Chapter 4
Determining Influential Attributes
4.1 Introduction

As specified in the problem statement and illustrated in Figure 4.1, the first step in the proposed solution for deciding which elicitation techniques to select is to determine the set of attributes sourced from all the elements that influence the elicitation process. These attributes will be typed and grouped as factors, and will then be used to determine values that distinguish between and single out elicitation techniques based on adequacy.

Figure 4.1. Influential Attributes in the Proposed Framework.

This set of attributes considers features that are not inherent to the elicitation techniques, that is, these attributes describe not the actual techniques but contextual elements that have an influence on their use. The aim is to somehow encapsulate the techniques and associate only their operational behaviour with each attribute value.

The starting point for establishing the influential or contextual attributes is the information on the state of the art. Accordingly, studies related to technique selection are the main information source. We examined two types of studies in particular: problem-solving framework proposals, of which we gathered six, and empirical studies, of which we retrieved eleven. The problem-solving framework proposals include problem-solving approaches for technique selection defining attributes or factors that the authors propose as applicable for decision making. The empirical studies include experiments aiming to demonstrate that a variation in some contextual attributes makes a difference to the effectiveness of some techniques. Generally, the frameworks propose more techniques and/or attributes than the experiments, but the empirical studies achieve more reliable results to support a selection.

After defining this baseline configuration, we analysed each candidate attribute to decide, based on a number of criteria, whether it should be included in, modified or
removed from the proposed solution. Finally, we analysed attributes not considered in earlier studies, which we believe, from our experience, to be important in decision making on elicitation technique selection.

Apart from defining each attribute, we propose its descriptive values, that is, the benchmark against which it can be measured in a real-world situation. This completes the final set of contextual attributes.

4.2 Attribute Universe

There are a wide range of elements that characterize the requirements elicitation process. They can vary from one development project to another, conditioning elicitation operativeness and effectiveness. From this we can deduce that a particular configuration of these elements will possibly be more advantageous for some elicitation techniques or, alternatively, a particular technique will perhaps be more effective with a certain configuration of process elements. For this reason, it is worthwhile determining the set of elements that characterizes the elicitation process environment. By carefully observing this environment, we will be able to identify some elements that play an obvious role, but others will be trickier to detect or their influence harder to demonstrate. However, if an element is fuzzy or uncertain, it will be harder to demonstrate its relationship to the effectiveness of techniques.

To be able to determine this set of elements we have taken into account related studies on elicitation techniques and the literature associated with their use. The starting point on the path towards this goal is previous research, as, although there is no definitive solution to the selection problem, many authors have studied these elements either as attributes conditioning technique selection or as factors in experiments that aim to compare techniques.

Therefore, some problem-solving attributes that are proposed here were sourced from the experience of researchers who have outlined solutions to the technique selection process, whereas most come from empirical studies that try to demonstrate the bearing that the attributes have on the outcomes of applying the techniques. We have classed the contextual elements influencing elicitation by five factors:

- **Elicitor**: Development team agent that elicits information on software system requirements. Other names, such as analyst or requirements engineer, are used in the literature to refer to this figure or role.
- **Informant**: Human agent that, for the purposes of this research, has the information required to define the requirements. Informants can be customers, users and, generally, anybody that has a stake in software development.
- **Problem Domain**: Set of characteristics describing the focus of the development, that is, the problem that the software system under construction is to solve, and that has an impact on the elicitation process.
- **Solution Domain**: Set of characteristics describing the software product being developed to solve the problem.
- **Elicitation Process**: Part of the development process focusing on gathering requirements.

Table 4.1 presents the initial set of attributes found in the literature grouped by the above factors. We list the authors and the type of studies dealing with each attribute, that is, theoretical proposals (shaded dark grey), empirical studies (shaded light grey) or both (white). Additionally, we annotate their source area, particularly,
whether they were researched software engineering (SE) or knowledge engineering (KE).

