Requirement Elicitation Process in Software Engineering

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Abstract—Software Engineering emphasis on all features of software production that is discipline, method and concept. This paper discuss the needs and process of requirement elicitation in Software Engineering. First of all we will discuss literature review. Next, we will design an architecture in which first discuss needs elicitation, then process elicitation will be defined. Needs elicitation will be known through situational characteristics and sources of information. Elicitation techniques are used for finding information, these information will be tested through data validation and data verification. At the end, an early item in the process of software development will be generated named as User Requirement Document. And finally, in the next phase, we will give the detailed result of our survey that we will conduct on choosing the best requirement elicitation technique. And also we will discuss the best technique according to the survey result.

Index Terms—Elicitation Techniques, Requirement Elicitation, Survey, User Requirement Document, Validation & Verification

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1 INTRODUCTION

In requirement elicitation process requirements are collected for a software from customers, users and stakeholders. In this process some important questions is mandatory to be answered-[1][2]

- Functional and non-functional requirements of the system?
- Characteristics of the system?
- Type of stakeholders that are involved in the system?
- Explain expected outcomes from elicitation process?

Analysis of the needs is the first phase in software designing for software design[3]. The purpose of this phase is to analyze the current conditions and to know the needs of user and organization. Some unexpected problems will be occur if needs analysis result is incomplete, namely: system making time is longer and all the user's needs cannot meet.

We will discuss the software engineering needs elicitation concept and process elicitation. In process of needs elicitation the information search from all stakeholders is extreme and complete related to software [4]. Firstly, we will discuss literature review. Next we will be design an architecture in which first discussed needs elicitation then process elicitation will be defined. The domain and background information are needs elicitation that must be known for a service provider to start an elicitation process. Needs elicitation will be know through

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situational characteristics and sources of information. In situational characteristics a service provider must to be know the types of stakeholders (domain expert, not domain expert, homogeneous, heterogeneous), domain of the system being developed (existing system or new system), scope of the system, know the environment, followed approach, know the problem etc. In sources of information a service provider has knowledge about competitors, technical literature, expert advice, surveys etc. All this prepares you for the elicitation process.

Now process will be start. Data collection will be the first phase of elicitation process. Through requirement elicitation techniques information finding can be completed. After this, data analysis will be done. Data analysis mainly an effective test used for the obtained data. The validity of data can be check through credibility, transferability, dependability, confirmability. Finally, an early item in the process of software development will be generated named as User Requirement Document (URD). And finally, in the next phase, we will give the detailed result of our survey that we will conduct on choosing the best requirement elicitation technique. And also will be discussed the best technique according to survey result.

2 LITERATURE REVIEW

2.1 Situational Characteristics

Mohd. Mahrin, Suriayati C. & Huma Khan [5] introduce situational characteristics list in the process of Requirement Engineering (RE) through Global Software Development (GSD). For identification of situational aspects a methodical literature review is accomplished. Systematic Literature Review (SLR) is accomplished for situational aspects identification and acknowledged 37 situational features.

M. Tariq, Saima Farhan, H. Tauseef, M. Abuzar Fahiem [6] elaborate contrast of elicitation approaches with its characteristics in addition to situational characteristics. On the basis of altered situational characteristics this comparative analysis can facilitate analyst within the choice of accurate RE approach. They presented a model useful in mechanizing the procedure of RE strategy determination.

Paul Clarke [7] presents a thorough reference system of situational features influencing the process of software development. This structure can be utilized to build up a profile of the situational features of a software development setting. This structure delivers a sound basis for the process of software development definition and enhancement.

2.2 Sources of Knowledge

C. Burnay [3] offers a way of obtaining information through an instrument and describes other sources of information instead of the stakeholders. He recommends TELIS-(A Taxonomy of Elicitation Sources) used to review sources of information about the future of a system. Eventually, the consequence of this taxonomy helps to increase the success chances in the plan of information systems and better manage the challenges of traditional elicitation.

