

## Log In

Log In

[Forgot your Password?](#)

[Contact](#) | [About](#) | [Help](#)

# CRUISE: A Platform for Crowdsourcing Requirements Elicitation and Evolution

<http://cruise-platform.in>

RICHA SHARMA - BML MUNJAL UNIVERSITY ([SRICHA@GMAIL.COM](mailto:SRICHA@GMAIL.COM))

ASHISH SUREKA - ABB CORPORATE RESEARCH ([ASHISH.SUREKA@IN.ABB.COM](mailto:ASHISH.SUREKA@IN.ABB.COM))

PRESENTATION AT IC3 2017

# Presentation Outline

---

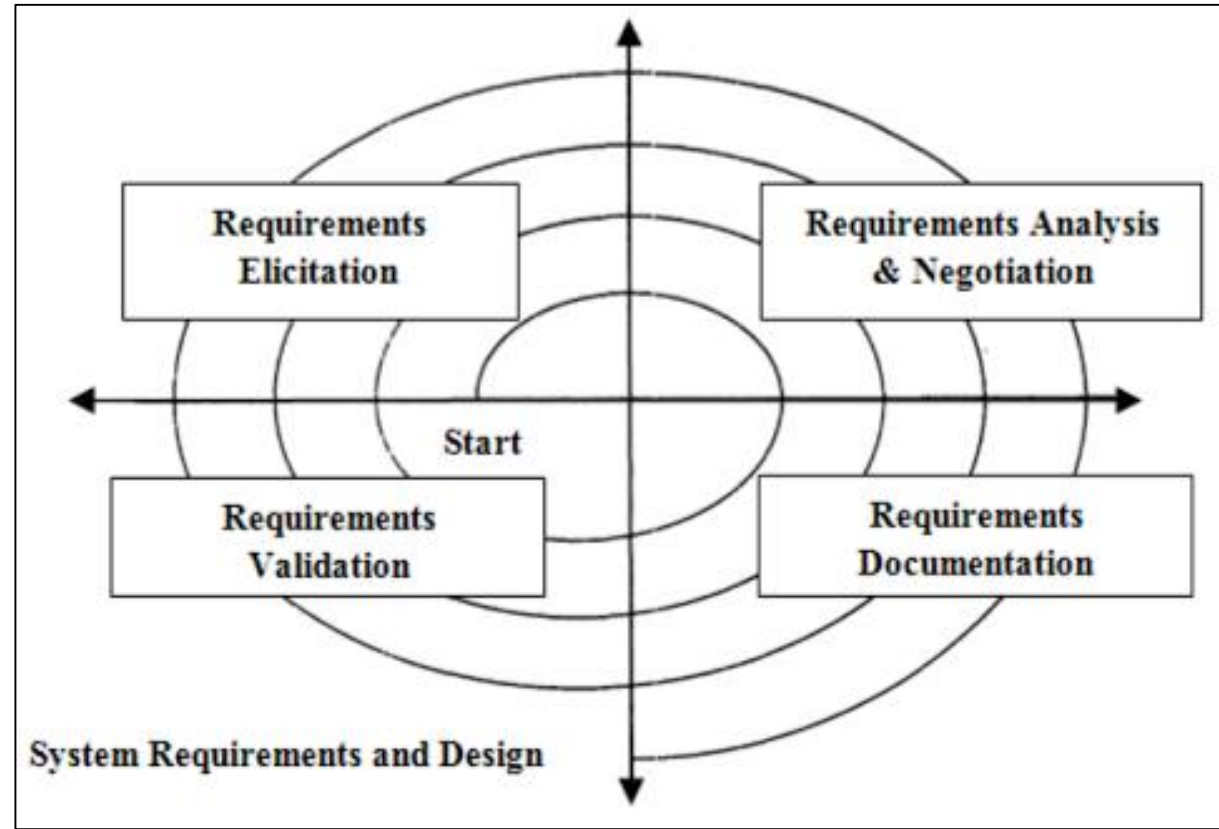
- ✓ Research Motivation and Aim
- ✓ Related Work
- ✓ Research Contributions
- ✓ Technical and Design Challenges
- ✓ Solution Approach
- ✓ Experimental Design and Setup
- ✓ Experimental Results
- ✓ Observations and Conclusions
- ✓ References

