Identifying and Reviewing the Most Relevant Socio-technical Aspects of Requirements-Driven Collaboration in Agile Teams

Irum Inayat, Siti Salwah Salim, Sabrina Marczak, and Zarinah Mohammad Kasirun

Abstract—The dynamic nature of agile methods and volatility of requirements claim frequent team collaboration. This collaboration encompasses various socio-technical aspects like knowledge sharing, communication etc. In this paper our aim is twofold. First, we identified the most relevant socio-technical aspects of requirements-driven collaboration; and second, we reviewed those aspects in literature for agile teams. We conducted a questionnaire based survey with agile practitioners for identification of the most relevant socio-technical aspects of requirements-driven collaboration. The survey results revealed that practitioners consider communication and awareness the most relevant socio-technical aspects of requirements-driven collaboration among many. Furthermore, the review results showed that less research has been done on social aspects (e.g. awareness) involved in agile requirements engineering activities. Hence this study provides implications in terms of more empirical investigations to further the knowledge on the social aspects of requirements-driven collaboration among agile teams.

Keywords—Requirements-driven Collaboration, agile software development methods, socio-technical aspects, requirements engineering.

I. INTRODUCTION

REQUIREMENTS engineering is a social activity and involves stakeholders collaboration [1]. Likewise, agile software development methods involve team’s collaboration throughout the development life cycle. The collaboration driven by requirements related activities is defined as requirements-driven collaboration (RDC) [2]. Therefore, requirements related activities in agile teams involve social and technical relationships between team members. The team members working together on certain interdependent work items or user stories (requirements) develop social and technical dependencies on each other. These dependencies give rise to socio-technical relationships. Collaboration among teams is the only way to tackle the dynamic and volatile nature of requirements in agile methods [3].

In literature several social aspects playing role in technical work have been emphasized for agile methods such as: communication [4], [5], trust [6], [7], organizational culture [8] and fleeting knowledge [9] etc. Although these social factors play part in team performance and outcome quality, yet it needs the most relevant social factors to be identified for agile teams. Therefore, in this paper we aim to identify the most relevant socio-technical aspects of RDC for agile teams and review them in literature.

This paper is divided into a number of sections. Section 1 is about the introduction. In Section 2, we discuss our research design and methodology. In Section 3, we present our Phase 1: Survey study; context, objectives and findings. In Section 4, we describe our Phase 2: Literature review of identified aspects. Section 6, concludes the paper if your paper is intended for a conference, please contact your conference editor concerning acceptable word processor formats for your particular conference.

II. RESEARCH QUESTIONS AND METHODOLOGY

It is of prime importance to focus on social aspects of a collaborative activity like requirements engineering in collaboration oriented agile methods. Therefore, we pose our research questions to investigate and further the knowledge on the topic.

RQ1. What are the most relevant socio-technical aspects of Requirements-driven collaboration for agile teams?

SQ1. How do agile practitioners perceive collaboration?

SQ2. What are the effects of collaboration on agile teams?

RQ2. What is currently known about the identified aspects of requirements-driven collaboration for agile teams in literature?

To fulfill the study aims we adopted questionnaire based survey method for Phase 1. The questionnaire consisted of open and closed ended questions because it is suggested to combine open and closed ended questions in a survey as a survey design tactic [10]. The open ended questions were used for demographic details and rest of the questionnaire comprised of closed ended questions. While designing the web-based questionnaire it was intentionally chosen to keep the number of open-ended questions lower to avoid missing data [11]. In Phase 2, we performed literature review to study
the current knowledge about the identified socio-technical factors.

III. PHASE 1: SURVEY STUDY

The main objective of this survey study was to identify the important socio-technical aspects according to the perception of practitioners using agile methods.

This study employed online survey method for gathering data. A twofold approach was used for data collection through (i) emailing targeted worldwide communities and companies that adopt agile and (ii) uploading invitations to related groups at the LinkedIn Professional Network website. LinkedIn is a professional social network which owns millions of groups, communities, and users. It has been used for professional discussions, knowledge sharing, and job listings since early 2002.

We posted our survey questionnaire to specific groups such as Agile, Agile and Lean, Agile CMMI, Agile Bangalore, Agile Project Managers, Extreme Programming (XP), Group Lean Brazil, Agile Project Managers Extreme Programming (XP), QA in an Agile World, Requirements Engineering, Scrum Alliance Inc., Scrum China, Scrum Gathering Orlando 2010, Scrum Manager, Scrum Practitioners, and Software Engineering Professionals. Fig. 1(a) and (b) shows the distribution of the respondents per location.

