EFFECTIVENESS OF REQUIREMENTS ELICITATION TECHNIQUES IN SOFTWARE ENGINEERING PROCESS: A COMPARATIVE STUDY BASED ON TIME, COST, PERFORMANCE, USABILITY AND SCALABILITY OF VARIOUS TECHNIQUES

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ABSTRACT

Requirement gathering is the first step in Software development life cycle but plays a vital role in the success of a software. There are many techniques to gather requirements from customer but it's hard to choose one to get the maximum benefit. This paper fills the gap by presenting an empirical research to find the most preferred technique to be used in different phases of requirement gathering process. The research also evaluated 11 RGTs against time, cost and quality constrains to help the practitioners pick the right technique in a given scenario.

KEYWORDS: Requirement Gathering Techniques, RGTs, Constraints, Time, Cost, Quality

INTRODUCTION

Requirement collection is the first step towards software development. A major portion of how the end product will look like depends on requirement gathering process. Requirement engineering has evolved in the last few years. There are many tools and techniques available to gather requirements from customers. Each technique has some advantages and limitations but if choose wisely can improve quality of requirements. Since requirement gathering is the first phase of software development, it should be performed using the right tools to ensure the success of the project. Quality of the products is evaluated by the customer, so it's very important to understand customer perception of the product. Customer does not always possess technical knowledge. It is the responsibility of requirement analyst to extract information from the customer. There are many techniques available for requirement gathering but to choose the right technique in the right situation is tricky. This research is intended to find the right Requirement Gathering Technique (RGT) in different phases of requirement engineering. Also the research aims to evaluate eleven commonly used RGTs against five constraints (Time, Cost effectives, Performance, Scalability and Usability) to find the best technique to be used under different circumstances. List of RGTs used in the research is given below:

- Requirements reuse.
- Interviews.

- Brainstorming.

- Role Playing.

- Requirement Workshop.

- Story Boarding.

- Prototyping.

- Social Analysis.

- Introspection.

- Background Reading.

- Questionnaires.

The next section will highlight related work from other researchers in the field of requirement engineering.

LITERATURE REVIEW

W. Lloyd et al (Lloyd et al. 2002)conducted a research to find the effective requirement gathering techniques for projects with distributed development team. Since the development team and customers are geographically apart, it is not possible to conduct meeting for requirement gathering phase. Authors evaluated 8 techniques for this purpose. A survey was conducted in a controlled simulated environment to test the effectiveness of selected techniques. Collaborative tools also called groupware tools were used to by the teams for communication. Results showed that Question and Answer method, Use case, Brainstorming and requirement management showed better performance in gathering requirements, however asynchronous techniques reduces the quality of SRS documents hence are not recommended for this purpose. The survey should be conducted with real life projects to better get the insight of problems faced by distributed teams.

R. Young (Young 2002) in this research has summarized 10 recommended requirement gathering practices through extensive literature review and practical experience. These practices cover the steps that should be performed during requirement engineering phase. Author (Young 2002) has also discussed some preferred requirement gathering techniques like interviews, Requirement workshop, brainstorming, story board etc that have been proved to be effective in requirement gathering and explain the use of these techniques in different scenarios. Research suggests that customer should be involved with the development team throughout the development phase of project to better understand the real needs of customers.

J. M. Moore and F. M.. I. Shipman (Moore & Shipman 2000)in their research has designed a new requirement gathering techniques called Graphical Requirement Collector (GRC). The suggested tool allows user to make interfaces for their projects and add description about the process of the system. This allows development team to better understand needs of the customer. In contrary to questionnaire where user has less freedom to express himself, GRC provides user with greater flexibility and sense of ownership. The new technique is than compared with questionnaire using a real life project example. A set of 11 users were selected to give their requirements about a project. 6 users used GRC while 4 users filled questionnaire. Results showed that GRC provides better understanding of requirements than questionnaire.

T. U. Rehman et al (Rehman et al. 2013) conducted a literature survey to review the tools and techniques available for requirement engineering. The research broadly studied the tools and techniques from four main categories of requirement engineering i-e classic/traditional techniques, cognitive techniques, modern and group elicitation techniques and contextual techniques. A critical review was done on the available techniques and the pros and cons of each technique were discussed. The research showed that each technique has pros and cons and no single technique can be used for all kind of projects or for all the phases of requirement engineering. Different techniques should be combined and used for better extraction of requirements. However group workshops, interviews, observation and scenarios techniques are most commonly used techniques for requirement gathering according to the literature.