# Research Motivation and Aim

## Requirements Engineering

Process of defining, documenting and maintaining requirements

1. Requirements elicitation
2. Requirements analysis
3. Requirements specification
4. Requirements validation
5. Requirements management



# Research Motivation and Aim

What Makes a Good Requirement ?

## Reference

Specifying Good Requirements

Donald Firesmith, Software Engineering Institute, U.S.A.

[http://www.jot.fm/issues/issue\\_2003\\_07/column7/](http://www.jot.fm/issues/issue_2003_07/column7/)

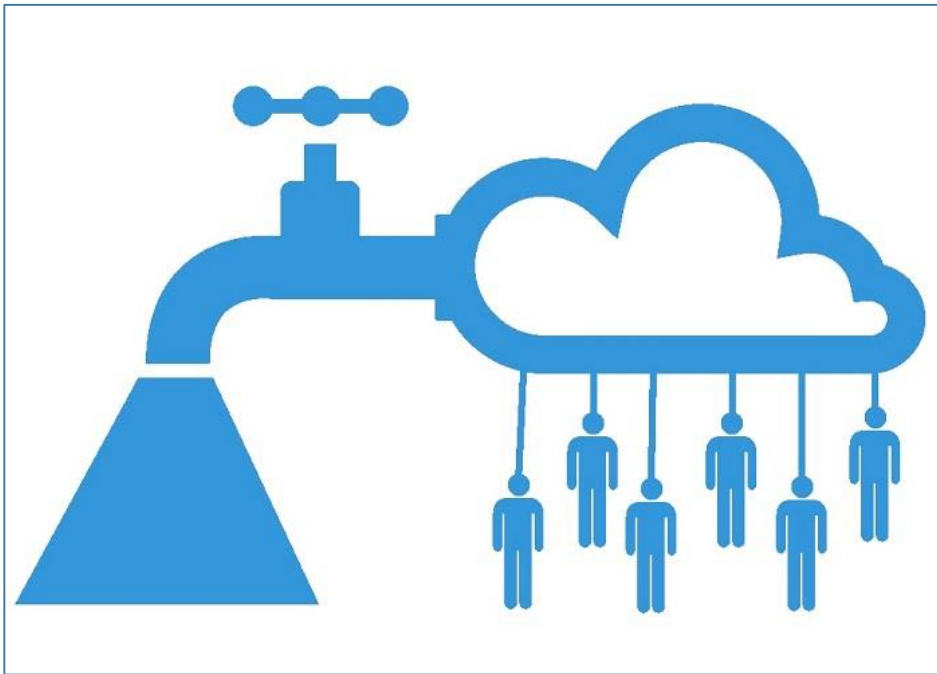
- ✓ Cohesiveness
- ✓ Completeness
- ✓ Consistency
- ✓ Correctness
- ✓ Currency
- ✓ Customer/User Orientation
- ✓ External Observability
- ✓ Feasibility
- ✓ Lack of Ambiguity
- ✓ Mandatory
- ✓ Metadata
- ✓ Relevance
- ✓ Usability
- ✓ Validatability
- ✓ Verifiability

# Research Motivation and Aim

## Crowdsourcing

---

The practice of obtaining information or input into a task or project by enlisting the services of a large number of people, either paid or unpaid, typically via the Internet

