Extracting Soft Issues during Requirements Elicitation: A Preliminary Study

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***Abstract*—Requirements Engineering (RE) is a critical process in Software Engineering (SE) activities. RE helps stakeholders to manage requirements appropriately before dedicated requirements are used to design and implement software. The first stage in RE process is known as requirements elicitation whereby during elicitation, stakeholders will perform a set of activities to permit understanding in problem domain for respected scenario and hence proposing a set of established requirements in developing software. In elicitation, stakeholders need to collaborate and communicate in order to produce unambiguous requirements and create mutual agreement for software design and development. This can produce desired solution for all stakeholders. Soft issue is one of non-technical requirements that can associate with social presence, social interaction elements such as comfort, connectedness and motivation. This requirements need to be emphasized during RE process especially for a system that is categorized in Computer-Supported Collaboration Working (CSCW) domain. Users need CSCW domain system to carry out virtual communication, knowledge sharing via system's features. The aim of this paper is to carry out a preliminary study on RE process and requirements elicitation activities by identifying whether soft issues have been engaged in existing requirements elicitation process. Another aim is to compare stakeholders' roles based on selected articles. The method to investigate requirements elicitation process is done by identifying existing elicitation processes as well as involvement of stakeholders' collaboration during elicitation. According to the study, the comparison of existing requirements elicitation processes and comparison of job roles have been produced as a result in this paper.**

***Index Terms*—requirements engineering, requirements elicitation process, stakeholders, soft issues, collaboration, development.**

I. Introduction

Software Engineering (SE) can be depicted as the process of developing and maintaining software throughout software development process. "Software engineering is an engineering discipline that is concerned with all aspects of software production from the early stages of system specification to maintaining the system after it has gone into use"[1]. Another definition stated that SE is about developing, maintaining and managing high-quality software systems in a cost effective and predictable way[2]. These two definitions have stated that SE is an area which is related with software development process. It is not only limited to software development but also on keeping up with good software products as well as delivering quality and usable services for users.

Section 2 reviews requirements engineering and requirements elicitation. Section 3 describes an overview requirements elicitation in RE. Section 4 elucidates the advantages of requirements elicitation process in CSCW domain. Section 5 describes existing requirements elicitation in handling soft issues during stakeholders' collaboration. Section 6 summarizes roles and responsibilities in requirements engineering field for stakeholders such as business analyst, system analyst, test analyst, requirements engineer and business process analyst. Section 7 concludes the paper based on the paper content.

II. Relationship of Requirements Engineering (RE) and Requirements Elicitation

A. Requirements Engineering Activities: Comparison of RE Activities

Although closely related to Software Engineering, which focuses on 'designing the thing right', Requirements Engineering concentrates on 'designing the right thing'[3]. Thus, RE is moving closer to Usability Engineering (UE) in the sense that it incorporates users and concerns itself with methods aiming to improve communication within the project team as well as between the project team and application users[4]. RE is a crucial stage in software production since initial activities such as determining software functionality and software boundaries are identified to reduce software production cost and error prevention during earlier stage[5]. RE consists of a few processes such as requirements elicitation or requirements discovery, requirements analysis and reconciliation, requirements representation or requirements modeling, requirements verification and validation and requirements management[6].

Other study has stated RE consists of activities such as eliciting requirements, modeling and analyzing requirements, communicating requirements, agreeing requirements and evolving requirements[7].

This section reveals RE activities introduced by Nuseibeh and Esterbrook[7] which is illustrated in Tab. 1 and also Laplante[6, 8] in Tab. 2. Tab. 1 illustrates four activities in RE.

Whereas, another study also described RE in five activities which comprised of requirements elicitation or requirements

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discovery, requirements analysis and reconciliation, requirements representation or requirements modeling[8].

Tab. 1 and Tab.2 depicts RE activities that dwelled in SE area and both tables have shown the importance of requirements elicitation to address the issue of capturing information by stakeholders regardless of technical, business, cost and soft issues.