A knowledge audit model is suggested to advance the RE process through recognizing components of knowledge and knowledge sources which exist also their relationships in the process of Requirement Elicitaion. To verify the rationality of the model review is directed. Findings of the suggested model enhance the performance of RE. L. Taheri, Abdullah R., Abdullah S., Y. Shafazand [8].

2.3 Techniques for requirement elicitation

The requirement elicitation process involves the establishment of the overall organizational objectives, gathering and understanding of the background information of the system, knowledge organization and collection of requirement. Requirement elicitation techniques are divided into four categories [9][10][11].

2.3.1 Traditional Techniques:

This technique refers to the verbal communication between stakeholder and the experts. **Questionnaire** is a technique to obtain the requirements of a large number of people at lower costs and times. A well-designed questionnaire can be useful for achieving unambiguous and consistent stakeholder requirements. **Interview** is a method to identify facts and opinions from users and other interested parties of the development system through personal interview. There are two types of interviews closed and open interviews.

2.3.2 Collaborative Techniques:

This technique provides a different way to communicate between stakeholder with analysts to require the accuracy requirements. **Brainstorming** offers an open discussion environment, where users are free to meet their needs and expectations of the system. **Focus group** is a technique involving a group of four to nine people from different background users with different skills, discussing freely and worrying about the characteristics of a system that will be made. **JAD (Joint Application Development)** is a methodology for requirements engineering in which stakeholders, subject matter experts (SMEs), end users, architects and software developers take part in intense

- Requirements for priority prioritization are prioritized on the basis of criticality and very complex and critical activities are identified for the risk graph and low-level activities are considered for easy implementation.

external meetings to work on the details of a system. JAD concentrates on the business problem rather than on technical details. **Prototyping** of a system is an initial accumulation of the system, which is often used to validate system requirements. There are two different types of prototypes: disposable prototypes help you understand difficult requirements. Evolutionary prototypes offer a valid system for the customer and often become part of the final system. **Work shop** is a collection of different types of meetings carried out by the interested parties to meet the requirements of the project under development.

2.3.3 Cognitive Techniques:

The cognitive technique deal with the documents of extraction of knowledge. **Document analysis** is the process of analyzing documents about the domain of the problem to collect the information, which it is the flow with the organization. **Card sorting** method is used to generate information regarding the association and grouping of a collection of data elements. Participants in a classification of cards are invited to organize individual items without classifying them in groups. **Laddering** is a form of structure, dialogue in which a limited number of standard questions are addressed to interested parties. The question series is organized in hierarchical order, the success of this technique depends on the knowledge of the domain interested parties.

2.3.4 Observational Techniques:

It gives a strong understanding of the main problem through observes the human activity. **Observation** techniques include a survey the work of the user and write down the activities that are being carried out. The observation can be direct or indirect note shows the viewer what users actually do in context, overcome problems with interest groups, idealized or describes work processes that are simplified. **Social analysis** is the process of interaction discover with interested parties and users from different backgrounds political environment within the organization.

2.4 Requirement/Data Analysis:

The analysis of the requirements is mandatory to verify why the product is necessary. Requirement analysis includes:

- Requirements to verify needs that do not contribute to the business goals of the organization or to the specific problem the system faces must be verified to determine the need for system development.
- Check consistency and completeness without inconsistencies and feasibility checks in terms of budget and program.
- The discussion of the requirements emphasizes the requirements and the discussion of the problematic elements through introspection and interviews.

- Conformity requirements have jeopardized the set of requirements on the basis of the feasibility check.

2.5 User Requirement Document (URD)

Requirements gather from customers in natural language. S. Vemari [12] classifies actors and use cases from the

textual format of the requirement using a probabilistic grouping model. Result of this research exhibits that more progress to this method can entirely automate the analysis-phase.