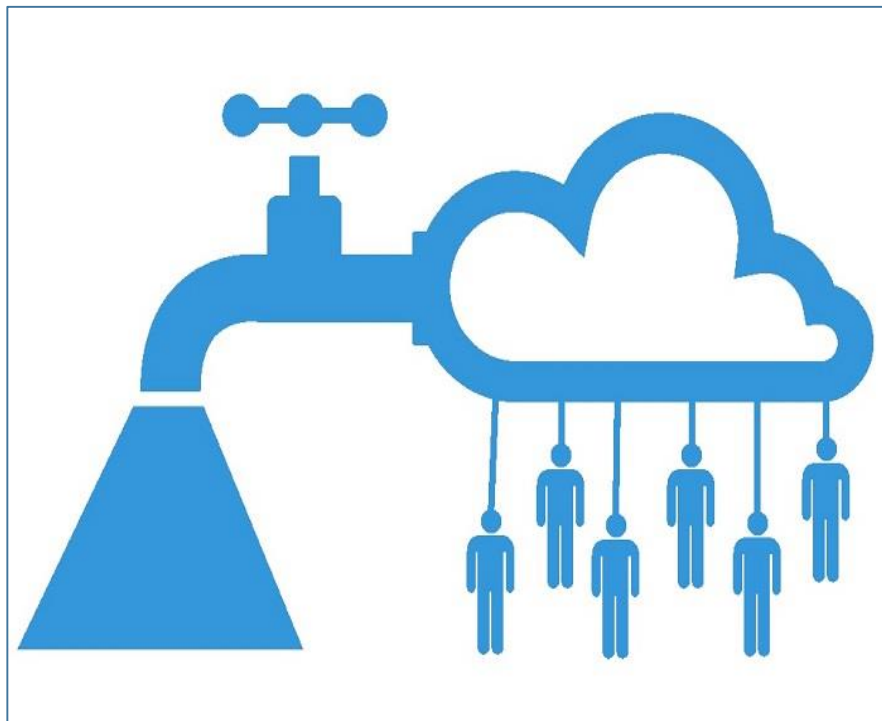


- Crowdsourcing Design (logo design)
- Crowdfunding (money donation)
- Microtasks (breaking work up into tiny tasks\_
- Open Innovation (work together on a project)

# Research Motivation and Aim

Application of Crowdsourcing in Requirement Engineering

Explore the applicability of crowdsourcing to one of the RE activities, requirements elicitation or gathering



+



# Research Objectives

## Research Questions Guiding Our Work

---

**RO1:** To design and develop a crowdsourcing based requirements elicitation platform. The platform de-sign and development includes building a website and implementing processes and structure which should guide the platform users to participate and complete their respective tasks effectively and efficiently

**RO2:** To investigate the effectiveness of the pro-posed platform in-terms of the quality, completeness, and coverage of the elicited requirements

**RO3:** To compare and contrast the proposed crowdsourcing based platform with traditional approaches and discuss the limitations of the proposed approach and future research directions

## Related Work

### Previous Work on Crowdsourcing for Requirements Engineering

---

**Breaux and Schaub** [17] have explored crowdsourcing for extracting privacy requirements from privacy policies. Their study reveals increased requirements coverage as compared to manual extraction by trained experts.

**Sutcliffe and Sawyer** [20] recommend social collaboration for facilitating categorization and prioritization of requirements for product lines

**Muganda et al.** [21] advocate group-thinking for prioritizing and refining the requirements.

**Lim et al.** [22] have explored the potential of crowdsourcing for stakeholder analysis.



## Related Work

### Previous Work on Crowdsourcing for Requirements Engineering

---

**Lim and Finkelstein** [23] suggest using social networks for large-scale requirements elicitation.

**Adepetu et al.** [24] have proposed an outline of a platform to support RE activities in general using crowdsourcing, CrowdREquire.

**Snijder et al.** [25] suggest Crowd-Centric Requirements Engineering (CCRE), and through a prototype of CCRE, Refine, they demonstrate that CCRE can provide engaged stakeholders and valuable interaction among those stakeholders

Requirements Bazaar tool, developed by **Renzel et al.** [26], aims at requirements elicitation and prioritization of requirements.

