Measuring Communication Gap in Software Requirements Elicitation Process

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Abstract: - Requirements elicitation is a process of seeking, uncovering, acquiring and elaborating requirements for developing a computer-based system. These processes involve communication between customers and developers. Techniques of communication that are normally used includes verbal, written and interpersonal. According to previous researches, there are numerous communication problems occurred between customers and developers during the requirement elicitation process. This study describes a technique for measuring communication gap between customers and developers during requirements elicitation. This technique is constructed by using Iterative Triangulation method. Five variables are proposed in this measurement: input, communication skills, personality, medium and procedures. The evaluation indicates that the proposed technique is able to produce the right measurement of the communication gap between customers and developers during requirements elicitation.

Key-Words: - Requirement Elicitation, Software Requirement, Communication Gap

1 Introduction

Requirements elicitation is a process of seeking, uncovering, acquiring and elaborating requirements for developing a computer-based system. For most of the projects, requirement elicitation process will last between four to twelve months. It is an essential part of the software development process. The effects of poor software requirements include cost rework, schedule overruns, poor quality systems, stakeholders' dissatisfaction and projects failure. In order to solve this problem, a number of researches have been carried out to study the elicitation requirements practices, problems and issues.

One of the important issues in requirement elicitation is the communication between customers and developers, which include the cognitive aspect, personalities, techniques and tools [1][2]. The issue of communication skills and analyst-client relationship has been a consistent issue in IS literature for over 20 years [3]. Communication problem is also considered to be a major factor caused the delay and failure of software projects [4]. Other researchers has identified poor communication as one of the most common problem that hinder the identification and definition of the user's needs [5].

We are currently involved in a research project to develop a communication model between customers and developers in order to reduce the communication gap between them [6]. One of the issues that has to be addressed in developing this model is to find a good technique for measuring the communication gap. A proposed technique for measuring this gap is described in this paper.

This paper is divided into three parts. The second section of the paper describes the problem faced in developing the instrument. In the third section, we describe the method used for developing the instrument, that is Iterative Triangulation method. The validation of the instument is also discussed in this section. The last part is the conclusion.

2 Problem Formulation

Communication between customers and developers can be described in term of communication between two parties as shown in Figure 1.

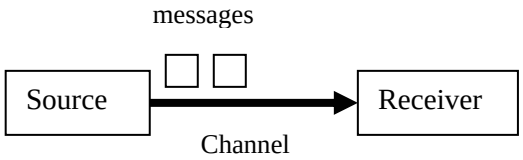

Figure 1: Communication between two parties

This type of communication involves four

components as listed in Table 1.

Table 1: Components and Variables of Communication Involving Two Parties

Component	Variables
Message	Input (user's statements of requirement)
Source and Receiver	Personalities (Customers and Developers)
Channel	Medium
Constraints	Communication skills Procedure

The explanation for each variable is given in Table 2.

Table 2. Explanation of Each Variables

Variables	Descriptions
Input	Data and information needed for developer to develop the system.
Personalities	Characteristic of a person involves in the communication process.
Medium	Medium used to transmit messages between customers and developers
Communciation Skill	Ability and skill to interact with other people..
Procedure	Policy and rules provided by management and organization for particular task that affect the elicitation process.

In order to develop the technique for measuring the communication gap, we need provide answers to two questions:

1. What are the right scale to measure these variables?
2. Based on these scales, can we propose a formula to indicate the level of communication gap between customer and developer and a requirement elicitation process?

3 Problem Solution

The solution to the problem can be found by using a method based on Iterative Triangulation Method [7]. This method employs systematic iteration between literature review, case studies and intution in order to develop a new theory or technique. This method involves four phases as described below.

- Phase 1 - Groundwork: Review literature in order to select cases.
- Phase 2 - Induction: Analyse cases in order to shape conjectures.
- Phase 3 - Iteration: To refine theory
- Phase 4 – Conclude: Evaluate theory and suggest future research direction.

The relationship between these phases is shown in Figure 2.

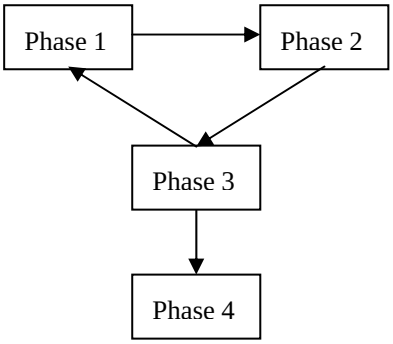

Figure 2: Iterative Triangulation Method

3.1 Selecting Case Study

To identify communication problems, we have used a case study that was conducted earlier. This study involves 9 different software projects. For each project, we manage to interview one member of the developer's team and one or two customers. All of them were involved in the requirements elicitation process.

