

Web-Based Focus Groups for Requirements Elicitation

Carla Farinha
IST / Opensoft, S.A.
Lisboa, Portugal
carla.farinha@opensoft.pt

Miguel Mira da Silva
IST / INOV
Lisboa, Portugal
mms@ist.utl.pt

Abstract—Requirements determine how an Information System should operate. Requirements Engineering errors become failure reasons of the Information System. In this paper we propose a Web-based focus group method to overcome many problems of the requirements elicitation activity. Collaboration is promoted in discussions involving all stakeholders to achieve consensual decisions. The proposal was evaluated with two real-world experiments the results of which reveal the potential of the method. The successful implementation of the proposed method can avoid many limitations of the requirements elicitation traditional methods, such as misunderstandings between stakeholders and analysts.

Keywords: *Requirements Elicitation; Focus Groups; Collaboration Tools*

I. INTRODUCTION

Requirements are the heart of Information Systems Development since the earliest days of computing [1] because they determine how the system will operate [2], [3], [4]. Nevertheless, errors on the elicitation activity still represent major causes for the failure of these systems [5].

Requirements elicitation is influenced by many factors, including contextual, human, economic, and educational factors. It is also constrained by issues such as the specific process and project, the difficulties in communication and understanding between stakeholders and analysts, the quality of identified requirements, stakeholders' conflicts, and the experience and practice of the analyst [4]. Moreover, stakeholders should identify real needs but they may not know what they need and analysts may not understand business concepts [6], [7], [8]. Errors made at this activity cost around 80-100 times more if discovered at the implementation stage [1] and are very hard to fix [9].

The social nature of Requirements Elicitation has been leading to the usage of social sciences approaches [4], including ethnography [10], [11] interviews [3], [12] or group work [13-17].

We propose a web-based Focus Groups method to overcome major problems of Requirements Elicitation [15]. Requirements are discussed between all stakeholders that want to contribute with ideas. The goal is to find a global overview of real needs and to negotiate incoming conflicts. Finally, identified needs are resumed in a report according to their relevance. Our proposal was evaluated with Action Research with a real problematic situation, developing skills of organizational members to overcome that situation, and adding scientific knowledge [18, 19].

We present recent trends of requirements elicitation methods and relate collaboration tools in Section 2. Section 3 describes our proposal and research, including our experiments. Finally, Section 4 discusses concluding remarks and future research work.

II. REQUIREMENTS ELICITATION

Requirements Elicitation is a critical activity of the Requirements Engineering process [4, 20] for many reasons. First, the activity relies on a complex and error-prone communication between stakeholders and analysts. Second, stakeholders are not always clear about what they want or need. Finally, analysts may not understand the business concepts [1, 7, 8].

The communication nature of the Requirements Elicitation activity and its social context is incontestable [6, 8, 12]. As such, methods for this activity are deriving from social sciences' methods [4].

A. *Methods from Social Sciences*

Zowghi and Coulin [4] surveyed aspects of techniques, approaches and tools for requirements elicitation and aggregated them in 8 groups that cover the whole spectrum. The groups that actively involve stakeholders are ethnography, interview and group work, considered as alternative to each other.

Ethnography is the observation of people in their natural environment [10, 11]. Crabtree, Nichols, O'Brien, Rouncefield and Twidale [11] studied this method and reveal limitations, including risk of incorrect interpretation [10], impossibility of identifying new requirements [20] or difficulty of generalizing results. Sommerville [21] says that ethnography is incomplete, being useful as a complement.

Interviewing is an informal interaction where analysts gather requirements asking questions about the system in use and the system to be [4, 9, 21]. Davey and Cope [3] studied interviews as best practice for requirements elicitation but they admit that more research is needed about the nature of conversations in the field to bring successful results. Goguen and Linde [12] evaluated techniques for eliciting requirements, including interviews, and concluded that this method is limited by the stimulus-response interaction and by the need of participants to share basic concepts and methods. Sommerville [21] states that interviewing is unsuitable to identify organizational requirements and constraints, but could be used as complementary method.

Group work, such as brainstorming, joint application development, creativity workshops or focus groups, gathers stakeholders to collaborate reaching solutions about an identified problematic situation. Typical limitations of group work are dominant participants, biased opinions, high logistic costs and gathering stakeholders [4, 22].

Concluding, ethnography is incomplete on covering the fundamental types of activities of requirements elicitation and has relevant limitations. As for group work and interviews, the group work have many advantages since they can obtain a more complete overview of the system, richer information and resolution of conflicts through stakeholders' discussions rather than with individual interviews [4].

