Library Progress International
Vol.44 No. 3, Jul-Dec 2024: P.18097-18110

Print version ISSN 0970 1052
Online version ISSN 2320 317X

Original Article

Available online at www.bpasjournals.com

Study Of Literature For Development Of Questionnaire On Requirement Elicitation

Dr. Sheetal Kumar M, [2]Dr. S. Kumar

Assistant Professor, Justice K. S. Hegde Institute of Management, Nitte (Deemed To Be University), NMAMIT campus, Nitte-574110, Karnataka, India, sheetalkumar@nitte.edu.in
Assistant Professor, Economics, Research Institute for Social Science, Tirunelveli.
kumarspm2013@gmail.com , ORCID id: 0000-0003-2355-8886

How to cite this article: Sheetal Kumar M, S. Kumar (2024) Study Of Literature For Development Of Questionnaire On Requirement Elicitation. *Library Progress International,* 44(3), 18097-18110.

ABSTRACT

Purpose – The purpose of this paper is to determine the questions to be included in the questionnaire (relating to the choice of requirement elicitation for software projects) and to investigate the scale of measurements for the respective items. The targeted search strategy included articles on the selection of questions and scale of measurement and their method of analysis. Findings were assembled and collated based on pre-determined categories: Project duration, experience of the Requirement elicitor, domain experience, time to elicit the user requirements, number of functionalities, and software project duration.

Design/methodology/approach – This paper conducts a systematic literature review using databases like ProQuest and Google Scholar.

Findings – Results show that: Five-point likert scale is popularly used to measure the level of project complexities. This study also draws the attention of practitioners towards the use of closed-ended questions to measure their perception towards the appropriate RET.

Keywords: Project Duration, Functionalities, Stakeholders, Domain Experience

Introduction:

Requirement elicitation technique is one of the essential factors for the successful development of the software project (Kotonya, 1998). In general, the software system development adopts a very complex process to manage its system requirements (Deepti, 2011). This process follows six steps in software development life cycle (SDLC) those are: planning, requirements analysis, design, coding, testing, and documentation (Martin, 2022). The most commonly used system development methodologies are agile software development, traditional system development life cycle, prototyping, structured analysis and design, and object oriented (OO) (Stoica, 2013).

Bringing improvement in system development process, through requirement engineering process is one of priorities from the perspective of the practitioners (Niazi, 2002). The process adopted during requirement gathering decides the success of the software projects (Delone and Mclean, 1992). A successful system is one that meets the requirement of the information system, finishes within estimated time, and within the time allocated for the project. According to Jacobs (2007), the majority of systems are delivered with around 42 to 67 percent of requirements being met. The practical experiences of the requirement engineers have proved that there are frequent mistakes in accurately determining the software user requirements (SourourMaalem, 2016). Therefore, determining exact requirement is a vital part of software development process (Uddin, 2019). One of the common understandings among the business analyst states that the corrections in system requirements made during the process of requirement engineering is costs less compared to the cost of correction made after the requirement analysis phase (McGovern, 2003). Findings of this manner suggest the need for extensive research on information systems requirements in order to design successful IS that adequately support end-users' requirements (Maguire, 2002). Requirement engineering (RE) is one of the most important facets of software system development. Past research suggested that a good number of software development problems can be traced back to RE (Leffingwell, 2000). For example, Beecham (2003) conducted a study on software process improvement in twelve software

companies. It collected the responses from 45 focus groups that involved approximately 200 technical staff. The findings of this study indicated that the project participants involved in the software system development have different worries. It further added that the system requirement determination is one of the major concerns of software practitioners. Requirement engineering is defined as a set of actions during which a user's needs and wants are elicited, analyzed, validated, and documented into a formal, complete and agreed requirements specification (Browne, 2002). The quality of elicited requirements could be improved upon by the use of many techniques (Bani-Salameh, 2015; Havelka, 2003). Based on the user wants and needs the system requirements are determined (Tuunanen, 2007). During information gathering, system requirement are determined based on the problems that needs to be solved, system boundaries, stakeholders, and system goals (Sajjad, 2010). The careful assessment of user requirements is one of the means to the ultimate success of an IS (Maguire, 2002). Information system requirement involves interactions between end-users and technical experts (developers, designers, testers, and system analysts) in an effort to list and specify information needed to develop software systems (Alvertis, 2016). The requirement engineering process consist three stages: ISR gathering, representation, and verification (Pohl, 1994; Browne and Ramesh, 2002). In the requirement gathering stage, the business analyst uses his/her prior knowledge and experience to collect information about the technical, functional and non-functional requirements for the proposed system (Eid, 2015). The outcome of the first stage could take several forms such as checklists, notes, outlines and formal or informal diagrams (Kabir, 2016). The second stage uses output of the previous stage. In this stage, business analyst use different representations techniques to document the elicited software requirements. The output of this stage may include several semi-formal diagrams (e.g. charts, boxes, dataflow diagrams), and wireframes (Elshandidy, 2013). In the third stage, the representations those are made in the second stage are then used to help validate the ISR elicit. End-users then sign an agreement, and the diagrams symbolizing the user requirements are given to technical experts to complete the system design (Al-Rafee, 2009). Organizations that manage effective requirement elicitation technique can accomplish multiple benefits that includes, reduce conflicts between end-users and analyst, minimum rework during later development stages (Walz et al., 1993) keeping IS development project and IS quality under control (Kotonya and Sommerville, 1998; Sommerville and Ranson, 2005).

