A Novel Framework for Selecting Elicitation Technique based on Attribute Mapping

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Abstract—**The software development process is completely based on the requirements of stakeholders. If the requirements of stakeholders are being integrated into the proposed system, then it can be assumed that the end product is going to be optimal and successful. To achieve a successful product, different Requirement Elicitation Techniques (RET) are being practiced. The selection of a suitable RET is based on the nature of the product being developed. So, a single RET doesn't fit all products. In this paper, we differentiate all RETs from each other which makes it easier for an analyst to choose suitable RET from the available ones. We further designed a novel mapping framework that extracts the best suited RET to any software based on its attributes. We have further implemented the proposed framework by using an online vehicle booking system as a running example.**

Keywords- Requirement Elicitation Techniques (RETs), Requirement Gathering, RETs in Software Development, Mapping of characteristics.

I. INTRODUCTION

In the software development process, the number of Requirement elicitation techniques is being incremented over time because every developer thinks of having the best technique to overcome the hurdles both in development as well as in the end product when the user uses the product. On the other hand, this idea has created a big problem for the industry which technique is the best among all? [1] And can be implemented to get a reliable and user-acceptable product [1].

By going through the literature, it can easily be judged that above 50% of the software projects get failed and the end users/stack holders don't accept the product [14]. The reason for failure can be due to one of the following aspects [2].

i. *Requirements Elicitation.*
ii. *Requirements Analysis.*
iii. *Requirements Implementation.*
iv. *Requirements Documentation.*
v. *Requirements Validation.*

Among all the above-mentioned phases of Requirement engineering, the most crucial and challenging phase is Requirement elicitation. This is the only stage through which the data and all other aspects of the product to be made can be extracted from stakeholders. So, if this phase goes wrong or is ambiguous, this will surely result in rejected end product [19].

In this paper comparison of almost all the RE techniques concerning different scenarios is being discussed which will surely be helpful for developers to choose the best technique and to gather maximum input from the stakeholders. The comparison comprises three phases. In the first phase, the pros and cons of all the RE techniques are discussed to have a birds-eye view of the techniques being implemented. The second phase is related to the characteristics of all techniques through which developers can decide to go or not to go with any specific technique. In the third and the last phase, a requirement elicitation framework is provided through which a developer can easily find out the best RE technique among the cluster. An example is also provided in which a suitable requirement elicitation technique is selected according to the proposed framework.

II. ADVANTAGES AND DISADVANTAGES OF DIFFERENT REQUIREMENT ELICITATION TECHNIQUES

Firstly, all the advantages and limitations of every single RE technique are discussed in Table I below to get a basic idea that what are the key strengths and limitations present in every RE technique [3][14].

The benefits of all techniques are mentioned in Table I to sort out the basic utilities and positive aspects present in them [13]. All the techniques are divided into four main categories namely Traditional, Cognitive, Collaborative, and Observational requirement elicitation techniques [1, 2] [13, 17]. The first group of techniques are very basic and are being used since the emergence of the said field. The reliability of these techniques is also very good and the techniques are well-reputed as well. But with time there emerged the need for some other techniques because the existing techniques were leaving some vacant spaces which directly challenge the success of the end product.

The Cognitive Techniques are also very reliable and are used mostly in gathering information regarding system development. The Collaborative and Observational techniques are also well in the industry and are being implemented by analysts and developers to develop the demanded and reliable end product. The benefits and limitations of every requirement elicitation technique are discussed below which enroots towards characteristics analysis and finally, the optimized techniques are sorted out to provide feasibility to the developer and stakeholders as well [1-3].