3.2 Analysis of Case Study

The case study was analyse in order to identify problems related to each variables. All together there are 96 issues that have been raised by customers and about the same number of issues have been raised by developers. Table 3 lists some of the issues given by the customers about developers.

Table 3: Issues given by Customers about Developers

Variable	Issues Raised by Customers
Input	1. Misunderstanding of information required. 2. Information requested is too detail
Communication Skill	1. Developers do not have the ability to plan and to work in groups 2. Developers lack the ability to solve ambigious problems 3. Developers lack the communication skills (verbal) 4. Developer do not have the ability to express ideas by using proper language construct.

Table 3 (continue)

	5. Lack of presentation skill 6. Lack of authority 7. Lack of the ability to write summarized documents 8. Lack of the ability to organize ideas
Personalities	1. Regular changes of staff 2. Lack of cooperation 3. Lack of comittment 4. Lack of tolerancy 5. Emotional 6. Lack of the ability to handle conflicts 7. Lack of work commitment 8. Lack of organization commitment 9. Lack of work knowledge in the domain area 10. Lack of management skill 11. Lack of interpersonal skill 12. Lack of skill for problems understanding and problem solving 13. Lack of ability to make decision
Medium Email Telephone Face-to-face	1. Late responses 2. Misinterpretation 3. Cannot access attachment file 4. Virus 5. Information not consistent 6. No formal information 7. No answer 8. Line busy 9. Unclear pronunciation 10. Informal information 11. Unrecorded information 12. Regular interruption (phone, guest) 13. Information not recorded
Procedures	1. Frequent request of requirement changes 2. Changes of report types 3. Changes of document format 4. Changes of management and political rules 5. Changes of acceptance criteria

Table 4 lists some of the issues given by the developers about customers.

Table 4: Problems given by Developers about Customers

Variables	Issues Raised by Developers
Input	1. Ambiguity and not clear 2. Redundancy of information 3. Regular request for requirements changes 4. Different information by different people 5. Changes of scope
Communication Skill	1. Lack of ability to work in groups 2. Not proactive 3. Lack of communication skills (verbal) 4. Lack of presentation skill 5. Lack of the ability to write documents. 6. Lack of the ability to organize ideas
Personalities	1. Regular change of staff 2. Lack of cooperation 3. Emotional 4. Lack of comittment 5. Lack of the ability to handle conflicts 6. Lack of cooperation 7. Lack of company loyalty 8. Lack of work commitment 9. Lack of organization commitment 10. Lack of work quality 11. Lack of ability 12. Lack of work knowledge 13. Lack of the ability to make decision
Medium Email Telephone Face-to-face	1. Late responses 2. Misinterpretation 3. Cannot access attachment file 4. Virus 5. Information not consistent 6. No formal information 7. No answer 8. Line busy 9. Unclear pronunciation 10. Different people answering the phone 11. Informal information 12. Unrecorded information 13. Interruption (phone, guest) 14. Information not recorded

Table 4(continue)

Meetings	15. Different people attending 16. Not frequent Lack of monitoring and action on decisions made during the meetings.
Procedures	6. Frequent request of requirement changes 7. Changes of report types 8. Changes of document format 9. Changes of management and political rules 10. Changes of acceptance criteria

3.3 Shaping Conjecture

Once we have identified the issues related to each variables, level of gap between customer and developer can be obtained by using an instrument that give the same statements to each one of them. They can then indicate to what extent they agree or disagree to each statement listed in the instrument.

Examples of statements to the customers are:

1. Developer requests adequate amount of information.
2. Information requested by the developer is very clear, adequate and suitable.

Similar statements are reprased for developers as follows:

1. Customer provides adequate amount of information.
2. Information provided by the customer is very clear, adequate and suitable.

If we use a scale of 0 (strongly agree) to 3 (strongly disagree) then we can get the gap for these statements by looking at the answers given by customer and developer. For example, if the answers given by them are 2 and 3 then we can conclude that the gap between them for this question is 5. The calculation of this gap can be shown in Figure 3. If both customer and developer giving 0 as the answer, then there is no gap between them for that particular issue.