B. Group Work Methods

There are many group work methods, including brainstorming and workshops, which includes JAD, creativity workshops and focus groups.

Brainstorming joins stakeholders in informal discussions to rapidly generate ideas without focusing on any one. It is used to develop the preliminary mission statement for the project but not to explore requirements [4].

Joint Application Development (JAD) discussions focus needs of business and users rather than technical issues to make decisions. JAD differs from brainstorms since main goals of the system are already established before the discussion [4]. Davidson [14] studied 3 organizations using JAD and concluded that, although there are improvements in systems development, JAD is difficult to sustain in practice. Coughlan [2] also presented studies of JAD in practice, demonstrating that JAD forces a rigid user-designer interaction, is weak at acquiring knowledge and complicated to use in practice.

Creativity workshops encourage creative thinking to discover and invent system requirements [23]. Maiden and Robertson [23] used creativity workshops to discover stakeholder and system requirements, concluding that the overall process was successful but not all of the workshop sessions.

Focus Groups are discussion groups facilitated by a specialist that follows a guide to orientate the discussion around key questions [24, 25]. The preparation of the method requires defining groups (size and composition) and procedures (number of sessions and moderator guide). This method differs from other group-based methods because of the group special characteristics: homogeneous and focused on key topics to collect inductive and natural information [24]. Engelbrektssohn, Yesil and Karlsson [17] studied methodological considerations with focus groups, concluding that an efficient choice of participants and mediating tools are also important to enhance the requirements elicitation activity. Farinha and Mira da Silva [16] applied Focus Groups in real-world experiments to better elicit requirements of information systems, concluding that stakeholders discuss different perspectives about the system as a whole and collaborate to formalize the requirements according to their needs but dominant users and analysis costs were serious limitations. Kasirun and Salim [26] evaluated a requirement elicitation tool based on

a forum that employed Focus Groups, demonstrating that a web-based tool supports shared involvement and eases requirements elicitation but further research is needed to prove results.

Many researchers have been studying requirements elicitation problem using social sciences' methods, particularly group work. However, the problem still exists and much more empirical work is needed [2, 3].

C. Collaboration Tools to Elicit Requirements

The intense communication of requirements elicitation [7, 22], demands a high level of collaboration [27]. However, it is difficult to gather stakeholders at the same time and place [1, 9, 28]. This is why collaboration tools have been applied to requirements elicitation [4, 27].

Collaboration tools allow the cooperation of all stakeholders in several phases of the software process, including in requirements engineering. Choosing one of the wide range of collaboration tools demands defining types of tasks to accomplish, making an inventory of the existing software and hardware infrastructures and knowing the experience and capabilities of the team [27].

Herbsleb [29] studied a desired global development considering coordination as a key. He considered challenges in several areas, including eliciting and communicating requirements, concluding that is needed a systematic understanding of what drives the need to coordinate and effective mechanisms for bringing.

Whitehead [27] studied goals of collaboration in software engineering and existing collaboration tools, particularly web-based tools. He realized that there is no integrated web-based environment to cover the entire development lifecycle. He also concluded that is important to understand the collaborative nature of software engineering combined with low costs of high capabilities of communication platforms to improve collaboration in the creation of software artifacts.

III. PROPOSAL

In this paper we propose to address requirements elicitation problems, including difficulties on gathering stakeholders, misunderstandings between stakeholders and analysts, quality of identified requirements and stakeholders' conflicts. In order to do so, our key concerns were allowing an asynchronous and distributed communication; avoiding interpretation of results by analysts; inviting all stakeholders to contribute with their ideas; and obtaining agreement of all stakeholders about the identified needs.

To accomplish these challenges, we propose an effective requirements elicitation method, based on a collaboration tool that integrates the Focus Group method. Before using the method, boundaries of the system and key discussion topics must be defined by project managers. Finally, a report with the results must be delivered to project managers.

Although many proposals of collaboration tools with focus groups exist, we introduce distinctive features. One of the most important features is opening the discussion to all stakeholders, allowing the input of all necessary parts of the problem. We also added a voting system, which is not usually applied to focus groups. We compared a focus group

with anonymous contributions versus a focus group with identified contributions. Finally, we evaluated our proposal in a real environment.

In order to be successful, we assume that all stakeholders are interested in the Information System and want to contribute with ideas. We also assume that questions to discuss are defined by client project managers that know the limits of their desired solution. Finally, we believe that stakeholders actually take advantage of the asynchronous communication, which allows thinking on the problem, understanding other perspectives and generate new ideas to contribute again.

