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A SURVEY ON THE REQUIREMENTS ELICITATION PRACTICES AMONG COURSEWARE DEVELOPERS

Zarinah Mohd Kasirun
Faculty of Computer Science and Information Technology
University of Malaya
50603 Kuala Lumpur
Malaysia
Tel.: 603-79676379
Fax: 603-79579249
email: zarinahmk@um.edu.my

ABSTRACT

Requirements elicitation in any application development has many important benefits. Due to this, it should be practiced in alignment to its objectives. This paper is based on the findings of a survey conducted among Malaysian courseware developers community. The paper starts with a definition of requirements elicitation and a description on how the survey was conducted. This is followed by the requirements elicitation practice as perceived by the respondents. Finally, a conclusion is drawn on the requirements elicitation practices and how to improve them.

Keywords: ***Requirements engineering, Requirements elicitation, Malaysia, Requirements elicitation practice***

1.0 INTRODUCTION

Requirements elicitation is recognised as the first stage in many requirements engineering (RE) process definitions. The success of the requirements elicitation activity gives high impact on the achievement of the goals set for RE, which leads to the development of correct application. Hence, the development of any application is indispensable from incorporating good practices of requirements elicitation. In fact the consideration has an impact to the usability of the application [3].

Requirements elicitation is defined as a process to understand a problem and its application domain [1]. The problem and the application domain are given in a form of statement of organisational needs and other inputs from various different sources to establish user requirements. The goal of requirements elicitation is to identify as many requirements as possible to prepare several alternate solutions for the stated problem. This activity will define initial input statements of desired functions and features that the user expresses in some way, usually referred to as requirements. These requirements may not be complete and may be expressed in a vague and unstructured way. However, they will be written in a user requirements document (URD) as the output of the requirements elicitation activity.

2.0 DIFFICULTIES AND FRUSTRATIONS

The requirements elicitation activity is practiced by requirements engineers but most of the time it is practiced by system analyst or system developer. The main activity is eliciting requirements for an application, whereby requirements here include functional, non-functional, software and hardware requirements [1, 3]. Among these, functional requirements are always subject to change. Their goals also differ.

Deriving functional requirements is a long process. If a similar system exists, its documentation and the system itself are good sources to identify functional requirements particularly by analysing its strengths and weaknesses. If an observation on the use of the system can be done, investigation on the aspect of the human-machine interaction is possible. However, if such a system is not available, market research is needed and any reliable sources have to be sought in order to examine the modules that need to be included in the system that will be developed. In any case, individuals who are directly and indirectly involved should be identified. Though many requirements elicitation techniques have been identified to be useful [2, 3], good cooperation still could not be guaranteed. Another important aspect in requirements elicitation is the ultimate goal of requirements elicitation. Software engineers

always target for complete, accurate and unambiguous URD documentation of requirements. The question is by using the techniques that they practiced; do they manage to complete the URD?

Realising the importance of requirements elicitation of any application development and the eagerness to see the status of courseware developers in Malaysia in conducting the elicitation activity, a survey was carried out. This study should be of help to software practitioners to use appropriate techniques in which users' participation can be guaranteed in order to produce a complete URD.

3.0 SURVEY METHODOLOGY

A survey was formulated to include questions on how courseware developers conduct the requirements elicitation activity. Questions in the background section ensure that the companies involved are qualified to be considered as respondents and can represent the courseware developers in Malaysia. Among them are:

- Categories of courseware developed
- The goal of requirements elicitation.

On the other hand, questions in the requirements elicitation practice section investigate the current practices of the requirements elicitation activity among courseware developers. The questions include:

- The use of requirements elicitation tools
- User requirements document completeness
- Technique used for eliciting user requirements
- Major reason of the chosen technique
- Techniques to record the findings
- People most consulted in the development of courseware
- The resources most referred.

3.1 Survey Method

Before the questionnaires were distributed to the target respondents, a pilot test was carried out. The first draft was sent to two companies which focus its activities on developing courseware. The test concentrates on the ease with which the questions flow, the word chosen in the questionnaire, the appropriateness of the number of questions and the issues presented in the questionnaire. Both companies agreed on the questionnaire form with few comments particularly on the language used. Therefore, most of the arrangement of questions was not changed except for a little amendment in the structure of some of the sentences.

The modified questionnaires were then sent out to courseware developers in the Klang Valley. This area was selected as it is the most active area in software development activities as compared to other parts of Malaysia. Besides the questionnaire survey, electronic mail questionnaire and telephone interviews were also used in conducting this study. The interview was to confirm the correct person for correspondence and address. The electronic mail was used most as the medium to send and to collect the questionnaires.