# Proposed Tool : CRUISE

## Design Challenges - I

---

- Should guest users be able to contribute to projects or only registered users have the permission to contribute
- Should the registration be controlled or any user can register and go ahead with contributing to projects
- Who holds the ownership of the project



# Proposed Tool : CRUISE

## Design Challenges - II

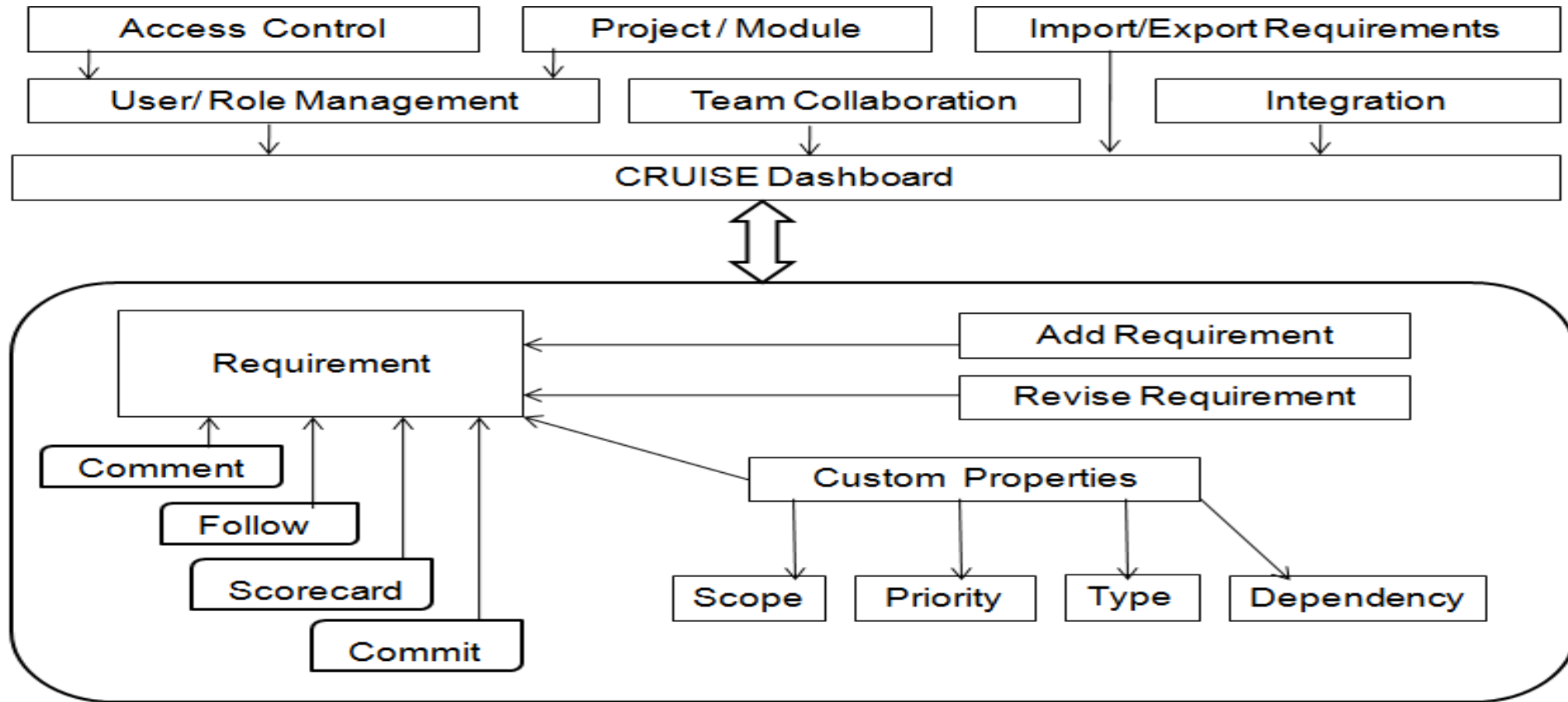
---

- What should be the various roles associated with the users
- Should requirements gathering be itself broken to some sub-tasks, i.e. should the users be given with guided questions
- How and when a requirement can be marked as finalized to be promoted to development