TABLE I.   COMPARISON OF REQUIREMENT ELICITATION TECHNIQUES

Category	Elicitation Techniques	Merits	Demerits
Traditional R.E. Techniques	Interviews	The proposed system is discussed in detail. Data is informative and useful.	The amount of data is very large and hard to summarize.
	Surveys	Many users can be involved by using this very cheap method to get large information.	A system as a whole can't be analyzed, which is the actual demand of elicitation.
	Questionnaire	A basic approach in which every aspect is asked remotely from stakeholders.	Only for basic and quick knowledge. Further ideas can't be generated.
	Task Analysis	It directs the user to the system interface.	Time-consuming because details are needed for a small product.
	Domain Analysis	It derives its strength from existing system documentation and manuals.	It becomes more than a task, converted to a case study.
	Introspection	The smart and useful technique has almost no cost.	Comprehensive knowledge of business areas is demanded.
Cognitive R.E. Techniques	Card Sorting	Differentiation between different requirements. Customer knowledge is analyzed.	Work in collaboration is more realistic and useful compared to this technique.
	Class Responsibility Collaboration (CRC)	Provides fundamentals to make UML diagrams.	It suits only the designer, not the software engineer
	Laddering	Hierarchy-based requirements arrangements.	Not suitable for large projects because addition and deletion are difficult.
	Repertory Grid	Identification of characteristics is easy.	Identification becomes hard in complex systems.
Collaborative R.E. Techniques	Focus Group	Every condition defined by stakeholders can be evaluated and useful data can be collected from them.	In the case of multiple stakeholders, it results in a conflict.
	Brainstorming	New ideas are generated by this technique. Decision-making is easy.	Does not suit to Busy and Crowded environment
	Joint Application Development (JAD)	Customer-Developer collaboration is easy to create, change or delete any aspect of the system.	Expert Knowledge at both ends lacks.
	Requirement Workshop	Large and complex data can be extracted by the detailed workshop.	It has a huge cost and does not align with small tasks.
	Protocol Analysis	All the stakeholders and users are required to participate to get a suitable system.	Deadlock can occur due to multiple thoughts.
	Prototyping	Developing a new system becomes easy due to the involvement of stakeholders, especially in making GUI.	Time and cost both are utilized at a high rate.
Observational R.E. Techniques	Ethnography	Social behaviors are brought into context to get quality attributes.	Multiple Communities can create a hurdle in using this technique.
	Observation	This technique is helpful in requirement analysis and validation phases for analysts.	Observation can be partial or leftover due to travel expenses.
	Apprenticing	Facilitates both analyst and stakeholder to work in cooperation.	The willingness of stakeholders is optional.

III. CHARACTERISTICS BASED ANALYSIS OF DIFFERENT REQUIREMENT ELICITATION TECHNIQUES

The characteristics of every elicitation technique are different from each other in various aspects which are discussed in Table II. Every technique has different characteristics concerning the location of analysts and stakeholders, the role of the analyst, mode of conduction, type of data, size of data, and the number of stakeholders [2, 14].

TABLE II. CHARACTERISTICS BASED ANALYSIS OF REQUIREMENT ELICITATION TECHNIQUES

Category	Elicitation Techniques	Location Analyst/Clients	Role of Analyst	Mode of Conduction	Type of Data	Size of Data	Stakeholders
Traditional R.E. Techniques	Interviews	Same	To Lead	Direct	Qualitative & Quantitative	Large	One/Many
	Surveys	Different	Facilitate	Indirect	Qualitative & Quantitative	Large	Many
	Questionnaire	Same	To Lead	Indirect	Quantitative	Medium	Many
	Task Analysis	Same	Facilitate	Indirect	Quantitative	Medium	N/A
	Domain Analysis	Same	Facilitate	Indirect	Quantitative	Medium	N/A
	Introspection	N/A	Passive	Direct	Quantitative	Small	N/A
Cognitive R.E. Techniques	Card Sorting	Same	Facilitate	Indirect	Quantitative	Medium	Many
	Laddering	Same/Different	Facilitate	Indirect	Qualitative & Quantitative	Small to Medium	One
	Repository Grid	N/A	Facilitate	Indirect	Qualitative & Quantitative	Small	Many
Collaborative R.E. Techniques	Focus Group	Same	To Lead	Indirect	Qualitative	Small	Many
	Brainstorming	Same	To Lead	Direct	Qualitative	Small	Many
	Joint Application Development (JAD)	Same	To Lead	Direct	Qualitative	Medium	Many
	Requirement Workshop	Same	To Lead	Direct	Qualitative	Small	Many
	Protocol Analysis	N/A	Passive	Direct	Qualitative	Medium	Many
	Prototyping	N/A	Passive	Direct	Qualitative	Small	More than 1, not many
Observational R.E. Techniques	Ethnography	Same	Passive	Direct	Qualitative	Medium	Many
	Observation	Same	Passive	Direct	Qualitative	Medium	Many
	Apprenticing	Same	Passive	Direct	Qualitative	Small	One