Focus of the study

This study aims to shed light on the importance of item and scale development for survey questionnaire based on requirement elicitation practices of RE techniques. Practical experience of the past researchers indicated that many systems failed in India, mainly because of misunderstood, wrong, or incomplete ISR which is a common observation elsewhere (Keil et al., 1998; Schmidt et al., 2001). In addition, Requirement engineering subject received much attention in developed countries, while very little is known about RE practices in developing countries like India (Al-Rafee, 2009). In this region, most researchers focused on including acceptance of different systems, system effectiveness, IS project performance, issues in e-commerce and IS usage and satisfaction (Rouibah, 2008). In order to fill in this gap this study will solely focus on RE technique usage/perception in India. Second, the existing research related to requirement elicitation consists mainly of qualitative reports of practitioners (e.g., Cox et al., 2013; Young, 2017). From a sustainability perspective, it is essential to determine the factors in selecting the RET for software projects in order to determine the behavior of the business analyst while making decisions pertaining to RET selection. At present, quantitative studies that would allow for testing and thus generalization of these qualitative findings are difficult, because no scale that can measure preference towards RETs under different project complexities have been developed (Aspers, 2019).

Related Works

Project Complexities and Human Attributes

Aspects that can influence RET selection for performing software project development is: (1) attributes of the project, and (2) attributes of analyst (Analysis, 2008). Past studies indicate that analyst vary greatly in their RET selection behaviour (Ackermann et al., 2018): While some analyst select RET based on their past experience, while others prefer to RET based on their personal intuition. Some analyst select RET based on their overall domain experience (like client domain, nature of the industry etc.). Some RET selection are based on project complexities. The project complexities attributes that influences RET selection include for example the total number of stakeholders those are included in the software project development (Lefebvre et al., 2018). Some of the project complexities attributes that influences RET selection are the number of functional points those are included in the software development process. The total estimated project duration refers to the project

complexity. In general, a RET selection decision also depends on the total estimated RE duration

Development of a scale to measure preference towards RET selection

The focus of the current study is the construction and validation of a scale to assess the tendency for the RET selection for the software project development. Based on previous research, we assumed that this tendency is determined by project characteristics and analyst attributes, which are necessary dimensions that do not necessarily correlate with each other. So it makes sense to include project characteristics as well as the relevant analyst attributes to be considered into our scale.

Questionnaires are widely used in software engineering research, yet the processes employed to develop questionnaires lack consistency, vary in quality and rigorous standards. The AMEE Guide introduces a systematic, seven-step design process for creating high-quality survey scales fit for research purpose and program evaluation (Sharma, 2014). This guide includes seven-step design process and it synthesizes multiple techniques those are employed by the survey designers (Jr., 2014).

The survey design process described in this Guide includes the following seven steps: (1) conduct of systematic literature review, (2) carry out focus groups and/or interview, (3) synthesize the findings of focus groups and/or interview, (4) develop items, (5) collect feedback on the items through an expert validation, (6) employ cognitive interviews to ensure that respondents understand the items as intended and (7) conduct pilot testing.

This seven-step design process differs from previously described processes in that it blends input from other experts in the field as well as potential participants. In addition, this process front loads the task of establishing validity by focusing heavily on careful item development. A comprehensive review of the literature was conducted to identify questions in the development of instruments and the empirical evidence used to justify the appropriate scale type by context of use. The targeted search strategy included review articles on the selection of questions and scale of measurement and their method of analysis. Findings were assembled and collated based on pre-determined categories: Project duration, experience of the Requirement elicitor, domain experience, time to elicit the requirements, number of functionalities, and project duration

Study 1: Item generation

Searches were conducted in the Proquest, Google scholar databases. Limits were applied to include only full-text and peer reviewed articles. The duplicates across individual searches were removed prior to abstract/article review.

Study selection:

During the review process, both abstracts and then full text publications were evaluated for eligibility by the researcher. Articles were excluded if they provided no direct or indirect evidence relevant to the search objectives.

Literature review search terms

Sl. No.	Search Terms	Total number of articles
1	ab(Requirement elicitation) AND ab(empirical)	23
2	ab(Requirement elicitation) AND ab(prototype) and (empirical)	10
3	(Requirement elicitation) AND (empirical)	26
4	ab(prototype) AND ab(empirical) AND ab(elicitation)	NIL
5	ti(use case) AND ab(empirical) AND ab(elicitation)	NIL
6	ti(requirement elicitation) AND ti(quantitative)	1
7	ti(requirement elicitation) AND ab(quantitative)	NIL
8	ab(requirement elicitation) AND empirical	NIL
9	ab(requirement elicitation) AND quantitative	111
10	ti(requirement elicitation) AND FT(quantitative)	21
11	ti(prototype technique) AND quantitative AND software	NIL
12	ti(artificial neural network) and ti(logistic regression)	17
13	ti(artificial neural network) AND ti(logistic regression) AND (feed forward)	4
14	ti(artificial neural network) and ti(feed forward)	3
15	ti(number of stakeholder) and ti(software)	NIL
16	ti(Artificial neural network) and logistic regression	177
17	ti(number of stakeholder)	NIL
18	ab(complex software project) AND ab(empirical)	137
19	ab(large number of requirement) AND ab(empirical)	507

