A Systematic Mapping Study on Requirements Elicitation Techniques in Collaborative Application

Noorihan Abdul Rahman and Shamsul Sahibuddin

Abstract—This paper describes a mapping study to identify what are the existing requirements elicitation available for Computer-Supported Collaboration Work (CSCW) application. This study also points out type of requirements which the developers look for during requirements elicitation. Based on 14 papers that have been refined from the study, the authors look at types of domain involved in CSCW application. This paper also describes potential requirement to support social presence in collaborative application such as in E-learning as one of the domain in CSCW application.

Index Terms—User, requirements elicitation, interaction, CSCW, social presence, e-learning, collaboration.

I. INTRODUCTION

Effective collaborative application is very essential to drive users to learn and use the system actively as in online community. In developing E-learning as a collaborative application, requirements engineers should gather the requirements needed by users to ensure that they can interact and share knowledge actively in E-learning community. This paper produces a mapping study to see existing requirements elicitation process for various domains in CSCW. In addition, the study also reveals the requirements that developers usually look for in creating CSCW application, whereby it is usable for human-human interaction using CSCW application.

The objective of this work has been achieved through a systematic literature review (SLR), following the approach of Kitchenham *et al.*[1]. According to Kitchenham *et al.*, SLR is a research technique to analyze the state-of-the-art in a particular field of knowledge by formally defining the problem statement, the sources of information, the search strings, the criteria for inclusion and exclusion of the papers found in the searches, the quantitative analysis to be undertaken if necessary and the templates for ordering the information collected from the papers. To initiate SLR, authors need to carry out the search process based on Research Questions (RQ), which will be revealed in Section II. RQ is useful as the guidance for the authors to identify their keywords and limitation for systematic literature

survey.

II. SYSTEMATIC MAPPING PLAN

Broad search with some keywords have been used in finding related literature for the research. The papers are gathered based on some criteria of keywords during search process of SLR.

A. The Research Questions

This paper addresses two research questions related with the study. The first research question has helped the researchers to narrow down topic or issue that needs to be searched for. The first question, ‘What are existing requirements elicitation processes for E-learning or other Computer-Supported Collaborative Work (CSCW) applications?’ is equivalent to the original study.

The second research question is also taken from the original study. This research question is going through SLR process to see requirements that have been identified during existing requirements elicitation. The question is, ‘What are the type of requirements involved for supporting collaboration in E-learning or CSCW application for stakeholders?’

B. The Search Process

The search process involved Scopus Indexing System. The search took place between 2007 to recent and based on keywords from the paper. The authors have decided to include 5 keyword strings which consist of possible terms which may relate to systematic review objective. The search strings are as follows:-

- 1) “Requirements technique” and “requirements engineering” and “CSCW”.
- 2) “Requirements elicitation” and “requirements engineering” and “CSCW”.
- 3) “Requirements gathering” and “requirements engineering” and “CSCW”.
- 4) “Requirements model” and “requirements engineering” and “CSCW”.
- 5) “Requirements process” and “requirements engineering” and “CSCW”.

C. Study Selection

In acquiring data and assessing the quality of the reviews, authors have identified two objectives according to the research questions. The first objective is to identify papers that pointed out what is the requirements elicitation process that have been used in collaborative application. The second objective is to discover what requirements that they concern during requirements gathering. There is no specific protocol that has been established in order to do quality assessment.

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In producing the result, authors have selected publications which came from conference proceedings as well as from journal papers. There are some criteria of inclusion and exclusion from the results of paper which have been based on keyword strings earlier on.

D. Inclusion Criteria

The authors include studies which are related to requirements engineering area and Computer-Supported Collaborative Work (CSCW). The mapping studies also take into account empirical studies for identifying what is the existing requirements elicitation available for respective domain. The studies also try to spot type of requirements involved in CSCW application regardless from several domains selected. The studies are selected from journals and conference papers.

E. Exclusion Criteria

However, those studies exclude some criteria in the review protocol. It does not include concept papers, workshop papers, papers that are not related with information technology disciplines. There are papers that have been rejected during refinement process since the content is not related with the research questions for this study.

III. RESULT

The mapping study is done to see the example of existing elicitation that is related to possible requirements that they have gathered. Table I reveals existing studies on requirements elicitation from various domains from 2008 until recent.

IV. APPLICATION OF REVIEW PROTOCOL

The application of the review protocol produced as specified 14 publications consists of conference papers and journal papers. The 14 papers have been refined from 28 of papers. During the selection process, the authors have identified that there are a few identical papers resulted from different keyword strings. Most of the papers are selected from empirical studies and they may be published in the form of papers or journals simultaneously.

V. DISCUSSION

This paper provides some discussion from the variety of domains in CSCW and the requirements type that authors are interested for their research.

A. Domain

There are 7 categories of domains from the studies. Among 14 refined papers that have been selected based on inclusion and exclusion criteria. Table II stated number of papers for each domain for selected studies.