The target population was agile practitioners working in industry and using agile methods, i.e. Scrum, Lean, Kanban, XP etc. The roles to be investigated could be developer(s), tester(s), project manager(s), team lead(s), Scrum Master(s), or any other custom-created role by the company as long as directly involved with software development. Data was collected for 4 entire weeks in May 2012. A total of 103 responses were collected from all over the world. About three-quarters of the responses were gathered through the LinkedIn network while only about one-quarter were collected through e-mail (50 email invitations were sent and 30 were replied, considered 26).

The survey was designed consisting three sections as described below:

Demographics: Respondents’ background and work experience.

Respondents’ perceptions about collaboration and its impact designed to answer our two SQs.

Identification of the most relevant socio-technical aspects of RDC in agile teams, answers our RQ1.

As a part of pilot process the survey was sent to three subject matter experts and 7 agile practitioners working in industry and following agile methods to check the validity of content. The suggestions and reviews were used to improve the questions and to avoid ambiguities.

A. Findings of Survey

Data gathered using this survey was analysed in terms of determining its frequency and percentage to calculate the highly important socio technical aspects. The Likert-scale questions were statistically analysed to see the responses in order to determine future direction.

Fig. 1 Percentage distribution of Responses (a) through email and (b) linkedin.com

B. Demographics

The responses showed that most of the participants were experienced with agile methods: 32% have work experience of less than two years, 53% with three to seven years, and 15% having more than 9 years in the field working with agile methods (shown in Fig. 2(a)).

The distributed of the participants per role is as follows: 15% analysts, 22% developers, 20% are team leaders, 6% testers, 22% Scrum masters, 11% from Quality Assurance team, and 4% are Project Managers (Fig. 2(b)).

The experience of the respondents in their present role (fig. 2(c)) shows that 22% of the respondents have less than two years’ experience working on the current position, 34% of the respondents have less than four years, and 46% have four to nine years’ experience.

The agile methods in use by the respondents are showed in Fig. 2(d), which shows that Scrum was found to be the most adopted method with 46%, followed by Extreme Programming with 25% and Lean with 20%.

C. Perception of Requirements-driven Collaboration in Agile Teams

To answer the sub question 1 (SQ1), we asked about the perception of agile practitioners regarding collaboration. Results show that respondents perceive requirements-driven collaboration in agile teams mainly as communication among team members, shared awareness of each other’s work, and knowledge sharing. It can be seen in Fig 3(a) that 21% respondents mentioned communication, 30% mentioned awareness, and 16% mentioned knowledge sharing as the socio-technical aspects that define how they see collaboration among agile teams. These findings confirms the proposition suggested in [6] that collaboration is when team members are well aware of each other’s presence, work status and knowledge level, and then they communicate with each other in order to share knowledge while working on certain set of interdependent requirements. Moreover, 77% of the respondents agreed that collaboration among teams makes requirements engineering process easier (fig 3(d)) which confirms Cataldo’s study results that informal communication among Agile teams can reduce the rework [12]. Furthermore, while answering sub question 2 (SQ2) the respondents felt collaboration as crucial and if missing could affect project success (32%), product quality (27%), team performance (24%), and requirements quality (17%) (Fig 3. (b)).
D. Relevant Socio-Technical Aspects Related to RCD in Agile Teams

The analysis of survey results has been performed by applying pairing socio-technical aspects. Pairing is applied to gain relative opinion about both variables [13]. Paired samples are often attractive to the user and thus we paired our set of socio-technical aspects into identical pairs of two. While answering the research question 1 (RQ1) survey results showed that two highly recognized socio-technical aspects among Agile teams, were awareness and communication (Mean (M) = 1.22, Standard Deviation (SD) = 0.88) as shown in table 2. The successive aspects were communication and information sharing (M = 2.35, SD = 1.06), followed by communication and trust (M = 2.60, SD = 0.83). The socio-technical aspects used in this survey were communication, awareness, trust, information sharing and organizational culture. All of the selected socio-technical aspects were paired with each other resulting in nine distinct pairs. It can be concluded from the results shown in table 2 that the aspect considered least important by most of the respondents is organizational structure as the mean is higher whenever organizational culture is grouped with any other aspect. We used Cronbach’s Alpha [4] to calculate internal consistency and reliability of data (Table 1). The value ranges from 0.72 to 0.90 which shows acceptable to good consistency.

![Fig. 2](image1)
![Fig. 2](image2)

Fig. 2 (a) Respondent’s experience, (b) Respondent’s Roles studied, (c) Respondent’s experience in present role and (d) Agile methods in use.