DURATION OF THE PROJECT: STUDY OF LITERATURE

Author 1: Duration of the Project	
Reference	(Panagiotis, 2011)
Scale used to measure the variable	Planned project length (in days) that is it was measured on Interval scale
Study type	Binary Logit, Descriptive statistics (Contract award amount is independent variable and project duration is dependent variable)
Objective	To develop a statistical model that determines the likelihood of encountering a project time delay and its duration
Summary	The Binary Logit model indicated that for every $1M increase in the contract award amount, the duration of a project increased by about 21 to nearly 40 days **depending on the project type.** The researcher observed that for the vast majority of the projects, the likelihood of a time delay increased as the contract award amount increased. This

	finding has important implication: the effect of the contract award amount on time delay outcomes cannot be assumed to be uniform across projects.
Discussion on Scale of measurement	An interval scale was the most frequently utilized scale to evaluate Duration of the software development project and shows evidence of validity but there was no standardized interval scale to evaluate duration as scales were study specific.
Author 2: Duration of the Project	
Reference	(Serge Oligny,1997)
Scale used to measure the variable	Interval scale (one calendar-month to calendar-year)
Study type	Regression analysis (Project Duration was considered as independent variable and project effort was considered as dependent variable)
Objective	To develop parametric models based on estimates of project effort to predict the duration of software development projects.
Summary	This paper used empirical model to validate COCOMO duration models. Scatter diagrams were used to perform different analysis. Project effort was considered as independent variable and project duration was considered as dependent variable. They found that COCOMO duration estimating model tend to be lower than the duration estimates produced by the empirical model.
Discussion on Scale of measurement	Interval scale was used to measure project duration showed some evidence of construct validity but data on criterion validity, reliability, or sensitivity were not found.
Author 3: Duration of the Project	
Reference	(Khaled El Emam, 2008)
Scale used to measure the variable	Interval scale
Study type	Correlation analysis was conducted between Duration of the project and the Total Budget of the project.
Objective	To estimate IT projects' actual cancellation rates, and to determine what factors have the biggest impact on cancellation, and to estimate the success rate of projects that deliver.
Conclusion	They targeted midlevel and senior-level project managers in IT departments who would have firsthand knowledge and involvement in software projects. Correlation analysis results indicated a statistically significant and moderately sized Gamma correlation between project duration and project budget for 2005 (Correlation co-efficient = 0.189) and 2007 (correlation coefficient = 0.243). They found a statistically significant correlation in 2005 between project duration and schedule (correlation coefficient = 0.188), as well as duration and productivity (correlation coefficient = 0.197).
Author 4: Duration of the Project	
Author	(Shadi Shuraida, 2013)
Scale used to measure the variable	Interval scale
Study Method	ANOVA
Objective of Study	How does IS analysts experience in communication influence their Project Outcomes
Conclusion	Several IT managers and executives have been contacted by IS development and implementation efforts in their organizations, resulting in the identification of two

	projects one at LifeSci, a subsidiary of a pharmaceutical industry leader, and the other at Regional Insurer, also a regional subsidiary of a leading insurance firm. Each organization had around 2000 employees. Participants filled in a pre-treatment questionnaire on demographic data including age, educational background, Project Duration, IS related experience, systems English language proficiency, ERP package and SAP experience, and experience with the task knowledge domains, namely marketing and logistics. Then, they were informed that they were shown to be a task simulating a real-life context, which they would later be asked questions about. Then, they were shown recorded presentation that describes the organizational context operations, and market environment. Next, the participants underwent one of the two experimental treatments, and when finished, they were asked to complete a post-training questionnaire, and a declarative and structural knowledge test. The total time participants were spent same in both experimental treatments and was controlled by the facilitator (first author). ANOVA was considered for the statistical analysis. Project Duration was considered as Dependent Variable and Independent Variable was IS Work experience.
Author 5: Project Duration	
Reference	(Ayad Y. Aldaijy, 2013)
Scale used to measure the variable	Interval Scale
Study type	Average, Standard Deviation of Project Duration
Objective of Study	To examine the impact of requirements uncertainty and task uncertainty on outcomes in software development projects, limiting the attention to process and product quality.
Conclusion	A cross-sectional survey of 123 participants work in software development in 34 U.S organizations was employed to prove the research model. Analyzed data provided evidence of a significant negative association between requirements uncertainty and development quality factors: process and product. He has also tested to see if the sample was biased with respect to key characteristics, such as size of development team, respondent's positions, **project duration;** and project budget. Overall, the 123 projects showed a good dispersion of project context characteristics. Average and Standard Deviation of the project duration was calculated. MANOVA was undertaken to study influence of experience of the Business Analyst on project duration. MANOVA is a statistical technique used for assessing group differences across multiple metric dependent variables simultaneously, based on a set of categorical (non-metric) variables acting as independent variables.
Conclusion for "project duration" based on past literature and further work involved in our study	
In our study, question 8 and 13 will be derived from S Shuraida, H Barki(2013), "The Influence of Analyst Communication in IS Projects". The author has used the questions to test the influence of analyst communication on meeting the project time and cost constraints. The purpose of this question was to determine whether the system implementation was on-time or not, listing the major obstacles or constraints that respondents faced during the implementation. These questions were modified and asked as to what was the duration of the project development? Responses to these questions were collected on interval scale. The decision to choose interval scale or other type of scale of measurement depends on the type of regression to be used. When the linear regression is used, it is appropriate to use continuous scale for the dependent as well as independent variable. On the other hand, a logistic regression performs better with binary dependent variables and independent variable is on a continuous scale. Hence in our study the responses will be collected on interval scale because accuracy of interval scale will provide more accurate results. The responses will be collected on interval scale because accuracy of interval scale will provide more accurate results. Different RE techniques are proposed for different levels of Project duration. Eight RE techniques are considered as nominal variable. The choice of RE technique has to be decided based on project duration. Hence logistic regression is	