# Proposed Tool : CRUISE

## Schematic Diagram



# Proposed Tool : CRUISE

## Dashboard of a Logged-In User

**CRUISE**  
Crowd-Sourcing Based Requirements Elicitation Platform

Welcome, Richa [Sign Out](#)

CRUISE DASHBOARD

### PROJECT OVERVIEW

[+ Create Project](#) [View Project](#) [Delete](#) [Archive](#)

Projects you own	Brief Overview	Date Posted
<input type="radio"/> Meeting Room Booking	<u>User Management</u> This module will take care of managing details of registered users.	25 December, 2016
<input type="radio"/> Mobile App for room-booking		25 December, 2016
<input type="radio"/> Course Registration project	<u>Login Module</u> This module is used by the presently registered students ( who are going to 2nd sem or onwards ). These students will login to their respective dashboard and select the subjects they want in their upcoming semester.	05 January, 2017

[View Project](#) [Withdraw](#) [Archive](#)

Projects As Contributors	Brief Overview	Date Posted
<input type="radio"/> Library Management System		25 December, 2016

[Contact](#) | [About](#) | [Help](#)

# Proposed Tool : CRUISE

## Guest Vs. Registered Users

---

Only those users who get an invite from the project owners or from the admin users of CRUISE can register

Invited users can browse the projects, express their willingness to contribute to some project, and start contributing to projects

We have not restricted formation of project's moderation group at tool level, leaving this decision to project owner as he may like to continue as moderator, or he may like to choose a moderator group

# Proposed Tool : CRUISE

## Project Ownership and Access Control

---

We decided to let contributors only view the project details. However, they can add modules as well to the project

Moderators can decide later whether that module should be a part of the project or not

CRUISE allows the users, who have created the project, to modify, archive, and delete the project

The privilege to archive or delete a project also lies with the CRUISE administrators so that the projects that have not been accessed for long and are lying idle may be removed to avoid any cluttering of projects in CRUISE database

# Proposed Tool : CRUISE

## Requirements Identification

---

User may choose to gather requirements from crowd and seek scores for requirements in terms of likes, comments, follow-ups, and priorities of requirements

With the help of moderation group, the project owner may finalize the requirements statement and its priority

Project owner can seek opinion on finalized requirements statements

The moderators only can commit a requirement, i.e. can finalize a requirement to be promoted for design and development



# Experimental Study

## Validation of Proposed Approach - I

We decided to carry out our experimental study with under-graduate students who are currently doing a course in Software Engineering (SE)

We were able to **incentivize** the students and keep them motivated in the study through a small percentage of marks in their SE course project grades

We identified **two groups**: One of the groups, thus, was in the role of control group while the other one formed the hypothesis group in our study



# Experimental Study

## Validation of Proposed Approach - II

We **hypothesized** that requirements collected through CRUISE are almost similar (at least 90% similarity) to the one collected through traditional requirements elicitation techniques

The course advisor assigned project titled – ‘Automate students’ registration process at the onset of the semester’ to both of these groups

The **control group** has 5 members, and the hypothesis group has 6 members



# Experimental Study

## Hypothesis Testing – Creation of Control Group - I

---

The control group is supposed to collect requirements by interviewing the Dean and the program office that is responsible for registering students at the beginning of semester through a manual process of form filling and approvals

The hypothesis group is supposed to work as moderator for the 'registration' project created in CRUISE

We conducted meetings with the hypothesis group and the crowd



# Experimental Study

## Hypothesis Testing – Creation of Control Group - II

---

A total of **17 requirements** were collected through CRUISE

The control group collected requirements for the same project using interview technique of requirements elicitation. They collected a total of 8 requirements from the Dean and the program office.

