

## Study of Elicitation Techniques Adequacy

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### Abstract

Requirements engineers can make use of a great many techniques to elicit user needs. However, there is no comprehensive practical guide on how to select the best techniques for a particular contextual situation within a software development project. We propose a framework to support developer decision making on which are the best elicitation techniques for the project at hand. Our framework identifies which elicitation technique responds better to certain project features.

### 1. Introduction

Requirements engineering (RE) covers the activities of requirements elicitation (capture, discovery, acquisition), analysis (and negotiation), specification and validation [1]. Most of the work in the requirements engineering field deals with requirements representation or modelling methods or techniques [2] rather than how those requirements are gathered. In other words, RE research has overlooked elicitation, which, because it serves the purpose of identifying user and customer requirements, is of key importance during the requirements process [3].

There are a range of methods and techniques for eliciting requirements [4]. Nevertheless, information is still captured, in most cases, using interviews only, although there is clear evidence that traditional interviews are not always the best option for extracting user needs [5].

We aim to generate a framework that helps developers to select the best elicitation techniques. We

analyzed the information found in the literature about when and where it is appropriate to use certain elicitation techniques. We then determined a set of project attributes influencing technique effectiveness. Finally, we compiled the information in a framework that matches elicitation techniques to project attributes.

To build a framework to support decision making on what elicitation technique it is best to apply at a any given time in a particular project, we need two types of information; i) the attributes or characteristics influencing the selection of one or other requirements elicitation technique and ii) the recommendations on the adequacy of the techniques for certain values of those attributes, as figure 1 shows. To gather this information, we ran an exhaustive survey of the literature related to requirements elicitation. The survey covered some thirty specialized books and around 320 articles published in journals and congress proceedings.

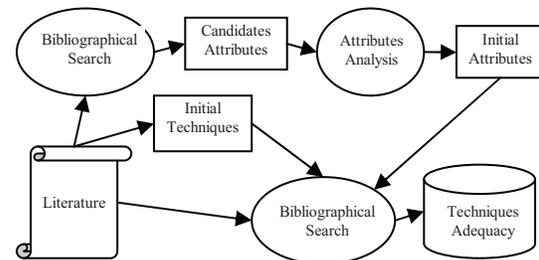


Figure 1. Generation of framework.

Our proposal is presented as follows. Section 2 shows the more important related works. Section 3 describes the contextual attributes influencing

elicitation technique fitness. Section 4 discusses the adequacy of techniques for the context attributes. Finally, section 5 presents a discussion and the conclusions of our study.

## 2. Related work

In an earlier article [66], we presented a survey of work related to the problem of elicitation techniques selection. The works covered by the survey range from theoretical studies presenting models or approaches to support technique selection in a particular area to simpler, often statistically unconfirmed empirical studies testing the use of some technique or method in a very specific case. We surveyed two main areas: requirements elicitation (obviously) and knowledge acquisition (because this is where elicitation techniques have mostly been applied).

There are few works in the field of requirements elicitation related to the problem of selecting the right technique to apply in a particular situation. Maiden and Rugg [10] and Davis and Hickey [27], especially, propose theoretical frameworks that include a sizeable number of techniques and factors that influencing the selection problem. However, there has been little validation of these proposals and their practical application is not evident. The other related work is confined to not very reliable experimental studies on just a few techniques. These experiments consider very few factors, and their results are, therefore, difficult to generalize and only valid for the situation in which the examined attribute values apply. Therefore, it is difficult to extend their validity to other attributes or techniques, for which purpose the experiment would need to be replicated.

In the field of knowledge engineering, not much work has been done on evaluating techniques for the purpose of prescribing their use either. The only framework is proposed by Dhaliwal and Benbazat [7] who discuss this problem at length and state the key influential factors, albeit without providing further detail. Consequently, it should not be considered as a selection framework, but merely as a guide for running future empirical studies. Other related work includes experiments of varying reliability which have tested only a few techniques. These studies consider very few attributes that can affect the choice of a technique, and are therefore not terribly useful.