used to determine the possibility/ probability of choosing RE technique based on project duration. We also want to determine the techniques that are suitable when the available project time is less and some RE techniques are suitable for more available project time.	
Author 1- Experience of the IT professional in the IT domain	
Author	(Shadi Shuraida, 2013)
Scale used to measure the variable	Nominal scale
Relevant questions in the questionnaire	Questions that were relevant to our study were: Have you ever gathered information requirements from individuals as part of an information system development project? (No/Yes), If yes: For how many information system development projects? (1-2 projects, 3-4 projects, 5-6 projects, 7-8 projects, 9-10 projects,11 projects or more).
Study type	Case Study
Objective of Study	How does IS analysts experience in communication influence their Project Outcomes
Conclusion	Several IT managers and executives have been contacted by IS development and implementation efforts in their organizations, resulting in the identification of two projects one at LifeSci, a subsidiary of a pharmaceutical industry leader, and the other at Regional Insurer, also a regional subsidiary of a leading insurance firm. Each organization had around 2000 employees. Participants filled in a pre-treatment questionnaire on demographic data including age, educational background, Project Duration, IS related experience, systems English language proficiency, ERP package and SAP experience, and experience with the task knowledge domains, namely marketing and logistics. Then, they were informed that they were shown to be a task simulating a real-life context, which they would later be asked questions about. Then, they were shown recorded presentation that describes the organizational context operations, and market environment. Next, the participants underwent one of the two experimental treatments, and When finished, they were asked to complete a post-training questionnaire, and a declarative and structural knowledge test. The total time participants were spent same in both experimental treatments and was controlled by the facilitator (first author). ANOVA was considered for the study. It was found that though the analyst had more extensive experience in systems analysis and domain knowledge, the LifeSci analyst should have delivered a more successful project than the Regional Insurer analyst. The fact that the opposite actually has taken place.
Author 2- Experience of the IT professional in the IT domain	
Author	(Freeman l.a., 2001)
Scale used to measure the variable	Interval Scale
Study type	Correlation Analysis, ANOVA
Objective of Study	To determine the impact of analyst's **experience** on the use of the concept map will serve as a bridge between the user and the analyst who may come from very different backgrounds, experiences, perceptions, and styles.
Conclusion	The users were recruited as volunteers from the senior-level, non-IS courses in the undergraduate program of a large, midwestern business school. Analysts were recruited from the senior-level, undergraduate IS courses at the same business school and had already completed at least one (and possibly two) systems analysis and design courses. All analysts received approximately 25 minutes of training and exposure to additional material (as described above) before they were given the scenario. The analysts that were assigned to the concept mapping group received training on creating concept maps based on Novak and Gowin's (1984) and Novak's (1998) introduction

	and training technique, though adjusted based on Shavelson et al.'s (1994) and Taber's (1994) modifications. Each analyst in this treatment group was given a short measure of his/her understanding of the components and rules regarding concept mapping. Following the training session, the analysts were given an abridged version of the scenario to use as a basis for discussion in the upcoming session with the user. While the analysts were receiving the appropriate training, the users received a full description of the scenario. Three experiment groups were created based on the experience of the Analysts. The analysts were asked to indicate their perceived accuracy on a 0-100% scale and to explain any rating that was less than 100%. No analyst had a ranking of 100% – the range was between 50% and 98%. The ANOVA indicates an overall difference among the three treatment groups (p-value of 0.021). Independent variable was training program and dependent variable was experience of the analyst. While the means are quite different for all three groups, the Map group's ratings were not significantly different from either of the other groups' ratings.

Conclusion for "Experience of the Elicitor" based on past literature and further work involved in our study

Shadi Shuraida(2013) has conducted a study on "Understanding Analysts' Learning Behaviors in Information System Projects". The experience parameter was measured on the nominal scale. Questions that were relevant to our study were: Have you ever gathered information requirements from individuals as part of an information system development project? (No/Yes), If yes: For how many information system development projects? (1-2 projects, 3-4 projects, 5-6 projects, 7-8 projects, 9-10 projects,11 projects or more). **But the total experience of the analyst was measured using nominal scale, in our study the same question is tweaked and measurement was done using interval scale.** Freeman l.a.(2001) in his article '*The effects of concept mapping on shared understanding during the requirements elicitation'* developed concept maps for graphical representations of conceptual and relationship knowledge of a particular domain. The author developed a questionnaire to measure the total number of years the professional was employed, whether the expert had experience as a system analyst, if so, for how many years? **These questions were relevant to our study since the questions measured overall experience of the respondent in IT domain as well as experience as Requirement Elicitor.** Respondents of different experience, designation could understand and could complete an interval scale question.