In location, it is distinguished whether the location of analysts and stakeholders is the same or not? If the location is the same then the 'same' value is entered otherwise if the location is different, then the value 'different' is entered in the field. Likewise, if the role of the analyst is to facilitate the stakeholders, then 'facilitate' value is entered. If the role is to lead the system, the 'to lead' value is entered into the field. In some cases where the analyst is not directly involved and is not currently on the active side, then 'passive' value is entered in the field.

In the column 'mode of conduction,' it is decided that if the elicitation technique is designed for direct elicitation purpose, then the value 'direct' is entered, and if the elicitation technique is performing some other functions as well, then 'indirect' is entered in the required field. 'Size of data' plays a huge role in the elicitation process because if the data provided at the output is small, then there might be a lack of complete data according to the situation, but if it is large, then there is the probability of

vague and irrelevant data. But in both cases, the values to be entered in the required field would be 'small' and 'large' as the case may be [17].

Lastly, the numbers of stakeholders are also discussed to analyze the people involved in every elicitation technique. This is because involving the stakeholders every time is time consuming and difficult task which leads to delays in finalizing the end product. In Table II the values 'One' or 'Many' can be entered according to the suitable case.

IV. FRAMEWORK FOR SELECTING SUITABLE TECHNIQUE

After a complete analysis of the system, a complete framework is hereby proposed (Figure. 1) which can be used to find out the best requirement elicitation technique according to the proposed system's attributes, characteristics of all the above-mentioned techniques, situation based/ on-ground analysis by the analyst.
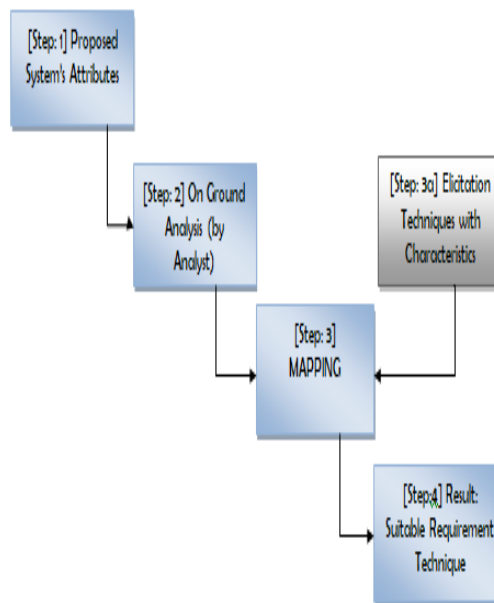

Figure 1. Characteristics Based Analysis Of Requirement Elicitation Techniques

The proposed system attributes are defined by the stakeholders in whom they define the system as well as their requirements in the final product. The number of stakeholders is also defined in this step to facilitate the analyst/developer.

All the elicitation techniques are also defined in the framework, which is essential to mention here to map them with the system which is to be created. The characteristics are comprehensively discussed earlier in this study and are well versed to map them with the system which is to be created. The characteristics are comprehensively discussed earlier in this study and are well versed to implement in any upcoming system.

On-ground analysis are also given as input to the framework, which is done by the analyst because the observation is compulsory before requirement engineering. In requirement engineering, one of the basic things is to identify the social environment in which the proposed system will be used and grow. The criteria are changed as the situation gets changed and the elicitation technique is also changed according to realities.