The questionnaire used was a mix of closed-ended and open-ended types of question with ordered response options which is easy for the respondents to answer. Another reason for using these types of question was to save space. The responses of 1 and 2 are considered as weak while 3, 4 and 5 are considered strong. Even though there are about 130 companies which were listed under MSC status in the early 2001 [5], only 40 were selected as their main business activity is on developing courseware. Out of 40 companies, 26 responded to the questionnaire and their responses were analysed.

In calculating the percentage [4] for questions of courseware developed, the following scores were used:
Strongly Agree = 5, Quite Agree = 4, Agree = 3, Less Agree = 2 and Disagree = 1. The percentage takes only 3, 4 and 5 as Agree.

3.2 Data Collection

Data collection constitutes the collection of the responses to the questionnaire. Telephone and e-mail are used to make follow-up if the respondents' answers were vague.

3.3 Survey Results

The survey results are described according to the issues highlighted below.

3.3.1 Background

The background section of the questionnaire identified the kinds of courseware that the company developed and the level of their understanding of the requirements elicitation term. As shown in Fig. 1, the majority of the respondents are developing multimedia applications followed by web-based learning and computer aided learning (CAL) applications. Among the courseware developers surveyed, 80% agreed that the main characteristic of requirements elicitation is to obtain as many requirements as they can. About 68.2% pose to obtain only correct and comprehensive requirements, while 60% agreed to put the characteristic of requirements elicitation into obtain potential requirements only. Even though these findings show that the majority of developers want to find as many requirements as possible, it also shows that some of them do not exactly know the goal of requirements elicitation. Nevertheless, most of them are aware of the main goal of the requirements elicitation activity which is to generate as many requirements as possible.

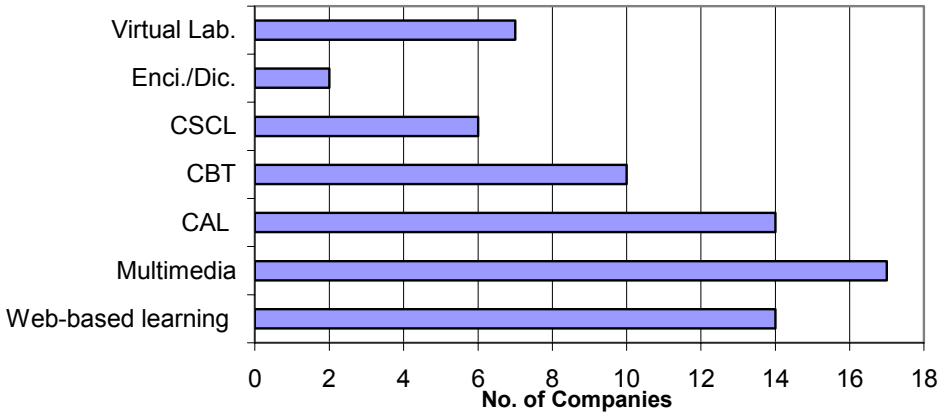

Fig. 1: Distribution of Companies by the Type of Courseware Developed

3.3.2 Requirements Elicitation Practice

For each of the issues discussed in this section, the percentage for each question is calculated in order to examine its trend. The percentage takes the values of 3, 4 and 5 as Agree to the listed measurements variables. Tables 1 – 5 show the percentage in decreasing order as perceived by the respondents.

a) The Use of Requirements Elicitation Tools

The respondents were asked whether they had used any requirements elicitation tools while extracting requirements from potential users. 80.8% of the companies surveyed answered that they had not used any tools to support the requirements elicitation process, while the remainder claimed that they had. Among the tools that were used are Visio, diagramming tool and Microsoft Project 2000. While on the question of whether they would like to use a tool to support the requirements elicitation process, only 44% of the companies answered in the affirmative.

b) User Requirements Document (URD) Completeness

The respondents were also asked to give the status of the completeness of the URD, i.e. the product of the requirements elicitation activity. The schema of the survey is classified as follows: less than 75% complete as not complete, 75% to 85% fairly complete, and more than 85% to 99% almost complete. The survey shows that only 19.2% of courseware developer surveyed completes the URD while the rest are either almost complete (46.2%), or fairly complete (38.5%). Most of the developers are relieved to say that they nearly completed the document. Even though the number of developers who fairly completed the URD is also quite high, none of them claimed that they did not complete the URD.

c) Techniques Used for Eliciting User Requirements

For the techniques used in eliciting user requirements, the courseware developers were asked to rate/choose seven methods. Table 1 shows the result of the major techniques used.

d) Major Reasons for Choosing Techniques

They were also asked about the reason behind their decision to choose certain techniques. Table 2 depicts the result.

