



Visual Narrator: results

2

- Positive results
  - High precision and recall in the extracted concepts (~90%)
  - Perceived useful for training learners by practitioners

- Negative results
  - Low cognitive scalability: we moved from large collection of user stories to large models
  - NLP issues
    - Hard to cope with compound nouns
    - Difficult to associate the right object to the verb

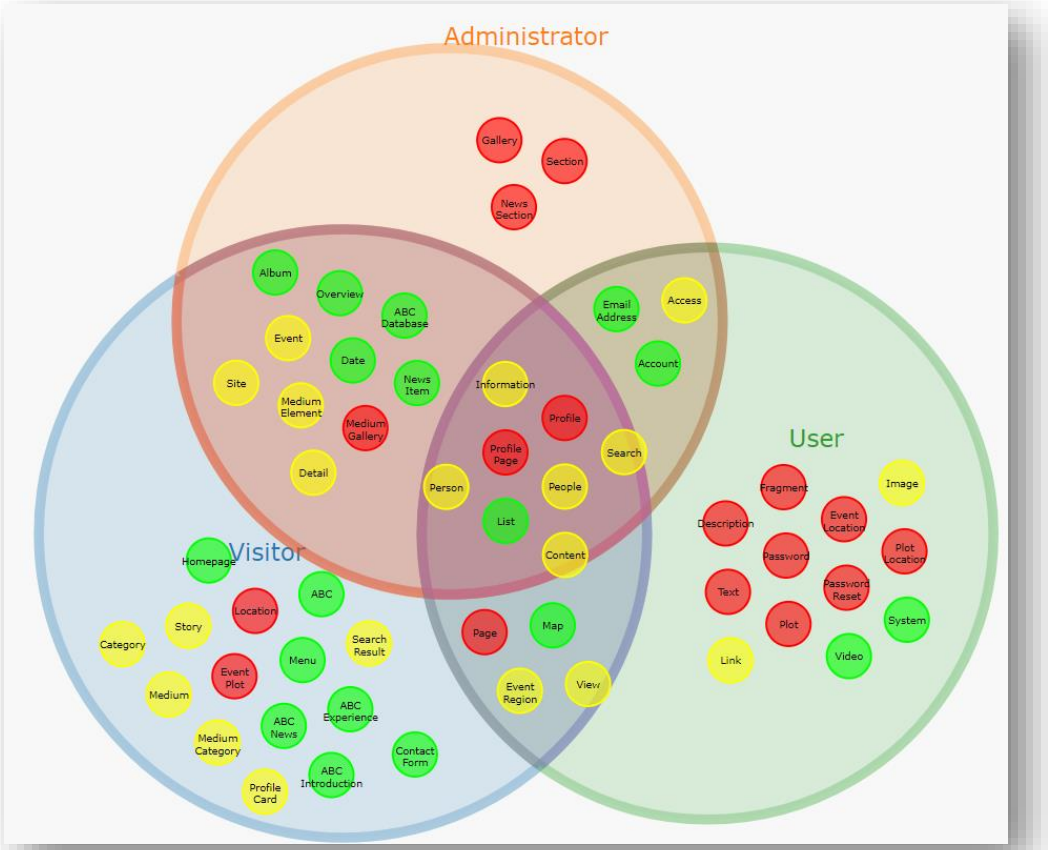
Terminological ambiguity

3

- Quasi-synonyms in user stories
  - Problem: are those two words referring to the same entity?
    - image gallery – gallery
    - image – picture
    - to view – to see
  - Idea: to combine semantic similarity with info. visualization

Terminological ambiguity

- The REVV-Light tool
  - Input = Visual Narrator's output
  - Calculates semantic similarity between the terms
    - Semantic fingerprinting
  - Synonyms are possible ambiguities



Experiments with REVV-Light

3

- Quasi-experiment against manual inspection
  - 28 real-world data sets, 2,000+ requirements
- Results about our approach
  - Manual inspection was better in the time constrained setting
  - High usability expectations by the participants
  - The similarity algorithm needs context information!
- General finding: reaching consensus on ambiguity is hard!