Our requirement elicitation method demands defining limits and goals with project managers conduct the focus group and resume results. We propose the following steps:

- 1) *Define scope and questions*
- 2) *Prepare the focus group in a collaboration tool configuring desired properties (anonymity, navigation, etc.)*
- 3) *Conduct the focus group*
- 4) *Report results*

A. Define scope and questions

This step intends to define limits of the desired solution and key questions to address in the focus group. Analysts have to meet with project managers to define these limits and the questions they find important to discuss.

B. Prepare the focus group

The focus group must be configured in a collaboration tool according to desired and adequate features. For example, shall the participants be identified or anonymous? Is there a navigation rule to answer the questions? How shall participants give their contributions?

In this experiment, we compared two approaches:

- 1) *Comment-oriented forum*, based on comments.
- 2) *Vote-oriented forum*, based on comments and votes.

The comment-oriented forum was configured in a self-hosted blogging tool. Each page had a question where stakeholders could comment. Following the orientations of a regular focus group moderator guide, these pages had a sequential order. Participants were advised to navigate and comment according to that order in the first time but they could freely navigate and comment any page. Opening and ending questions were excluded because they wouldn't make sense in an online method. Anonymity was integrated in this forum so that stakeholders could freely express opinions.

The vote-oriented forum was configured in a question & answer tool. Only key questions from a regular focus group were initially introduced to reduce the extensiveness of the time spent to answer. Participants could comment questions and others' ideas vote on posted ideas and introduce new questions. No navigation recommendations were provided. Anonymity wasn't integrated in this approach.

C. Conduct the focus group

The administration of the forums had to moderate the discussions. This moderation required to follow comments

and, if needed, delete comments, encourage discussions or probe for more information.

When conflicts of interests rise and it is impossible to satisfy different identified needs, participants shall be advised to resolve the disagreement. Whether they all agree with a solution becomes irrelevant after all because the most voted need is chosen.

D. Report Results

In order to avoid interpretation of results, analysts shall list identified needs and organize in a descending order. This order must be according to the number of positive comments asking for the need or to the positive votes.

IV. EVALUATION

Our proposal was evaluated on an enterprise of technological solutions, mainly e-government solutions. There are 60 employees that are from 23 to 40 years old and, the majority, are IT savvy.

The desired Information System was an in-house Information System to manage activities. The enterprise had an old solution that was outdated and not aligned with current needs. The modules they wanted to improve were time reporting, project management and financials.

Both forums defined in subsection B of the proposal were evaluated for a period of time. The comment-oriented forum was applied to discuss the time reporting module while the vote-oriented forum was applied to discuss the other two modules. Table I resumes the features of these forums.

TABLE I. FEATURES OF THE FORUMS

Forum	Comment-Oriented	Vote-Oriented	
<i>Module Feature</i>	<i>Time Reporting</i>	<i>Project Management</i>	<i>Financials</i>
Participation	Comments	Comments and Votes	Comments and Votes
Period	20 days	20 days	20 days
Initial Questions	8	3	3
Sequential Navigation	Yes	No	No
Anonymity	Yes	No	No

All employees have to report time and, as such, stakeholders of the time reporting module are all of the employees. As with project management and financials modules, only project managers and directors have to coordinate these activities. As a result, only the 14 employees that are project managers and directors were invited to discuss these two modules.

V. RESULTS

The main results are presented in Table II. The comment-oriented forum obtained around 10.25 comments per discussion topic and 15 identified needs. Anonymous comments made it impossible to measure the average comments per user and no vote system was integrated. Some

participants posted figures and graphics as examples of their perspectives.

The vote-oriented forum obtained, per discussion topic, around 18 comments in the project management module discussion and 11.30 comments in the financials module discussion. No other discussion topics were introduced by the participants. The average comments per user were 4.79 in the project management module discussion and 1.36 in the financials module discussion. The vote system verified around 7.14 votes per user. Finally, 33 needs were identified for the project management module and 11 needs for the financials module.

TABLE II. MEASURED INDICATORS

Forum Module Characteristic	Comment-Oriented	Vote-Oriented	
	Time Reporting	Project Management	Financials
Comments per topic	10.25	18	11.30
Comments per user	-	4.79	1.36
Votes per user	-	7.14	
Identified Needs	15	33	11

The number of comments during the discussion period was also measured. Figure 1 shows that the comment-oriented forum had a regular participation over time. However, the vote-oriented forum had a higher participation on the last days of the discussion, particularly in the last three days.