Rational for choosing interval scale:

Dichotomizing of continuous variable is strongly condemned by statisticians because it loses one-third of data information. Categorization of continuous covariate is justified only when covariate is highly skewed or has nonlinear relationship. The basic aim of our analysis will be to describe the way in which RE techniques are chosen and to determine the factors to select the RE techniques based on overall experience of the elicitor in Requirement Elicitation. An example of the type of research question that we will consider is the extent to which the association between Choice of RE techniques and overall experience of the Elicitor. Interval scale is used to measure the overall experience so that comparison between different categories of the RE techniques can be possible using Logistic Regression. The trend in the area of Requirement Elicitation research is for researchers to recognize limitations of ordinary least squares (OLS) regression and turn increasingly to logistic regression for explaining relationships between a categorical outcome variable and a mixture of continuous and categorical predictors. The decision to choose interval scale or other type of scale of measurement depends on the type of regression to be used. When the linear regression is used, it is appropriate to use continuous scale for the dependent as well as independent variable. On the other hand, a logistic regression performs better with binary dependent variables and independent variable is on a continuous scale. Hence in our study the responses will be collected on interval scale because accuracy of interval scale will provide more accurate results. The responses will be collected on interval scale because accuracy of interval scale will provide more accurate results. Different RE techniques are proposed for different levels of Experience of IT professional in IT domain. Eight RE techniques are considered as nominal variable. The choice of RE technique has to be decided based on project duration. Hence logistic regression is used to determine the possibility/ probability of choosing RE technique based on Experience of IT professional in IT domain. We also want to determine the techniques that

are suitable when the Experience of IT professional in IT domain is less and some RE techniques are suitable for more Experience of IT professional in IT domain.	
Author 1: Time required to complete Requirement Elicitation	
Author	(Seyed Mohammad Amin, 2016)
Scale used to measure the variable	Interval scale
Study type	Average
Objective of Study	To define the characteristics of information requirements of information systems
Conclusion	To examine the extent to which the pre-treatment questions assess domain knowledge, we compared MBAs pre-treatment domain knowledge with that of Computer Science students. It was expected that MBA students were likely to have more marketing and logistics domain knowledge than CS students given they study marketing and operations management courses. The experimental task was to collect the requirements of SAP clients. These Requirements mainly consisted of logistics (i.e. stocking and replenishment) and marketing (i.e. pricing and marketing) tasks. Average Time to elicit requirements were calculated. The data dispersion was also studied.
Author 2: Time required to complete Requirement Elicitation	
Reference	(Shadi Shuraida, 2013)
Measure of Scale	Interval Scale
Study Method	Average
Objective	To articulate the information transmission activities of IS analysts: the information they can transmit when learning about users and information needs
Conclusion	To reflect the maximum variety of feedback, the IS practitioners for the exploratory study were selected from experts with different types of experience in developing information systems (i.e. managers, system developers, system analysts, information analysts, user interface designers). Selected IS practitioners, in their jobs were either directly involved with requirement determination process or had/have dependencies on its results. To identify the potential participants to be interviewed for this study, a list of the IS practitioners with practical experience in information system development projects were generated by discussing the subject with two senior researchers in the Business Information System (BIS) department, University College Cork (UCC). Following that, the researcher contacted all IS practitioners in the list to arrange a date and time for an interview. Nine IS practitioners expressed interest as the potential interviewees. Average time to elicit requirements was determined in order to determine the total time required to understand the users needs.

Conclusion for "Time required to complete Requirement Elicitation" based on past literature and further work involved in our study

(S Shuraida, H Barki, 2013) in their paper titled "Understanding Analysts' Learning Behaviors in Information System Projects" modified the same questions and measured the project characteristics using nominal scale. Test-retest reliability assessments were conducted by all the three authors. Interval scale had higher acceptability and demonstrated superior reliability, validity, and discriminatory power. This RE characteristics is corresponding to the question in our questionnaire: Rate this RE technique on the basis of time required to complete elicitation of all requirements of the project (rate 10 if very less time is required for RE, rate 1 if more time is required). Researcher desires to collect accurate information of time required to complete RE. What was the time duration for eliciting requirements for this project? Question Number 8, 9 and 10 are derived from Shadi Shuraida(2013).

Rationale: Need to include different levels of time requirement. Different RE techniques are proposed to meet different time duration for Eliciting requirements. Some techniques require less time and some techniques are suitable for the RE sessions with more available time for elicitation. Therefore, time duration for Eliciting

requirements needs to be considered in the questionnaire. The responses were collected on interval scale because accuracy of interval scale will provide more accurate results. We may wish to know whether the time required to complete RE, a continuous variable, was different for different RE techniques and whether this difference could have influenced the association between choice of RE techniques and time required to elicit requirements. In fact, in real life, we are interested in assessing the concurrent effect of several predictor factors (both continuous and categorical) on a single dichotomous outcome. This is done using "multivariable logistic regression" – a technique that allows us to study the simultaneous effect of multiple factors on a dichotomous outcome.

