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A Survey on Requirements Elicitation for Computer-Supported Collaborative Learning (CSCL) Application Development among Software Developers - A Malaysian Perspective

ZARINAH M. K. & SALWAH S. S.

ABSTRACT

Requirements elicitation has been studied in Software Engineering field to acquire as many requirements as possible for the development of an application including Computer-Supported Collaborative Learning (CSCL). These requirements are gathered using many requirements elicitation techniques such as discussions, interviews and meetings. These user requirements are recorded in a documentation called draft of user requirements document (URD). The paper suggests that development of an application should be based on complete draft of URD. The complete of URD depends on several requirements elicitation factors. The paper investigates requirements elicitation factors from several aspects namely tools, time, techniques, people, communications, processes and documents. The study discusses these factors which provides insights for devising group requirements elicitation tool, which allows the user involvement to support requirements elicitation activity. We hoped that the tool can be an effective aid of requirements elicitation activity that will produce complete draft of URD.

Keywords: requirement elicitation, user requirements document, group elicitation technique and tool.

ABSTRAK

Perolehan kehendak telah dikaji dalam bidang Kejuruteraan Perisian untuk memperoleh sebanyak mungkin kehendak bagi pembangunan sesebuah aplikai termasuklah Pembelajaran Kerjasama Berbantu kompouter (CSCL). Kehendak ini dikumpulkan menggunakan berbagai cara termasuklah perbincangan, temuduga dan mesyuarat. Kehendak pengguna ini direkodkan dalam satu dokumen yang dipanggil draf dokumen perolehan kehendak pengguna (URD). Kertas ini mencadangkan yang pembangunan sesebuah aplikasi sepatutnya berasaskan sebuah URD yang lengkap. URD yang lengkap bergantung kepada beberapa faktor perolehan kehendak. Kertas ini menyiasat faktor-

faktor perolehan kehendak dari beberapa aspek iaitu alatan, masa, teknik, manusia, komonukasi, proses dan dokumen. Kajian membincang faktor-faktor ini yang akan menfokuskan kepada penghasilan alatan perolehan kehendak berkumpulan, yang membenarkan penglibatan pengguna untuk menyokong aktiviti perolehan kehendak ini. Diharapkan dengan adanya alatan sebegini akan menjadi satu bantuan yang berkesan untuk aktiviti perolehan kehendak yang akan menghasilkan draf URD yang lengkap.

Katakunci: perolehan kehendak, dokumen kehendak pengguna, teknik perolehan berkumpulan dan alatan.

INTRODUCTION

Many software finished but not delivered and some system used but with extensively reworked and later abandoned (Davis, 1993). Among the reason is that they are building software that is not based on complete user requirements document (URD) which results in large amount of financial and business losses. Completing URD is an important issue which is addressed rigorously by researchers in Software Engineering (SE) and Information System (IS) in 1990s. In this aspect, user requirements is the main attribute which should be emphasized and documented early in the process of any software development.

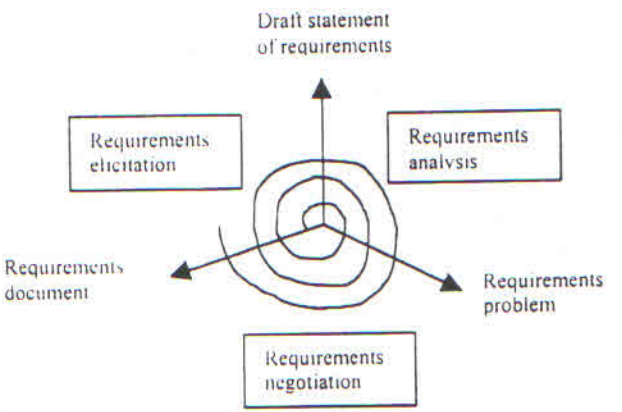

FIGURE 1. Requirements Engineering Process (Sommerville, 1998)

The particular field related to user requirements in SE is referred as requirements engineering (RE). According to Jarke and Pohl in (Siddiqi & Chandra, 1996), RE involves three main steps namely requirements elicitation,

expression and validation. Sommerville (1998) defines RE as an iterative activity which involves task like requirements elicitation, requirements analysis and requirements negotiation as depicted in Figure 1 above. Both definitions clearly show that requirements elicitation is the first step in the RE process. The goal of requirements elicitation is to produce complete URD i.e. listing as many requirements as possible. Therefore, to ensure software developers produce complete URD, requirements elicitation should be stressed as early as the first step in RE process. Requirements elicitation is referred as RElicit in the rest of the article.