TABLE I: LIST OF RE ACTIVITIES FOR SOFTWARE DEVELOPMENT[7]

RE Activities	Objective
Eliciting requirements	This process is to gather requirements from stakeholder by using some approaches to obtain product features from stakeholders.
Modeling and analyzing requirements	The process of visualizing requirements into more understandable representation and usually can be depicted by diagrams or figures.
Communicating requirements	To have in-depth understanding of requirements by relating those requirements into a sequence of processes that can best picture the idea of business process for certain software development.
Evolving requirements	The process needs the analyst and stakeholders to continuously clarify an agreement upon a set of requirements in order to mature requirements process in software development. The requirements might change or progress throughout the software production process.

TABLE II: LIST OF RE ACTIVITIES FOR SOFTWARE DEVELOPMENT[6]

RE Activities	Objective
Requirements elicitation or requirements discovery	Allow customers or users reveal their expectation and needs to be identified so that accurate requirements can be produced for next stage of RE activity.
Requirements analysis and reconciliation	Involve with analyzing and interpret the requirements into sensible requirements to the proposed system. These requirements come from data which has been gathered from users' input. Requirements engineer needs to understand that users can always give opinion regardless whether it is related to the proposed system or vice versa. These collected requirements can be deficient whereby it will cause difficulty to requirement engineer to understand in order to ensure that it is not disagree with the main objective of the proposed system.
Requirements representation or requirements modeling	Transform analyzed requirements in the previous stage to understandable and easy to be visualized by all the stakeholders. The visual representation is represented into some model such as using natural language, mathematics and visualizations.
Requirements verification and validation Requirements management	A process to determine whether specified requirements represent users' needs. Specified requirements can be validated using semi-formal and formal methods, text-based tools, visualizations, inspections and so forth.

III. WHAT IS REQUIREMENTS ELICITATION

Requirements elicitation is an activity to collect significant information for planning accurate requirements that is desired by stakeholders. To gather requirements, appropriate techniques are used to produce a set of requirements specification and this can be prepared by frequent interaction and agreement among stakeholders in RE process[9]. This stage is specified for requirements engineer who needs to elicit requirement for identifying system objectives for software development. Steps in requirement elicitation can be tiresome since time, commitment and patience are needed during task completion. Besides recognizing technical issue, stakeholders have to obtain soft issue which is related with human aspect[10].

"Requirements elicitation is the process of seeking, uncovering, acquiring, and elaborating requirements for computer based system." It is not just a gathering process but it is a process to understand the requirements that have been collected by going through activities with appropriate tools, techniques and approaches[11]. Understanding what the outcome for software development is very important in elicitation. The right combination of elicitation technique and clear proposed objective produce quality software whereby clear proposed objective after doing requirements elicitation is essential to the success of software development projects[12].

IV. REQUIREMENTS ELICITATION PROCESS: ADVANTAGES

A. What is Requirements Elicitation

Requirements elicitation engages with negotiation and collaboration activities with all stakeholders that will eventually result clear basis for a set of requirements that is going to be used for system development. This comes from frequent interaction and agreement among stakeholders in RE process[13]. Requirements elicitation is done to identify solution for designing and developing system based on certain scenario which helps developer for implementation[14] and is considered as a crucial step in software development process whereby users' demand are collected using appropriate technique that can produce a set of requirements specification for developer's reference. Requirements engineer who needs to elicit requirement for specified proposed software must comprehend the proposed system objectives and how it is related with users during software development.

Requirements elicitation process involves human factor for attaining information in system development. Therefore, soft issues related with human aspect also needs to be considered besides identifying only the technical issues[9]. In this case, the output of requirements elicitation will be given to the next stage of RE process. In gathering requirements for Computer-Supported Collaboration Working (CSCW), the information must be gathered from appropriate individuals as well as investigating how they collaborate in the respective group[15]. Requirements elicitation is also essential to the success of software development projects[16]. There is a technical report from CMU/SEI mentioned that requirements elicitation can be identified as the process of discovering the needs from communities as well as solving the differences from various stakeholders perception towards proposed system development[13] and it is also a front end to systems development. The process of discovering requirements for developing system must be aligned with stakeholders' needs according to their perception and opinion. In using CSCW system, for instance, virtual communication among group members must be established to result effective CSCW system. Developers need to identify proper tools and techniques to design and enable knowledge sharing system for users. Next section elaborates existing requirements

elicitation in RE process for solving soft issues such as collaboration, interactivity, motivation which leads social presence in computer-mediated communication system[17].