B. Requirements Elicitation Technique

From the mapping study, the authors have found out that researchers use different kinds of elicitation technique to gain type of requirements that they want to extract from the

domain, however, their goals is the same which is to improve user interaction and collaboration in using CSCW application. Storytelling has been used as the technique to elicit requirements and to transform the requirements into technical representation which the developer is able to understand[16]. Two papers use psychological approach to obtain requirements from users. The two approaches have been identified as Activity Theory and small group theory respectively[11]-[16] whereby 2 papers have mentioned prototype as the way to get the requirements from their domain[9],[11],[15]-[16].

TABLE II: DOMAINS FROM MAPPING STUDIES.

<i>Domain</i>	<i>No of Paper(s)</i>
Ubiquitous computing	2
E-learning	2
Enterprise Resource Planning	1
Online service for disabilities	1
Socio-technical system	1
Medical/Health information systems	3
CSCW-related system	5

Regardless of various elicitation techniques, a traditional technique such as interview[5]-[7] is still being implemented in order to gain requirements from user and there is also a participatory approach from expert as well as users[13]-[14] in CSCW development.

C. Type of Requirements in Existing CSCW

From 28 papers, there is only 14 papers stated clearly types of requirements that authors have interest at. Table III shows type of requirements in CSCW application.

TABLE III: TYPE OF REQUIREMENTS IN SELECTED STUDIES.

<i>Reference</i>	<i>Requirement Type</i>
[2]	Improve requirements from team using Activity Theory.
[3]	Help willingness Initial availability Preferences Student knowledge level Potential helper as an agent
[4]	Requirements for ubiquitous E-learning system.
[5]	Requirements for disabilities.
[6]	Requirements for collaboration projects.
[7]	Requirements for 4D collaboration tools.
[8]	Requirements for cooperative task in multi-group environment.
[9]	Requirements for multi modal interaction.
[10]	Requirements to improve human interaction using collaborative theory.
[11]	Social computing requirements.
[12]	Requirements for collaborative product.
[13]	Requirements for elderly homecare.
[14]	Requirements to integrate users in medical devices.
[15]	Requirements for data integration, analysis services, communication mechanisms.

D. Possible Requirements for Collaboration Activities

TABLE I: EXISTING STUDIES ON REQUIREMENT ELICITATION

Reference	Paper Type	Objective	Elicitation Component	Domain
[2]	Conference paper	To support interaction between user and analyst and to convert the stories into a technical representation.	Storytelling, Activity Theory, use case construction.	CSCW
[3]	Conference paper	To improve collaboration between users in E-learning environment.	Intelligent system, e-assistant- to ensure E-learning is running dynamically between users.	E-learning
[4]	Conference paper	To gather information from users' input using scenario.	Distributed scenario based method.	Ubiquitous E-learning platform
[5]	Conference paper	To elicit information from various stakeholders including people with disabilities	Online surveys, interviews, focus group schedules, online mailing lists, review of existing literature	online services in education environments for people with disabilities
[6]	Conference paper	To model users' views in collaborative projects	Interviews	Groupware oriented system for construction project
[7]	Conference paper	To model users' views for 4D collaboration tools	Visualization task model	Architecture, engineering, construction (AEC)
[8]	Conference paper	To support cooperative works that involve multiple groups	Multi-group cooperative organization-activity model	CSCW
[9]	Conference paper	To support human collaboration in context-aware systems, support data centered requirement	Simulation, prototype	Ubiquitous computing
[10]	Conference paper Journal paper	To improve ERP by improving user-system collaboration	Cognitive walkthrough –the answer from the questions is taken as the basis for predicting users' success or failure to properly complete the task.	ERP
[11]	Conference paper	Propose a set of generic requirements or analysis issues that need to be addressed when specifying technical system from psychology view.	Use socio psychological Theory to analyze	Socio-technical systems
[12]	Conference paper	To support dynamic nature of collaborative design	Feature-based product data model	CSCW
[13]	Journal paper	To bring the experts to understand the same issue and achieve the same goal.	Participatory design using multi-disciplinary thematic seminar from user experts.	Health information systems
[14]	Conference paper	To elicit in participatory design for users	Participatory research	medical device development (MDD)
[15]	Conference paper	To come out with a conceptual model for CSCW system	Prototype	Medical

From selected studies, the authors have identified that all CSCW application have emphasized on collaborative activities among user in order to improve user interaction. Therefore, this section is to give some preview regarding possible requirements that involved in collaborative activities. This section gives preview according to E-learning domain as one of CSCW application.

Collaborative involves a group of people working together to attain goal[17]. According to Alonso *et al.*[18], there are importance in collaboration whereby it enables people to learn mutually and participate actively to do tasks. According to Shulman[19], 'the active, collaborative, reflective re-examination of ideas in a social context is one

of the most important remedies for combating the illusion of misunderstanding and persistence of misconceptions'. Collaboration needs support from effective groupware application for encouraging users to access online environment. In order to have effective groupware, developer should identify what are the factors that may lead to successful online communities. In developing an application or software that has the capability to support collaborative activities among user, developers need to obtain a set of requirements which has the element of supporting collaborative activities for users.