In order to ensure the success of RElicit task, particularly accomplishing complete URD, it is necessary to perform each user requirements (UR) development stage correctly. The UR development stages include

i) identifying relevant sources of requirements,
ii) gathering the wish list for each relevant source of requirements,
iii) documenting and refining the wish-list for each relevant source of requirements,
iv) integrating the wish-list across various relevant sources of requirements and
v) determining the non-functional requirements (Christel & Kang, 1992).

Although understanding of UR development stages is important to the production of complete URD, it is important to examine other factors that might barred some software companies from doing RElicit activities appropriately. Furthermore, discussion on URD completeness has always been linked to various factors including people, process, technique, time, tool, communication and document. As such, domain knowledge among all involved, awareness, participation, tools involved, documentation, time management and technique chosen should be considered to produce complete URD.

In an attempt to understand the RElicit problems encountered in the local context, a survey was conducted to investigate the RElicit factors among courseware developers in Malaysia. A total of 40 companies which emphasize on courseware development from both the commercial and government sectors were invited to participate in this survey. Of these, 65% responded. This survey was based on the initial hypothesis that RElicit is new in software development life cycle (SDLC) and several RElicit factors need to be considered to attain the completeness of URD.

Next, the paper presents the background of the study. Section 3 describes the survey methodology and the data processing technique briefly. The results of the survey are described in Section 4. Section 5 analyses and discusses the findings of the survey covering the important RElicit factors in relation to URD completeness. Section 6 concludes the article.

One of the works on RElicit techniques emphasized on the use of group and cooperative method such as in Rolland (1999). The group-oriented RElicit technique called CREW-L'Ecritoire combined GroupSystem® and goal-scenario coupling method. GroupSystems® helped the brainstorming and meeting sessions while goal-scenario method tackled the elicitation task. Although, the use of scenario in RElicit enhanced the communication between analyst and user and thus promoted the emergence of requirements (Millard et al, 1998), it required some kind of scenario fitness checking to ensure scenario completeness and removing ambiguities (Rolland et al, 1999). Furthermore, the term used in its representation is not suitable for non-expert which result in poor user involvement.

According to Heisel and Souquieres (1998), the starting point for RElicit was a brainstorming process where the application domain and the requirements are described in natural language. This informal description was then transformed into a formal representation. However, the process in brainstorming is quite free whereas RElicit task needs quite specific steps and guidance. Hence, a guided discussion method is more appropriate, as the members know the stages of the discussion to give appropriate view. Furthermore, it does not involve with formal description which is too early in RElicit.

Another work done was the use of viewpoint approach by Sommerville et al (1998). It specified clearly the RElicit output to incorporate cooperative environment. In contrast to the first study, this approach not only increased user involvement but also emphasized on the RElicit task documentation. It used common term which allowed multiple viewpoints from the participation of all stakeholders involved. An enhancement to this approach by inserting guidance in the discussion process would ensure the discussion always inline with the topic.

Many earlier works on RElicit focus on techniques of RElicit that concern on the communication factors. Not many studies focus on other issues related to RElicit as described in Section 1. This study attempts to investigate all those issues to ensure the success of the RElicit activity. Thus far, no study on RElicit is carried out on aspects involved in RElicit task. Next, the paper presents the survey methodology to carry out the investigation.

SURVEY METHODOLOGY

Mail questionnaire, electronic mail questionnaire and telephone interview were three main methods used for the survey. Telephone interview was used

to gather the names, the correct addresses of the potential respondents and the preferred kind of questionnaire. The survey questions were sent to two companies involved in courseware development for a pilot test. It is to check the suitability of the language used, selection of words, number of questions of RElicit and its flow. Generally, the test showed that both companies agreed on the questions with some comments on some of the sentences. The final survey used the modified questionnaire forms which are mainly improved on the selection of words. Of the 40 sets of the questionnaires distributed, 75% were sent to organizations from the commercial sectors, of which about 90% were based in Kuala Lumpur and Selangor state. The survey was focused in these two states as they are in the Multimedia Super Corridor (MSC) area. Moreover, these are the most active areas compared to other parts in Malaysia. Undoubtly, they could represent Malaysia's scenario in this study.