3 Requirement Elicitation Process

Software engineering is a step by step procedure and method that focusses on all aspects related to software development. Service provider is a person that collect requirements for the development of a software according to user's need. Service provider must follow step by step process to collect the required requirements. Following is an architecture that can be followed to collect the requirements in Figure 1.
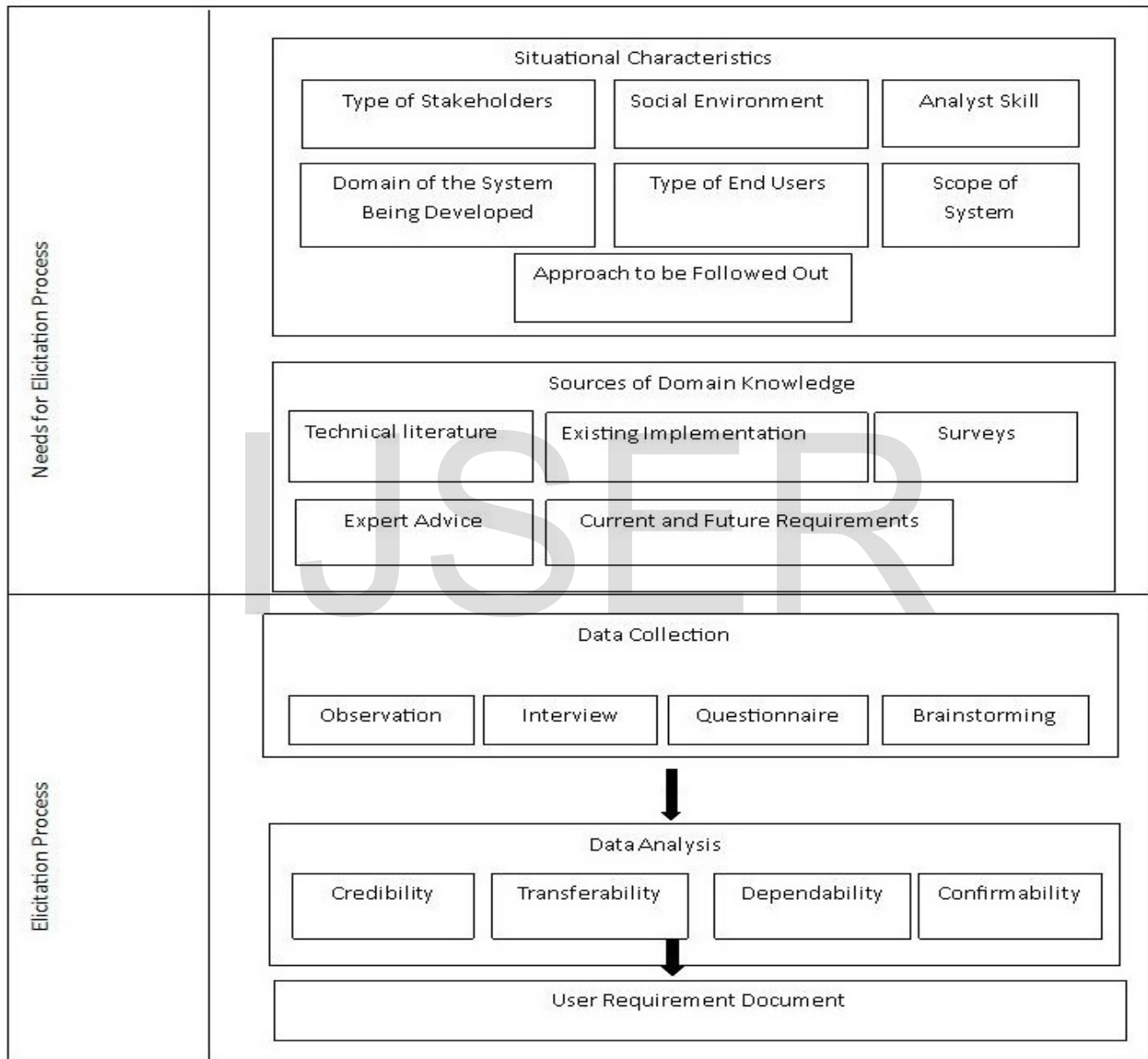

Fig 1. Proposed Requirement Elicitation Process

3.1 Needs for Elicitation Process
3.1.1 Situational characteristics

Software project's situational characteristics might be relevant to the entire offered domain. We identified seven situational characteristics and list down.

