

Requirement Engineering Practice Research Framework for the Public Service Organisation

Azlana Haron

Department of Computer Systems & Communication,
Faculty of Computer Science & Information Systems,
Universiti Teknologi Malaysia (UTM), Malaysia
azlena.haron@yahoo.com

Mazlan Harun

National Institute of Public Administration (INTAN),
Malaysia Public Sector
drmazlan@intanbk.intan.my

Shamsul Sahibuddin

Advanced Informatics School (AIS),
Universiti Teknologi Malaysia (UTM), Malaysia
shamsul@utm.my

Nor Hawaniah Zakaria

Faculty of Computer Science & Information Systems,
Universiti Teknologi Malaysia (UTM), Malaysia
hawaniah@utm.my

Abstract— The requirement engineering (RE) practice was implemented without knowing by IT Personnel. This RE framework design purposely to identify the RE practice that implemented during software project requirement in Malaysian Public Sector. We determine the software requirement system (SRS) flow from the initial interview. We have a list of IT Personnel RE practice experience for the software project from the pilot test. We identified the problem arise and the RE practice implemented from the actual survey. The RE practice that identify will validate by the IT expert in Malaysian Public Sector. We plan to developed standards, tools, and methods can help to improve the current practice. Our expectation is the practice that can be as a guideline to IT Personnel using RE practice during software project requirement.

Keywords-component; requirement engineering; requirement engineering process; requirement engineering practice; research framework; software project success factor

I. INTRODUCTION

Many projects in the organization run in parallel to fulfill the stakeholder demands. Sometimes these projects running without monitoring and tracking; the implementation beyond their expectations. Therefore, we need a standard practice for software project development as a guideline. The need of RE practice is to make sure the development process follow the standard. We cannot blindly adopt the RE without knowing the critical issues in the organization [1]. RE practice will be identify through the experience of IT personnel in Malaysian Public Sector. We developed the RE practice from the implemented of the software project requirement guided by RE Practice Research Framework suggested.

This paper is organized as follows. Section II: The RE Practice Implemented In The Organization; III: The Research Framework for RE Practice; IV: The Result; and Section V: Discussion and Conclusion.

II. THE RE PRACTICE IMPLEMENTED IN THE ORGANIZATION

We explain the implemented of RE practice in Malaysian Public Sector in the context of software project development scenario. The software project decided by management which usually as a decision maker. The needed software project is to develop new system application, upgrading the current system, and changes of technology.

Starting with the idea of the software project presented to decision maker in the organization. The development team produced a set of initial requirement for software project. They studied the current situation (as is) a particular procedure or current system and come out with the new idea in improving the current process. The requirement discussed or brainstorm with stakeholder. If they have enough time, they do the feasibility study to make sure the requirement fulfill the stakeholder need. Mixed tool and technique used in helping the stakeholder understood what their needs are. The idea from the agency which has the similar business process is a good guidance in preparing the requirement. The initial requirement presented to the committee. Several committees will involve in the monitoring of the software project. There are Jawatankuasa Pemandu will chair by organizational itself, Jawatankuasa IT dan Internet Kerajaan (JITIK) chair by MAMPU and Treasury.

The software project success factor (SPSF) involve in RE practices are managers, stakeholder, developer, business rules, business process and technology [2]. The different level manager with different function involve in software project development. There are Leader, Project Leader, Project Manager and Project Team which can group as Management [3]. Stakeholder will direct to business process while the developer will suit the practice with the technology. Manager usually act as approval for every practice should be done by IT Personnel and Stakeholder. The action guided by business rules. Stakeholders, all those who are involved in a project and have some interest in the software to be developed, may vary from one project to another [4]. Development Team have to

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know and familiar with the variety of tools and technique in the market. If the developer (IT staffs) is lacking in the required technical expertise then the project risk is higher [5]. A business rule is a statement that aims to influence or guide behavior and information in an organization and categorized to mandate, policies and guidelines [6]. A business process recognized as a set of procedure of task that should complete or action taken by the people involved [6]. Technology: The development of software projects are involved with the IT infrastructure, software and hardware which can group as technology.