All three inputs are applied to a mapping function that takes the inputs from three sides and maps them with each other to provide outcomes with the resultant techniques which are most suitable to the system attributes given by the stakeholders, characteristics provided by this analysis, and situations mentioned by the analyst.

Lastly in our framework, results are mentioned, in which the analyst finds the result of all the processes and finds the best technique for elicitation of requirements which is more likely to produce a successful product at the end of the process of software development life cycle.

V. IMPLEMENTATION OF FRAMEWORK

A complete study of different elicitation techniques concerning various parameters is conducted, and then at last a framework is proposed in which all the parameters are mapped together and a suitable solution in the form of any elicitation technique is provided.

To express the above-mentioned framework in a better way, a real-world project is defined here, on which said framework is implemented and a resultant elicitation technique is provided at the end which is suitable to the given project.

VI. RUNNING EXAMPLE

The online vehicle booking system is an online web-based project which is intended to provide the customer's facilities to communicate with the organization and to book a vehicle by performing some well-defined functions on the web portal. The stakeholders then validate the data and after completing all the preliminary proceedings send the vehicle to the customers at their venue as mentioned while filling out the online form. The payment method is also integrated into the web portal or app to give ease to the customers for paying the requisite amount after consulting with the organization.

It works on different modules like the customer module and administrator module. Customers can browse for the demanded vehicles from the store and can apply for the vehicle as well. The administrator can look into the matter of vehicle booking and other relevant tasks regarding the platform.

The actual company also has employees who are responsible to provide end-to-end delivery of any designated task. So, in all, we have three modules which are client, agent, and employees. The said project has some on-ground realities/ situations which are expressed below.

A. *Step 1:* In the above online web project; there are numerous stakeholders like administrators, employees, and end-users/ customers. The administrator and employees are always available for requirement elicitation, but clients/ customers are not present at the time of the startup of the said web portal. So, in this on-ground analysis, the analyst has to perform some functions to collect the customer needs from the portal, which is mandatory.

B. *Step 2:* If we talk about the scope of the project, we have various users on the platform. So, we have to go for those Characteristics which ensure that multiple users can access the system without any difficulty.

C. *Step 3:* As the number of customers accessing the system is very large. All the customers have different intellectual regarding the use of the internet and web app. So, situational measures are also to be performed so that all customers can use the web system reliably.

D. *Step 4:* In this project, the characteristics which are demanded, are also present in the projects previously made. This project is not of a new sort, so use cases can also be implemented to evaluate the elicitation technique.

The elicitation techniques based on the situation can be more than one because in one scenario one technique is useful and for other scenarios, other techniques can be implemented. But the best technique is based on the percentage that how much a technique is suited to any specific domain. In an online vehicle booking system, all the employees and stakeholders can be brought onto a single table e.g., for Interviews.

Brainstorming is a technique that can also be used in this scenario because it includes customers who are not always available, especially at the time of development. The document Analysis technique can also be used to understand the previous work on the same type of project.

The last conversation is in between the selected techniques because a single technique must be chosen to ensure reliability in the development process. As far as the current situation is concerned, Interviews for sake of getting information from organizational stakeholders and Document Analysis for sake of getting information on the customers'/end-user's demands are the best techniques to be implemented.

VII. CONCLUSION AND FUTURE WORK

In this paper, we completely focused on different requirement elicitation techniques. A three-dimensional analysis of all the techniques is brought out. The first dimension was related to an in-depth analysis of different requirement elicitation techniques. In the second aspect, an efficient approach was applied to all techniques which were characteristic-based analysis. At the end of the research, a mapping framework is presented which is practically applied to a running example as well.

As we have provided a complete implementable framework to select suitable RE techniques but in the future, many aspects can also be considered. Time complexity can be a huge factor that can be given priority based on complete research. Likewise, many industries have their pre-implemented techniques which can be either successful or unsuccessful

depending on case to case. So, the characteristics-based techniques can also be implemented on the sample taken from any specific region or industry type as well.

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