Author 1: Experience of Requirement Elicitor	
Reference	(GA Wilt, 1999)
Scale used to measure the variable	Interval Scale
Study type	Average of experience in eliciting Requirement is calculated
Objective of Study	To compare laddered grids and verbal protocol analysis for effective elicitation of conceptual knowledge.
Conclusion	All subjects completed a pre-experiment demographic questionnaire designed to assess previous experience with knowledge elicitation techniques. Specifically, subjects were asked to rate their levels of **previous experience with knowledge elicitation**, with the laddered grids technique, and with the verbal protocol analysis technique. Each of these questions was rated on a five-point Likert scale, with anchors at scale points 1, 3, and 5. They were also asked about the total years of experience in using laddered grid techniques for Requirement Elicitation. Totally 60 IS professionals were interviewed. Average of the years of experience of the Requirement Elicitor was determined. Because of the very low levels of previous experience with knowledge elicitation techniques, these data were not used in any subsequent analyses.

Conclusion for "Experience of the Elicitor" based on past research and our work in this area

GA Wilt (1999) in his article mentioned that selecting an appropriate knowledge elicitation technique for a given application is a complicated process. He has compared laddered grids and verbal protocol analysis for effective elicitation of conceptual knowledge. Different questions on previous experience of the expert in knowledge elicitation were asked. The author measured the experience using eleven

Author 1: Number of functionalities	
Reference	(AY Aldaijy, 2004)
Scale used for measurement	Interval Scale
Study Selected	MANOVA
Objective	To examine the impact of requirements uncertainty and task uncertainty on outcomes in software development projects, limiting attention to process and product quality
Conclusion	He has tested to see if the sample was biased with respect to key characteristics, such as size of development team, respondent's positions, **project size;** and project budget. Overall, the 123 projects showed a good dispersion of project context characteristics. Average and Standard Deviation of the project duration was calculated. MANOVA was undertaken to study influence of experience of the Business Analyst on project size. MANOVA is a statistical technique used for assessing group differences across multiple metric dependent variables simultaneously, based on a set of categorical (non-metric) variables acting as independent variables. Multivariate Analysis Of Variance (MANOVA) was undertaken to determine whether differences in respondents in regard assessing the dependent variables, process quality, and product quality. MANOVA is a statistical technique used for assessing group differences across multiple metric dependent variables simultaneously, based on a set of categorical (non-metric) variables(in this case project size based on number of

	functionalities) acting as independent variables.
Conclusion for "number of functionalities" based on past literature and suggested work	
(AY Aldaijy, 2004) recognize system requirements as a critical step in the development of quality software (SW) systems. The main purpose of this research was to examine the impact of requirements uncertainty and task uncertainty on outcomes in software development projects, limiting attention to process and product quality. He stated that the interval scale was discriminative than a Likert scale. Some of the relevant questions were: Size of organization: (Small business (< = 200 employees), Medium to Large (> = 200 employees)), What was the size of project (Small (< = 100 K SLO C) [KSLO C = Thousands of Source Line of Code], Medium to Large (> 100 KSLOC)), Requirements engineering techniques used for this project: (Interviewing, Form Analysis, Organization objectives and goals analysis, JAD sessions, Scenario-based requirements elicitation, Others). (MANOVA) was undertaken to determine whether differences in respondents in regard assessing the dependent variables, process quality, and product quality. MANOVA is a statistical technique used for assessing group differences across multiple metric dependent variables simultaneously, based on a set of categorical (non-metric) variables acting as independent variables. The participants were classified, according to their positions in their organizations, into four positions: software project manager, requirements engineer, software developer, and software engineer. Some of the questions were modified. **These questions are relevant to our study because the choice of RE techniques can be based on the characteristics of project and size of the firm.** Item No. 8, 14 and 15 in the questionnaire attempted to measure factors led to the choice of this RE technique, the size of the project in terms of number of functionalities (approximately in numbers). Jane Coughlan and Robert D. Macredie(2002) attempted to measure the Line of Code and total number of functionalities. **This question was modified throughout the questionnaire**. **Rationale for choosing interval scale**: Different RE techniques are proposed for different number of functionalities. Some techniques are suitable when the project has a smaller number of functionalities and some RE techniques are suitable when the functionalities are more in number.	

Demographic Details of Requirement Elicitor: (PEEK G.S., 1991) conducted a study on preference elicitation which were used by practicing auditors. Some questions were relevant: What is your currant title? In your firm what management level corresponds to this title? (Senior, upper middle, lower middle, lower), for how long have you held your current title? How long have you been employed with your current firm, how long have you been-employed as an auditor in your current firm? How long have you been employed as an auditor (regardless of firm)? These questions were considered in our study without any modifications**. The purpose of asking these questions was to collect the demographic details of the respondent. In our study the same questions were measured using interval scale.**

Step 2: Sample and Procedure

For the data collected we contacted the requirement engineers through social network site and asked them the questions on demographic data via an online survey. Based on the feedback obtained through academic experts, we decided to use judgmental and snowball sampling. Each item was presented to the respondents: in the form of closed-ended questions and five-point likert scale. Participants indicated their level of agreement on a 5-point scale, ranging from indicating low project complexity and 5 being high project complexity. We contacted 50 people with the sample size consisting of wide demography.