## 3. Contextual attributes

We examined two types of studies to establish the contextual attributes: proposals of problem-solving

frameworks and empirical studies. We identified six frameworks and located eleven empirical studies. The frameworks comprise problem-solving approaches for selecting elicitation techniques. They define attributes that were found by the authors to have a bearing on decision making. The empirical studies cover experiments run with the aim of demonstrating how a change to some contextual attribute modifies the effectiveness of certain techniques.

From these sources we gathered a preliminary set of possibly influential attributes. We grouped the identified attributes under five key elicitation process factors describing the context in which elicitation takes place. These are:

- Elicitor: Development team agent that elicits information on requirements. Other names, such as analyst or requirements engineer, are used in the literature to refer to this role.
- Informant: Agent (for the purposes of this study, human) that has the information necessary to define the requirements. Informants can be customers, users and, generally, anybody that has a stake in software development.
- Problem Domain: The problem that the software system under construction is to solve, and that has an impact on the elicitation process.
- Solution Domain: Software product being developed to solve the problem.
- Elicitation Process: Set of elicitation sessions necessary to understand and extract requirements.

We have established a number of criteria to decide whether an attribute should be selected to be part of the final attribute set. These criteria are mostly related to whether or not the attribute can be defined and justified:

- Theoretical Justifiability (TJ): Can a logical justification be found for the attribute influencing elicitation technique effectiveness? The possible values are: No (N), Possibly (P), and Yes (Y).
- Assessability (A): Can ratings be established for the different attribute values? The possible values are: Low (L), Medium (M) and High (H).
- Instrumentability (I): Can a value be assigned to the attribute during a development project? The possible values are: Low (L), Medium (M), and High (H).

When the analysis criteria have been analyzed and assessed, a decision can be made about what to do with each attribute. The actions that can be taken with respect to an attribute are:

- Accept (A): Accepted as it is.
- Eliminate (E): Eliminated for not complying with one or more of the criteria.

- Merge (M): Merged with another attribute because they are similar.
- Change (C): Name changed to make its meaning clearer.

For an attribute to be eliminated, its influence *should not be justifiable*, or its assessability or instrumentability should be *low*. If the proposed framework really is to be a useful guide for practitioners, the attribute values should be clearly distinguishable, and it should be fairly easy and quick to assign a value in any particular development case.

Table 1 shows a summary of this analysis, and references to the sources used [67].

Apart from the attributes obtained from this analysis, we have aggregated five new attributes based on our practical and theoretical experience (they appear as '+' in Table 1). Although no one has so far proposed these new attributes, we believe they do influence technique effectiveness. Specifically, we found that *Location/Accessibility*, *Availability of Time*, *Availability of Information*, *Problem Definedness* and *Process Time* had not been proposed as attributes influencing elicitation technique selection. We think that *Location/Accessibility*, for example, clearly influences which elicitation technique should be used, because some techniques are designed to facilitate elicitation from informants that cannot attend a face-to-face session. Likewise, there are techniques that are more applicable when the informant does not have much time to spare to participate in elicitation sessions or techniques (*Availability of Time* attribute).

Similarly, *Availability of Information* is a relevant attribute since the use of some techniques is conditioned by the fact that they require certain information. Also, there are techniques that require a clear understanding of the problem prior to the session, whereas others ease this understanding. Accordingly, *Problem Definedness* has an impact on the decision about which elicitation technique to use. Finally, some techniques appear to work better at the start of the process than others (*Process Time* attribute).

As a result of this analysis to determine which attributes influence the selection of the best elicitation techniques, a great many of the baseline attributes were maintained, although the names of most were modified appropriately. Others were merged and a few others were added. This totalled 16 attributes: four for the *elicitor* factor, seven for the *informant* factor, three for the *problem domain* factor and two for the *elicitation process* factor.