They were educational-related software developers who are referred as courseware developer in the rest of the article. The questionnaires were addressed to software engineer, analyst programmer and system analyst of the companies. Lecturers in local universities who involved in educational software development researches were also considered to be one of the respondents. Out of 26 sets of questionnaires collected, 15 were received through electronic mail, while the remaining 9 sets of questionnaires were received through the postage mail. The companies surveyed developed courseware and most of them have been awarded Multimedia Super Corridor (MSC) status (MOE, 1997).

Out of 40 educational-software related companies, 26 respondents replied and most of the respondents answered more than 70% of the questions. Therefore, all 26 sets of questionnaires were used for data analysis. All of the questionnaires are closed-ended with ordered response options. Thus, the respondents were only required to tick one or more of the option(s) provided or specify otherwise or explain the answers in their own words. These types of questions not only save space, they are also easy to answer as well as facilitate data analysis. The opinion is measured using 5 scale of 1 to 5 which corresponds of very weak to very strong. Their opinion is considered as strong if the scored is 3, 4 and 5. Otherwise, it is considered weak.

A. SURVEY DESIGN

Based on the literature and the hypothesis set above, the questionnaire was divided into four parts. Part 1 asked question on background of the courseware developers. Part 2 asked question on their practice in RElicit activity. Part 3 asked question on factors that related to RElicit. Finally, Part 4 asked question on RElicit support.

B. DATA PROCESSING

Before analyzing the outcomes of this survey, each set of the questionnaire received was checked for completeness. Wherever necessary, clarifications are sought from respondents through the telephone or electronic mail if some questions in the questionnaire were not answered.

Several variables have been chosen, categorized and coded for these analyses. The coded data were then entered into data file and analyzed using a statistical package, SPSS for Windows Release 10.0 (SPSS, 1999).

SURVEY RESULT

The analysis and discussion of the survey will focus on the four parts as described in the survey design.

A. BRIEF BACKGROUND OF THE COURSEWARE DEVELOPERS

The first part of the questionnaire asked brief background of the organizations participated. The results are calculated according to the number of tick for each answer.

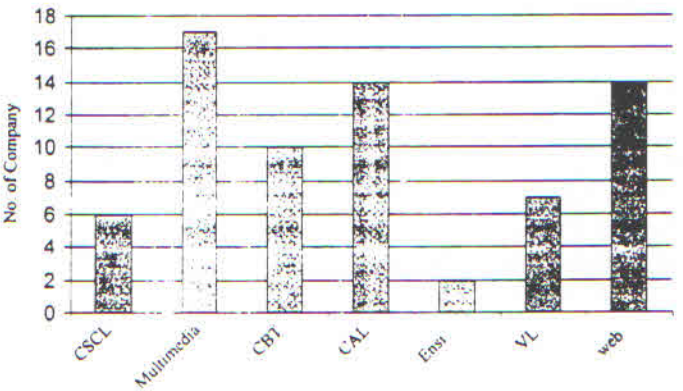

FIGURE 2. Category of Courseware Developed

The categories of courseware with different attributes, strengths and limitation (Zarinah & Siti, 2000) developed are surveyed among courseware developers in Malaysia. Figure 2 shows the trend shows of courseware developed by the organizations surveyed. Majority of the companies are concentrating on self-paced stand-alone multimedia even though CL has been chosen as one of the learning strategy in the local smart school project under the Multimedia Super Corridor (MSC) (MOE, 1997).

The survey also examined the term that they used for RElicit. Among the three terms given, namely requirements elicitation, requirements analysis and requirements negotiation, 19 organizations used requirements analysis term, 15 organizations requirements elicitation and 12 organizations used requirements negotiation. This shows that most of the respondents are still comfortable with requirements analysis but requirements elicitation term is quite new to some of them.

The courseware developers were also asked on the goal of RElicit to examine their level of RElicit knowledge. Suprisingly, most of them agreed that RElicit activity is to obtain as many requirements as you can. The other statements are to obtain only correct and accurate requirements and to obtain only potential requirements. This finding shows that most of them understand the RElicit goal.