Findings of the pilot study

The analyses were summarized to determine the factors in choosing Requirement Gathering Technique. Different themes were connected based on the informants' explanation. The respondents explicitly explained the process and parameters of decision making in choosing RET in different phases of Software Development Life Cycle. Further, the respondents also explained how different parameters of Project Complexity help in choosing RET.

In this part, the analysis of the study is associated with the main objectives, and each objective has been related with a number of interview questions. Thus, answers also have been arranged based on the objectives.

The descriptive analyses of fifty respondents was conducted. As a result of this, four main key research findings emerged. These findings/suggestions are (listed below) discussed in this article.

1.Suggestions to modify research design

Usability testing, user testing, user story mapping, user analysis, Sprint planning, discovery meeting can be

considered as one of the RET. None of the respondents have used Rapid Application Development Technique. Number of Users can be considered as one of the independent variables.

2. Preference Towards RET

Among the eight techniques, most frequently used techniques can be written in the descending order of preference (Most preferred to least preferred): Interview, Prototype, Brainstorm, Focus Group, Scenario and Workshop techniques.

3. Relationship between RET and Number of Stakeholders of the Project

Interview technique, Brainstorm and Focus Group is used when there are a smaller number of stakeholders in the project. Prototype is suitable technique for a project consisting of large number of stakeholders. Workshop would be a suitable technique for project with very large number of stakeholders

4. Project Duration has an impact on the choice of RET

Interview, Brainstorm is found to be appropriate when the required Project duration is less. JAD for projects is found to be appropriate when RE required long duration. Interview technique is used more frequently when the required RE Duration is less. Brainstorm, Workshop, Focus Group is used when the projects are of long duration.

Discussion:

Our aim is to develop a scale that enables the efficient assessment of RET selection process for software development projects. This scale can be used in the re-design of existing solutions and/ or development of new software products in order. As the project complexities and human attributes of software project has been shown to be a strong predictor of future RET selection (Sabbaghi et al., 2016).

The two factors relevance, project characteristics and human attributes present possible points of actions for companies: First, the relevance of RET selection for the requirement engineers can be strengthened by highlighting the need for RET selection: Software product life cycle assessment (LCA; see e.g., Kloepffer 2008) measures the economic burdens that come with all lifecycle steps of a product, from creation until end of project life. This information could make business analyst aware of their responsibility to take care of their projects during the initial stage, thereby reducing the project complexity impact. Second, RET selection process should be made as easy as possible, for example through a design that allows project managers to take care of the project themselves. The literature review in this study provided empirical evidence about the association between RET and different parameters of the project complexities. A comprehensive approach to combining the findings from the previous papers was developed. This article also categorised studies in terms of the different research approaches used by the authors to understand the impact of the number of functional points, number of stakeholders on the choice of RET. This research is intended to understand respondents' opinion in this regard.

Empirical Research on RE selection:

One of the reasons for the dearth of empirical research on choice of RE techniques could be the reason for a lack of instruments that are useful for measuring the variables of the RE model. Previous researchers of RE technique did partial tests of the model, and thus used instruments that measured only a few variables of the model. Since no instrument had been developed to measure Analyst Experience in eliciting requirement, Analyst experience in IT domain, Duration of the project, Number of Stakeholders, Time spent to elicit requirement, Number of functionalities. Therefore, in order to do a comprehensive test of the model, it was necessary to develop a comprehensive questionnaire that could tap all variables of the model. This article described how items were generated.

However, few questionnaires can be found in the literatures that cover single RE technique. More important, these questionnaires pay little attention on Agile and choice of eight Requirement Elicitation Techniques (Interview technique, Brainstorm, focus group, Workshop, Use case, Prototype, RAD, and JAD)**.** Most of the past studies focused on traditional single RE technique. For this reason, our questionnaire is designed and implemented to obtain the expertise of researchers and practitioners actively involved in software development using agile. This approach constitutes one of the major contributions of our research**.** The questionnaire includes many items. The questionnaire begins with a description of the purpose of the study, and included items related to two categories. In Session A, Participants are asked about the basic profile. The first category measures demographic characteristics of respondents. It includes job designation at the time of performing the Requirements Elicitation activity, years spent by the respondent at his company, Overall Experience in Software Industry, Years of experience in requirement elicitation in respondents current firm, Years of experience in requirement elicitation

regardless of the firm, total experience of the firm in developing the software system. Participants are then introduced to the session B, which contains questions related to Requirements Session Information. First, participants are asked to recall only one Requirement Elicitation session in which the respondent has **exclusively** used one of the eight RE techniques (Interview technique, Brainstorm, focus group, Workshop, Use case, Prototype, RAD, and JAD). There are 13 factual questions followed with 5 rating questions aimed at gathering the perception of the participants regarding the current RE technique with regards to total duration of the project, number of functionalities of the system, total time required to complete elicitation of all requirements.

Rationale for selecting a Closed-ended questionnaire:

Urša Reja(2003) in their article titled "Open-ended vs. Close-ended Questions in Web Questionnaires" A closed-ended questionnaire was chosen as the method for data collection and measurement for a number of reasons: it is uniform. Close-ended questions in general yield higher percentages than open-ended question for answers that are identical in both question forms. More important, it standardizes the collection of data and makes sure that each respondent gets the same questions in the same order so that the data will be comparable. In addition, past research findings suggest that open-ended questions produce more missing data than close-ended. Moreover, there will be more inadequate answers for open-ended question.