H. Saiedian and R. Dale(Saiedian & Dale 2000) claimed that no matter what requirement elicitation technique is used, the involvement of customer from the beginning till the end ensures the success of the project.

Problem Statement

The research is intended to answer the following research questions:

- Which RGTs should be used in different phases of requirement gathering process.

- Which RGT works best for time, cost and quality constraints.

RESEARCH METHODOLOGY

Two different surveys were conducted to address the two research questions. Questionnaire was designed with the following information:

The first section consisted of general information such as name, organization, gender, professional experience, designation, level of experience and organization. The second section of the questionnaire focuses on respondent's opinions about various RGTs there is also a brief description about RGTs for the respondent's reference also there is a scale (1-9, with 1 being lowest possibility to be used and 9 the highest) on which respondent may evaluate any RGT. However a respondent may evaluate any of the RGTs as N/A (not applicable) or Unknown if it does not satisfy organizational needs or if the respondent fails to answer in the light of his knowledge skills and experience. In the final section of questionnaire, the respondents will select their most preferred RGTs in light of their knowledge and field of work.

Also to mention that all sensitive information of participants will be kept confidential. The results will only be used to deduce a trend for RGTs in software market and to assess the level at which companies focus and use RGTs in their work.

RESULTS AND ANALYSIS

As mentioned above, two surveys were conducted to answer both the research questions.

- **Requirement Elicitation Phases Vs. Rgts**

The first survey finds out the best technique used by the professionals during different phases of requirement elicitation process. Response from the first survey shows the following results.

- 89% of the participants use Story board for understanding the application.

- 66.7% of participants use Requirement Workshops for identifying sources of eliciting requirements

- 94% participants choose Social analysis for analyzing Stakeholders' interests.

- 93.7% participants voted for Brainstorming for choosing the tools and techniques for development.

- 95% participants selected Questionnaires for gathering requirements from stakeholders and other sources.

- **Requirement Elicitation Phases Vs. Rgts**

The second part of research evaluates the selected RGTs against five constraints to find the most favorable techniques under different circumstances. Survey designed to achieve this purpose revealed the following results:

- **RGTs for Limited Time constraint**

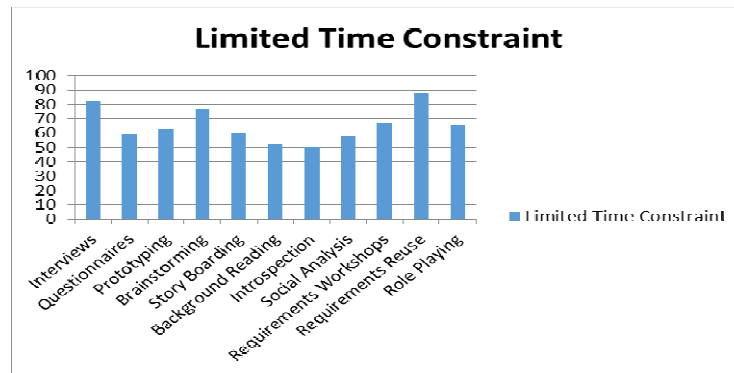The following graph shows the results for RGTs to be used under limited time constraint.

Figure 1: Different RGTs vs. Time Constraint

Graph shows that requirement reuse, interviews and brainstorming performs well if the time is limited. However Background reading and introspection should not be used if the time for requirement gathering is limited.

- **RGTS for Cost Effectiveness**

The following graph shows the results for RGTs to be used if the organization has limited budget.
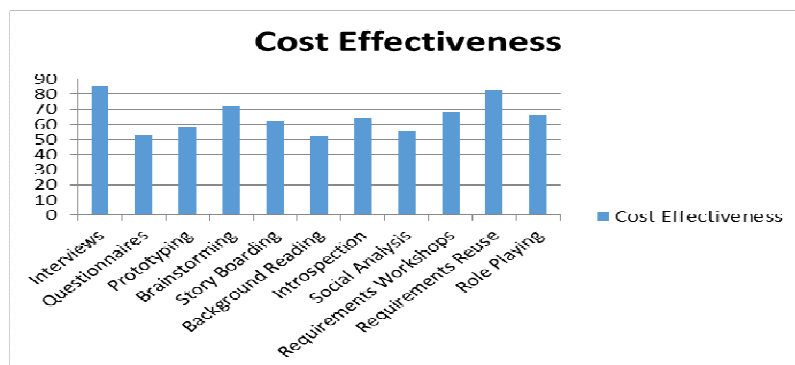

Figure 2: Different RGTs vs. Cost Constraint

Results show that interviews, requirement reuse and brainstorming are cost effective techniques for requirement gathering. However, Background reading, questionnaires and social analysis are costly methods in terms of money.

