What Are Practitioners Asking About Requirements Engineering?
An Exploratory Analysis of Social Q&A Sites

9th International Workshop on Software Product Management (IWSPM 2016)

Zahra Shakeri, Alex Shymka, Susant Pant, Ashley Currie, Guenther Ruhe
… Requirements Engineering (RE) plays a crucial role in any software development process!

“Writing system software is like planning a family. If you make a mistake you have to live with it for 20 years …”

Richard Marshall
Research Questions

- What are the main categories of topics of discussions about RE among practitioners?
- What types of questions are requirements engineers asking?
Research Questions

● **What are the main categories of topics of discussions about RE among practitioners?**
  ○ Grouping together common issues in RE and finding any outstanding lessons that can be derived from these groups

● **What types of questions are requirements engineers asking?**
  ○ What, Why, How, Who, .....
Data Collection

- Queried Stack Overflow, Programmers Exchange and Project Management
- To collect data relevant to RE, our query logic found posts containing the word “requirement” and at least one other keyword related to RE

Stack Exchange Data Explorer (SEDE): an interactive open source web tool for sharing, querying, and analyzing the data sets from every website in the Stack Exchange network

“engineer, analysis, stakehold, communicat, project, manag, develop, team, functional, scope, customer”
Data Collection

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“engineer, analysis, stakehold, communicat, project, manag, develop, team, functional, scope, customer”

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Stack Overflow</th>
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<th>Quora</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,204</td>
<td>12,930</td>
<td>2,731</td>
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Data Collection

"engineer, analysis, stakehold, communicat, project, manag, develop, team, functional, scope, customer"

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Manually analyzed 1,000 of the posts from iteration #1

"job requirements"
"hardware requirements"

"analysis, stakehold, communicat, manag, functional, scope, customer, evaluat, elicit, client, verif, use case, user stor[yi], estimat, specification, prototype, methodology, gather, expectation"
Data Collection

“analysis, stakehold, communicat, manag, functional, scope, customer, evaluat, elicit, client, verif, use case, user stor[yi], estimat, specification, prototype, methodology, gather, expectation”

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<td>2,278</td>
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Manually analyzed 800 of the posts from iteration #2

verif, validat, elicit, use case, user stor[yi], estimat, specification, prototype, gather, captur, fucntinal, document
Data Collection

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verif, validat, elicit, use case, user stor[yi], estimat, specification, prototype, gather, captur, fucntinal, document
Study Design (Data Preparation)

- The data returned from stack exchange was not immediately ready for analysis …

- Convert to lowercase
- Remove HTML tags
- Manual transformation
- Remove numbers and punctuation
- Remove stopwords
- Strip whitespace
- Stemming
- Manual transformation
- Remove additional words

End users, customer, customers → “client”
High level → “highlevel”
Class diagram → “model”
functional/non-functional → ffunction
Study Design (Data Preparation)

- The data returned from stack exchange was not immediately ready for analysis …

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Non-functional → “nonfunctional”
Study Design (Data Preparation)

- The data returned from stack exchange was not immediately ready for analysis …

- Convert to lowercase
- Remove HTML tags
- Manual transformation
- Remove numbers and punctuation
- Remove stopwords “The”, “is”, “of”, “can”, “if”, … [tm-map package (R)]
- Strip whitespace
- Stemming
- Manual transformation
- Remove additional words
Study Design (Data Preparation)

- The data returned from stack exchange was not immediately ready for analysis …

- Convert to lowercase
- Remove HTML tags
- Manual transformation
- Remove numbers and punctuation
- Remove stopwords
- Strip whitespace
- Stemming (the process of reducing words to their origins by removing suffixes)
- Manual transformation
- Remove additional words

Functionality, functional, functioning → “function”
Study Design (Data Preparation)

- The data returned from stack exchange was not immediately ready for analysis …

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- Remove HTML tags
- Manual transformation
- Remove numbers and punctuation
- Remove stopwords
- Strip whitespace
- Stemming
- Manual transformation
  - Second iteration
- Remove additional words
Data Analysis

- Clustering
- Topic Modeling
“Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters).”
TOPIC MODELING
## Data Analysis (Topic Modeling)