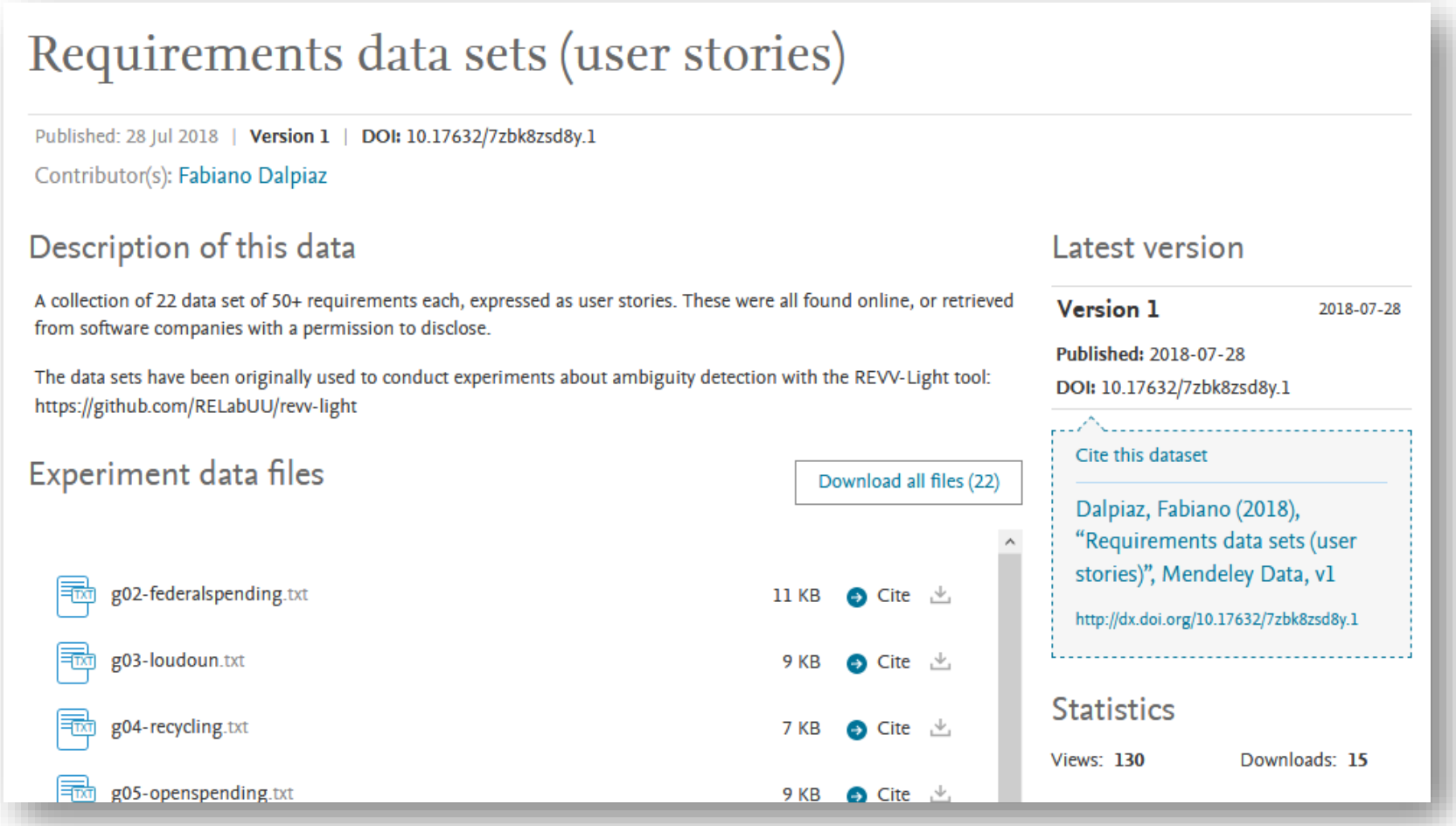
Detecting terminological ambiguity in user stories: Tool and experimentation