III. THE RESEARCH FRAMEWORK FOR RE PRACTICE

This research framework adopted from empirical studies [7] and redesign as Fig. 1. The implementation of research framework base on research problem; the needed of standardized guideline for IT Personnel to make sure that the requirement proposed of acceptance for software development practices will align with the Public Sector ICT's Vision. The research question for the framework are: RQ1: What is common RE practice in Public Sector? We expect to have a list of IT Personnel experience while they done the RE practice for the software project. RQ2: How can developers know when a set of RE is good? We expect to know the problem arise and the RE practice implemented during the software project requirement. RQ3: What standards, tools, and methods can help to improve the current practice; do they exist, or must they be developed? We plan to developed standards, tools, and methods can help to improve the current practice.

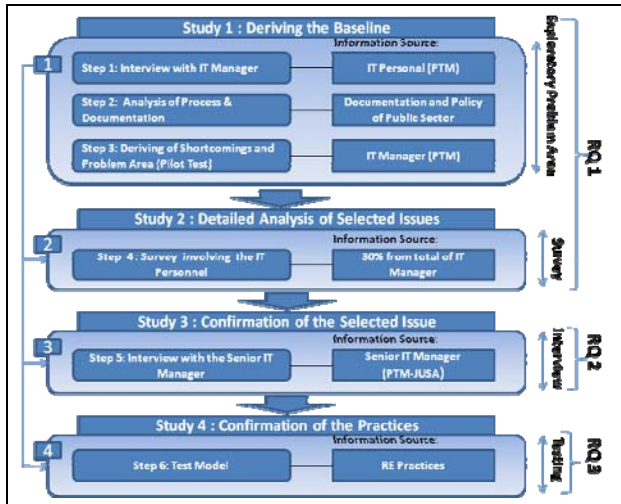


Figure 1: Research Framework for Requirement Engineering

A. Study 1 : Deriving the Baseline

This is a phase where we have to exploratory problem area. Study 1 contains of three steps, Step1, Step2 and Step3.

Step 1 is pre-test where data collection methods semi-structured interviews with IT Personnel within domain expert. A semi-structured interview is one in which the interviewer prepares a list of general questions and topics for discussion, but is prepared to be flexible regarding the order in which the

questions are answered, and open to discussing questions other than those specifically anticipated on his or her script [8].

The criteria of domain expert are the IT Personnel in Malaysian Public Sector that had experience with development of software project and categorize in Grade F48 and above. These groups of personal are IT Manager and have experience in leading the ICT project. The respondent selected by their experience and from different agency or organization. We divide the interview into two part, Demographic Profile (Part 1) and Investigate the preparation of RE. The interview will guide by a set of questionnaire. The purpose of the interview is to investigate the current RE practices during the preparation of SRS for software project. The objectives of questionnaire are: 1. workflow for SRS; 2. roles of decision maker, development team and vendor; 3. identify who will responsibility in monitoring the requirement specification; and 4. the implementation of need analysis in proofing the needs of implementation of software project. The technique during interview included recorded, face to face interview and interview through telephone.

Step 2, inspections of documents, observations of requirements and policy that can support the research. The objective is related document procedure to support the analysis. Literature related to preparing and development of questionnaire.

