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Requirement Elicitation: Identifying the Communication Challenges between Developer and Customer

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ABSTRACT

Eliciting requirements for a system is an important activity in requirement engineering. This process occur at the early stages in system development which involves communication between customers and developers. Researchers have identified that poor communication is one of the most common problem in identifying and defining customer's requirements. This problem will contribute to bad result e.g. poor system, failure of the system and budget overruns. The communication is challenging and difficult as this process also includes cognitive aspect, personalities, techniques and tools. A study was carried out to explore the communication challenges that are faced by developers and customers during software requirement elicitation in Malaysia. The results of this study had shown that there are some important communication challenges during software requirements elicitation process in Malaysia. In addition, most of the practitioners were pursuing the practices that have been traditionally used by the organizations. Consequently, the results of this study have given us a good incentive to expand our research in the area of software requirements elicitation.

KEYWORDS

Requirement elicitation, software requirements, communication

1 INTRODUCTION

Requirements elicitation is a process of searching, revealing, acquiring and detailing of requirements for computer based system [1]. Software requirements are categories into two which are functional and non-functional requirements. Functional requirements are referred to function or service that prepared by system. These requirements depend on types of software that was developed, the user and kind of system. Its also known as system behavior [2]. Non-functional requirements is referred to system constraint [3]. Software requirements document was the foundation to software development. Hence this document is very important in software development process. The effects of poor software requirements include cost rework, budget overruns, poor quality systems, stakeholders' dissatisfaction and projects failure. In order to solve this problem, many studies are concerned with elicitation requirements practices, problems and

tools. One of the important issues in requirement elicitation is the communication between customers and developers, which include the cognitive aspect, personalities, techniques and tools. The issue of communication skills and analyst-client relationship has been a consistent issue in IS literature for over 20 years [4].

The purpose of this paper is to identify some of communication challenges that may arise during requirement elicitation and propose some possible interventions that may be carried out in order to mitigate these challenges. This paper is structured as follows: in second section we provide some issues in requirements elicitation. In the third section, we introduces communication model in general. The fourth section discusses on the communication activities and processes in requirements elicitation. The fifth section discusses the research that we have carried out to identify some communication challenges in the process of software development in Malaysia. The last part is the conclusion.

2 REQUIREMENTS ELICITATION

According to [5], issues on requirements elicitation is important and becoming critical in development software. This is because the lack of requirements elicitation will cause failure of the whole project [6]. The issue which was debated is sources of requirements, techniques, problem that faced and support tools during requirements elicitation. This process also involves the movement of data to the meaningful information which is software requirements documents. This process is looked as negotiation processes among stakeholder to achieve an agreement on system that wish to be developed [7], [8]. [9] state that in general, the process are made up by four principal activities communication, setting priorities, negotiation and cooperation with stakeholders. According to [7] the negotiation process which are:

1. interaction need to be supported and being examined.
2. important decision in process need to be maintained to present in project that is further.
3. negotiation process need to be carried out instinctively to avoid from bias.

More often, this process is carried out repeatedly. Various techniques have been used for requirements elicitation such as interviews, document analysis, group work, ethnography, prototyping, questionnaires, scenarios, and Viewpoint. These techniques may be divided into two categories which are personal interaction and non-personal interaction. According to [1], most of these techniques are adapted from various disciplines such as social science and engineering.

According to [10], the most technique used is interview technique. This technique requires direct interaction on between the interviewer and the respondent. Great and quick information will be accessible from individuals and particular group by using this technique. The qualities of the information obtained are closely related to interviewer's skill.

Document analysis technique is conducted by reviewing documents and application of an existing system. This technique is most suitable for the renovation of obsolete systems or by a new analyst. The documents involved include design documents, manual systems, as well as forms and files used in the business processes. However,

more often the documents involved contain outdated or incomplete, and are inconsistent with the current business requirements [10].