IV. PHASE II: REVIEW OF RELEVANT SOCIO-TECHNICAL ASPECTS OF RCD IN AGILE TEAMS

In this section, we present the review of the identified socio-technical aspects of RDC in agile teams. In literature there exists several articles that study social factors and their impacts on agile teams for projects of variable sizes [12][14][15]. However, unfortunately a little material is available on identification and impact analysis of social factors of agile RE. We present a review of identified socio-technical aspects i.e. communication and awareness in agile teams for RDC from present literature (answering RQ2), as shown in Table 2 below.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Mean</th>
<th>SD</th>
<th>Cronbach’s Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration with distributed teams is easy</td>
<td>4.05</td>
<td>0.73</td>
<td>0.7</td>
</tr>
<tr>
<td>Collaboration with co-located teams is easy</td>
<td>1.44</td>
<td>1.21</td>
<td>0.7</td>
</tr>
<tr>
<td>Collaboration with distributed teams you have already worked with is easy</td>
<td>1.35</td>
<td>1.86</td>
<td>0.8</td>
</tr>
<tr>
<td>You can easily collaborate with people you can trust</td>
<td>1.88</td>
<td>1.25</td>
<td>0.8</td>
</tr>
<tr>
<td>You can easily collaborate with people you are aware of</td>
<td>1.35</td>
<td>0.74</td>
<td>0.9</td>
</tr>
</tbody>
</table>

(5-point Likert scale: 1-strongly agree, 5- strongly disagree)

A. Communication

Agile RE addresses some of the challenges of traditional RE like communication gaps and over-scoping [5]. A case study was conducted at a large scale software development company using product line approach. To overcome these challenges the authors suggested measure such as: i) gradual detailing of requirements; finalizing the requirements only when they are about to be implemented makes them more stable, ii) representing requirements as user stories; enhances communication among stakeholders and clarifies user’s perception, iii) cross functional development teams and iv) integrated requirements process; enhances communication. Requirements could be easily identified, agreed upon and communicated among stakeholders by diminishing the communication gaps.

The authors explored the causes and effects of communication gaps among agile teams in [16]. An exploratory study was conducted with a large scale market driven software organization. Four factors that affect the requirements communication, were identified as i) scale; the size and complexity of software project, ii) temporal aspects; lack of continuity of requirements awareness, common view; iii) common goals and vision and decision structures; and iv) unclear or weak goals lead to unstable requirements. The
findings revealed that communication gap causes unfulfilled customer requirements, generates quality issues and rework. Communication delay was studied among agile teams i.e. pairs to identify the dependency among roles it was observed that intra-team communications are easier than inter-team communications across the boundary of organization. The findings of this study showed that sharing of tasks by stakeholders reduces communication delay.

Communication patterns of an agile team were studied at a large UK based telecommunication company in [4]. The results proposed that team members should communicate over user stories to develop a better understanding and share knowledge to achieve mutual consensus.

In [17] the authors have identified the two most relevant social aspects of requirements-driven collaboration [18] among agile teams through an online survey and presented the results of a case study carried out to study communication and awareness among agile teams. The case studied was of an international software development organization and the findings revealed that the teams well aware of each other’s presence, professional ability and work status face less communication challenges which eventually lead to lesser rework.

In summary, we can see that main focus while studying communication among agile teams remained on studying communication gaps, reasons and effects of gaps, communication delay and communication patterns among agile teams.

B. Awareness

There are just a handful of studies that discuss awareness in terms of agile methods. This opens the gates towards more empirical work in this direction. In [19] an ambient system was designed and implemented for determining build status awareness among agile teams. An industrial case study was conducted to test the approach prototype. The findings revealed that proposed approach helped to enhance the build awareness among team members which enhanced their sense of responsibility for broken builds. Moreover, the increase in awareness decreased the number of broken builds.

In [9] Agile Service Networks (ASN) approach was introduced and compared with Scrum method for agile teams. The prototype was designed and implemented on French National grid. The results revealed that ASNs reduce latency times of “wicked-problems” i.e. defects, bugs in documentation, mistaken design decisions, and employee turnovers, etc. by promoting awareness among globally distribute agile teams.

In summary, we can see that the studies only discussed current awareness for globally distributed teams through ambient system and ASNs.