The requirements collection phase was then followed by **comparative study** of the requirements collected through the two different ways – traditional and using CRUISE



# Experimental Study

## CRUISE and Interview Requirements Comparison

---

Total Requirements in CRUISE	Requirements Count		
	Both in CRUISE and interviews data	Through Cruise only	Through interviews only
15	9	2	3

This study is intended to analyze not only the number of requirements identified through manual reviews and through our tool but also the quality of the elicited requirements and the time taken to prioritize the requirements manually against the time taken to carry these tasks through tool.

# Observations and Conclusion

Takeaways from a Quantified Comparison Study - I

---

The requirements gathered through CRUISE, and missed through interviews were about one module only - 'administrator', and the privileges of the user acting as administrator.

The requirements elicited during interviews but not found in CRUISE tool included categorization of registration application users as 'new' and 'old'.

Another missed requirement through CRUISE was related to getting students' consent on a couple of forms for 'new' students (in addition to registration form).





# Observations and Conclusion

## Takeaways from a Quantified Comparison Study - II

---

The requirements gathered through CRUISE platform are at least as good as collected through interviews.

There was a miss of one (business) aspect but at the same time, there was a value addition in terms of 'system administrator' role and his privileges.

These observations answer RO2 and RO3 as – with a careful crowd formation, crowd control and moderation, one can expect the quality of requirements gathered using crowdsourcing approach as good as elicited through traditional methods of requirements gathering



# References

## List of Papers Referred - I

---

1. B. Nuseibeh and S. Easterbrook, "Requirements Engineering: A Roadmap," in proceedings of the conference on The Future of Software Engineering, 2000, Ireland, pp. 35-46.
2. L. Karlsson, A.G. Dahlstedt, B. Regnell, J.N. Dag and A. Persson, "Requirements engineering challenges in market-driven software development – An interview study with practitioners," in Information and Software Technology, vol. 49, 2007, pp. 588-604.
3. J.M. Bhat, M. Gupta and S.M. Murthy, "Overcoming Requirements Engineering challenges: Lessons from offshore outsourcing," IEEE Software, 2006, pp. 38–44.
4. S. Kujala, M. Kauppinen, L. Lehtola and T. Kojo, "The Role of User Involvement in Requirements Quality and Project Success," in proceedings of 13<sup>th</sup> IEEE International Conference on Requirements Engineering, 2005, pp. 75-84.
5. M. Bano and D. Zowghi, "A systematic review on the relationship between user involvement and system success. Information and Software Technology," 2015, pp. 148–169.
6. T. Johann and W. Maalej, "Democratic Mass Participation of Users in Requirements Engineering?," in proceedings of IEEE 23<sup>rd</sup> Requirements Engineering conference, 2015, pp. 256-261.
7. B. Ramesh, L. Cao and R. Baskerville, "Agile requirements engineering practices and challenges: an empirical study," in Information Systems Journal, Wiley & Sons Ltd., vol. 20, no. 5, 2007, pp. 449-480.
8. B. Boehm and R. Turner, "Management Challenges to Implementing Agile Processes in Traditional Development Organizations," IEEE Software, 2005, pp. 30-39.
9. D. C. Brabham, "Crowdsourcing as a model for problem solving an introduction and cases," in Convergence: the international journal of research into new media technologies, vol. 14, no. 1, 2008, pp. 75–90.
10. J. Howe, "The rise of crowdsourcing," Wired Magazine, vol. 14, no. 6, 2006, pp. 1-4.
11. R. Snijders, F. Dalpiaz, M. Hosseini, A. Shahri, and R. Ali, "Crowdcentric requirements engineering," in Proceedings of the 2014 IEEE/ACM 7th International Conference on Utility and Cloud Computing, 2014, pp. 614–615.
12. M. Hosseini, K. Phalp, J. Taylor, and R. Ali, "Towards crowdsourcing for requirements engineering," in Joint Proceedings of REFSQ-2014 Workshops, Doctoral Symposium, Empirical Track, and Posters, 2014, pp. 82–101.
13. R. Snow, B O'Connor, D. Jurafsky and A.Y. Ng, "Cheap and Fast – But is it Good? Evaluating Non-Expert Annotations for Natural Language Tasks," In proceedings of EMNLP – 2008, pp. 254-263
14. P.-Y. Hsueh, P. Melville, V. Sindhvani, "Data Quality from Crowdsourcing: A Study of Annotation Selection Criteria," NAACL HLT Workshop on Active Learning for NLP, 2009, pp. 27–35.
15. D. Zowghi and C. Coulin, "Requirements Elicitation: A Survey of Techniques, Approaches, and Tools," chapter in Engineering and Managing Software Requirements, A. Aurum and C. Wohlin (eds.), Springer Berlin Heidelberg, 2005, pp. 19–46.