Elicitation techniques that involve work group are meetings focus groups, and workshop. [11] and [12] have categorized meeting techniques that involve time and high cost as it requires the involvement of many parties at one time. Focus group is one of the techniques performed in a group interview. This technique involves participation of the customer representatives and the developer to exchange information through discussions [13].

Prototyping is another requirements elicitation technique that allows user feedback and considers in-depth information, which is considered the most suitable technique for developing the user interface requirements that have not been identified in full. A prototype can be built with any computer language or development tool to simplify the process [10]. The prototype responds better to uncertain or changing of requirements [14].

Questionnaires are used to gather information when the project involves many respondents and is to be completed within a short time period. The information obtained is usually lack in depth, less authentic, and less interactive. Normally, this technique is best used to obtain information on attitudes, beliefs, and basic features for a system.

Scenario-based elicitation technique is basically a summarized description of the system as described in the beginning of the process, along the process, and at the end of the process. The scenario is served in the form of a story and contains information on the process, actions and interactions of users with the system.

Ethnography is a study that is committed against individual in an environment which is obvious [13]. This technique use various form and suitable to get information such as usability and interaction among users system-with. This technique is found appropriate to be used to get software needs on new system because it could identify problems that are faced relating with process and system procedure that was used.

Viewpoint is based on point of view approach [15]. This technique model a domain from various perspectives like going through operation, implementation and interface. This technique is effective to develop a system if it involves entity and relationship which is complicated between one another. Apart from that it may serve as one way to aid organization for setting priorities on software needs. Multi perspective need's engineering approach (PREview) that used to form system requirement from resources that is different[16].

Selecting the techniques to use depends on the need for rich or thorough, the time, budget available, the need for confidentiality and the desire to get people involved and committed to a project [10]. This selection also influenced by types of problem, solution and system domain.

Although [17] may consider the following reasons for an analyst selecting one or combination of techniques: (i) the technique that they know; (ii) the technique which became their liking; (iii) to suite to particular method and (iv) based on intuition that the technique are effective. Usually some techniques used together because a

technique can never be able to cater to all situations.

3 COMMUNICATION MODEL

In this section, we provide some communication model in general which have been proposed by researchers from several disciplines. The communication elements most frequently mentioned are source-receiver, encoder-decoder, feedback, message, noise, context and effect [18] The first model discussed is linear by Shannon-Weaver. This model describes the communication process as having information sources, a message, a transmitter, a signal, a receiver, a destination and noise. Transactional model is another communication model described by [19]. This model involves two or more participants who act and react to one another. A message can be successfully exchanged only when both the sender and the receiver perceive it in the same way. This process relies on feedback from the receiver to the sender, and is influenced by both the context in which the communication process occurs, and the channel chosen for the transmission of that message. Boone also noted that the perception of the receiver is critical in effective communication [19]. Another model stated that the meaning of a message does not reside completely in the message, but is constituted by the receiver based on their own background [20]. Due to the differences in background, this meaning can differ considerably from the intended meaning of the sender.

Communication is more than just an expression, it requires participants to share qualities such as language, experience, cultural values and knowledge [18]. It has been agreed that communication occurs within a particular context, and this context has at least four dimensions: physical, social, psychological and temporal. The physical dimension refers to the physical environment in which the communication occurs and may exert some influence on the content as well as the form of the message. The social dimension reflects the relationships between the participants and the norms and cultures of the society in which they are communicating. The psychological context consists of such aspects as the friendliness or unfriendliness and the formality or informality. The temporal dimension includes the time at which the communication takes place. Berlo's model emphasizes that communication is an interactive process, without beginning, end, or a fixed order of events [20]. He specifies that four significant elements of communication. which are source, message, channel and receiver. The channel for sending and receiving messages consists of five human senses: seeing, hearing, touching, smelling and tasting. A perception and personality screen for each participant in the communication process is highlighted by [21]. The argument by [21] is that a message will be encoded with factors of the sender's personality and perceptions of the environment, the context, the message and the receiver, and their self-perceptions. Besides that, the receiver of the messages were influenced by their own perceptions and personality. Barnlund model explains that cues are signals that a person processes from the environment [22]. Another model illustrated by Wenburg represents the communication process as an infinity symbol. This model demonstrates that communication is a never-ending process. This model can

also be expanded by similar loops to indicate several participants in the communication transaction [22].