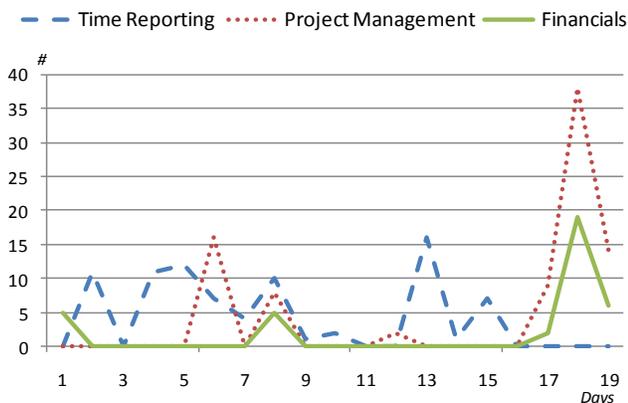


Figure 1. Participation during the Discussion Period.

The resolution of conflicts was performed by participants themselves. When conflicts of interests rose and it was impossible to satisfy different identified needs, participants were advised to resolve the disagreement. The discussion with all stakeholders allowed them to understand the other perspective. More support and justifications were given to one of the perspectives and the most approved was finally agreed.

After closing the discussion period, employees were asked about their participation, including reasons that lead them to participate or not. The received feedback involved 30% of the participants invited to the comment-oriented forum and 50% of the participants invited to the vote-oriented forum. The results are presented in Table III.

TABLE III. FEEDBACK

Type	Feedback
Nonparticipation Reasons	No ideas, lack of time to participate and recent employees with no experience
Positive Aspects	Extensive to all employees, anonymity, simple participation rules, structured discussion and open comments about discussion topics
Improvements	Present just key discussion topics, give rewards to participants, support the vote system to avoid repeating ideas, suppress suggested answers, no anonymity to avoid unreasonable censures

No transcriptions of the discussion were needed since it was already written. Identified needs were resumed in a descending order and included in a report delivered to project managers. Priorities were defined according to the number of references in the comment-oriented forum and to the number of votes in the vote-oriented forum

VI. LEARNING

Stakeholders' feedback confirms that this initiative was considered useful so that they could express their opinions.

Results show a higher participation rate in the vote-oriented forum although this forum involved only 14 stakeholders. Votes also counted as participations, which may explain this result. Typically, people avoid spending time on writing or exposing detailed ideas and the participants' final feedback for the voting system highlights this fact. It is easier to vote than to write comments.

Although we verified a higher participation rate in the vote-oriented forum, we consider that both forums had a fair participation rate. The contributions were rich, since they were always justified and, some included uploads of hand-made illustrations to explain and substantiate the participant's idea. As such, the comments were not only quantitatively but also qualitatively meaningful.

The asynchronous communication aspect of this tool allowed participants to express perspectives along time whenever they could. Also, the online tool allowed users to contribute with their ideas from wherever they were.

We also verified that users of both forums did not answer to all of the discussion topics. The topics with high discussion rates were key discussion topics in the comment-oriented forum and difficulties questions to judge the existing modules in the vote-oriented forum. This not only reveals that stakeholders prefer to directly answer key questions, but also that people are critical since there were more criticisms than comments about positive aspects or new ideas. Criticisms are also useful to understand what is wrong and should be improved.

The identified needs were mostly technical requests. For example, users wrote that the existing modules are too slow, that some buttons should be available, that certain

information is needed or that a particular navigation would be better than the existing one. This can easily be explained by the participants' profiles: almost all participants are computer engineers and, as such, they understand the problems behind the existing modules and tend to express technical opinions. This is clear since the comments of less technical users were also less technical.

Anonymity promoted free answers in the one hand, but it lead to less participation and conflicts in the other hand. Anonymity brought unexpected criticisms that otherwise could not have been revealed. These criticisms also brought conflicting perspectives that were discussed, always reaching consensus. However, the forum without anonymity had more comments per user indicating a commitment sense of identified users. The lack of conflicts may mean that users agreed to each other or that they did not feel free to disagree. Some participants believe that anonymity allows free expression of ideas without fear of consequences while others think that anonymity brings unreasonable criticisms.