Finally, we established the possible values of each attribute, that is, how the attributes can be rated in a real-life situation. Table 2 presents the selected set of

attributes, the values of each attribute and the respective descriptions.

#### 4. Technique adequacy

To determine the adequacy of the techniques, we reviewed the related literature to find out whether or not the techniques are recommended for use with each influential attribute. From the books and articles on requirements, we were able to identify two sources: expert opinion and empirical studies. The expert opinion is a proposal made by an expert in the field prescribing the use of the technique under certain circumstances. The empirical studies output adequacy values deduced from the results of an experiment.

Table 3 shows the type of information we have found for every technique-attribute pair. The expert opinions are placed at the top of the cell and the empirical studies at the bottom.

By making this distinction between sources, the adequacy prescriptions that the framework will generate can be rated in ascending order of reliability. These ratings are described below and are shaded differently in Table 4 to highlight:

- Expert opinion: Experts that propose the use of a particular technique under certain circumstances (shaded light grey).
- Empirical sign: There is just one experiment showing a particular technique to be adequate under certain circumstances (shaded dark grey).
- Empirical evidence: There are two or more experiments corroborating the adequacy of the technique (shaded with horizontal lines).

Where entries are left blank, it means that there are no prescriptions on the adequacy of the techniques for those attributes. We have analysed the cases about which no information is forthcoming from the viewpoint of logic, our own experience and the key characteristics of each technique in order to generate possible adequacy levels.

Table 5 shows the final result, where the different technique adequacy levels are represented according to the following notation:

- √: The technique is adequate for the attribute value in question. This means that the results of using this technique to elicit information would be better than using a technique with a lower adequacy level. Therefore, if the context has this attribute value, this technique should be given priority during selection over less adequate techniques.

Table 1. Analysis of contextual attributes of influence.

FACTOR	ATTRIBUTES	PROPOSING AUTHORS	ASSESS-ABILITY	INSTRUMENT-ABILITY	THEORETICAL JUSTIFIABILITY	ACTION
<b>Elicitor</b>	Requirements engineering experience (Elicitation)	Lloyd 2002 [6] Dhaliwal & Benbazat 1990 [7] Agarwal & Tanniru 1990 [8]	H	H	Y	C
	Technical knowledge of (training in) elicitation methods	Dhaliwal & Benbazat 1990 [7]	H	H	Y	C
	Knowledge of (familiarity with) domain	Dhaliwal & Benbazat 1990 [7]	H	H	Y	C
	Experience with elicitation methods (technique)	Dhaliwal & Benbazat 1990 [7]	H	H	Y	C
	Cognitive problems	Byrd et al. 1992 [9]	M	L	P	E
<b>Informant</b>	Number of users (per session)	Maiden & Rugg 1996 [10]	H	H	Y	C
	Number of experts	Roth & Wood 1993 [11]	H	H	Y	M
	User involvement (interest)	Lloyd 2002 [6]	H	M	Y	C
	Location/accessibility		H	H	Y	+
	Availability of time		H	H	Y	+
	Expertise	Burton et al. 1990 [12] Dhaliwal & Benbazat 1990 [7]	H	H	Y	H
	Cognitive styles (articulability)	Dhaliwal & Benbazat 1990 [7]	M	M	Y	C
	Personality variables	Dhaliwal & Benbazat 1990 [7]	M	L	P	E
	Cognitive problems (consensus among informants)	Byrd et al. 1992 [9]	M	M	Y	C
Cognitive skills	Chao & Salvendy 1995 [13]	M	L	P	M	
<b>Problem Domain</b>	Type of phenomena	Maiden & Rugg 1996 [10]	M	L	P	E
	Type of information (to be elicited)	Browne & Rogich 2001 [14] McCloskey et al. 1991 [15] Kim & Courtney 1988 [16] Maiden & Rugg 1996 [10]	M	M	Y	C
	Type of heuristics	Grabowski 1988 [17]	H	M	P	M
	Availability of information		M	M	Y	+
	Domain fields	Shadbolt & Burton 1989 [18]	L	M	P	E
	Perceived structuredness	Dhaliwal & Benbazat 1990 [7] Kim & Courtney 1988 [16]	M	L	N	E
	Problem definedness		H	M	Y	+
	Uncertainty	Dhaliwal & Benbazat 1990 [7] Fazlollahi & Tanniru 1991 [19]	H	M	P	M
	Type of tasks	Dhaliwal & Benbazat 1990 [7] Wagner et al. 2003 [20] Chao & Salvendy 1995 [13]	L	M	Y	E
	Domain entities	Byrd et al. 1992 [9]	H	H	Y	M
	Confusedness	Fazlollahi & Tanniru 1991 [19]	H	M	P	M
	Size	Kim & Courtney 1988 [16]	H	L	N	E
	Complexity	Kim & Courtney 1988 [16] Holsapple & Raj 1994 [21]	H	L	Y	E
<b>Solution Domain</b>	Product type	Keil & Carmel 1995 [22]	L	M	Y	E
	Problem-solving methods	Dhaliwal & Benbazat 1990 [7]	M	L	N	E
<b>Elicitation Process</b>	Purpose of requirements	Maiden & Rugg 1996 [10]	M	H	N	E
	Constraints (time)	Maiden & Rugg 1996 [10]	H	H	Y	C
	Process time		M	H	Y	+
	Development methodology	Dhaliwal & Benbazat 1990 [7]	L	H	P	E