Step 3, is a Pilot Test. The new practices must also be piloted to ensure the practicality and usefulness of the developed RE process [9]. The survey will distribute through email to IT Manager in Malaysia Public Sector from different organization and level. IT Managers are the IT personnel which group on grade 48, 52 and 54. They act as Head of IT Unit in IT Department. These persons is dedicated to development software project or the project manager of the certain of software project development

We divide the survey into 2 separate booklets; the questionnaire and the answer sheet. The purpose is to help respondent monitor the answer. The survey for pilot test consists of four parts. Therefore Demographic Profile (Part 1), Personal Experience in Software Project Requirement (Part 2), Problems during Software Project Requirement (Part 3); and Investigation on RE Practice during software project requirement (Part 4). The information of IT Manager derived from Part 1. The information included their department, organization, gender, education and working experience. Part 2 is purposely for getting the personnel experienced in the software project requirements. Here, we will know the project involved, who gave the approval, IT Manager position in this project and the length of project to be completed. From their experience in software project requirement, there happened some problem such as the roles of manager, stakeholder and developer. In addition, the roles of business rules, business process and technology [2]. The explicit and implicit RE practice derive from part 4. These parts divided five sections, Elicitation Process, Analysis and Negotiation Process, Documentation Process, Management Process; and Verification and Validation Process [3]. We listed the practice that developed from the RE Critical Issues [10] in every RE process.

The pilot test focus for the acceptance of questionnaire regarding to RE practice that implemented during the software project requirement. The scale of survey is 1 to 10, which 1: Strongly Disagree and 10: Strongly Agree. For the analysis we divided the scale into 5 groups. The groups are 1-2: Strongly Disagree; 3-4: Medium Disagree; 5-6: Natural Agree; 7-8: Medium Agree; and 9-10: Strongly Agree. We used a SPSS to analyses the data

B. Study2 : Detail Analysis of Selected Issues

During Step 4, the questionnaire will be rework based on pilot test comment. After that, the questionnaire will be spread to the respondent (30% from the total of IT Manager) in the agency or IT department. Beside to get feedback for the finding, we also want the IT manager aware of the practices that they have done and should be done.

The major problem of the requirements will determine after the data analysis. The result of this part shows the improvement of the current practices for requirement of software project development in Public Sector.

C. Study3 : Conformation of Selected Issues

During Step 5, the survey of main issues will answer by the PTM Expertise as respondent. This group usually had the experience in development or maintenance of software projects. How can they be recognised? The more senior of the position in organisation, it means of they have to handled a software project such as software development or maintenance, networking, operational and managing data centre. The respondent will evaluate the current practices of requirement for software project development.

D. Study4: Conformation of the Practices

During Step 6, we have to validate the approving requirement of software project with suggested tools. Once the requirements been determined, giving them a weighting. It is for capture the knowledge and experience of experts familiar with the software requirement process. The weights for these factors were determined using expert opinion through the use of a Delphi survey [11]. This testing will produce the best practices as an appropriate guideline in developing for software projects in Public Sector

IV. THE RESULT

A. The Interview

The development activity was initiated by e.g. an order, which generally resulted in a project (maybe preceded by a pre-study) and then requirements engineering was initiated through this project [12]. We identified several entities that assist to preparation of software requirement specification (SRS) for Software Project in Malaysia Public Sector. We divide this entity into two parts, Main Entity and Support Entity (Fig. 2). Main entity contains of process flow for the preparation of SRS. Meanwhile, the support entity will faultless the process flow and make the SRS more stable and usable. In preparing the requirement, they have a process flow that we should follow. The process starts with how they get

the idea in developing software project. The idea should support with the identify requirement to propose to the management. During the decision making process, the management meeting will decide either to accepted or not accepted the proposal. The decision will note in the meeting minute. The accepted proposal will past to IT Department for preparing the detail requirement and implementation. The entities involved are Idea, Initial Requirement, Decision Making, Implementation and Detail Requirement. The SRS process flow supported by Reference, Committee and Guideline entity. This process flow monitoring by appointed people or committee.