Figure 1 shows that the comment-oriented forum had more regular participation than the vote-oriented one, which had more participation at the end of the period. This fact may be explained because votes also count as participation and at the end of the period there were more comments to vote. Actually, this voting system helps users not to repeat ideas and to prioritize needs. It is also possible to vote when comments are available, incrementing the participation rate.

Most important, suggested needs were integrated in a new version of the time reporting module and the overall feedback of stakeholders was positive. Moreover, they use the module more frequently, with fewer problems and without spending much time. These results prove that our method helps overcoming limitations, such as difficulties in communication and understanding between stakeholders and analysts, quality of identified requirements, stakeholders' conflicts, and the experience and practice of the analyst. Also, this method overcomes well know problems of group work methods, including dominant users with no limitations of time for each participant; gathering stakeholders at the same time and place with an online tool; generalization of results with the involvement of all stakeholders; and simplification of the analysis since no transcriptions or interpretations are needed.

VII. CONCLUSION

Stakeholders approved the initiative of freely expressing ideas in a simple and structured online forum. They prefer the voting system than repeating others' ideas and the discussion of key questions than starting with trivial and irrelevant discussion topics. Anonymity on the one hand helps users to make more censorious comments but, on the other hand, seems to take out the participation commitment and to discourage the disagreement of ideas. As such, some participants would prefer anonymity while others think that comments should be identified to avoid unreasonable and thoughtless criticism. We conclude that this proposal allowed quickly eliciting needs from all stakeholders.

After implementing the suggested needs for the time reporting module, the results prove that the method was a

success. Stakeholders are pleased with the new system and report their time more frequently, without mistakes or complaints. As such, we can conclude that the proposed method was a success.

Our method seems more effective over existing methods with our new features. The most significant feature is opening the discussion to all stakeholders. With this features, we wanted to ensure that inputs of important requirements would not be forgotten. Also, our proposal added a voting system and compared the anonymity aspect in two different approaches. This is also an unusual configuration of collaborative tools, particularly those who integrate focus groups as an elicitation method. These features bring effectiveness to the method by allowing a richer overview of the system with inputs of everyone, ordered needs with priorities given by participants and free expression with the anonymous approach or commitment sense with the approach with identified participants.

The major concerns we wanted to address, allowing an asynchronous and distributed communication; avoiding interpretation of results by analysts; inviting all stakeholders to contribute with their ideas; and obtaining agreement of all stakeholders about the identified needs, were met. As such, the problems we identified to resolve were actually addressed.

This paper proves that a collaboration tool based on focus groups allows eliciting requirements more quickly than the regular focus group of our previous experiment. This fact is easily understood since our previous effort required weeks to schedule a meeting with key stakeholders at the same time and place and more weeks to analyze results, transcribing the sessions and examining the information.

This paper also proves that a collaboration tool overcomes many problems of regular focus groups and elicitation methods. For example, communication between stakeholders and analysts is eased with this tool. Quality of identified requirements is higher since discussion provides richer information. Stakeholders' conflicts may be resolved in discussion with other participants. Dominant users are no longer a problem since time spent with the contribution of a participant does not steal time of another participant. Gathering stakeholders at the same time and place is no longer a problem as well.

Note that the demonstrated improvements are not meant to apply in general domains but in the maintenance/evolution of an existing Information System.

More research work is needed to confirm these results in other projects. The feedback of stakeholders also suggests other aspects to include in a future research. First, rewards to participants should be given to encourage participation. Second, only key discussion topics should be initially provided but allowing to add new discussion topics. Third, the voting system should always be present. Fourth, suggested answers should be removed so that users do not feel biased to answer.

ACKNOWLEDGMENT

We would like to thank the participants in the presented experiment as well as the managers of the organization which made the experiment possible.