### 4.3 Criteria for Analysing Attributes

Based on this initial grouping, we output a final set of attributes in order to implement and validate the proposed solution. To do this, we analysed each candidate attribute and justified its inclusion, modification or removal from the final attribute set. Additionally, we added some attributes that no other authors have proposed to date, but which, based on our practical and theoretical experience, we believe to have an influence on technique effectiveness.

The attributes were analysed according to criteria used to make a decision about the attributes. Below, we describe the criteria and actions underlying the attributes analysis.

We established a number of criteria to decide whether an attribute should be selected to be part of the final attribute set. These criteria are related to the feasibility of building a thorough scheme, that is, attributes with their values. They should implement the framework for use by end users (requirements engineers), where the attribute is guaranteed to somehow make a difference to technique effectiveness.

These criteria are:

- **Theoretical Justifiability (TJ):** Possibility of finding a justification for the attribute influencing elicitation technique effectiveness. The possible values for this criterion are: No (N), Possibly (P), and Yes (Y).

- **Assessability (A):** Possibility of establishing ratings for the different attribute values. The possible values are: Low (L), Medium (M) and High (H).

- **Instrumentability (I):** Possibility of rating the attribute in a reasonable time during a development project. The possible values are: Low (L), Medium (M), and High (H).

After analysing and assessing these criteria for all the attributes, a decision can be made about what to do with each attribute. These criteria are an objective and reasoned basis for deciding which attributes are to be part of the elicitation process. The actions that can be taken with respect to the attributes are:

- **Accept (A):** Approve as it is.

- **Eliminate (E):** Remove because it fails to comply with an eligibility criterion. To be precise, the Influence is **NOT** justified, or Assessability is **LOW** or Instrumentability is **LOW**. This requirement is due to the fact that, if we want the proposed framework to really be a practical guide, the values of the attributes must be clearly distinguishable and should be able to be quite quickly and easily assigned a value in a particular development case.
## Table 4.1. Set of Candidate Attributes.

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>ATTRIBUTES</th>
<th>AUTHORS</th>
<th>STUDY</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elicitor</td>
<td>Requirements engineering experience</td>
<td>Lloyd 2002</td>
<td>Empirical</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agarwal &amp; Tanniru 1990</td>
<td>Empirical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td>Technical knowledge</td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td>Domain knowledge</td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td>Elicitation methods experience</td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td>Informant</td>
<td>Number of users</td>
<td>Maiden &amp; Rugg 1996</td>
<td>Theoretical</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td>Number of experts</td>
<td>Roth &amp; Wood 1993</td>
<td>Empirical</td>
<td>KE</td>
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<tr>
<td></td>
<td>User participation</td>
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<td>Empirical</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td>Expertise</td>
<td>Burton et al. 1990</td>
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<td>KE</td>
</tr>
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<td></td>
<td>Dhaliwal &amp; Benbazat 1990</td>
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<td>KE</td>
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<td>KE</td>
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<td>Theoretical</td>
<td>KE</td>
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<td>Cognitive skills</td>
<td>Chao &amp; Salvend&amp; 1995</td>
<td>Empirical</td>
<td>KE</td>
</tr>
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<td>Problem Domain</td>
<td>Phenomena type</td>
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<td>Theoretical</td>
<td>SE</td>
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<tr>
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<td>Information type</td>
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<td>Empirical</td>
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<td></td>
<td>McCloske&amp; et al. 1991</td>
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<td>KE</td>
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<td></td>
<td>Lauesen 2002</td>
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<td>SE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kim &amp; Courtney&amp; 1988</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maiden &amp; Rugg 1996</td>
<td>Theoretical</td>
<td>SE</td>
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<td>KE</td>
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<td>Shadbolt &amp; Burton 1989</td>
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<td>KE</td>
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<tr>
<td></td>
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<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kim &amp; Courtney&amp; 1988</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
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<td>Uncertainty</td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td>Task types</td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wagner, Chung &amp; Najdawi 2003</td>
<td>Empirical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chao &amp; Salvend&amp; 1995</td>
<td>Empirical</td>
<td>KE</td>
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<td>Domain entities</td>
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<td>SE</td>
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<tr>
<td></td>
<td>Fuzziness</td>
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<td>Theoretical</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>Kim &amp; Courtney&amp; 1988</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td></td>
<td>Complexity</td>
<td>Kim &amp; Courtney&amp; 1988</td>
<td>Theoretical</td>
<td>KE</td>
</tr>
<tr>
<td>Solution Domain</td>
<td>Product type</td>
<td>Keil &amp; Carmel 1995</td>
<td>Theoretical</td>
<td>SE</td>
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<td>KE</td>
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<td>Maiden &amp; Rugg 1996</td>
<td>Theoretical</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td>Constraints</td>
<td>Maiden &amp; Rugg 1996</td>
<td>Theoretical</td>
<td>SE</td>
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<tr>
<td></td>
<td>Development methodology</td>
<td>Dhaliwal &amp; Benbazat 1990</td>
<td>Theoretical</td>
<td>KE</td>
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</tbody>
</table>
• **Merge** (M): Fuse with another attribute because proposals by different authors are similar.