1) **Stakeholder's type:** Stakeholders distribute into four groups. Homogeneous (consistent), heterogeneous (diverse), expert in the domain, not expert in the domain, but makes decisions.

2) **Societal Surroundings:** This feature is divided into three classes: low, medium, high, depending on the

influence of the community atmosphere on the process of RE.

3) **Area of the system being developed:** The project area(domain) means project built for a new system or an existing system. There are two natures: new area (domain) of the system, area (domain) of the existing system.

4) **End-user:** Three kinds of user types: new user, related area knowledge, domain expert.

5) **System scope:** The system being developed consists of two kinds: to adapt the use of the system within an organization, the general use of the product in public.

6) **Analyst's skill:** The ability of the analyst to obtain the requirement through the use of a particular method is a major feature for choosing the RE process. There are four categories: new, less-skilled, skilled, specialists.

7) **Followed approach:** Several organize the use of a specific RE methodology, which leads to select the RE technique. Agile, IBIS, FODA etc.

3.1.2 Sources of knowledge

In requirement engineering process sources of attaining the domain knowledge can be technical surveys, existing systems, we classify the software in diverse domains (areas), these domains (fields) are Educational software, Medical software, web-based software, utility software, Business software and various other based on the domain knowledge.

- Technical works (Literature)
- Existing systems implementation
- Surveys to get knowledge
- Advice of the Expert
- Current Requirements and Future Requirements

3.2 Elicitation Process
3.2.1 Data Collection Techniques

The process for obtaining the requirements includes defining the general objectives of the organization, collecting and understanding the basic information of the system, organizing the knowledge and drafting the requirements.

- **Questionnaire:**

It is a technique of eliciting requirement for a large number of people in lesser cost and time. A good questionnaire can be useful to elicit the actual requirements from the stakeholders.

- **Interview:**

It can give deeper understanding of views in interviews. It takes more time and few people are involved.

- **Brainstorming:**

This is a simple technique and easy to understand, and it can generate new ideas and answer many questions. The data collected after this process is then discussed and analyzed.

- **Observation:**

Observation enables the viewer to see what users actually do with context, overcome problems with stakeholders and describe the idealized. The observation can be direct or indirect.

3.2.2 Requirement/Data Analysis

The mechanism of data analysis needs when designing software is in fact a valid test for the information obtained[13].

- **Credibility:**

Some activities have been undertaken to increase the level of trust, that is to say extend the analysis time of data. Make continuous observation of the details; triangulating or verifying data with different sources, such as data comparison to reveal the obtained interim or final results in an analytical discussion with colleagues; Conduct negative case studies by collecting items that do not match the existing scheme as a comparison; compare with comparable analysis results in other organization and Data verification, interpretation and conclusion with other members of software designers.

- **Transferability:**

Transferability means that the result of data acquisition can be applied to other situations, so that the software can be adapted and developed if necessary.

- **Dependability:**

Reliability means that if the result of data acquisition refers to the coherence of the system of the designer to collect data, establish concepts and use them when making an interpretation to draw conclusions.

- **Confirmability:**

Confirmability means that the result of the collection of data can be justified when the URD project agrees with the collected data. This is done by discussing the URD project with software engineering experts who do not participate and are not interested in software design, and the result of the analysis of data and information must be more objective.

3.2.3 User Requirement Document

User Requirements Document (URD) is complete data gained from everyone who is interested in normal language. The URD can be result of discussions that arise from communicating with stakeholders about the existing software needs that needs might be constructed. URD can also be used as a reference for the contractual pact among the developer and the stakeholder.[4]

4 A Survey for Best Requirement Elicitation Technique

We have seen that different techniques can be used for the collection of required requirements for the development of a software. There are different questions that need to be consider before the collection of data.

Which technique is best for requirement collection?

How much effort will be required for gathering the requirements?

How much time will be spent for gathering the requirement?