B. COURSEWARE DEVELOPERS PRACTICE OF RELICIT

The second part of the questionnaire asked questions on how the courseware developers practiced RElicit. The percentage is calculated by the sum of strong opinion responses (i.e. score 3, 4 and 5). On the question of technique that they used, the finding shows that most of the courseware developer surveyed used group discussion to handle RElicit task. The use of group approaches such as Joint Application Development (JAD) in software development has been introduced since 1988 and showed effective result (Daniels, 1991). The other techniques that they always used are use cases and prototyping. However, other group technique such as workshop and role-playing are still not widely practiced as shown in Table 1.

On question why they choose the technique, the top three reasons are comfortable to all involved, suitable with the time allocated and effective and efficient technique. The other reasons are it is the practice in your organization, it can generate as many requirements as you require, it helps to understand the user's application domain problem, it will generate only potential requirements, it assures to generate only complete, accurate, consistent and relevant requirements and it easy to manage users' reaction.

TABLE 1. RElicit Technique Used

Technique	Percentage
Group discussion	100
Use cases	96
Prototyping	96
Observation	87.5
Interview	83.3
Workshop	58.3
Role-playing	50

On question of the people that they consult, the survey shows that 95% of the courseware developers surveyed consulted requirements analyst. It is followed by sponsor or customer (91.7%) and user (89.5%). The other people are developer and quality assurance team. On question of the object that they refer, they refer to courseware domain knowledge (100%), followed by work processes (96%) and current business rule (95.7%) in developing URD. The others are similar system and desired system documentation sample.

The courseware developers are also asked on how they record the gathered requirements. Most of the courseware developers (96.2%) used self-drawing with text. The other methods are low fidelity prototype, use of video or cassette recorder and memory. The use of self-drawing varies from one person to the other which would impact the people understanding.

They are also asked question on diagrams that they often use to represent users' need, 92.3% of the courseware developers surveyed used flowchart, 80.7% used context diagram and 57.7% used hand-sketch. The other methods are concept map, repertory grid, object-oriented diagram and warnier-orr diagram. In handling RElicit activity, majority of the courseware developer (42.3%) did not use any tool but they were keen to have right supportive tool to achieve the goal of RElicit. While, 27% of the courseware developers did not use any tool and did not need any tool. On the other hand, the tools that some of the respondents used are not suitable for RElicit activity including VISIO and Microsoft Project.

C. RELICIT ISSUES IN MALAYSIA

The completeness of URD is still low in which only 19.2% of the companies surveyed completed the URD and the rest were either almost completed or fairly completed the URD. In conjunction to that, the courseware developers surveyed are asked the major hindrances in handling RElicit. 20 out of 26 courseware developers agreed that stakeholders do not know how to express their needs. It is followed by lack of time or resources to do the activity correctly and the nature of the activity is also difficult. The details of the hindrances are given in Table 2.

TABLE 2. Hindrances of RElicit Activity

Reason	*No. of Responses*
Stakeholders do not know how to express their needs	20
Not enough time or resources to do the activity correctly	17
The nature of the activity is difficult	16
No cooperation from stakeholders	14
Hardly meet all stakeholders in every meeting	13
Difficult to understand the stakeholder's needs obtained	12
There is no CASE tool to expedite the activity	12
Difficult to identify the stakeholder	11

D. RELICIT SUPPORT TOOL

The final part of the questionnaire asked questions on RElicit support tool. Figure 3 shows that most of the courseware developers surveyed believed that the tool would help to integrate the needs from all sources and produce draft statement of requirements that can be integrated into a requirements specification. Among the expected features of the RElicit tool is to expedite the eliciting task. On the question of in which RElicit phase that they expect the tool will help, courseware developers surveyed agreed that RElicit tool should help the most in documenting and refining the wish list for each relevant source of requirements.