Table 2. Selected contextual attributes of influence.

FACTOR	ATTRIBUTES	DESCRIPTION	VALUES	DESCRIPTION
Elicitor	Training in Elicitation Techniques	Elicitor's previous training and practice with each elicitation technique	High	Formal and practical training
			Low	Training without practice
			Zero	No knowledge at all
	Elicitation Experience	Number of earlier projects in which the elicitor has carried out elicitation activities	High	More than 5 elicitation projects
			Medium	2 to 5 elicitation projects
			Low	Less than 2 elicitation projects
	Experience with Elicitation Techniques	Number of earlier elicitation activities in which the elicitor has applied each technique	High	More than 5 technique applications
			Low	From 1 to 5 technique applications
			Zero	No application of the technique
	Familiarity with Domain	Number of earlier projects in the domain carried out by or domain knowledge acquired by the elicitor	High	More than 2 projects or formal knowledge
			Low	From 1 to 2 projects or formal knowledge
			Zero	No knowledge at all
Informant	People per Session	Number of individuals that can simultaneously participate in the elicitation session	Individual	1 individual
			Group	From 2 to 5 individuals
			Mass	More than 5 individuals
	Consensus among Informants	Initial agreement between informants	High	Consensus
			Low	No consensus
	Informant Interest	Informant's eagerness to participate in the elicitation sessions	High	Very interested
			Low	Not very interested
			Zero	Uninterested
	Expertise	Informant's expertise in the problem or work domain	Expert	More than 5 years in the domain or role
			Knowledgeable	From 2 to 5 years in the domain or role
			Novice	Less than 2 years in the domain or role
	Articulability	Informant's skill at explaining his or her knowledge	High	Explains knowledge very well
			Medium	Explains knowledge reasonably well
			Low	Does not explain knowledge clearly
	Availability of Time	Time the informant has to spend on the sessions	High	Has enough time
Low			Has less time than necessary	
Location/ Accessibility	Informant's physical location with respect to the elicitor	Far	In a different city from the elicitor	
		Near	In the same city as the elicitor	
Problem Domain	Type of Information to be Elicited	Type of categorized information that the technique can elicit	Strategic	Elicits strategies, control, directives
			Tactical	Elicits processes, functions, heuristics
			Basic	Elicits concepts, attributes, elements
	Availability of Information	Categorized information type that is available before the session	More	There is tactical/strategic information
			Less	There is basic/tactical information
			Zero	There is no information
Problem Definedness	Clarity of the objectives and scope of the project	High	Well defined	
		Low	Poorly defined	
Elicitation Process	Project Time Constraint	Relative time available in the project for applying the technique	High	Not enough time
			Medium	Enough time
			Low	More than enough time
	Process Time	Pre-session stage of the elicitation process	Start	Elicitation of general definitions
			Middle	Elicitation of key requirements
End			Elicitation of last information	

Table 3. Expert opinion and empirical studies supporting the adequacy of techniques.