How much level of difficulty will be faced for gathering the requirements?

How many concepts will be cleared through requirements?

How many requirements will be gathered completely?

A service provider should consider the answers of above questions for successful requirement collection. For this purpose service provider selects a data collection technique to collect the requirements. We conduct a survey for the selection of best requirement collection technique. The main objective of this survey is to find best requirement elicitation technique for data/requirement collection of any software system. We conduct this survey from different domain of people like: programmers, IT specialist, project managers, RE specialists and software engineering students. The results are shown in table 1.

	Interviews	Observations	Focus Group	Prototyping	Survey
Effort Required	High	High	Low	High	High
Time Required	High	High	Medium	High	High
Level of Difficulty	High	High	Low	High	Low
Clear the Concepts	Medium	Medium	Medium	Low	Low
Requirement Completion	Medium	Low	Medium	Medium	Medium

Table 1. Survey result

5 Best Technique

According to the survey result we can see **"Focus Group"** is a best technique to collect the requirements for software development. Service provider choose a set of people that represented a group related to the field in which software is developed. With less effort and minimum difficulties service provider can collects all requirements according to the user needs and expectations.

6 Conclusion

Software engineering is a step by step procedure to make a software. In requirement elicitation process requirements are collected for a software from customers, users and stakeholders. In this paper we discussed the concept of needs elicitation and process elicitation in software engineering. For this purpose we designed an architecture in which first discussed needs elicitation then process elicitation. Needs elicitation are known through situational characteristics and sources of information. In situational characteristics a service provider must to be know the types of stakeholders (domain expert, not domain expert, homogeneous, heterogeneous), domain of the system being

developed (existing system or new system), scope of the system, know the environment, followed approach, know the problem etc. In sources of information a service provider has knowledge about competitors, technical literature, expert advice, surveys etc. All this must prepares you for the elicitation process. Now start the process. Data collection is the first phase of elicitation process. After this, data analysis is done. Lastly, an early item in the process of software development will be generated named as User Requirement Document (URD). And finally, in the next phase, we give the detailed result of our survey that we conduct on choosing the best requirement elicitation technique. We also mentioned which is the best technique according to the survey result.

7 Future Work

In future, requirement elicitation process can be manage in a better way or choose necessary steps that are more relevant to elicitation process with the participation of RE specialists.

References

[1]   S. Tiwari, S. S. Rathore, and A. Gupta, "Selecting Requirement

Elicitation Techniques for Software Projects," no. September, 2012.

[2]   A. M. Hickey and A. M. Davis, "Requirements Elicitation and Elicitation Technique Selection : A Model for Two Knowledge-Intensive Software Development Processes Unsolved Problem Software Development S o f t w a r e S o l u t I o n s," 2002.

[3]   C. Burnay, "Are Stakeholders the Only Source of Information for Requirements Engineers ? Toward a Taxonomy of Elicitation Information Sources r r r," vol. 7, no. 3, 2016.

[4]   M. A. Ramdhani, D. Sa, A. S. Amin, and H. Aulawi, "Requirements Elicitation in Software Engineering," vol. 7, pp. 772–775, 2018.

[5]   H. H. Khan, M. Naz, and S. Chuprat, "Situational Factors Affecting Requirement Engineering Process in Global Software Development," pp. 118–122, 2013.

[6]   M. Tariq, S. Farhan, H. Tauseef, and M. A. Fahiem, "A Comparative Analysis of Elicitation Techniques for Design of Smart Requirements using Situational Characteristics," 2015.

[7]   P. Clarke and R. V. O. Connor, "The situational factors that affect the software development process : Towards a comprehensive reference framework," *Inf. Softw. Technol.*, vol. 54, no. 5, pp. 433–447, 2012.

[8]   L. Taheri, N. C. Pa, R. Abdullah, and S. Abdullah, "Identifying Knowledge Components in Software Requirement Elicitation," pp. 286–291, 2014.

[9]   S. Tiwari, "A Methodology for the Selection of Requirement Elicitation Techniques."