Table 1: Major Techniques used in Eliciting User Requirements

Technique	Percentage
Focus group	100
Use case	96
Prototyping	94
Observation	87.5
Interview	83.3
Workshop	58.3
Role-playing	50

Table 2: Reasons for Selecting Those Techniques

Reason	Percentage
Comfortable to all involved.	100
Suitable with time frame allocated.	100
An efficient and effective technique.	100
It is the practice in their organisation.	95.8
It helps to understand user's domain model.	95.8
It generates as many requirements as it can.	91.7
It generates only complete and accurate requirements.	91.7
It is easy to manage user's action.	88
It generates only potential requirements.	73.9

e) Techniques Used to Record the Findings

The respondents were also asked on the techniques used to record the findings of the requirements elicitation activity. They were asked on several methods that they preferred to use and the result is depicted in Table 3.

f) People Most Consulted in the Development of Courseware

In achieving the goals set, the respondents were asked whom they consulted with the most and the result is shown in Table 4.

Table 3: Major Recording Techniques

Recording Technique	Percentage
Self-drawing and text	96.2
Low-fidelity prototype	63.6
Memory	47.8
Video or cassette recorder	30.4

Table 4: People Most Consulted / Approached

People Approached	Percentage
Requirements analyst (RA)	95
Sponsors or customers	91.7
Users	89.5
Developers	67.2
Quality assurance (QA) team	61.9

g) The Resources Most Referred To

The respondents were also asked which resources that they referred to the most in conducting elicitation of user requirements. Table 5 shows the analysis of the responses to the question.

Table 5: Resources Most Referred To

Resources Referred	Percentage
Domain knowledge.	100
Work processes.	96
Current business rule.	95.7
Desired system documentation.	88
Similar system.	86.4

Table 6: Diagram Most Used

Diagram Used	Percentage
Flowchart	84.7
Context diagram	80.8
Hand sketch	57.7
Concept map	53.8
OO diagram	53.8

h) The Diagram Most Used

The respondents were also asked on the kinds of diagram that they used most if they need to sketch the requirements. Table 6 depicts the analysis of the responses to the question.

3.4 Discussion

The discussion will cover the background of respondents and their requirements elicitation practices.

3.4.1 Respondents Background

Although not many of the courseware developers surveyed use the term 'requirements elicitation', most of them agreed that the goal of requirements elicitation is to obtain as many requirements as they can. This means that they do know what requirements elicitation is and therefore, they are considered as qualified to answer the questions.

3.4.2 The Requirements Elicitation Practices

As pointed earlier, handling the requirements elicitation activity correctly can contribute to the completeness of the URD in courseware development including in Computer Supported Collaborative Learning (CSCL) applications. This involves several factors such as considering a suitable and comfortable technique in requirements elicitation. Advancement in ICT has elevated the incorporation of new techniques [2] in requirements elicitation tools. For instance, some requirements elicitation tools permit all those involved to participate. They or commonly known as stakeholders, are able to propose new ideas and give feedbacks or responses. This situation will certainly aid in completing the URD. Therefore, a discussion on the requirements elicitation practices that have been surveyed will be linked to the completeness of the URD. The particular issues that will be studied here are the use of tools, the use of Focus Group Discussion (FGD) technique, the object referred most, the people referred most and the recording technique used most.

The result of the five aspects studied is given in Fig. 2. The first issue surveyed is the use of tools in handling the requirements elicitation activity. The result shows that most of the respondents did not use any tools, as there is none available. As far as Visio is concerned, the respondents did not mention which version they were using. The Internet-enabled Visio allows the sharing of diagrams and communicating ideas across corporate intranet, the Web and around the world [7]. Whilst, Microsoft Project 2000 gives the power and flexibility to plan and track projects and meet business needs. With Microsoft Project Central, the new Web-based companion product, team members can communicate and collaborate on projects across an organisation [8]. Nevertheless, the diagramming tool used is not clearly stated, thus its suitability in the requirements elicitation process is not known.