V. Existing Requirements Elicitation for Collaboration: Soft Issues from Users

There are elements of 'soft issues' that need to be identified during RE[18]. These elements affect system development and also users that are going to use the application. 'Soft issues' that are interrelated with social aspects elements is one of the concerns in E-learning implementation. This literature elaborates various examples of elicitation process in software development for group collaboration software. This section also highlights whether requirements elicitation process supported social presence element in elicitation activity. The following (A-H) contains description of existing requirements elicitation process for specific domain.

A. Elicitation Process using Focus Group Discussion (FGD-RElicit) Technique

Elicitation process used FGD-RElicit tool which facilitates brainstorming and discussion technique[19]. There are some advantages which can be found from this technique. It includes less time in requirements gathering since developer managed to obtain requirements easily and quick from the interviewees. Besides that, this technique is an appropriate technique which can be used to interview a number of people at the same time and social interaction among group members is freer and thus leads to more complex responses. The study explained about how to elicit requirements for GSD using brainstorming and discussion technique from different locations of participant. However the study did not mention whether requirements or opinions of one participant with other participant can be agreed among them. Social requirements such as mutual understanding among participant in terms of requirements collected are not mentioned in the paper.

B. Elicitation Process using Preference-based Model

Preference-based model is used as elicitation technique during requirements elicitation process in order to obtain requirements from virtual teams in terms of cognitive perspective. Elicitation process can be improved by using various tools to elicit requirements and these tools are selected based on stakeholders' preferences. The right choice of groupware tools and elicitation techniques can also make them comfortable as well as improve their performance[20]. Based on the study, communication activities among stakeholders can be improvised by using asynchronous tools or synchronous tools. Examples of asynchronous tools are e-mail, mailing lists, newsgroups, asynchronous shared whiteboards and forum whereas synchronous tools comprised of instant messaging, synchronous shared whiteboards, chat or video conferencing. This study helps to determine system's behaviour by referring to stakeholders' preference. Nevertheless, there is a possibility for conflicting preferences among stakeholders. Some stakeholders might want to communicate using e-mail whereas some might just feel easy using video conferencing. Therefore, difficulty can arise in eliciting requirements among virtual stakeholders. The process for determining suitable collaborative application has been simplified in a flowchart in Fig. 1. Please refer to Fig. 1 for workflow for choosing groupware tool in eliciting requirements.

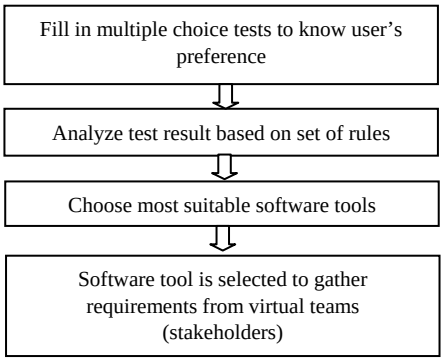

Fig. 1. Workflow for choosing groupware tool for eliciting requirements.

C. Elicitation Process using Requirements-based Approach

The process is using requirements-based approach for eliciting groupware application[21]. The advantage from this model is it supports features like communication, collaboration, cooperation, coordination, time, space, awareness. TOUCHE CASE tool will automatically or semi-automatically generate diagrams based on requirements of groupware applications which ease developer to visualize requirements from modeling representation such as use case diagram, organizational structure diagram (OSD) and co-interaction diagram. From social support point of view, the process model needs to improve its feature in terms of interactions among users.

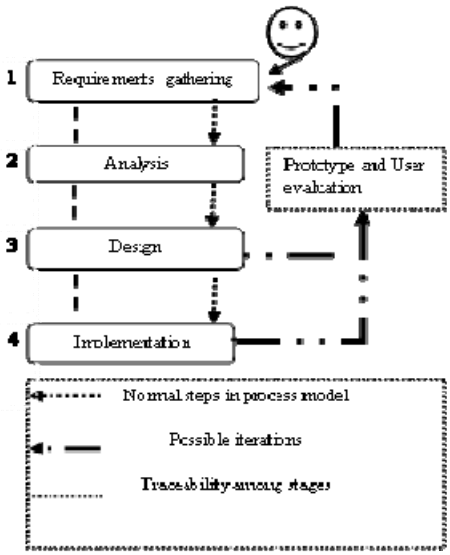

Fig. 2. Steps in the TOUCHE process model[21].