Advantages of Systematic Reviews

Systematic literature reviews have certain advantages because of using specific methods those are successful in increasing the reliability, limiting bias and derive precise conclusions. It also delivers the required information to the requirement engineers, researchers, and top management decision makers. Systematic literature review helps the decision makers to shorten the time gap through research discoveries in implementation. Consequently, by improving the generalizability and consistency of results increase precision of the results.[18]

Limitations in Systematic Reviews/Meta-analysis

As with all research, the value of a systematic literature review depends upon the adopted method, research findings and the clarity of reporting. As with other publications, the quality of reporting the systematic literature reviews varies, limiting readers' ability to assess the strengths and weaknesses of those reviews. [5]

Although systematic literature review are considered as one of the best method to achieve the required objective, and for getting a definitive answer to a research question, there are certain criticism associated with it, such as the selection of studies, location, loss of information on important outcomes, heterogeneity, inappropriate subgroup analyses, duplication of publication and conflict with new experimental data.

Summary

This study explored the degree of influence the project complexities had on choosing the right RET for developing Software Application. Project Complexity was measured in terms of number of functionalities, number of stakeholders, project duration, duration required for eliciting the Software Requirements. Content analysis (using Systematic Literature Review and VOSviewer) of the past literature found that interviewing technique is suitable when there are a small number of stakeholders. Workshop technique was suitable when there were large number of stakeholders and it is capable of eliciting large number of functionalities.

A systematic literature review is an outline of primary studies that consists of explicit statement of objectives, materials, and methods, and has been conducted according to explicit and reproducible methodology. A meta-analysis is a mathematical synthesis of the results of two or more primary studies that addressed the same hypothesis in the same way. Although meta-analysis can increase the precision of a result, it is important to ensure that the methods used for the reviews were valid and reliable.

References

[1] S. Lauesen, "IT Project Failures, Causes and Cures," IEEE Access, pp. 72059 - 72067, 08 April 2020.

[2] R. B. A. Javed Iqbal, "Requirements engineering issues causing software development outsourcing failure," PLoS One, vol. 15, no. 4, 2020.

[3] M. H. AMJAD HUSSAIN ZAHID, "A CRITICAL ANALYSIS OF SOFTWARE FAILURE CAUSES FROM PROJECT MANAGEMENT PERSPECTIVES," VFAST Transactions on Software Engineering, vol. 13, no. 3, pp. 113-119, September-December, 2018.

[4] Z. Kurtanovic´ and W. Maalej, "Automatically classifying functional and non-functional requirements using supervised machine learning," in IEEE 25th International Requirements Engineering Conference, Lisbon, Portugal, 4–8 September 2017.

[5] D. D. F. B. A. a. S. Ç. F. Dalpiaz, "Requirements Classification with Interpretable Machine Learning

and Dependency Parsing," in EEE 27th International Requirements Engineering Conference (RE),, Jeju Island, Korea (South), 2019.

[6] E. M. Aoife De Brún, "Social Network Analysis as a MethodologicalApproach to Explore Health Systems: A CaseStudy Exploring Support among SeniorManagers/Executives in a Hospital Network," International Journal of Environment Research and Public Health, 13th March 2018.

[7] Kawaljeet Kaur Kapoor & Kuttimani Tamilmani & Nripendra P. Rana & Pushp Patil & Yogesh K. Dwivedi & Sridhar Nerur, "Advances in Social Media Research: Past, Present and Future," Information Systems Frontiers, Springer, vol. 20, no. 3, 6th November 2017.

[8] S. P. David K Loomis, "A comparison of data collection methods: Mail versus online surveys," Journal of Leisure Research, vol. 49, no. 1, pp. 1-17, September 2017.

[9] I. Abdalla, "Social Engineering Threat and Defense: A Literature Survey," Journal of Information Security, vol. 09, no. 04, pp. 257-264, January 2018.

[10] M. Kirişci, "Comparison of artificial neural network and logistic regression model for factors affecting birth weight," SN Appl. Sci., vol. 1, no. 378, 2019.

[11] P. S. Sheetal Kumar, "Requirement Elicitation: Systematic Literaure Review," Journal of Advanced Research and Dynamic Control Systems, vol. 11, no. 12, 2019.

[12] R. Sequier, "Exploring the Effectiveness of Convolutional Neural Networks for Answer Selection in End-to-End Question Answering," DeepAI, 07/25/2017.

[13] M. Iqbal, "BusinessofApps," 2020. [Online]. Available: https://www.businessofapps.com/data/linkedin-statistics/.

[14] Invensis, 2020. [Online]. Available: https://www.invensis.net/. [Accessed 2020].

[15] P. R. Bilal Amir, "There is no random sampling in software engineering research," in ICSE '18: Proceedings of the 40th International Conference on Software Engineering, May 2018.

[16] "Statista," 2020. [Online]. Available: https://www.statista.com/.

[17] "QuestionPro," 2020. [Online]. Available: https://www.questionpro.com/.

[18] "LinkedIn," 2020. [Online]. Available: https://about.linkedin.com/.