• **Change** (C): Modify the name or description originally suggested by their author to make the meaning clearer.

• **Aggregate** (+): Add an attribute that has not been considered before because we believe it to be relevant to elicitation technique effectiveness. We also justify why these attributes have been proposed based on the criteria scheme.

### 4.4 Attribute Analysis

In the following we detail the analysis of each attribute. Table 4.2 is a summary of this analysis presenting the attributes followed by the analysis criteria applied to determine an action on the attributes.

The results of the analysis are organized below by groups of attributes depending on the actions: first the eliminated attributes (shaded light grey with the elimination criterion in bold type), followed by the accepted, merged and changed attributes (white) and, finally, the added attributes (shaded dark grey).

#### 4.4.1 Eliminated Attributes

Of the 29 attributes gathered from the literature, there are 12 for which, although they are interesting, it is hard to either establish possible values, assign a particular value in a real case or justify their influence.

#### 4.4.1.1 Elicitor Factor

**4.4.1.1.1 Cognitive Problems**

Byrd and colleagues deal with this aspect as a dimension for relating their categorization scheme to the adequate techniques [Byrd et al. 1992]. They classify these problems into three types of obstacles to the communication that should take place between the elicitor and informant.

These characteristics do appear to be somehow related to technique effectiveness, but this is hard to demonstrate. That is, some theoretical justification could possibly be found for this attribute influencing technique effectiveness.

The values of these problem types can be used to rate this attribute, although it is unclear whether they cover the universe of existing cognitive problems. The above justifies rating the assessability criterion as medium.

The task of assigning a value for this type of problems in a real elicitation situation would be even more complicated. This would mean running psychological tests. The time this would take would be unwarranted in the case of technique selection decision making. For this reason, the instrumentability of the attribute is considered to be low.

On the above grounds, we decided to eliminate the attribute.
<table>
<thead>
<tr>
<th>FACTOR</th>
<th>ATTRIBUTES</th>
<th>ASSESSABILITY</th>
<th>INSTRUMENTABILITY</th>
<th>THEORETICAL JUSTIFIABILITY</th>
<th>ACTION</th>
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<td>C</td>
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<td>Cognitive problems</td>
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<td>P</td>
<td>E</td>
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<td>M</td>
<td>Y</td>
<td>C</td>
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<td>Number of experts</td>
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<td>Y</td>
<td>M</td>
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<td></td>
<td>Time availability</td>
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<td>M</td>
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<td>P</td>
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<td>+</td>
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<td>Development methodology</td>
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<td>M</td>
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</table>

Table 4.2. Analysis of candidate attributes.
4.4.1.2 Informant Factor

4.4.1.2.1 Personality Variables

Dhaliwal and Benbazat proposed this attribute as a moderator variable for relating their model to adequate techniques [Dhaliwal & Benbazat 1990]. However, it is not well enough explained—or even defined—to be able to analyse it correctly.