Technique Attribute	Open-ended Interview	Structured Interview	Task Observation	Card Sorting Laddering	Questionnaires	Protocol Analysis	Repertory Grid	Brainstorming	Nominal Group T.	Delphi Technique	Participant Observation	Prototyping	Focus Group	JAD Workshop	Scenarios/ Use Cases	
E L I C I T O R	<b>Training in Elicitation Techniques</b>	Batista & Carvalho 2003 [23]	Batista & Carvalho 2003 [23]	Maiden & Rugg 1994 [10] Batista & Carvalho 2003 [23]	Batista & Carvalho 2003 [23]	Holsapple & Raj 1994 [21]		Isaksen 1998 [45] Batista & Carvalho 2003 [23]				Batista & Carvalho 2003 [23]	Respect 1997 [33]	Batista & Carvalho 2003 [23]	Sommerville & Sawyer 2004 [35] Batista & Carvalho 2003 [23]	
	<b>Elicitation Experience</b>	Pan et al. 1997 [24]						Offner et al. 1996 [46] Oxley et al. 1996 [47]						Duggan & Thachenkary 2003 [62] Leffingwell & Widrig 2006 [63]	Respect 1997 [33]	
	<b>Experience with Elicitation Techniques</b>	Cooke 1994 [25] Scott et al. 1991 [26]	Agarwal & Tanniru 1990 [8]			Easterby-Smith 1981 [58]								Duggan & Thachenkary 2003 [62]	Dong Gil Ko 1999 [65]	
	<b>Familiarity with Domain</b>		Hoffman 1987 [32]		McGeorge & Rugg 1992 [39]		Holsapple & Raj 1994 [21]					Respect 1997 [33] Zowghi & Coulin 2005 [43]	Lloyd 2002 [6]			Lloyd 2002 [6]
I N F O R M A N T	<b>People per Session</b>	Davis & Hickey 2002c [27] Christel & Kang 1992 [28]	Christel & Kang 1992 [28]	Davis & Hickey 2002c [27]	Cooke 1994 [25]		Liou 1992 [44]	Maiden & Rugg 1994 [10] Respect 1997 [33] Osborne 1953 [48]	Delbecq & Van de Ven 1971 [50]	Boose 1986 [40]				Nielsen 1993 [59] Respect 1997 [33] Engelbrektsson 2002 [60]	Christel & Kang 1992 [28] Wood et al. 1989 [64]	
	<b>Consensus among Informants</b>							Delbecq et al. 1975 [49]	Roth & Wood 1993 [11]							
	<b>Informant Interest</b>	Batista & Carvalho 2003 [23]	Batista & Carvalho 2003 [23]	Jitnah et al. 1995 [29] Respect 1997 [33] Sommerville & Sawyer 2004 [35]		Batista & Carvalho 2003 [23]		Batista & Carvalho 2003 [23]			Jitnah et al. 1995 [29] Saiedan & Dale 2000 [52]	Teng & Sethi 1990 [54] Zowghi & Coulin 2005 [43] Batista & Carvalho 2003 [23]		Batista & Carvalho 2003 [23]	Batista & Carvalho 2003 [23]	
	<b>Expertise</b>	Lloyd 2002 [6]										Lloyd 2002 [6] Alavi 1984 [55]			Lloyd 2002 [6]	