The CASE tool does not visualize social requirements like social bonding or anticipation of user using diagrams. It only shows how actors and features are related in the case study. Please refer to TOUCHE process model in Fig. 2 which has requirements gathering activity as an activity to collect information from stakeholders.

D. Elicitation Process using Activity Theory (ATRE)

Activity Theory for Requirements Elicitation (ATRE) is a framework to assist customers and engineers to add new information using social properties. ATRE is a process that is supported by a repository which used Activity Theory (AT). It is to study human contexts for a system and this theory can be used to extract social aspect of system during software development process[15]. Human contexts are related with social properties that a system has by using RE process. Social practitioners check human contexts based on social properties that have been described earlier in the process.

There are three social property's objectives which are to aid communication between stakeholders which comprised of social practitioners, domain experts, customers and requirements engineer. Besides that, social property is also to give clarification of information by justifying what information is needed and thus giving out properties that can help to solve mentioned problem contained in information[22]. The process of gaining social properties is described as a flowchart in Fig. 3.

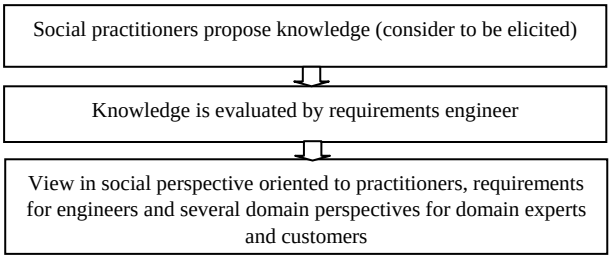

Fig. 3. Process flow in getting human context for a system.

E. Elicitation Process using Stakeholders' Stories for Acquiring Business Process

Another elicitation process is to capture business process by using group storytelling approach. This process obtains stakeholders' stories to collect information regarding business process of the organization based on selected stakeholder's experience. This process is divided into three phases. Fig. 4 illustrates method for business process (BP) elicitation based on group storytelling. The first phase is for stakeholders to understand their own roles in order to tell story about their roles and daily works. Current procedures and future needs are also being brought up during the storytelling session. The second phase discuss and refine information from previous phase by extracting activities, roles, rules, business sequence as well as what trigger certain process in the business flow. The third phase builds graphical representations in containing workflow model of business process that has been previously described by stakeholders.

The advantage of this approach is stakeholders can always insert and update stories regarding to business process by using a web-based software called, Tellstory software. This software supports collaboration from participants and analyst whereby analyst can directly gain information from Tellstory based on the web-based discussion with the tellers. During this session, both teller and analyst are aware that they are communicating using the web-based software. The interaction is held in casual form and story session is not too long. This is to ensure only related information is needed from not more than three tellers for each role. Storytelling approach allows tellers to clarify their functions in the company and ease analysts to extract knowledge from them.

Besides having the advantage of ease of extracting knowledge, this model does not show how to extract emotion from user. Tellers might give their opinion and express their feeling towards some stories which they have come across. However, there is no technique mentioned in the process for eliciting social requirement such as feeling and emotion which related to their daily works. Please refer to Fig. 4 for steps to elicit business process from storytelling approach.

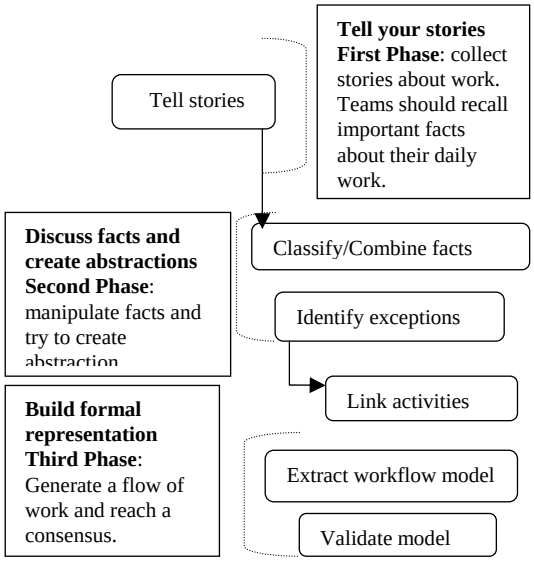

Fig. 4. Method for Business Process (BP) elicitation based on group storytelling.