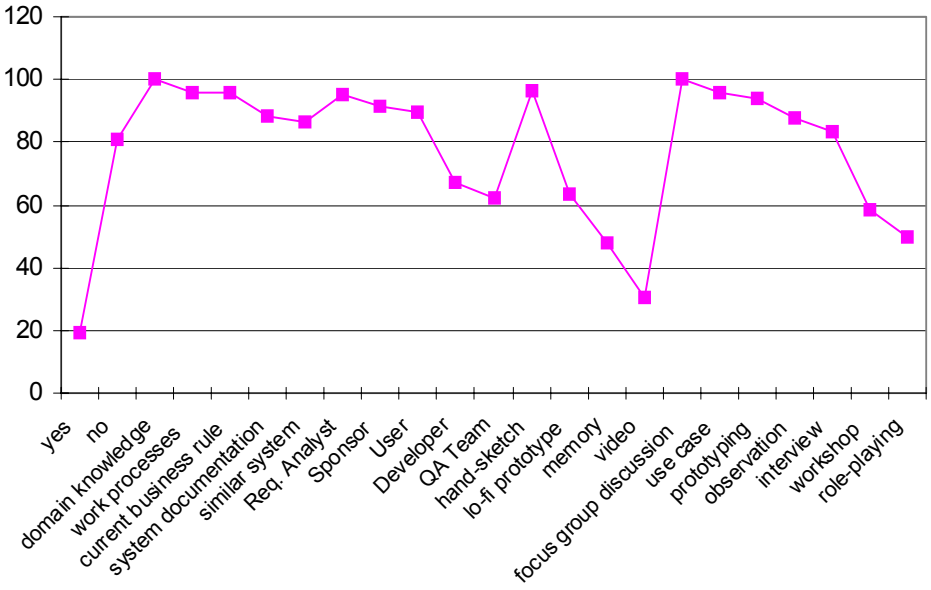

Fig. 2: Requirements Elicitation Practices

Most of the existing tools fall under the requirements management, requirements analysis and requirements traceability tools (INCOSE, 2000). Realising this situation, only 44% of the companies surveyed would like to have them. The finding shows that the requirements elicitation tools are needed to guide and expedite the requirements elicitation activity. The advancement of networking allows for a collaborative synchronised web-based requirements elicitation tool to address the requirements elicitation group activity. The tool should be accessible at anytime from anywhere for all involved. This means that the participation of those involved will be much higher as compared to using a standalone requirements elicitation tool. A cross tabulation [4] was performed to see the importance of using a tool in order to complete the URD as shown in Table 7. The URD is used to keep the recorded wishes and needs from all the stakeholders involved. Although it is a preliminary document of user requirements, it will be the basis for the development of any applications.

Table 7: Cross Tabulation of the Rate of URD Completeness vs. the Use of Tool

Cases	Number of Companies		
	Complete URD	Almost Complete URD	Fairly Complete URD
Use tool	2	3	0
No & need tool	1	6	5
No & Do not need tool	2	3	4

As can be seen in Table 7, many companies that used a tool had either completed the URD completely or almost completely. However, many companies for the case of 'no and do not need tool' only managed to achieve a fairly complete URD. For the case of 'no and need tool', most of these companies achieve an almost complete URD.

The second issue surveyed is the object most referred to by courseware developers. In eliciting user requirements, some information can be elicited from resources like system documentation, and business procedures and workflows. Having a good understanding of the problem will help courseware developers identify correct requirements. They can refer to sources about the problem domain in order to understand the scenario, the environment and objectives of the new system. Most of the courseware developers refer to the domain knowledge, followed by the work processes and the current business rules in handling requirements elicitation. This result stresses that consulting users is important, as they are the domain knowledge experts. A cross tabulation of the objects referred versus the rate of the URD completeness is shown in Table 8.

Table 8: Cross Tabulation of the Object Referred vs. the Rate of URD Completeness

References	Number of Companies		
	Complete URD	Almost Complete URD	Fairly Complete URD
Domain knowledge	5	12	8
Work process	4	11	10
Business rule	5	10	8

The table shows that the number of companies which referred to the domain knowledge experts and business rules had either completed or almost completed the URD as compared to those that referred to the work processes. Therefore, courseware developers should emphasize on the requirements elicitation techniques that refer to domain knowledge experts and business rules.

Among the people that the courseware developers consulted with the most is the requirements analyst (RA), as depicted in Table 4, as they assumed that the RA would have a more understanding of the problem domain. They assumed that the RA has experience in conducting the task and knows what to include in the new system. Unfortunately, similar solutions are often not applicable to different problems. The survey shows that the users fall in third place in the category of people most approached or consulted, after the RA and sponsors. This contradicts with the statement that users and customers are the most knowledgeable in the problem domain. As mentioned earlier, a user is the domain knowledge expert, and as previously shown, contributes to the URD completeness. This is shown again here, in Table 9, whereby the total number of companies that have completed the URD completely, almost completely and fairly completely is the highest for users as the people most approached.