### K=3

<table>
<thead>
<tr>
<th>Topic#1</th>
<th>Topic#2</th>
<th>Topic#3</th>
</tr>
</thead>
<tbody>
<tr>
<td>model</td>
<td>implement</td>
<td>test</td>
</tr>
<tr>
<td>document</td>
<td>function</td>
<td>time</td>
</tr>
<tr>
<td>client</td>
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<td>team</td>
</tr>
<tr>
<td>design</td>
<td>new</td>
<td>change</td>
</tr>
<tr>
<td>specify</td>
<td>method</td>
<td>product</td>
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<tr>
<td>want</td>
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<td>document</td>
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<tr>
<td>problem</td>
<td>new</td>
<td>implement</td>
<td>product</td>
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<tr>
<td>time</td>
<td>type</td>
<td>design</td>
<td>process</td>
</tr>
<tr>
<td>want</td>
<td>service</td>
<td>specif</td>
<td>manag</td>
</tr>
<tr>
<td>change</td>
<td>method</td>
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<td>estimate</td>
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</thead>
<tbody>
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<td>implement</td>
<td>make</td>
<td>team</td>
</tr>
<tr>
<td>model</td>
<td>document</td>
<td>new</td>
<td>time</td>
<td>product</td>
</tr>
<tr>
<td>want</td>
<td>design</td>
<td>valid</td>
<td>know</td>
<td>process</td>
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<tr>
<td>implement</td>
<td>specify</td>
<td>service</td>
<td>change</td>
<td>manage</td>
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<tr>
<td>business</td>
<td>write</td>
<td>database</td>
<td>good</td>
<td>estimate</td>
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<tr>
<td>problem</td>
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<td>type</td>
<td>better</td>
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<th>Topic#3</th>
<th>Topic#4</th>
<th>Topic#5</th>
<th>Topic#6</th>
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<th>Topic#3</th>
<th>Topic#4</th>
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<th>Topic#6</th>
<th>Topic#7</th>
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<td>implement</td>
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<td>model</td>
<td>client</td>
<td>test</td>
<td>design</td>
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<tr>
<td>new</td>
<td>know</td>
<td>product</td>
<td>document</td>
<td>manage</td>
<td>change</td>
<td>function</td>
</tr>
<tr>
<td>service</td>
<td>make</td>
<td>estimate</td>
<td>business</td>
<td>write</td>
<td>function</td>
<td></td>
</tr>
<tr>
<td>database</td>
<td>good</td>
<td>agile</td>
<td>detail</td>
<td>change</td>
<td>implement</td>
<td>implement</td>
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<tr>
<td>valid</td>
<td>problem</td>
<td>task</td>
<td>implement</td>
<td>want</td>
<td>spec</td>
<td>differ</td>
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<tr>
<td>return</td>
<td>start</td>
<td>sprint</td>
<td>tool</td>
<td>process</td>
<td>bug</td>
<td>support</td>
</tr>
</tbody>
</table>
Data Evaluation

● **Word Intrusion**: measures the quality of the inferred topics by calculating their "cohesiveness"

● **Topic Intrusion**: measures whether the contents of a document align with the topics it has been assigned to, according to human judgement
Data Evaluation

- **Word Intrusion:** measures the quality of the inferred topics by calculating their “cohesiveness.”
  
  Introduce a random, unrelated word - the Intruder - into a Topic and see if Participants can find it out. If they can do so regularly, then the other words have high cohesiveness.

- **Topic Intrusion:** measures whether the contents of a document align with the topics it has been assigned to, according to human judgement.
  
  Introduce a random, unrelated cluster of words as a new Topic alongside the three most strongly associated Topics for an excerpt. If the intruder is identified, then the three other topics do indeed have strong association with the excerpt, so the modeled Topics have significance.
Data Evaluation

<table>
<thead>
<tr>
<th>$K$</th>
<th>Participant Responses (WI)</th>
<th>Documents</th>
<th>Participant Responses (TI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>4</td>
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<td>7</td>
<td>119</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>369</td>
<td>220</td>
<td>220</td>
</tr>
</tbody>
</table>
Data Evaluation

\[ MP_k^m = \left( \sum_s 1(i_k,s = \omega_k) \right) / S \]

\[ TLO_d = \left( \sum_s \log \hat{\theta}_{d,jd,*} - \log \hat{\theta}_{d,jd,s} \right) / S \]
Results and Findings