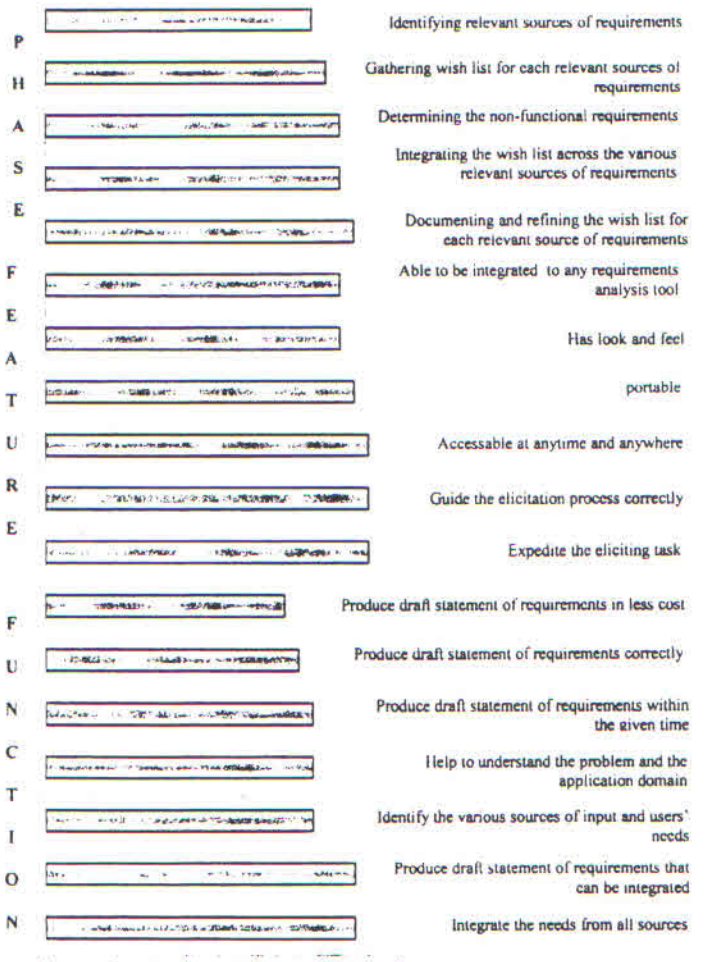

FIGURE 3. RElicit Phases, Features and Function

ANALYSIS AND DISCUSSION

Several points from the survey findings will be highlighted in this section in relation to the completeness of draft of URD.

A. RESPONDENTS BACKGROUND

Although the respondents are not very familiar with the RElicit term, they are capable to answer the questions as they are aware of the RElicit goal.

B. THE RELICIT PRACTICE

The RElicit practices by those respondents have direct link to URD completeness.

i) The Use of Tool and URD Completeness

Table 1 above shows that the tool factors of category lead the RElicit problems. The finding shows that respondents need RElicit support tools to guide and expedite the RElicit process. They need tool to guide in handling this activity, as they perceived the task is very difficult and time-consuming. In this network world, a collaborative synchronized web-based RElicit tool is possible to address RElicit group activity which is accessable at anytime from anywhere. The importance of tool in relation to URD completeness is shown by the cross tabulation in Table 3.

TABLE 3. Cross Tabulation of 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

The number of organization completed the URD are less compared to the number of organization that almost and fairly completed the URD. The organization that used tool either complete the URD completely or almost complete but many organizations that did not used tool only fairly complete the URD.

ii) The Use of Group Discussion Technique and URD Completeness

The group discussion such as FGD technique is identified as the technique most used among courseware developers surveyed. In relation to the URD

completeness, it shows that the increase of agreement towards FGD method in the organization increases in the number of organization complete the URD. This is shown in Table 4 below.

TABLE 4. Cross Tabulation of FGD Vs Rate of URD Completeness

Use of FGD technique	Number of Organizations		
	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

iii) The Relation of Object Referred and URD Completeness

Most of the courseware developers referred domain knowledge, followed by work processes and current business rule in handling RElicit. This result stresses that consulting user is important, as they are the domain knowledge experts. The cross tabulation of object referred versus the rate of URD completeness is shown in Table 5.

TABLE 5. Cross Tabulation of Object Referred Vs Rate of URD Completeness

References	Number of Organizations		
	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 organizations which refer to domain knowledge experts that completed and almost completed the URD is higher than organizations that refer to work process and business rule. Therefore, courseware developer should emphasize RElicit technique that refers to domain knowledge expert.

iv) The Relation of People Approached and URD Completeness

The survey shows that user is the third people approached after requirements analyst and sponsor. This contradicts with the statement that user and customer are the most knowledgeable of the problem domain. As shown earlier, user is the domain knowledge expert who previously showed that its relation with the URD completeness Table 6 below shows the cross tabulation of people approached (user) versus rate of URD completeness.