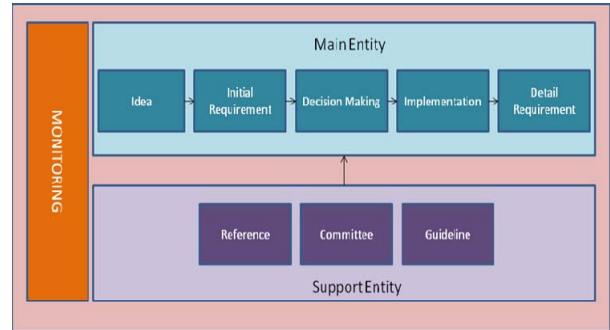


Figure 2: SRS Process Flow

Our research focused to the Guideline entity. For the time being the software project requirement guided by “Surat Pekeliling Bilangan 1 Tahun 2009: Garis Panduan Mengenai Tatacara Kelulusan Teknikal Projek ICT Agensi Kerajaan” and “Tatacara Pengurusan Aset”. The plan should align with the ISP for Malaysian public sector. Both of the guideline more focused to the progress project and inventory of the ICT equipment. The suggested guideline will focus to the software project requirement.

B. The Pilot Test

We developed the RE practice as a guideline for the IT Manager in preparing the software project requirement. We identified the software project success factor (SPSF); business rules, business process, technology, stakeholder, developer, and manager [2]. We blend with RE process that identified: elicitation, analysis and negotiation, documentation, and verification and validation [3]. We derived RE critical issues from the problem listed by SPSF [10]. We done the mapping to developed the RE practice. We tested the guideline to the selected 25 IT Manager in Malaysia Public Sector.

TABLE 1: A SOFTWARE LIFE CYCLE PROCESS

Methodology	Frequency	Percent
Waterfall Model	3	25.0
Agile	1	8.3
Incremental	1	8.3
Evolutionary	1	8.3
Prototyping	4	33.3
Rational Unified Process (RUP)	1	8.3
Total	11	91.5

The result shows (Table 1) that's 91.5 percent from the respondent whose response to the survey uses the available methodology to guide them during the requirement process. There are, Waterfall Model, Agile, Incremental, Evolutionary, Prototyping, and Rational Unified Process (RUP). A software lifecycle defines the different stages in the lifetime of a software product. A software lifecycle defines the principles and guidelines with different stages [13]. They used different of methodology because of some reason. Therefore, type of software project, project leader, duration of the software project, and experience in using the methodology. We developed the guideline and suitable with their knowledge and experience. This is the best way for them to follow the simple and easy to understand. This guideline blend with the standard suggested.

C. The Actual Survey

We distributed the survey to 325 IT Manager in the IT agency or IT department in Malaysian Public Sector. The IT Personnel data is delivered from HRMIS system. We take the time to distribute surveys for a month because of the different departments and location. Collection of the survey took three months to achieve 30 percent number of respondents.

TABLE 2: A MEAN OF RE PRACTICE FOR SPSF

SOFTWARE PROJECT SUCCESS FACTOR (SPSF)	REQUIREMENT ENGINEERING (RE) PROCESS				
	Elicitation	Analysis & Negotiation	Documentation	Management	Verification & Validation
Business Rules					
Number of RE Practice	3	2	3	3	2
Valid N	103	105	106	104	104
Mean	3.98 to 4.12	3.45 to 4.04	3.78 to 4.25	4.07 to 4.17	3.07 to 4.09
Business Process					
Number of RE Practice	3	2	3	3	2
Valid N	104	104	104	105	102
Mean	3.86 to 4.36	3.46 to 3.83	3.73 to 4.28	3.99 to 4.32	4.06 to 4.08
Technology					
Number of RE Practice	3	2	3	3	2
Valid N	105	105	104	102	104
Mean	3.92 to 4.30	3.48 to 3.97	3.89 to 4.43	4.15 to 4.32	4.00
Stakeholders					
Number of RE Practice	6	5	6	5	4
Valid N	105	102	101	105	104
Mean	3.65 to 4.15	3.52 to 4.14	3.98 to 4.37	4.01 to 4.32	3.91 to 4.31
Developers					
Number of RE Practice	6	5	6	5	4
Valid N	103	105	103	102	104
Mean	3.95 to 4.37	3.49 to 4.09	3.52 to 4.22	3.83 to 4.27	3.90 to 4.14
Managers					
Number of RE Practice	5	4	6	5	4
Valid N	104	104	101	102	104
Mean	3.96 to 4.37	3.38 to 4.29	3.66 to 4.16	4.18 to 4.31	4.02 to 4.22