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- **RGTS for Performance:**

Following graph represents results for RGTs for performance constraint.

Figure 3: Different RGTs vs. Performance Constraint

According to the graph, Interviews and Requirement Reuse are the best techniques in terms of performance. Role playing and Brainstorming are also shows good results for performance constraint. However, organizations does not use Background reading and Questionnaires if they want to achieve high performance.

- **RGTs for Usability (User Friendliness)**

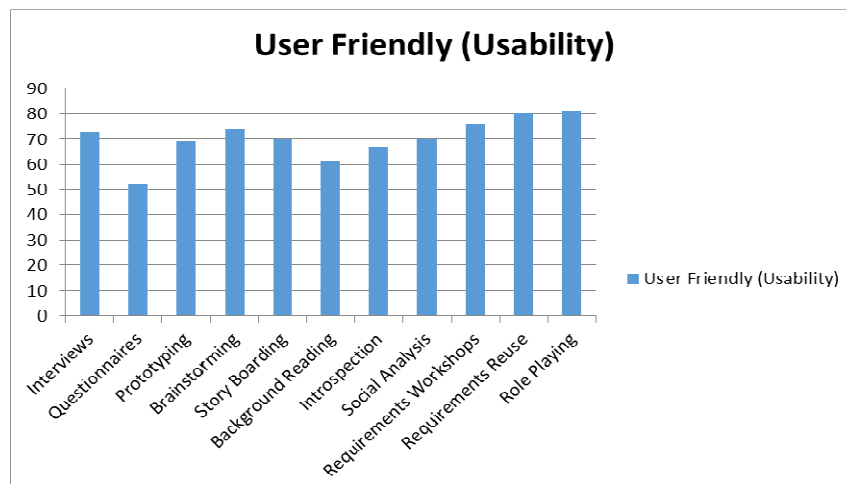The graph below shows the results for RGTs against Usability constraint.

Figure 4: Different RGTs vs. Usability Constraint

Role Playing and Requirement reuse proved to be the most user friendly techniques for requirement gathering. Role playing is a very interactive exercise and ensure excessive communication with customers. However Questionnaires is the least user friendly among the other techniques because it does not allow real time user interaction and user has to make their own assumptions to answer the questions.

- **RGTs for Scalability**

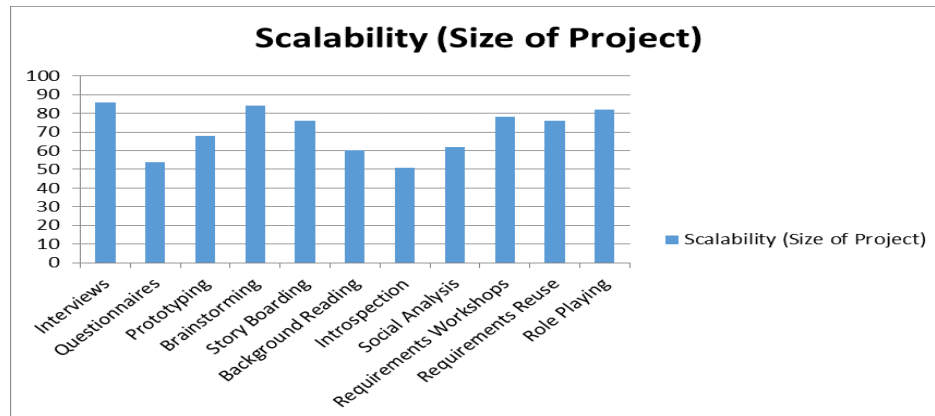The following graph shows the results for RGTs against the scalability constraint.

Figure 5: Different RGTs vs. Scalability Constraint

Interviews, Brainstorming and Role playing should be used for requirement gathering if the project is large and complex. However Introspection is least favored for these kinds of projects.

CONCLUSIONS

There are many RGTs available to collect requirements from customer but to choose the right one in any given situation is tricky. This research evaluated 11 RGTs against time, cost and quality constraints. Results showed that most commonly used techniques by the professionals are Interviews, Requirement reuse and Brainstorming however Questionnaire is the least preferred one because it doesn't allow real time interaction with the customer. The research also guides the practitioners in adopting the right technique under different situations to improve software development process and customer satisfaction. Results from the research also reveal the right technique that should be used in different phases of requirement gathering process. This research will save the practitioners a lot of effort and time in selecting the right RGT in different circumstances.

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