F. Elicitation Process using Keyword Mapping Technique

Rajagopal *et. al*[23] has introduced a requirements elicitation process using keyword mapping technique. During initial stage, stakeholders are asked to collect information about user's needs and expectations. Stakeholders need to prepare for interviews with users by writing description of user's needs. Keyword mapping is used by developers so that they can identify keywords used by users to assist them in preparing formal requirements. Keyword will be categorized accordingly to clarify operational definitions of the prototype. Prioritization will be done for conflict resolution and requirements classification based on cost and schedule.

Domain expert and knowledge experts analyze recorded interview session based on keywords for avoiding ambiguity in requirements specifications. The authors have categorized the keywords using template according to a few sections such as functional requirements, non-functional requirements, performance or reliability, interface, design constraint. There are also additional keyword such as behavioral which portrays user initiative and responses to the system and also attributes or properties of the system. The process is useful for eliciting social requirements during software development process since the project used domain experts to analyze keywords from user's description.

G. Elicitation Process using Shared Artifacts

Paay *et. al*[24] brought in ROADMAP model in the elicitation process to capture quality goals using shared artifacts. From the shared artifacts, non-functional

requirements can be extracted as a quality goal and also support social requirements from participants' attitudes and behaviour. ROADMAP model uses ethnographic as a method for observing and monitoring the participants. Please refer to Fig.5 for ROADMAP model.

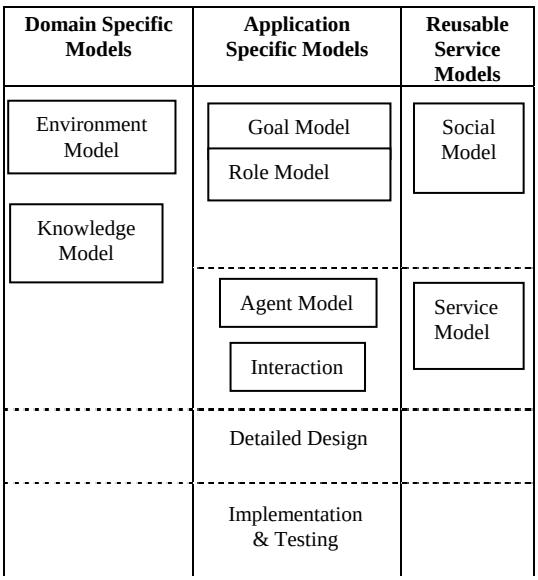

Fig.5. ROADMAP model[24]

H. Elicitation Process for Global Software Development Project(RE-GSD Framework)

Aranda *et. al*[25] has set up a requirements elicitation process which helps to increase communication activities between stakeholders. This process is implied for Global Software Development (GSD) project. GSD project involved with cultural diversity, time and location and those criteria has affected elicitation. Different culture, time and location has led to problem in managing requirements. Thus, strategies in elicitation process have been introduced in earlier stage of elicitation by Aranda to minimize communication problem. Please refer to Fig. 6 for strategies in requirements elicitation in GSD project domain.

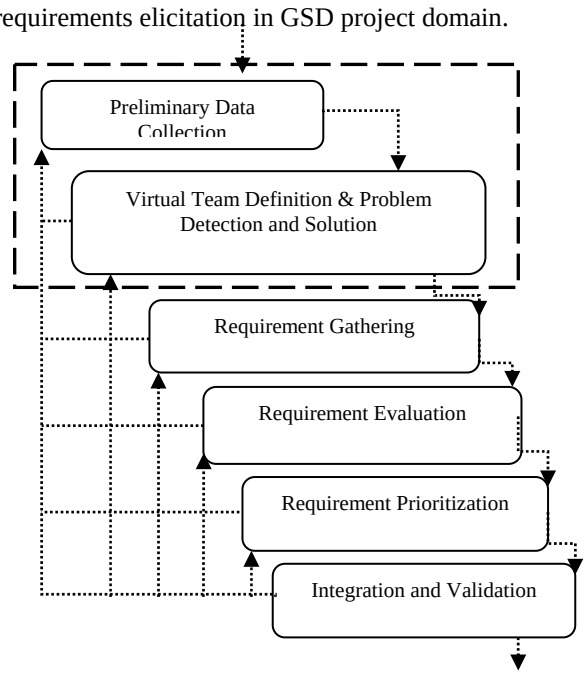

Fig.6. Requirements elicitation-global software development Methodology[25]