REFERENCES

- [1] D. Avison and G. Fitzgerald, *Information systems development: methodologies, techniques and tools*. New York, NY: McGraw-Hill, 2006.
- [2] J. Coughlan and R. Marcredie, "Effective communication in requirements elicitation: a comparison of methodologies," *Requirements Engineering*, vol. 7, pp. 47-60, 2002.
- [3] B. Davey and C. Cope, "Requirements elicitation - what's missing?," in *Issues in Informing Science and Information Technology*, vol. 5, 2008, pp. 543-551
- [4] D. Zowghi and C. Coulin, "Requirements Elicitation A Survey of Techniques, Approaches and Tools," in *Engineering and Managing Software Requirements*, A. Aurum and C. Wohlin, Eds. Berlin: Springer, 2005.
- [5] T. S. Group, "The Chaos Report," 2009.
- [6] A. Al-Rawas and S. Easterbrook, "Communication problems in requirements engineering: a field study," in *First Westminster Conference on Professional Awareness in Software Engineering* London, 1996.
- [7] J. F. M. Burg, *Linguistic instruments in requirements engineering*. Amsterdam: IOS Press, 1997.
- [8] B. Nuseibeh and S. Easterbrook, "Requirements engineering: a roadmap," in *Conference on The Future of Software Engineering 2000*, 2000, pp. 35-46.
- [9] R. Hossenlopp and K. B. Hass, *Unearthing business requirements: elicitation tools and techniques*. Vienna: Management Concepts, 2007.
- [10] A. Crabtree, "Ethnography in participatory design," in *1998 Participatory Design Conference* Seattle, 1998, pp. 93-105.
- [11] A. Crabtree, D. M. Nichols, J. O'Brien, M. Rouncefield, and M. B. Twidale, "Ethnomethodologically-informed ethnography and information system design," *Journal of the American Society for Information Science*, vol. 51, pp. 666-682, 2000.
- [12] J. A. Goguen and C. Linde, "Techniques for Requirements Elicitation," in *Requirements Engineering*, S. Fickas and A. Finkelstein, Eds.: IEEE Computer Society, 1993, pp. 152-164.
- [13] W. S. Davis and D. C. Yen, "Joint application design (JAD)," in *The Information System Consultant's Handbook*: CRC Press, 1998.
- [14] E. J. Davidson, "Joint Application Design (JAD) in practice," *Journal of Systems & Software*, vol. 45, pp. 215-223, 1999.
- [15] E. W. Duggan and C. S. Thachenkary, "Supporting the JAD facilitator with the nominal group technique," *Journal of Organizational and End User Computing*, 2004.
- [16] C. Farinha and M. M. d. Silva, "Focus Groups for eliciting requirements in information systems development," in *14th UK Academy for Information Systems*, 2009, p. 20.
- [17] P. Engelbrektsson, Ö. Yesil, and I. C. M. Karlsson, "Eliciting customer requirements in Focus Group interviews: can efficiency be increased?," in *7th International Product Development Management Conference* Belgium, 2000.
- [18] J. Bhattacharjya and J. Venable, "An Action Research Approach to Strategic Information Systems Planning in a Non-profit Organization," in *3rd International Conference on Qualitative Research in IT and IT in Qualitative Research* Brisbane, Australia, 2006.
- [19] D. Coghlan and T. Brannick, *Doing Action Research in your own organization*, 3 ed. Los Angeles: SAGE Publications Ltd, 2009.
- [20] M. Sadiq, M. Shahid, and S. Ahmad, "Adding thread during software requirements elicitation and prioritization," *International Journal of Computer Applications*, vol. 1, 2010.
- [21] I. Sommerville, *Software engineering*, 6 ed. Harlow, England: Pearson Education, 2001.
- [22] J. L. Maté and A. Silva, *Requirements engineering for sociotechnical systems*. Hershey, USA: Idea Group Inc (IGI), 2005.
- [23] N. Maiden and S. Robertson, "Integrating creativity into requirements processes: experiences with an air traffic management system," in *13th IEEE International Conference on Requirements Engineering* Paris, 2005, pp. 105-114.
- [24] R. A. Krueger and M. A. Casey, *Focus groups: a practical guide for applied research*. California: SAGE, 2000.
- [25] J. Kitzinger, "The methodology of Focus Groups: the importance of interaction between research participants," *Sociology of Health & Illness*, vol. 16, pp. 103-121, 1994.
- [26] Z. M. Kasirun and S. S. Salim, "Supporting collaborative requirements elicitation using Focus Group discussion," *International Journal of Software Engineering and its Applications*, vol. 3, 2009.
- [27] J. Whitehead, "Collaboration in software engineering: a roadmap," in *Future of Software Engineering, 2007. FOSE '07*, Minneapolis, 2007.
- [28] D. Apshvalka, D. Donina, and M. Kirikova, "Understanding the Problems of Requirements Elicitation Process - A Human Perspective," in *Information systems development: challenges in practice, theory, and education*, vol. 1, C. Barry, K. Conboy, M. Lang, G. Wojtowski, and W. Wojtowski, Eds. New York, NY: Springer, 2008, p. 600.
- [29] J. D. Herbsleb, "Global software engineering: the future of socio-technical coordination," in *Future of Software Engineering, 2007. FOSE '07*, Minneapolis, 2007, pp. 188-198.