Based on the various models of communication that has been described above, we can simplify that a model of communication consists of six elements as shown in Figure 1. This model includes sources that encode the message, the channel or medium through which the messages are transmitted, noise that interfere with the communication process, a receiver who decode it, and feedback that is sent to the source.

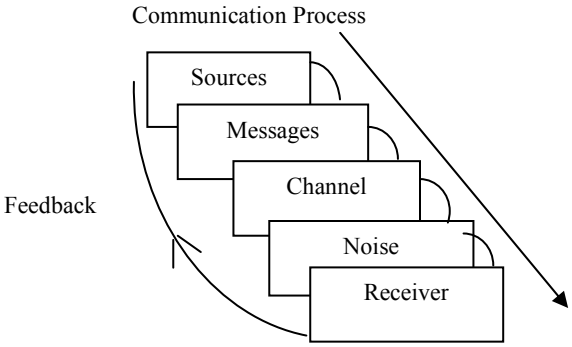

Figure 1. A Simple Communication Model

4 COMMUNICATION PROCESS AND ACTIVITY IN REQUIREMENTS ELICITATION

According to [23][24] communication activities in requirement elicitation can be comprised into three phases: knowledge acquisition, negotiation and integration.

1. Knowledge acquisition: As the whole process, facts share an understanding e.g. ideology, vision, knowledge, experience and technology.
2. Knowledge negotiation: As the whole process facts negotiate for software requirements information.
3. Knowledge integration: As the whole process facts accept e.g. strategy and software requirements.

We can use the model described in Figure 1 as a model of communication in a requirement elicitation process as described in Figure 2. The source is the customer, the message is the requirements, the channel is the technique, the noise is the communication challenges, the receiver is the developer and the feedback is the software requirements specification. In other words, the connections between communication theory and requirements elicitation go beyond the simplistic of the communication fallacy.

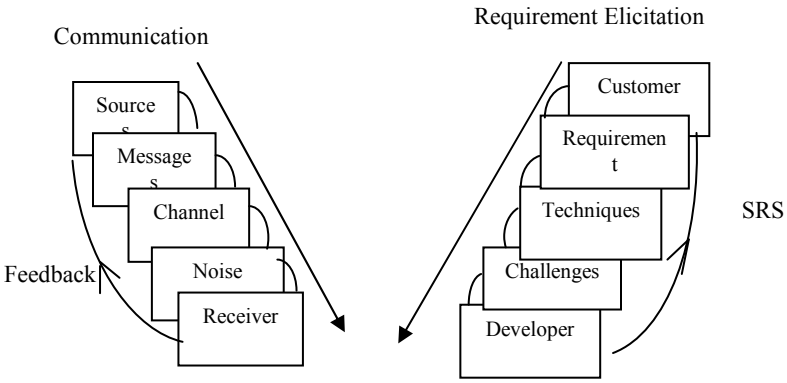

Figure 2. Communication and Requirements Elicitation Process

[25] present a communication framework that can be used for requirement elicitation. This framework consists of selection and participation of stakeholders, stakeholder's interaction, communication activities and use of communication techniques. This framework also considers other aspects such as cultural and political factor, communication plan, approach and purpose of interaction. Several possible

challenges that may arise during communication activities have also been identified (as indicated in Table 1).

During the knowledge acquisition an adequate level of understanding needs to be reached on the part of developer and customer, However knowledge acquisition can be disadvantaged if they face barriers to understanding. These barriers are mostly called gaps understanding, which obstruct the acquisition of knowledge and as a result uncorrected an understanding. Innovative thinking, illustrates the difficulties in bridging gaps in understanding in terms of allowing existing assumptions to remain unchallenged, stifling creativity and the generation of new ideas. Commitment will vary naturally between developer and customer, given the many different factors that can effect participation.