Aranda has added a phase known as 'Virtual Team Definition and Problem Detection and Solution'. This phase is initiated after 'Preliminary Data Collection'. The added phase has been identified as a crucial activity since during the activity, requirements are extracted based on source of future problems in virtual team communication and then solution is addressed according to detected problems. The strengths and weaknesses for eight examples of requirements elicitation process have been identified earlier in this section. Those examples have a similarity in terms of involvement of stakeholders in producing desired set of requirements document.

The author thinks that there is still a challenge in understanding requirements from stakeholders' view regardless of any domain due to various perceptions from kinds of users' job roles. One user might focus on an issue that another user feels is less important. In CSCW software production, user's requirements on collaboration should be considered thoroughly and element to produce collaboration element must be examined by developers in order to provide usable CSCW system.

VI. Examples of Roles and Responsibilities in Requirements Engineering

This section shows the evaluation of responsibility for job roles in requirements engineering area. Selected job roles that have been taken for distinguishing responsibilities are Business Analyst (BA), Requirements Engineers (REng), Test Analyst (TA)and System Analyst (SA). In the previous study done by Fuentes-Fernández[26], social practitioner has been considered as one of the stakeholders in order to extract social properties information in users' stories. This section compares roles based on five articles that have identified job specification for dedicated position during requirements gathering stage. Tab. 3 is also to forecast whether existing stakeholders and social practitioners hold different functions or have overlapped their roles.

TABLE III: Responsibilities of Business Analyst(BA), Requirements Engineer(REng), Test Analyst(TA), System Analyst(SA) in Requirements Gathering Activities

Responsibility	[27] BA	[28] REng	[29] BA	[30] BA	[30] TA	[30] SA	[31] BPA
Ensure delivery of solution meets the client's business needs / strategic goals	√	√	√		√		
Translator during design and development	√	√		√		√	√
Good communicator / facilitator / negotiator with various clients / stakeholders	√	√	√		√		
Provide expertise/ consultant in business and technical domain	√		√	√	√	√	
Good communicator	√	√		√	√	√	
Requirements acquisition and validation		√		√		√	
Requirements specification		√		√	√	√	√
Requirement management		√		√	√	√	
Identify soft factor							√

According to the comparison of stakeholders' roles in Tab. 3, the selected articles did not clearly mention social property in their domain. According to Tab. 3, the responsibility on gathering soft factor has the least interest on stakeholders. The soft factor comprised of non-technical activities such as group dynamics and motivation of people. The author is in the process of extracting soft factor from users and hence interprets it in a meaningful manner to the developers.

VII. Conclusion

In developing software, stakeholders are requireed to identify system's objectives to meet users' requirements. In CSCW system, for example, the system should provide a platform for effective communication and knowledge sharing system among users. To do so, developers must play their role to study what are the requirements for effective communication and how to produce operational system for knowledge sharing. Requiremens elicitation for specific purpose must be drawn out to cater those goals and also to reduce software errors during implementation. The study of stakeholders' demand is a challenging tasks in RE process since stakeholders come from different background and profiles. Their needs and expectation vary due to different interests towards the software.

Existing requirements elicitation process which have been introduced previously might contain element for soft issues, however, those processes are used for different domain. The author thinks requirements elicitation process for soft issues has the possibilities to be revised and improvised for future use. Identification of correct mechanism for extracting soft issues information can contribute to software development process in software engineering area. Besides that, different stakeholders such as requirements engineers, developers, vendor, users, top management and so forth require requirements engineer,system analysts or business analyst to coordinate effective communication with stakeholders and therefore extract needed information from them. Effective social interaction element in collaborative activities and motivation to use specific sytem need to be emphasized during software requirements elicitation for addressing non-technical requirements as well as resolving soft issues in online environment.

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