Table 9: Cross Tabulation of the People Most Approached vs. the Rate of URD Completeness

People Most Approach	Number of Companies			
	Complete URD	Almost Complete URD	Fairly Complete URD	Total
Sponsors	4	12	7	23
Developers	4	6	6	16
Users	4	11	10	25
QA Team	4	6	4	14
RA	5	6	6	17

The above table shows that consultation with users ensures that more companies complete the URD either fairly, almost completely or completely. Table 10 shows the cross tabulation of the three people most approached namely, requirements analysts (RA), users and sponsors, versus the rate of URD completeness in more detail. Therefore, courseware developers should increase the consultation time with users in order to increase the URD completeness.

Table 10: Cross Tabulation of the People Approached (Sponsors, Users, RA) vs. the Rate of URD Completeness

Three People Most Approach	Number of Companies								
	Complete URD			Almost Complete URD			Fairly Complete URD		
	Sponsors	Users	RA	Sponsors	Users	RA	Sponsors	Users	RA
3 (fairly agree)	0	0	0	4	1	6	0	2	0
4 (agree)	0	1	0	3	4	3	3	3	5
5 (most agree)	4	3	5	5	6	0	4	5	1
Total	4	4	5	12	11	9	7	10	6

The storing of all the information gathered is important to ensure the production of the elicitation output. All of the stakeholders' needs and wishes are recorded in order to carry out the next action. Most courseware developers record their entire findings using text and self-drawing or hand sketch as shown in Table 11. It is common for people to jot down and sketch using certain figures while explaining certain concepts. However, a cross tabulation between the diagrams most used in recording versus the rate of the URD completeness shows that many courseware developers who used context diagram had completed or almost completed the URD as compared to those who used hand sketch and flow chart.

Table 11: Cross Tabulation of Diagram Most Used in Recording vs. the Rate of URD Completeness

Diagram Most Used in Recording	Number of Companies		
	Complete URD	Almost Complete URD	Fairly Complete URD
Hand sketch	4	7	4
Flow chart	4	11	10
Context diagram	5	10	7

The last issue studied is the technique of consultation used by courseware developers. From the analysed result, most respondents used FGD in eliciting users' requirements. The nature of a courseware developer's job is working in a group that is led by a project leader. Group discussion techniques such as FGD has been identified as the technique most used among courseware developers surveyed. In regards to URD completeness, a cross tabulation is performed to see the distribution of the number of companies that achieved a complete, almost complete or fairly complete URD versus how strongly they agree with using FGD. Table 12 shows that the stronger the companies are in agreement with using FGD as a consultation technique, the higher the number of companies that achieve complete, almost complete and fairly complete URD.

Table 12: Cross Tabulation of FGD vs Rate of URD Completeness

Use of FGD Technique	Number of Companies		
	Complete URD	Almost Complete URD	Fairly Complete URD
3 (fairly agree)	1	2	3
4 (agree)	1	5	2
5 (most agree)	3	5	4

4.0 CONCLUSION AND FURTHER WORKS

The investigation on the current practices of requirements elicitation in Malaysia discovered several issues. First, the study shows that courseware developers have not attempted to use specific requirements elicitation tool while eliciting users' requirements. Budget constraint may be one of the reasons why no tool has been used. Hence, the development of such a tool for the local market is useful. Furthermore, the survey that was conducted showed that the use of a tool has some impact on the rate of completeness of the URD and this will lead to a reduction of abandoned applications due to less coverage of functions. Second, on the findings of the object most referred to, to the people most approached, to how to record findings, the survey has given some guidelines in order to successfully complete the URD. The results provide wide knowledge and guidelines of good practices of requirements elicitation particularly for the Malaysian environment. Last but not least, the deficiencies that were discovered should be considered as a bottom-line in practicing requirements elicitation activity. Due to that, for instance, courseware developers should increase user consultations using appropriate techniques such as FGD since the use of FGD has shown to contribute towards URD completeness.

Thus far, the study has yet to identify any problems in conducting the requirements elicitation activity. It also did not propose any success factors in order to conduct a good requirements elicitation process. For further work, the study should investigate the problems faced by courseware developers and also the success factors in conducting the requirements elicitation activity. The result would further reduce any doubts on how to conduct requirements elicitation and at the same time increase courseware developers' confidence in conducting requirements elicitation.

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BIOGRAPHY

Zarinah Mohd Kasirun is a lecturer at the Faculty of Computer Science and Information Technology, University of Malaya. She obtained her Master in Computer Science from the Universiti Kebangsaan Malaysia in 1993. Her current research interests include CSCL, requirements engineering and GIS.