# References

## List of Papers Referred - II

---

16. K. Mao, L. Capra, M. Harman and Y. Jia, "A survey of the use of Crowdsourcing in Software Engineering," Technical Report RN/15/01, Department of Computer Science, University College, London, 2015.
17. T. Breaux and F. Schaub, "Scaling Requirements Extraction to the Crowd", in proceedings of 22<sup>nd</sup> IEEE International Conference on Requirements Engineering, 2014, pp. 163-172.
18. M. Hosseini, A. Shahri, K. Phalp, J. Taylor, R. Ali, and F. Dalpiaz, "Configuring crowdsourcing for requirements elicitation," in proceedings of the 9th International Conference on Research Challenges in Information Science, 2015.
19. P. Nascimento, R. Aguas, D. Schneider, and J. de Souza, "An approach to requirements categorization using Kano's model and crowds," in proceedings of the 16th IEEE International Conference on Computer Supported Cooperative Work in Design, May 2012, pp. 387–392.
20. A. Sutcliffe and P. Sawyer, "Requirements Elicitation: towards the unknown unknowns," in proceedings of 21<sup>st</sup> IEEE International Conference on Requirements Engineering, 2013, pp. 92-104.
21. N. Muganda, D. Asmelash, and S. Mlay, "Groupthink decision making deficiency in the requirements engineering process: Towards a crowdsourcing model," SSRN Electronic Journal, 2012.
22. S. L. Lim, D. Quercia, and A. Finkelstein, "StakeSource: Harnessing the power of crowdsourcing and social networks in stakeholder analysis," in Proceedings of 32<sup>nd</sup> IEEE International Conference on Software Engineering, 2010, pp. 239–242.
23. S. L. Lim and A. Finkelstein, "StakeRare: Using social networks and collaborative filtering for large-scale requirements elicitation," IEEE Transactions on Software Engineering, vol. 38, no. 3, 2012, pp. 707–735.
24. A. Adepetu, K. A. Ahmed, Y.A Abd, A.A. Zaabi and D. Svetinovic, "CrowdREquire: A Requirements Engineering Crowdsourcing platform," In Wisdom of Crowd, AAAI Spring Symposium series, 2012.
25. R. Snijders, A. Ozum, S. Brinkkemper and F. Dalpiaz, "Crowd-Centric Requirements Engineering: A method based on crowdsourcing and gamification", Masters Thesis, 2015, Department of Information and Computing Sciences, Utrecht University, Utrecht, The Netherlands.
26. D. Renzel, M. Behrendt, R. Klamma and M. Jarke, "Requirements Bazaar: Social requirements engineering for community-driven innovation," in proceedings of 21<sup>st</sup> IEEE International Requirements Engineering Conference (RE), Rio de Janeiro, 2013, pp. 326-327.
27. C. Wohlin, M. Host and K. Henningsson, "Empirical Research Methods in Software Engineering," Lecture Notes in Computer Science: Empirical Methods and Studies in Software Engineering: Experiences from ESERNET, Wang, A. I. and Conradi, R., Springer Verlag, 2003, pp. 7-23.
28. M. Höst, C. Wohlin, and T. Thelin, "Experimental Context Classification: Incentives and Experience of Subjects," In Proceedings of IEEE International Conference on Software Engineering, 2005, pp. 470-478.