Collaborative activities in e-learning allow learners to communicate for knowledge sharing during learning process

regardless of ways of interaction in E-learning platform. Learners can perform activities like discussion, online quiz and assignment, announcement in online forum, chatting with friends and other related tasks which can help them to share their knowledge and ideas. However, there is a challenge in sustaining learning interest in E-learning. Some students lack of motivation to interact and feel insecure to expose their opinions in E-learning. There is also an issue in preserving the usability of E-learning among students and hence reduce the flexibility to learn anytime anywhere. Having said that, we believe that there is an opportunity in enhancing the knowledge of requirements elicitation for collaborative application especially for E-learning domain. This is due to the fact that developers and other stakeholders need to be aware on how to plan and design the right application in order to sustain collaboration among learners. Requirements engineers also take part in discovering the right requirements that can maintain collaboration and therefore improve requirements elicitation for developers by preparing accurate requirements specification document for sustaining social interaction among learners. The element of interaction needs to be studied further by the requirements engineer in order to come out with an accurate set of requirements. Table IV reveals examples of element on interaction in Computer-Supported Collaborative Work (CSCW) application.

Social factors in software development can be considered as the requirement to permit interaction between users and the application whenever the system is being use. Social factors are factors that can be studied in order to raise social interaction in CSCW application. In E-learning, for instance, users interact by sharing knowledge on certain topics, according to their preferences. The interaction among users is also motivated by active collaboration since they feel comfortable and created social bonding virtually. By having comfort and sufficient bonding among themselves, it also affects users' emotion in learning. As the result, effective learning process is achieved even though it is online. Table IV depicts social factors in the context of software development. Those factors are the possible factors in CSCW application whenever users interact among themselves. In this paper, the authors relate social presence with possible factors of social interaction by identifying how social presence exists in E-learning during learning process. Subsection E elucidates social presence definition and its role in E-learning application.

TABLE IV: FACTORS OF SOCIAL INTERACTION IN CSCW

Factors of Social Interaction in CSCW	References
Knowledge sharing	[20-23]
Personal preferences	[24]
Customer/User collaboration	[25, 20, 22, 26-28]
Motivation	[25, 22, 29]
Social bonding /social interaction	[30, 29, 31, 32, 28]

E. Social presence as the Social Interaction Element

This section converses definition of social presence and its role in E-learning domain. The theory of social presence is important since social presence technology is hoped to be

an alternative to face to face interaction among individuals[33]. The theory is also related to mediated-interaction technology which particularly explained different technological forms that can assist social interaction which encourage mind interaction among users. Table V summarizes the definition of social presence for clearer description on social presence.

Social interaction in E-learning is an activity among users in order to achieve effective learning process. It happens during online discussion or interaction regarding E-learning contents. In developing E-learning, developers need to comprehend what is the element of social presence as to support social interaction among E-learning users. Therefore, the authors suggest that it is important for requirements engineer to carry out with requirements elicitation technique which can help to transform element of social interaction into meaningful information for requirement specification.

TABLE V: DEFINITION OF SOCIAL PRESENCE

Definition of Social Presence	References
"the degree of awareness of another person in an interaction and the consequent appreciation of an interpersonal sense of "being with others"	[34]
A quality inherent in a communication medium	[35]
"the extent to which a medium allows users to experience others as being psychologically present"	[36]
"the degree to which participants in computer-mediated communication feel affectively connected one to another, has been shown to be an important factor in student satisfaction and success in online courses"	[37]
Social presence is divided into three concepts which are co-presence, mutual awareness and connectedness. Social presence as co-presence is the feeling of collaborating with other person as if they are in the same location, space or room. Whereas, social presence as mutual awareness can be considered as the feeling of others' existence in a mediated environment and connectedness revealed the meaning of having social exchanges and to be acquainted among each other.	[38]

VI. CONCLUSION

Collaboration plays a major role in collaborative application [25, 39, 40, 21, 30, 31, 41]. In collaborative application such as E-learning, users need to experience effective collaboration and knowledge sharing in order to achieve learning process. The authors believe that social interaction is the important element to promote effective learning process. This can be done by ensuring that the feeling of connectedness and awareness live whenever learners or users use E-learning application. The feeling can be categorized as social presence in online application and in this case, requirements elicitation technique can support the implementation by preparing accurate requirements documents which has the social presence element for encourage social interaction in E-learning.

Requirements elicitation technique plays essential part in preparing a set of requirements which may cater human activity such as social presence in E-learning. Our future work will focus on how to elicit requirements based on social presence in collaborative application. Proposed requirements elicitation technique will also help

requirements engineer and developer to extract social presence in a preferable and understandable way for developers. The selected domain, E-learning, will be the case study to identify collaborative activities that involved with human activities in E-learning. From human activities, the authors plan to propose and accommodate suitable requirements elicitation technique to support social presence in the interaction. The authors believe that the proposed technique may contribute in enhancement for knowledge of requirements elicitation technique by supporting requirements that consists of social presence element for improving social interaction in CSCW.

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