Table 2 is a result analysis of the survey purposely for RE practice. The result group by software project success factor and subgroup for RE process. The actual survey focus for the acceptance of suggested RE practice that implemented or experience by IT Manager during the software project requirement. The scale of survey is 1 to 10, which 1: Not implemented at all; and 10: Implemented all the time. For the analysis, we divided the scale of mean into 5 groups. The groups are 1: Strongly Disagree; 2: Medium Disagree; 3: Natural Agree; 4: Medium Agree; and 5: Strongly Agree. We used a SPSS to analyses the data.

The analysis shows that the result can divide to three group of respondent. First, the respondent medium agree that they implemented all the time the suggested RE practice because of the practice similar with they have done during software project requirement. As example, mean for business rules during the management process is 4.07 to 4.17. The other example is mean for business process during the verification and validation process is 4.06 to 4.08. Second, the respondent natural agree that they implemented all the time the suggested RE practice because some of the practice not suitable to implement in their situation. As example, mean for business process during the negotiation process is 3.46 to 3.83. The other example is mean for technology during the analysis and negotiation process is 3.48 to 3.97. Third, mixed of the respondent which medium agree and natural agree that they implemented all the time the suggested practice. It is happen because of the duration of software project requirement, type of software project, and experience in handling software requirement process. The requirement process involve cost and time such as total cost of the requirements effort, average cost per requirement, percentage of total development duration used for requirements [14].

The RE practice suggested for business rules is 13. The respondent medium agrees that they implemented all the time the suggested practice for business rules during the management process of the software project requirements. The information is the important resources in the organization [15]. These resources will be form as business rules by combining various elements or processes. It can be changed as needed of the business process [16]. The mean of the suggested practice implemented all the time by respondent also mixed in mediums agrees and natural agree. The process involve is elicitation, analysis and negotiation, documentation, and verification and validation. The lower mean is 3.07, and the greater mean is 4.25.

The RE practice suggested for business process is 13. The respondent medium agrees that they implemented all the time the suggested practice for business process during verification, and validation process of software project requirements. A plan to accept the changes of the business process. These changes are caused by several factors, such as errors in original requirements, evolving customer needs, technological changes, and changes in the business environment or organization policy [17]. The mean of the suggested practice implemented all the time by respondent also mixed in mediums agrees and natural agree. The process involve is elicitation, analysis and negotiation, documentation, and management. The lower mean is 3.73, and the greater mean is 4.32.

The RE practice suggested for technology is 13. The respondent medium agrees that they implemented all the time the suggested practice for technology during management, and verification and validation process of software project requirements. There is a tendency in some of the organisation increased technology focus as requirements [18]. The technical team should understand the limit of ICT infrastructure. The complexity of software projects as well as

the multidisciplinary nature of requirements engineering (RE) requires developers to carefully select RE techniques and practices during software development. [19]. There should be a plan for check and balance of the current infrastructure with the system requirement. The mean of the suggested practice implemented all the time by respondent also mixed in mediums agrees and natural agree. The process involve is elicitation, and documentation. The lower mean is 3.89, and the greater mean is 4.43. Meanwhile, the respondent natural agrees that they implemented all the time the suggested RE practice during analysis and negotiation.

The RE practice suggested for stakeholders is 36. The respondent medium agrees that they implemented all the time the suggested practice for stakeholders during management process of software project requirements. The communication gap between stakeholder and development was also obvious. The stakeholder view of specifying requirements was to write down for future functionality, while the developers expected clear and detailed requirements that could be used for design [18]. The right requirements will remodel. The mean of the suggested practice implemented all the time by respondent also mixed in mediums agrees and natural agree. The process involve is during elicitation, analysis and negotiation, documentation, and verification and validation. The lower mean is 3.52, and the greater mean is 4.37.