Negotiation is a type of communication activity that involves the sharing of information, in particular shared perspectives. A shared view of alternative perspectives is required in order to negotiate successfully to the benefit of all parties. Information exchange can be referred to out the requirements, that is information which is made relevant to them.

Knowledge acceptance revolves around the degree of acceptance and satisfaction users feel for a new system. Feedback is referred to communications obtained from users on documents. Theme fear factor can inhibit participation, communication and ultimate acceptance of the system. A lack of clear procedures or a dedicated change manager dealing with change is exposed by change management. These challenges need to be reduced in order to ensure effective communication. The knowledge must be acquired in terms of understanding of requirements and commitment to the changes. Knowledge once acquired, need to be negotiated so that perspective can be shared and an overall understanding of the problem area reached. Then knowledge needed for acceptance by all parties.

Table 1. Challenges in Communications Activities

Activities	Problems
Knowledge Acquisition	1. Gap in understanding 2. Innovative thinking 3. Redundant aspects
Knowledge Negotiation	1. Commitment 2. Shared perspective 3. Information exchange
Knowledge Acceptance	1. Feedback 2. Fear factor 3. Change management

Source: Coughlan et al. (2003)

5 COMMUNICATION DURING REQUIREMENT ELICITATION IN MALAYSIA

It is the general objective of this study to investigate the processes and issues of communication during requirements elicitation activities between customers and developers specifically in Malaysia. The questionnaire encompasses questions on communication practices and the challenges during elicitation activities.

The specific objectives of this study are to (1) to identify the communication practices during requirements elicitation process and (2) to identify the actual challenges involved during requirements elicitation. To achieve the above objectives, the following are some research questions that need to be addressed:

1. What are the sources of requirements elicitation for communicating

requirements during requirements elicitation in Malaysia?

2. What is the method used in conducting communication for requirements elicitation?

3. What are the challenges when performing requirements elicitation?

5.1 Research Approach

This study was carried out by using a questionnaire survey and case study approaches. The questionnaire includes questions on communication and the challenges to this activity. The results of the survey have been analyzed using SPSS. This approach is suitable to gather broad information of the study.

Table 2 shows respondent distribution according to sector. They are from various agencies that are categorized as government agencies, semi government, private agencies MSC status and non MSC status. Analysis of data shows that 42.9% respondents are from the private agencies Multimedia Super Corridor (MSC) status, 33.3% from private agencies non-MSC status, 21.4% from government agencies and 2.4% are from semi government.

Table 2. Respondent Distribution according to Sector

Sector	Frequency	Percentage (%)
Government	9	21.4
agencies	1	2.4
Semi-government	18	42.9
Private agencies	14	33.3
(MSC status)	42	100
Private agencies		
(MSC non-status)		
Total		

Table 3 shows respondent distribution according to respective positions. They are individuals involved in this activity along requirement elicitation process. Analysis of data shows that most respondents are project leader 52.4%, analyst 21.4%, software engineer 2.4%, programming 4.8% and others 19.0%.

Table 3. Respondent Distribution according to Position

Position	Frequency	Percentage (%)
Project Leader	22	52.4
Software		
engineer	1	2.4
System analyst		
Programmer	9	21.4
Others		
	2	4.8
	8	19.0
Total	42	100

Requirements sources are information that was gathered from the customers. These refer to customer needs for the new or upgrading system implementation. From the analysis, it is shown that numerous sources were used in process identification requirements. These sources come from customers. Respondent chose work process as their main source to identify software requirements.

Other sources used are based from existing system (50%), organization rules (50%), expert knowledge (50%), document (42.9%) and others source (4.8%) (refer Table 4).

Many organizations choose and modify their sources in accordance with technology changes. Besides that, sources of project are also influenced by changes of other factors such as economic, politic, social, regulations, financial, psychology, history and geography. For example an organization that practices a birocracy system can

cause difficulty in gathering requirements comparing to others. Moreover, the changes of management and political pattern in an organization also influence in delivering the requirements sources. These new changes made some customers feel unhappy and unable to accept the service. Rarely, changes in requirements and scope will affect on changes of information delivered. Also information that was prepared becomes inconsistent. Information was delivered through email, telephone and interview. Information which was received by email is easier to understand compared to other medium.