	<b>Articulability</b>	Jitnah et al. 1995 [29]			Byrd et al. 1992 [9]		Wagner et al. 2003 [20] Jitnah et al. 1995 [29]	Byrd et al. 1992 [9]	Byrd et al. 1992 [9]	Liou 1992 [44]		Beyer & Holzblatt 1995 [53]	Christel & Kang 1992 [28]	Engelbrektsson 2002 [60]	Duggan & Thachenkary 2003 [62]	Jones & Britton 1996 [56] Byrd et al. 1992 [9]
	<b>Availability of Time</b>	Chao & Salvendy 1995 [13]				Liou 1992 [44]										
	<b>Location/ Accessibility</b>	Davis & Hickey 2002c [27]								Liou 1992 [44] Roth & Wood 1993 [11]						
	D O M A I N	<b>Type of Information to be Elicited</b>	Christel & Kang 1992 [28] Maiden & Rugg 1994 [10] Kotonya & Sommerville 1998 [30]	Christel & Kang 1992 [28] Maiden & Rugg 1994 [10]	Maiden & Rugg 1994 [10] Cooke 1994 [25]	Boose 1985 [40] Maiden & Rugg 1994 [10]	Liou 1992 [44]	Holsapple & Raj 1994 [21] Kim & Courtney 1988 [16] Maiden & Rugg 1994 [10]	Boose 1985 [40] Kim & Courtney 1988 [16] Pan et al. 1997 [24]	Liou 1992 [44] Maiden & Rugg 1994 [10]	Liou 1992 [44]	Maiden & Rugg 1994 [10] Beyer & Holzblatt 1995 [53] Kotonya & Sommerville 1998 [30]	Maiden & Rugg 1994 [10] Jones & Britton 1996 [56] Sutcliffe 1996 [57] Wiegens 1999 [58]		Christel & Kang 1992 [28]	Maiden & Rugg 1994 [10] Jitnah et al. 1995 [29] Pan et al. 1997 [24] Wiegens 1999 [58]
<b>Availability of Information</b>			Cooke 1994 [25] Hart 1986 [31] Respect 1997 [33]		McGeorge & Rugg 1992 [39] Zowghi & Coulin 2005 [43] Maiden & Rugg 1994 [10]		Maiden & Rugg 1994 [10]	McGeorge & Rugg 1992 [39] Maiden & Rugg 1994 [10]			Respect 1997 [33]					
<b>Problem Definedness</b>													Teng & Sethi 1990 [54] Jones & Britton 1996 [56] Wiegens 1999 [58]			
P R O C E S S	<b>Project Time Constraint</b>	Batista & Carvalho 2003 [23]	Cooke 1994 [25] Geiwitz et al. 1988 [34]	Alexander & Stevens 2002 [36] Precece et al. 1994 [37] Maiden & Rugg 1994 [10]	Batista & Carvalho 2003 [23]	Liou 1992 [44] Cooke 1994 [25] Wagner et al. 2003 [20] Maiden & Rugg 1994 [10]	Geiwitz et al. 1988 [34]	Batista & Carvalho 2003 [23]		Roth & Wood 1993 [11] Delbecq et al. 1975 [49]	Respect 1997 [33] Alexander & Stevens 2002 [36]	Maiden & Rugg 1994 [10] Jones & Britton 1996 [56] Sommerville & Sawyer 2004 [35]		Respect 1997 [33] Alexander & Stevens 2002 [36] Batista & Carvalho 2003 [23]	Batista & Carvalho 2003 [23]	
	<b>Process Time</b>	Cooke 1994 [25] Pan et al. 1997 [24] Hart 1986 [31]						Pan et al. 1997 [24]	Respect 1997 [33]			Jones & Britton 1996 [56]	Respect 1997 [33] Kuhn 2000 [61]		Pan et al. 1997 [24]	