Fabiano Dalpiaz[a,*], Ivor van der Schalk[a], Sjaak Brinkkemper[a], Fatma Başak Aydemir[b], Garm Lucassen[c]

IST Journal 19

Side output of the project

http://dx.doi.org/10.17632/7zbk8zsd8y.1



Requirements data sets (user stories)

Published: 28 Jul 2018 | **Version 1** | **DOI:** 10.17632/7zbk8zsd8y.1

Contributor(s): Fabiano Dalpiaz

Description of this data

A collection of 22 data set of 50+ requirements each, expressed as user stories. These were all found online, or retrieved from software companies with a permission to disclose.

The data sets have been originally used to conduct experiments about ambiguity detection with the REVV-Light tool: https://github.com/RELabUU/revv-light

Experiment data files

Download all files (22)

g02-federalspending.txt	11 KB	Cite
g03-loudoun.txt	9 KB	Cite
g04-recycling.txt	7 KB	Cite
g05-openspending.txt	9 KB	Cite

Latest version

Version 1 2018-07-28

Published: 2018-07-28

DOI: 10.17632/7zbk8zsd8y.1

Cite this dataset

Dalpiaz, Fabiano (2018), "Requirements data sets (user stories)", Mendeley Data, v1

http://dx.doi.org/10.17632/7zbk8zsd8y.1

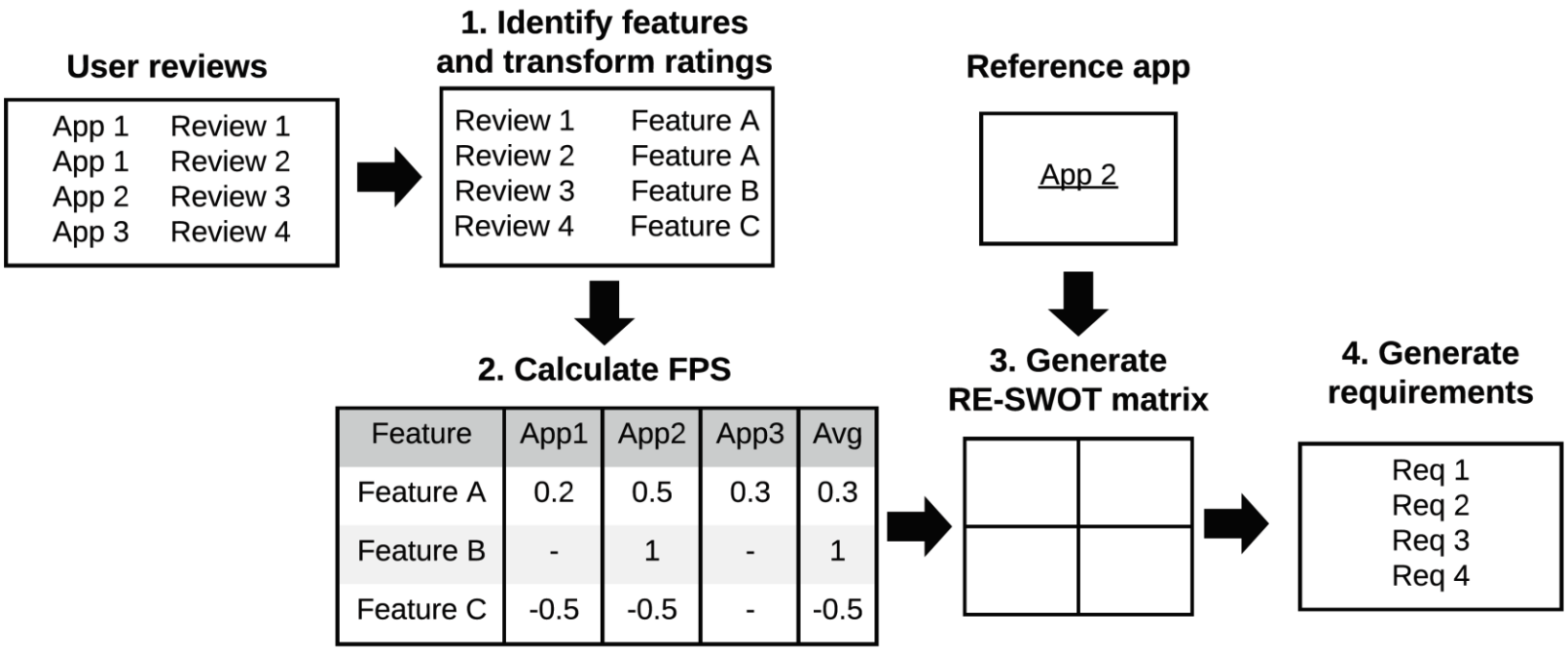
Statistics

Views: **130** Downloads: **15**

Requirements from competitors

4

The RE-SWOT method



NLP: feature extraction

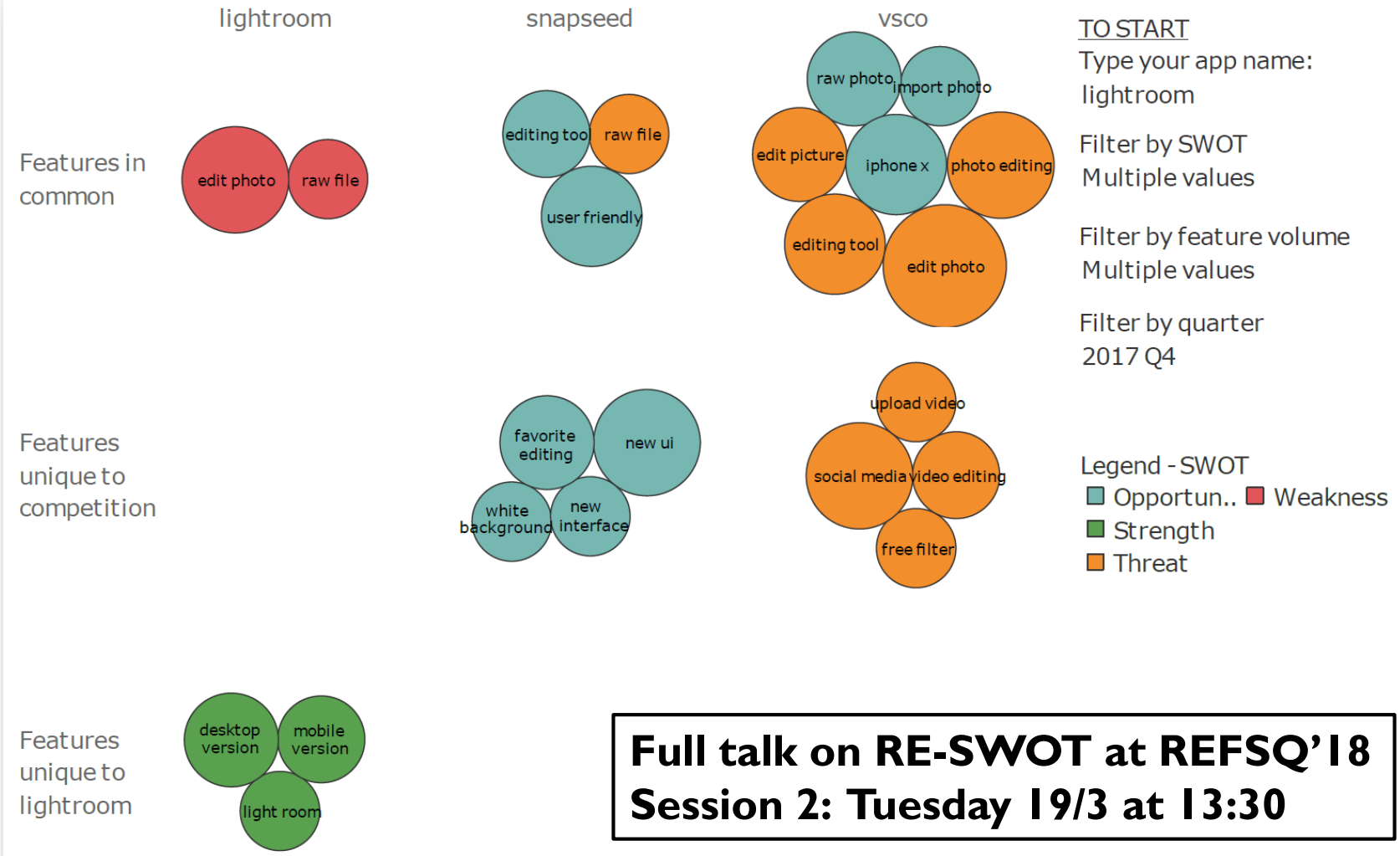
The RE-SWOT Matrix

4

Feature Performance Score ⬇ **App** ➡	*Reference app*	*Competitor app*
Positive and above market average	Strength	Threat
Negative and below market average	Weakness	Opportunity