Table 4. Sources of Software Requirements

Sources	**Number**	**Percentage (%)**
Work Process	29	69
Expert Knowledge	21	50
Organization Rules	21	50
Existing System	21	50
Document	18	42.9
Others	2	4.8

To know requirements elicitation practice that was implemented, a few issues related to selection technique and factor which influenced that selection and process have been stated to respondents. The respondents were requested to state in the questionnaire one or more techniques that were used for requirements elicitation process. As shown in Table 5 the organization uses different kinds of requirements techniques.

Table 5. Requirements Elicitation Techniques

Eliciting Techniques	Frequency	Percentage(%)
Interview	34	81
Survey	15	35.7
Scenario	12	28.6
Document Analysis	25	59.5
Questionnaire	13	31
Focus Group	9	21.4
Workshop	8	19
Use Case	8	19
Requirement Reuse	2	4.8

The analysis shows 34 from 42 respondents (81%) chose interview as the technique that most suitable for software requirement elicitation. While 15 from 42 respondents (59.5%) chose document study technique, 35.7% chose survey technique, 31% chose questionnaire, 28.6% chose scenario, 21.4% chose focus group, 19% chose workshop, 19% chose use case and 4.8% chose Requirement Reuse technique that most not chosen by respondent. This retrieval is pursuant past research which found interview technique is a technique that most popularly used for software requirements elicitation process.

Process of documenting software requirements includes some activities such as creating of software requirements specifications (SRS), reviewing SRS content and checking SRS. These activities were carried out to ensure document that was created followed the quality standard and satisfy the customer. Software requirements document is a statement which needs to be written by developer ([14]). The preparation for this document involves activities such as producing software requirements specifications (SRS), reviewing SRS content and checking SRS. The detail of software

requirements document depends on the kind of system that is to be developed and software development process ([14]). There are various standards which are suggested for requirements document such as IEEE, ISO 9000 and others.

The survey results show that respondents did follow some standard in preparing SRS documentation, among which are from the Institute of Electrical and Electronics Engineers (IEEE), International Standards Organization (ISO) 9000-3, National Standards or internal organization. Analysis of data showed that 53% respondent follows their own organization standard or at least refer to similar organization in writing the SRS document. While 28% of respondents do not adopt any formal standard, 13% of respondents adhered to standard set by IEEE, 3% adhered to ISO standard 9000-3, while the remaining 3% adhered to the National Standards.

Further analysis reveals that most of the SRS document content include the following items:

- Introduction
- Content
- Project background
- System cope and business
- System summary
- Interface
- Output and input
- Process
- Procedure

Meanwhile, only a small number of organizations incorporated the following additional items:

- Change control
- Storage data
- Review
- Validation

As for the tools, software that is used to prepare the SRS document is mainly word processor or a specific software. Findings show that 90.5% respondents used word processor to write SRS and 7.1% use other specific software, while the remaining 2.4% use both types of software. Examples of specific software are Microsoft Visio, Microsoft Excel and Microsoft Project.

5.2 Challenges

In this subsection, we present on communication challenges in Malaysia. In order to study the problem of communication between customers and developers with more detail, a case study has been carried out. The study involved nine projects. From the analysis, (refer Table 6) the results of the study showed that communication problems can be divided into five topics namely type of input, personalities involved, communication skills, medium of communication and procedures. The problems occurred in the delivery of input probably because the information is ambiguous, requirements and scopes are frequently changed. Besides that, a lot of information presented is outside of the customer' field of expertise. Therefore the customers neglect focusing on delivering the information. As a result, the developer feels that the information delivered by the customers is ambiguous and not consistent. This is because the customers do not understand their roles in system development. The communication skill needed to achieve effective communication. This skill could be shown as individual, oral skill and writing. The results have identified a few communication weaknesses on delivering and presenting the information because lack of

communication skill, presentation skill and logic written. Some developer stated the difficulty to understand information that written because lack of organizing an idea by customer.