The RE practice suggested for developers is 36. The mean of the suggested practice implemented all the time by respondent also mixed in mediums agrees and natural agree. The process involve is elicitation, analysis and negotiation, documentation, management and verification and validation. The lower mean is 3.52, and the greater mean is 4.27.

The RE practice suggested for managers is 24. The respondent medium agrees that they implemented all the time the suggested practice for stakeholders during management, verification and validation process of software project requirements. There were usually problems in understanding the impact of the requirements, which led to unacceptable suggestion [20]. The implementation solution should be informed to the project manager. The validations were performed to assure that the model complied with the needs of organization [12]. The project manager has to ensure the verification and validation done. The mean of the suggested practice implemented all the time by respondent also mixed in mediums agrees and natural agree. The process involve is elicitation, analysis and negotiation, and documentation. The lower mean is 3.38, and the greater mean is 4.29.

We will rework the RE practice which responded as natural agreed. We plan to summarize the tested RE practice and confirm with the senior IT Manager during Step 5.

V. DISCUSSION AND CONCLUSION

The success of research framework implementation depends on certain criteria:

A. The Respondent

The goal of interview and survey is to gain the tacit knowledge from the respondent. Our respondent is IT Manager

in Malaysian Public Sector. IT Manager in Malaysian Public Sector is given choice to be expert in eight fields of ICT. There are ICT Strategic Planning, Project Management, Knowledge Management, System Development, Data Center Management, Database Management, Networking and Security. It's difficult for us to identify which groups are really involves in RE practice. We plan to determine the right IT Manager is from their experience and problem facing during the software project development. The experience or senior IT Manager understood why we develop the RE practice. While the junior IT Manager answer the part that they really involve. We hope that the questionnaire will help the respondents recognized or recall or feel what they have done during the requirement process.

B. The Interview

This interview process will divide into two groups. The goal of the first group is to investigate the preparation of requirement for software project development. This is a small group of IT Manager that we are sure they have experiences in preparation the requirement. The open questionnaires really help them in understanding what we wanted. Usually the interview will take much of the respondent time. The goal of second group is to validate the survey finding. This group is an expert IT Personnel or very experience person in Malaysian Public Sector. We should have a plan to lead them focus to our need. The open question should be helpful base on our past experience during the interview process. Roughly, for one respondent take about an hour. For not disturbing the respondent, we make an appointment and guide them by a set of open questionnaire. The conversation will be recorded as evidence and for analysis. The critical part is to analysis the qualitative data. Our past experience very helpful in categorized the data into group or entity.

C. The Questionnaire

The development of questionnaire for actual survey should align with the Malaysian Public Sector environment. We determine public sector software project success factor based on the experience of software project development. We listed the issues and identified the critical issues. After that we map with the RE process. We tested the questionnaire to the selected respondent. To make sure that that the questionnaire did not bored the respondent, we have to rework the questionnaire in make it very simple and clear. We also have to make sure that it will not took much of respondent time even though there are many questions for them to answer.

D. The Survey

The survey distributed to the IT agency or IT department in Malaysian Public Sector.

The survey will be distributed to IT agency or IT department in Malaysian Public Sector. The location of IT agency or IT makes it difficult for us to distribute the survey. Therefore, we list the agencies and the IT with code. Each survey form will number with unique serial number. The purpose is to identify the forms with data, the form is not returned and the form is returned without data. It aims to ensure that the form containing the data received to meet the

required quota. The series number also seeks to prevent the redundancy data.

As conclusion, the result from actual survey will be used for Step 5. We will confirm the result with the senior IT manager. We hope the suggested research framework will guide us to identify the RE practices in Malaysian Public Sector. The RE practices identify will guide the IT Personnel in preparation of the requirement for software project development.

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