- We examined a sample of 150 titles from the threads we collected
  - 12% (Who): who is in charge of an aspect of the product, or how to deal with a stakeholder?
  - 10% (Why?): asking about the purpose of certain practices
  - 59% (What?): asked for more information on one of the topics.
  - 23% (When?): concerned with a certain specific stage of the RE process
  - 56% (How?): how to solve a problem related to RE?
Results and Findings (Details of the questions of type “How”)

- Specification and Gathering: 37.3%
- Planning and Optimization: 15.7%
- Methodology: 8.4%
- Change and Traceability: 6%
- FRs&NFRs: 3.6%
- Modeling: 10.8%
- Req Uncertainty: 6%
- Communication: 12%
Often developers and stakeholders do not thoroughly understand their methodology.
Results and Findings

- We examined a sample of 150 titles from the threads we collected

  - 67% (Problem domain): stakeholders, management, and more conceptual concerns
    “How do you manage customers with regards to changing requirements?”

  - 11% (Solution domain): achieving tangible results from requirements specifications, or maintaining development through requirements change
    “How did you adapt your unit tests to deal with changing requirements?”

  - 22% (Both): eliminating uncertainty and translating stakeholder defined requirements into tangible development.
    “Format for getting clear directions on data parameters from users”
Results and Findings (Product)

- We examined a sample of 150 titles from the threads we collected
  - 48% discussed some aspects of the product
    - 46%: Functionalities of a product: “Is writing software in the absence of requirements a skill to possess or a situation I should avoid?”
    - 21%: Release concerns
    - 12%: Financial concerns: “What types of requirements add the most value?”
    - 11%: Client satisfaction: “What specifications in software development are relevant to the clients?”
    - 12%: Quality of the products
results and findings (topic modeling)

- developers desiring to better understand their clients’ requirements, as well as increase their client’s understanding of the development process, through increased communication.
  - topic 1: test, make, problem, time, want, change
    - test, make, problem, time: developers limitations
    - want, change: clients interests
  
requirements validation and communication
Questions that directly asked for input from the Q&A community were mostly about technical details on implementing the project, rather than discussions about requirements engineering.

- Topic 2 - Implement, Validate, New, Type, Service, Method
A common desire among developers is to better track, document, organize and present their requirements

Requirements engineers are concerned about how to avoid the crunch through better estimates, better customer relationships, and a healthier development process through communication between clients, developers and executives.

- Topic 4 - Client, Team, Product, Process, Manage, Estimate:

  requirements communication
Results and Findings (Topic Modeling)

No specific topic significantly outweighed the others in popularity.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Percent of total questions</th>
<th>Average probability from all posts (%)</th>
<th>Average probability when most probable (%)</th>
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<tbody>
<tr>
<td>#1</td>
<td>24.23</td>
<td>25.47</td>
<td>23.65</td>
</tr>
<tr>
<td>#2</td>
<td>21.50</td>
<td>23.67</td>
<td>40.22</td>
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<tr>
<td>#3</td>
<td>25.76</td>
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<tr>
<td>#4</td>
<td>28.51</td>
<td>25.73</td>
<td>38.02</td>
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</table>
Results and Findings (Topic Modeling)

- Developers want requirements translated into well defined system functionalities.
  - 46% of posts related with their product were concerned with functionalities
  - Specification and Gathering was our most popular How topic at 37.37%
  - There is a gap between how stakeholders describe a system and what a developer needs to know in order to create the system
Threats to Validity

- The Query still picks up some *unrelated posts*
  - Our iterative process reduced this number significantly, especially by manually removing words that were introducing irrelevance
- Many question threads are considered ‘closed’. It is hard to evaluate if posts contribute to social Q&A sites if the community cannot engage with the thread
- There is no way to confirm post authors are necessarily *professional practitioners*
- *Quora* was scrapped because of a lack of meaningful data as well as the inability to search its database in an automated manner
Future Work

- Developing a tool that automates the process of mining and analyzing Q&A social websites
- Develop a tool that enhances communication between a project’s stakeholders, focusing on tracking requirements-changes over time through novel forms of requirements modelling
- Include other parameters available on Q&A websites (Experience, role, votes, …)
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