C. Discussion and Anticipated Challenges

In summary, we can see from the above discussion that we have observed that communication has been studied in agile teams from the perspectives of; i) communication gaps; ii) reasons and effects of communication gaps; iii) communication delay and communication patterns of agile teams. We can see that in context of social aspects of Agile RE, communication remained the preferred aspect. This emphasizes that there is a need to study other socio-technical aspects of requirements-driven collaboration for agile teams i.e. awareness, knowledge sharing etc. Moreover, it is also an interesting aspect to investigate that why only communication is the preferred aspect to be studied for agile teams.

| TABLE II | SUMMARY OF SELECTED STUDIES AT LARGE |
| Research concentration | Metric | Source |
| Communication | Communication gaps overscooping issues resolved by Agile RE [5] | Better communication, stakeholders’ agreement | Workshop |
| Causes and effects of gaps in requirements communication [16] | Lesser rework, Improved quality | Conference |
| Communication delay among pairs [20] | Better communication | Workshop |
| Communication patterns among agile requirements engineering [4] | Shared conceptualizations | Workshop |
| Communication & awareness [17] | Team performance | Workshop |

| Awareness | Awareness of build status among agile teams [19] | Lesser time between broken builds | Conference |
| Agile service nodes (ASN) to increase awareness among globally distributed agile teams[9] | Increase in the number of builds | Decreases delay time | Conference |

The authors have mentioned that agile teams are the most suitable for studying communication [12]. Furthermore, the authors also found that by keeping an eye on the communication happening among teams Managers can improve their team’s outcome [12]. Therefore, this study invites researches to probe into this aspect and dig the suitability of studying communication for agile teams. Awareness for agile teams is an under researched topic and needs attention. We can see that in agile teams awareness supports communication. Therefore, empirical studies should be conducted to study team’s awareness about each other’s presence, tasks and work status. The increase in level of awareness can be foreseen as an enhancing factor for increased communication and collaboration. The studies that discussed awareness in agile methods focused on general or current awareness only. This invites the researchers to explore other dimensions of awareness like task awareness, work status awareness, peripheral awareness etc. among agile teams. Awareness being an important socio-technical aspect needs to be explored further from variable dimensions i.e. dependency of awareness on other socio-technical factors, factors affecting awareness in agile teams etc.

Therefore, we invite researchers to focus on interdependence of other socio-technical aspects i.e. trust[6],

http://dx.doi.org/10.15242/IIE.E0314201
awareness for agile teams [17], etc. and further the knowledge domain with interesting results. Thus our study confirms these views, as the number of social factors of Agile RE related studies is relatively less. However, in order to provide absolute and concrete judgment, more social aspects related investigation and empirical results are required.

V. CONCLUSION

In this paper we have firstly identified the most relevant socio-technical aspects of requirements-driven collaboration among agile teams and then reviewed them in literature. The survey study was used to identify the aspects from industry practitioners. The survey results revealed communication and awareness as the two most relevant aspects of requirements-driven collaboration in agile teams. The second phase comprises of the review and it revealed that communication is one of the most relevant social aspects to be studied for agile teams. Communication gap, reasons and effects of communication gaps, delays and communication patterns have been studied so far among agile teams. However, awareness is an important yet under researched aspect which needs more empirical results to further knowledge on this topic. This study diverts the attention of researchers towards the relevant social aspects in a challenging scenario having dynamic agile teams with volatile requirements. This paper provides implications for the researchers to further explore the social aspects among agile teams.

ACKNOWLEDGMENT

The authors like to thank Bright Sparks Unit, University of Malay for funding this research. The authors also like to thank the experts for providing feedback on survey questionnaire and the participants for their cooperation.

REFERENCES


Irum Inayat is enrolled in Ph.D. program at the Department of Software Engineering, University of Malaya (UM), Malaysia. Her research interest lies in requirements engineering and agile software development methods and agile requirements engineering. She has several publications in International Conferences and ISI indexed journals.

Siti Salwah Salim is a Professor of Software Engineering at University of Malaya (UM). She is the Dean of Faculty of Computer Science and Information Technology, UM. She has a number of publications in ISI indexed high ranking journals. She is the principal Investigator of a high impact research group at UM. Prof. Dr. Siti S. Salim has her research interests in software requirements engineering, human computer interaction, computer supported cooperative work, component based software development and affective computing.

Sabrina Marczak is a Professor at Pontificia Universidade Católica do Rio Grande do Sul University (PUCRS), Porto Alegre, Brazil. She holds a PhD degree in Requirements Engineering from Victoria University, Canada. Her research interests lies in requirements engineering, requirements-driven collaboration, and social aspects in agile teams. She has published in to a number of international conferences and ISI journals.
Zarina M. Kasirun is an Associate Professor at University of Malaya, Malaysia. She is head of the department of software engineering at University of Malaya, Malaysia. She has acquired her PhD degree from University of Malaya. Her research interest lies in requirements engineering, collaborative computing, e-learning and computer based training. She has published into several international conferences and ISI journal.