[10] C. Pacheco and M. Reyes, "Requirements elicitation techniques : a systematic literature review based on the maturity of the techniques," no. iii, 2018.

[11] G. Sindre and A. L. Opdahl, "Eliciting security requirements with misuse cases," *Requir. Eng.*, vol. 10, no. 1, pp. 34–44, 2005.

[12] S. Vemuri, "Automated Use Case Diagram Generation from Textual User Requirement Documents," 2017.

[13] T. ur Rehman, M. N. A. Khan, and N. Riaz, "Analysis of Requirement Engineering Processes, Tools/Techniques and Methodologies," *Int. J. Inf. Technol. Comput. Sci.*, vol. 5, no. 3, pp. 40–48, 2013.

ANNEXURE-I

We are students of MS Software Engineering (1st semester). We conduct a survey for the selection of best requirement collection technique. We conduct this survey from different domain of people like: programmers, IT specialist, project managers, RE specialists and software engineering students.

A survey for choosing best elicitation technique

Objective: The main objective of this survey is to find best requirement elicitation technique for data/requirement collection of any software system.

Please complete the following information about yourself

Name: ---

Position: -------------------------------------

Department: ---------------------------------

Requirement Elicitation Technique: Interviews

1. How much effort will be required for gathering the requirement of a software system through interviews?
   o Low
   o High
   o Medium
2. How much time will be spent in gathering the requirements for a software system through interviews?
   o Low
   o High
   o Medium
3. How much level of difficulty will be faced gathering the requirements of a system software through interviews?
   o Low
   o High
   o Medium
4. Are you sure concepts are clear through interviews?
   o Low
   o High
   o Medium
5. Are you sure all requirements will be gathered through interviews?
   o Low
   o High
   o Medium

Requirement Elicitation Technique: Observation

6. How much effort will be required for gathering the requirement of a software system through interviews?
   o Low
   o High
   o Medium
7. How much time will be spent in gathering the requirements for a software system through interviews?
   o Low
   o High
   o Medium
8. How much level of difficulty will be faced gathering the requirements of a system software through interviews?
   o Low
   o High
   o Medium
9. Are you sure concepts are clear through interviews?
   o Low
   o High
   o Medium
10. Are you sure all requirements will be gathered through interviews?
    o Low
    o High
    o Medium

Requirement Elicitation Technique: Focus group

11. How much effort will be required for gathering the requirement of a software system through interviews?
    o Low
    o High
    o Medium
12. How much time will be spent in gathering the requirements for a software system through interviews?
    o Low
    o High
    o Medium
13. How much level of difficulty will be faced gathering the requirements of a system software through interviews?
    o Low
    o High
    o Medium
14. Are you sure concepts are clear through interviews?
    o Low
    o High
    o Medium
15. Are you sure all requirements will be gathered through interviews?
    o Low
    o High
    o Medium

Requirement Elicitation Technique: Prototyping

16. How much effort will be required for gathering the requirement of a software system through interviews?
    o Low
    o High
    o Medium
17. How much time will be spent in gathering the requirements for a software system through interviews?
    o Low
    o High
    o Medium
18. How much level of difficulty will be faced gathering the requirements of a system software through interviews?
    o Low
    o High
    o Medium
19. Are you sure concepts are clear through interviews?
    o Low
    o High
    o Medium
20. Are you sure all requirements will be gathered through interviews?

- o Low
- o High
- o Medium

Requirement Elicitation Technique: Survey

21. How much effort will be required for gathering the requirement of a software system through interviews?
    - o Low
    - o High
    - o Medium
22. How much time will be spent in gathering the requirements for a software system through interviews?
    - o Low
    - o High
    - o Medium
23. How much level of difficulty will be faced gathering the requirements of a system software through interviews?
    - o Low
    - o High
    - o Medium
24. Are you sure concepts are clear through interviews?
    - o Low
    - o High
    - o Medium
25. Are you sure all requirements will be gathered through interviews?
    - o Low
    - o High
    - o Medium