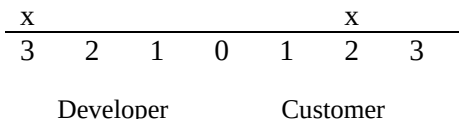

Figure 3: Calculation of the gap

We can now measure the communication gap for each variable by aggregating the gaps for all statements related to that variable. Thus, the gap for each variable can be calculated as follows:

$$\text{Gaps for each variable} = \frac{\Sigma \text{ (gaps for each statement)}}{n * M_j}$$

where n is the number of attributes and M_j is the maximum gap for each statement.

By using the same argument, the total gap between the customer and the developer for a project can thus be calculated as follows:

$$\text{Total Gaps} = \Sigma \frac{\text{(gap for each variable)}}{\text{number of variables}}$$

3.4 Refining the Idea

The purpose of this phase is to refine the idea that has been developed earlier. We realize that giving too many questions to customer and developer will make it very difficult for them to provide the answer. Thus we can improve the idea by limiting the number of issues for each variables.

Analysis of all of issues indicates that these issues can be combined into smaller number of issues. We call these as attributes for the variables. The list of these attributes as shown in Table 5. Since there are 15 attributes, the the number of statements in the instrument can also be reduced to 15.

Table 5: Variable and Attributes of Communication Gaps

Problems	Attributes
Input	1. Measurement (numbers and functional) 2. Characteristic of information 3. Magnitude of changes
Communication Skill	1. Interpersonal 2. Verbal 3. Written
Personalities	1. Domain knowledge 2. Technical knowledge 3. Quality
Medium	1. Information (equivalent and acceptance) 2. Timeliness 3. Duration of Feedback
Procedure	1. Management and Politics 2. Report format 3. Standard

We have to modify how we measure the communication gap for each variable by replacing statements with attributes:

$$\text{Gaps for each variable} = \frac{\Sigma \text{ (gaps for each attribute)}}{n * M_j}$$

where n is the number of attributes and M_j is the maximum gap for each attribute.

3.5 Evaluation

The evaluation process consists of applying this technique to a case study. The selected case study is a project to develop an information system for an Institution of Higher Education.

Based on the interviews conducted with the customer and the developer, we perceived the communication gap between them is high. The situation occurs because the system to be developed involves a lot of input, has to support a lot of functionalities and has to be integrated with other systems that are already available. The developer does not have enough experience in developing this type of system. Based on developer's perception, the customer always requested the changes of requirements and inputs based on their needs and management policy. This has affected the time duration for completing the requirement elicitation phase and has also interrupted the overall developing time for the project. The customer mentioned that the developer does not prepare concise and brief written documentations, which make it difficult for him to understand some of the information provided by the developer.

We also asked the customer and developer to mark their opinion on the given instruments. The values given by the customer and developer is shown in Table 6.

Table 6: Score by Customer and Developer for Project A

Variables	Attributes	Score by Custo-mer	Score by Develo-per
Input	Measurement of Information	2	3
	Features of Information	2	3
	Magnitude of Change	2	3
Communi-cation Skill	Interpersonal	1	1
	Verbal	2	2
	Written	2	2

Table 6 (continue)

Personalities	Domain knowledge	3	1
	Technical knowledge	1	3
	Quality	1	2
Medium	Information	2	2
	Time frame	2	2
	Feedback	2	3
Procedures	Management and Politics	1	1
	Report format	3	3
	Standard	2	3

Based on these values, the gap for each variable is calculated and the values are shown in Table 7.

Table 7: Gaps for Project

Variables	Gaps	Level
Input	0.83	High
Communication Skills	0.55	Medium
Personalities	0.61	Medium
Medium	0.72	High
Procedures	0.72	High

By using the fomula given earlier, the communication gap for this particular project can be calculated as

$$\text{Communication Gaps} = (0.83 + 0.55 + 0.61 + 0.72 + 0.72)/5 = 0.69$$

which is high. This result shows that the calculated value is similar to the perceived value that was obtained earlier.

4 Conclusions

This paper discuss a technique for measuring communication gap between customer and developer during requirements elicitation process. By having this technique, the communication gap between customer and developer can be measured regularly throughout the project, for example every month. If there is any significant gap between them, the project manager can take neccessary action to remedy the situation, for example, to replace the member of the development team or to request a new person to represent the customer. By taking action at the early stages, the porject manager can ensure that the software requirement produced during the requirement elicitation process will reflect the requirement needed by the customer. Since software requirement document is always taken as the basis for software development,

having a valid software requirement document is very important in order to ensure that the software development process can be carried out successfully.

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