Besides that, there are various medium that used to communicate between customer and developer. The result shows the medium that was often used are e-mail, telephone, face to face and meeting. There are some problems through these medium such as interpretation mistakes, information not consistent and late of responses. Often the information was delivered using different methods, thus problems occur since individual may have different views and understanding of a given topic.

These situation needs to improve to make sure good transmitting process of information. The personality of customer and developer also influenced the acceptance and information delivery. Personality attribute consisting of staff commitment and quality, environment support, and personal skill. The results show the lack of customer cooperation, commitment and capability contribute to conflict in personality. Among this situation cause the customer have daily routine work burden, turn-over and adequate number of staff. In addition, procedures also contributed to the challenges in communication.

Table 6. Challenges in Communication

Criteria	Challenges
Type of input	1. ambiguity and not clear of information 2. redundancy of information 3. frequent requirements changes 4. different information 5. changes of scope
Personalities involved	1. changes of staff 2. lack of cooperation 3. lack of comittment and participation 4. less tolerance 5. lack control of work burden 6. lack of ability to handle conflicts
Communication skills	1. lack of ability in solving the ambiguity 2. lack of ability in proactive and instructive information delivery 3. lack of communication skills (verbal) 4. lack of presentation skill 5. lack of logic written 6. lack of organizing an idea 7. lack of sorting information
Medium of communication	1. late of responses 2. interpretation mistake 3. cannot access file 4. information not consistent 5. informal information 6. unrecorded information
Procedures	1. changes of report frequently 2. changes of report types 3. changes of document 4. changes of management and political rules 5. changes of criteria acceptance

Sometimes, requirements and scopes are frequently changed and this affected the information that is delivered.

5.3 Proposed Intervention for Managing the Challenges

Some intervention needs to be carried out in order to mitigate the effect due to communication challenges that occur between customers and developers. The lists of intervention suggested are given in Table 7.

One of the challenges faced by developers is to understand the customer's real requirement. This is a difficult task since most of the customers do not understands computer and system terminologies. Thus it is possible that when they mention certain terms, they are actually referring to different things. To mitigate this problem, it is important that customers should have some basic knowledge about computers and systems.

Since most of the communication between customers and developers are in written form (emails, letters, documents etc), it is important that customers must be able to express the requirements without any ambiguities.

The third challenge is the medium. Currently most of the communication between customers and developers are done either through face-to-face oral communication (interview, meeting etc), letters or memos, and emails. There is a need to improve the medium of communication in order to reduce the possibility of misunderstanding.

The fourth and fifth challenges are related to developers' knowledge and ability to express the requirements properly.

Table 7. Intervention Steps for Managing Communication Challenges

Challenges	Intervention Steps
Customer Knowledge	Provide knowledge to customer so that they can describe the problems better.
Customer Expression	Provide checklist guide to customer for requirements that input completely and understand by developer.
Medium	Provide communication facilities to customer to allow customer to communicate for problem solving that occur during communication process such as lately and misunderstanding.
Developer Knowledge	
Developer Expression	Provide facilities to developer for writing requirements specification document and checking written content. Provide facilities to generate document that written by developer into specification document type that can be modify by developer

6 Conclusion

This paper discusses the identifying and managing communication challenges among customer and developer during requirements elicitation process. The knowledge in the intervention steps can be used by the customer to express their requirements. Hence it can reduce from getting incorrect input such as the ambiguous information and frequently changed requirements and scopes. Intervention steps also provide the communication facilities for the customer to discuss any information regarding the requirements. These intervention steps will be used in the process model to develop system in assisting communication between customer and developer during requirements elicitation. We also believe that it is not easy to achieve effective communication, but this intervention steps can be used to assist in managing

communication challenges. Furthermore, complete and adequately management of the communication challenges can successfully create good requirement. Requirements document is always taken as the basis for software development.

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