TABLE 6. Cross Tabulation of People Approached (User) Vs Rate of URD Completeness

People approached (User)	Number of Organizations		
	Complete URD	Almost Complete URD	Fairly Complete URD
1(disagree)	1	0	0
2 (less agree)	0	1	2
3 (fairly agree)	0	1	2
4 (agree)	1	4	3
5 (most agree)	3	6	5

The table 6 shows clearly that the increment of agreement to user consultation increases the number of organizations completed, almost completed and fairly completed the URD. On the other hand, the lack of user consultation reduces the number of organizations completed, almost completed and fairly completed the URD. Therefore, courseware developers should increase the consultation of user to increase URD completeness because lack of consultation lead to most of the stakeholders does not know how to express their needs.

B. MAJOR FACTORS IN RELICIT ACTIVITY

The categorization of RElicit problems in Table 7 shows that the respondents are very concern on three major factors in RElicit namely technique, document and tool (Zarinah & Siti, 2003). Courseware developers should consider these factors to ensure the generation of complete URD. As seen from the survey, currently their practices are having some lacking. Although they used group discussion technique, only 19.2% complete the URD. The use of improper tool could be one of the causes. As can be seen in the practices of RElicit, the tool that some of the courseware developers used are diagramming tool and project management tool. Therefore, the technique used could be improved to support group elicitation. Furthermore, they believed that RElicit activity is difficult. Enough time and resources, though, might help in the success.

CONCLUSION

In this paper, the findings from a survey on RElicit among courseware developers are presented. Their RElicit practices have shown the inclination towards the URD completeness which is stressed in the hypothesis. However, the survey shows that there are several factors in handling RElicit successfully. As shown in the last part of the survey finding, the consideration on technique, document and tool factors would bring better result in RElicit

TABLE 7. RElicit Issues and Criteria Investigated (Zarinah & Siti, 2003)

RElicit Issues Related To:	*Criteria Investigated*
Technique (94.3%) It refers to the criteria of choosing RElicit technique.	• It is the practice in their organization. • Efficient and effective technique. • Comfortable to all stakeholders involved. • It helps to understand user's domain model.
Document (91.9%) It refers to the documentation contents of URD.	• Draft statement of requirements that can be integrated to next phase in RE. • Integrate needs from all sources. • Produce draft statement of requirements within the given time. • Identify various sources of input and user's needs. • Produce draft statement of requirements correctly. • Produce draft statement of requirements in less cost
Tool (89.4%) It refers to the features of RElicit tool.	• Can be accessed anytime and anywhere. • Portable. • Has look and feel. • Generate as many requirements as it can. • Generate only complete and accurate requirements. • Generate only potential requirements. • Can be integrated to at least one existing requirements analysis tool. • Reliable.
Time (84.8%) It refers to the temporal factors involved in RElicit.	• Not enough time and resources to do the activity. • Suitable with time frame allocated. • Produce draft statement of requirements within the given time.
Process (77.6%) It refers to the RElicit process needs.	• No case tool to expedite the activity. • Expedite the eliciting task. • Guide the elicitation process correctly. • Nature of the activity is difficult.
People (73%) It refers to people factors in RElicit.	• Difficult to identify stakeholder. • Stakeholders do not know how to specify their needs. • Easy to manage user's action
Communication (65.7%) It refers to the interaction involved in RElicit task.	• Stakeholders do not know how to specify their needs. • Difficult to understand the stakeholders' needs obtained. • Understand the problem and application domain. • No cooperation from stakeholders. • Hardly meet all stakeholders involved.

activity. Therefore, in order to develop complete draft of URD for the use in the RElicit activity, technique, document and tool of RElicit factors should be examined.

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MAKLUMAT PENGARANG
Zarinah M. K. & Salwah S. S.
Dept. of Software Engineering
Faculty of Computer Science & Information Technology,
University of Malaya
zarinahmk@um.edu.my
salwa@um.edu.my