The RE-SWOT Matrix, visualized

4

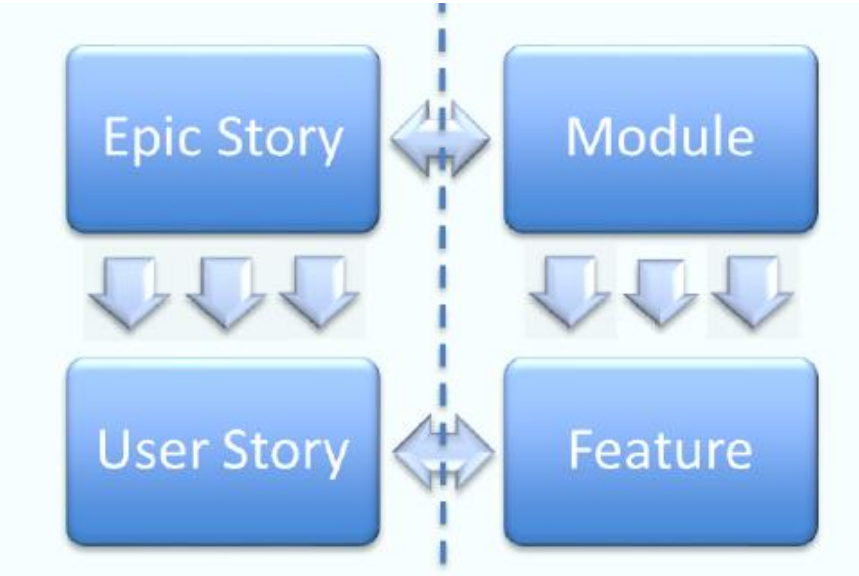


Full talk on RE-SWOT at REFSQ'18
Session 2: Tuesday 19/3 at 13:30

3. Future directions

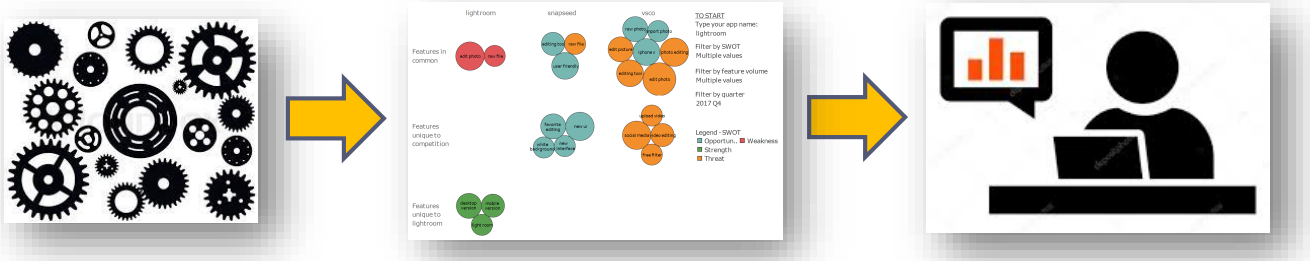
A. Linking reqs to architectures

- Establish traceability links via linguistic analysis
- Especially useful in software product companies
  - The linkage can be assisted by glossaries