Table 4. Table of references classed by adequacy of techniques.

Factor	Attributes	Open-ended Interv.	Structured Interv.	Task Observation	Card Sorting/Ladd.	Questionnaires	Protocol Analysis	Repertory Grid	Brainstorming	Nominal Group T.	Delphi Technique	Participant Obs.	Prototyping	Focus Group	JAD Workshop	Scenarios/U. Cases
Elicitor	Training in Elicitation Techniques															
	Elicitation Experience															
	Experience with Elicitation Technique															
	Familiarity with Domain															
Informant	People per Session															
	Consensus among Informants															
	Informant Interest															
	Expertise															
	Articulability															
	Availability of Time															
	Location/Accessibility															
Problem Domain	Type of Information to be Elicited															
	Availability of Information															
	Problem Definedness															
Process	Project Time Constraint															
	Process Time															

- : The technique is indifferent for the attribute value in question, that is, there is no guarantee that the results of applying this technique would be better than they would be if others were used. Although this technique is an option, a more adequate technique would be preferable.
- x: The technique has a low adequacy level for the attribute value in question. This technique is not recommended for use under the circumstances described by the attribute, because it is likely to produce worse results than other techniques.

To illustrate how we have compiled Table 5, let's look, for example, at how to assess the *Articulability* attribute for the *Protocol Analysis* technique. This technique involves the informants putting into words how they would reason out a proposed case. The session's success depends, then, on the informants' ability to express their reasoning. Informants that are very good at explaining how they proceed in certain situations will be able to describe quite clearly what actions and heuristics they apply.

If informants have average expression skills, the results are likely to be equally as good, although some significant information may not be delivered. In this case, it is not so clear that the technique should be used.

If informants find it difficult to express their knowledge, the effectiveness of the session will be at stake. Elicitors could capture wrong or shallow information that would not justify the high cost of applying this technique. In this case, the technique would appear to be inadequate.

Additionally, some authors have related the adequacy of this technique to the experts' personality and skill at introspection and correctly verbalizing processes [20]. Similarly, in their review of elicitation techniques, Jitnah et al. claim that users that cannot satisfactorily describe what they do are likely to compromise the technique's success [29]. In an experiment on a number of elicitation techniques, Chao and Salvendy concluded that significant cognitive skills, including expressability, are associated with the protocol analysis technique [13].

Table 5. Adequacy of elicitation techniques for contextual characteristics.