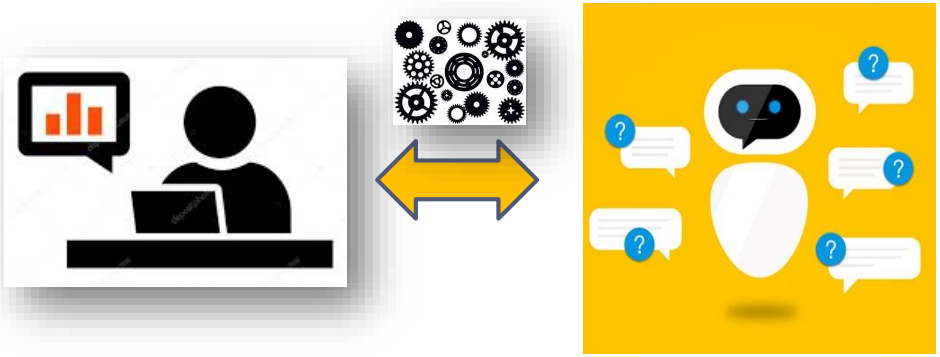


B. Automated elicitation via chatbots

- RE-Lab's research paradigm in the past few years

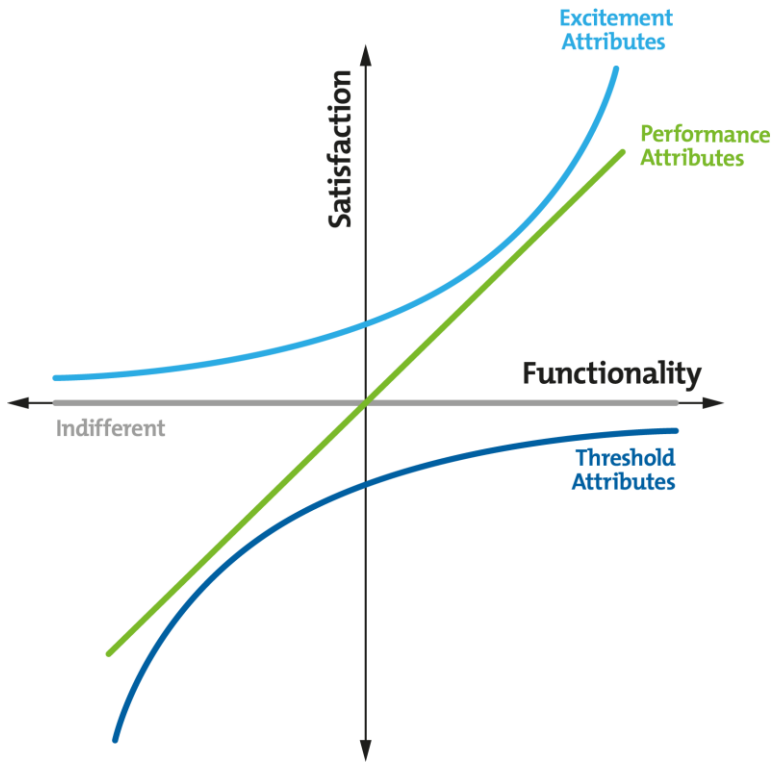


- Future paradigm: Chatbot conversation



C. Synthesis of creative requirements

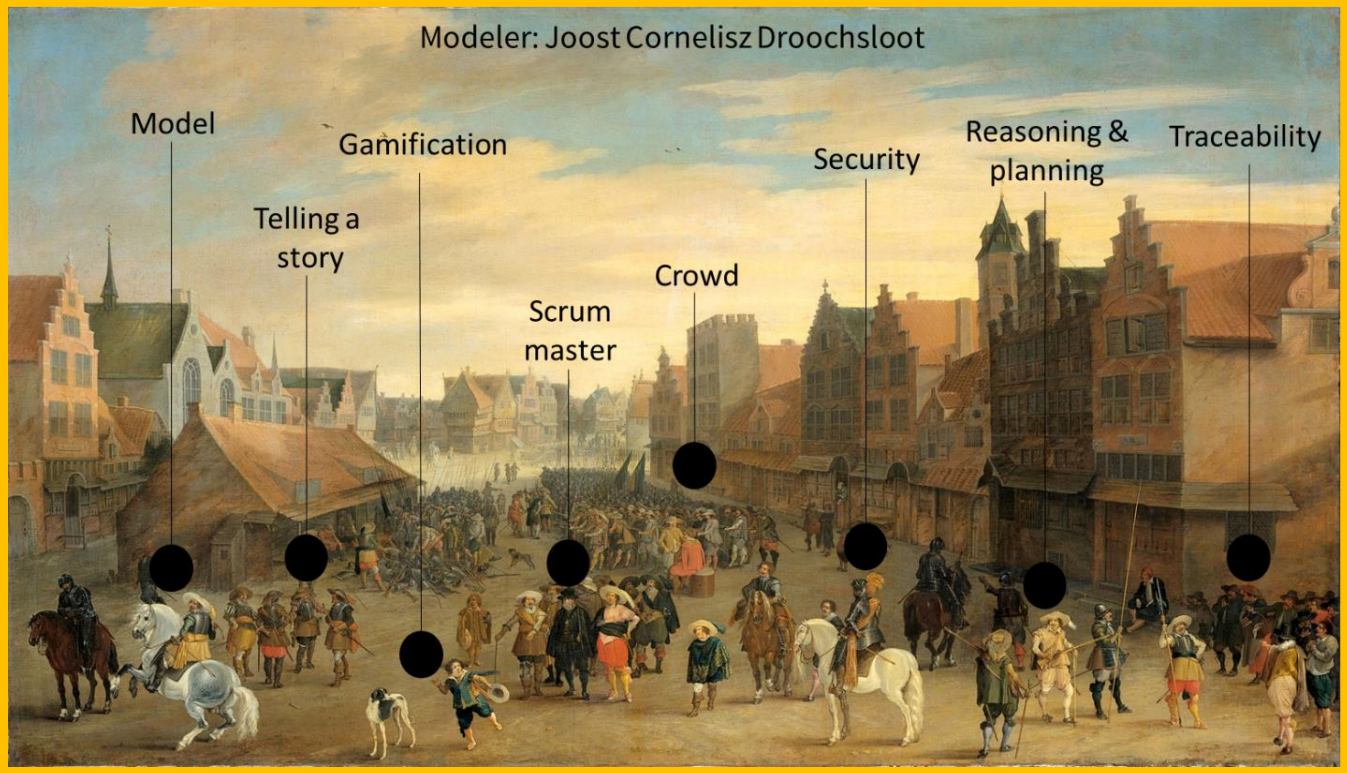
- Kano's model



- Can we automatically synthesize creative / exciting requirements?
- Work-in-progress with
  - Semantic similarity
  - Semantic role labeling
- The challenge? Requirements that make sense!

Thanks from the Requirements Engineering Lab at Utrecht University!

Fabiano Dalpiaz
Sjaak Brinkkemper
Marcela Ruiz
Sietse Overbeek
Davide Dell'Anna
Eduard C. Groen
Gerard Wagenaar



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