Factor	Attributes	Values	Open-Ended Interv.	Structured Interv.	Task Observation	Card Sorting/Ladd.	Questionnaires	Protocol Analysis	Repertory Grid	Brainstorming	Nominal Group T.	Delphi Technique	Participant Obs.	Prototyping	Focus Group	JAD Workshop	Scenarios/U. Cases	
Elicitor	Training in Elicitation Techniques	High	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		Low	-	√	√	-	√	-	-	√	√	-	√	-	-	-	-	
		Zero	-	-	-	x	-	x	x	-	x	x	-	-	x	x	-	
	Elicitation Experience	High	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Medium	√	√	√	√	√	-	√	-	√	√	√	√	√	√	-	√
		Low	-	-	√	-	-	x	-	-	-	√	√	√	-	-	x	-
	Experience with Elicitation Techniques	High	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Low	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Zero	-	-	√	-	√	-	-	-	√	-	-	-	-	-	x	-
	Familiarity with Domain	High	√	√	-	√	√	-	√	√	-	√	-	√	√	√	√	-
		Low	√	√	-	√	√	√	√	√	-	√	√	-	√	√	√	-
		Zero	√	-	√	-	-	√	-	√	-	-	-	x	x	x	-	
Informant	People per Session	Individual	√	√	√	√	√	√	√	x	x	x	√	√	x	x	√	
		Group	-	-	√	-	√	-	√	-	√	√	√	-	√	-	-	
		Mass	x	x	-	x	√	x	√	√	√	√	√	-	√	√	-	
	Consensus among Informants	High	√	√	-	√	√	√	√	-	√	-	-	√	√	-	√	
		Low	x	x	-	x	√	x	√	-	√	√	-	√	√	-	-	
	Informant Interest	High	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Low	-	-	√	√	√	-	√	-	√	√	-	√	√	-	√	
		Zero	x	-	√	-	√	x	√	x	√	√	x	√	-	x	-	
	Expertise	Expert	√	√	-	√	√	√	√	√	√	√	√	√	√	√	√	√
		Knowledgeable	√	√	√	√	√	-	√	√	√	√	√	√	√	√	√	√
		Novice	-	-	√	√	√	-	√	√	√	√	-	√	√	√	√	√
	Articulability	High	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Medium	√	√	√	√	√	-	√	√	√	√	√	√	√	√	√	√
		Low	-	-	√	√	√	x	√	x	x	√	-	√	x	x	-	
	Availability of Time	High	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Low	-	-	√	-	√	x	√	x	x	√	x	-	-	x	-	
	Location/Accessibility	Far	-	-	-	-	√	x	√	x	x	√	x	x	x	x	-	x
		Near	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Problem Domain	Type of Information to be Elicited	Strategic	√	-	-	x	√	-	x	√	√	√	√	-	√	√	-	
		Tactical	√	√	√	x	√	√	x	√	√	√	√	√	√	√	√	
		Basic	-	√	-	√	√	-	√	x	x	-	-	√	-	x	-	
	Availability of Information	More	√	√	√	x	√	√	x	-	-	√	√	√	√	√	√	√
		Less	√	√	√	√	√	x	√	√	√	√	√	√	√	x	√	√
		Zero	√	x	√	x	x	x	x	√	√	x	√	x	x	√	√	
Problem Definedness	High	-	√	√	√	√	√	√	√	√	√	√	√	√	√	x	√	
	Low	√	-	√	x	√	x	x	√	√	√	-	√	√	√	-		
Process	Project Time Constraint	High	-	-	x	√	√	x	√	x	x	x	x	x	x	x	√	
		Medium	√	√	-	√	√	-	√	-	-	-	-	-	-	-	√	
		Low	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
	Process Time	Start	√	-	√	√	-	x	-	√	√	-	√	-	√	√	√	-
		Middle	√	√	-	√	√	√	√	-	√	√	√	√	√	√	x	√
		End	√	√	x	x	√	-	-	x	x	-	x	-	-	-	-	

For all these reasons, the protocol analysis technique is *recommended* for use with informants that have a *high* articulability score. If the informant's articulability is *medium*, the use of the technique is *indifferent*. This technique is *not recommended* for use with informants that have a *low* articulability rating. We have analysed the other attributes/techniques similarly.

## 5. Discussion and Conclusions

Of the literature surveyed for this study (360 sources), only around 5% (17 papers) contained information about contextual attributes that influence the adequacy of elicitation techniques.

Another 15% (52 papers) provided information about the circumstances under which it is preferable to apply (or not apply) a given elicitation technique.

From the information on contextual attributes, we obtained 11 accepted and modified attributes, to which we added another 5 new attributes, totalling 16 attributes. From the literature on technique adequacy, we obtained 158 expert opinions on how adequate a given technique is under certain circumstances (attribute value), and 19 results from empirical studies supporting the same number of prescribed uses.

For the 15 chosen techniques and the 16 selected attributes, totalling 240 required adequacy values, we found: an expert opinion for 80 (33%), an empirical sign for 14 (5.8%) and empirical evidence for 3 (1.2%) of the required prescriptions.

For the other 143 cases (60%), we found no reference to their prescribed use in the literature. So, despite the pressing need for guidelines on elicitation technique selection, much more research still has to be done on the selection of the most adequate techniques for use in the elicitation process.

Even though more research is required, the framework proposed here can help practitioners to select what technique to apply in a given elicitation session. To do this, the requirements engineer should analyse the context to be able to assign values to the attributes. This assessment defines a scenario on which to apply Table 5. By instantiating Table 5 for their particular case, developers will get a set of elicitation techniques that are adequate for use in the next elicitation session.

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