We might venture that it refers to the intrinsic characteristics of each human being modelling his or her personal and social behaviour, for example, characteristics like sociability, warmth, sensibleness, introversion, etc. These characteristics could be somehow related to elicitation technique effectiveness, but this is hard to demonstrate. That is, some theoretical justification could possibly be found to influence technique effectiveness.

Looking at how to rate this attribute, the question then gets tougher as we would have to determine the set of all possible personalities, which would shift the problem into the domain of sociology or psychology. This justifies considering assessability as medium.

The task of assigning a personality value to a subject in a real elicitation process would be even harder. This would mean running psychological tests. The time this would take would be unwarranted in the case of technique selection decision making. For this reason, we consider the instrumentability of the attribute to be low.

On the above grounds, we decided to eliminate the attribute.

4.4.1.3 Problem Domain Factor

4.4.1.3.1 Phenomena Types

Maiden and Rugg suggest this facet in their proposal to differentiate the elicitation techniques [Maiden & Rugg 1996]. It should distinguish between visually perceptible acts that occur in the problem domain. There are no other studies that mention or use this attribute.

There is reason to subscribe to the idea that some techniques may, by nature, be better at capturing visual information than others. In other words, there are elicitation techniques that can capture facts that are not visible and others that cannot capture information that is not observable. Indeed, there are techniques that include the concept of observation in their name.

Therefore, it can be said that, yes, there is enough justification to indicate that this type of phenomena influence technique selection.

As far as the possible values for this attribute, it would appear to be quite straightforward to rate. The authors of the proposal define yes or no values to indicate whether or not the phenomena are observable. Accordingly, the value for assessability would be high.

Having to assign one of these values to a problem in a particular project would be a tougher order. There should be a simple rule or mechanism for determining whether or not the information to be elicited is observable. In practice, however, information is present in observable and non-observable events. This situation would unnecessarily complicate decision making on technique selection. Therefore, the instrumentability of the problem size is considered low.

On the above grounds, we decided to eliminate the attribute from the final set of attributes influencing elicitation technique selection.
4.4.1.3.2 Domain Fields

Domain fields refer to the professional areas to which the problem to be solved is confined. Shadbolt and Burton ran an experiment in an attempt to demonstrate that the fields of geology and geography made a difference to the effectiveness of some techniques [Shadbolt & Burton 1989]. However, they failed to reach conclusive findings. No other empirical or theoretical research proposes relating fields to technique effectiveness.

Some techniques are likely to be more effective in certain areas, but this is more likely to be due to the structure or the type of information than to the specific field. It is extremely difficult to find out whether the effectiveness is due to the field in question or to some other attribute conditioning the field. We find that there is possibly some justification for this attribute, but it is not satisfactory.

It would be a monumental and unmanageable task to define values for this attribute, as there are innumerable possible fields in which a software system might be developed. For this reason, assessability is considered low.

Equally, it could be hard to establish the value of the problem field in some developments. A transport system for a mining company can be considered to be in the transport field and the mining field. For this reason, the instrumentability criterion is rated as medium.

According to the above, we decided to eliminate the attribute and not select it for the final scheme.

4.4.1.3.3 Perceived Structuredness

This attribute is defined as uncertainty about the nature of the relations between the elements in the problem space. There are two theoretical studies that relate this attribute to the elicitation techniques. Dhaliwal and Benbazat present the attribute in their model as a moderator variable for technique choice [Dhaliwal & Benbazat 1990], and Kim and Courtney relate it to the effectiveness of certain techniques [Kim & Courtney 1988].

Based on the definition provided by the authors, it is very difficult to understand how this attribute could be related to technique effectiveness. It is to be supposed that some techniques work better for a certain level of structuredness. However, the theoretical or heuristic reasoning indicating which of the techniques is recommended for which level of structuredness is not specified. For this reason, we find that there is not enough justification to associate this attribute with techniques.

As regards domain structuredness, we have to define the values that it could take. In this case, the simplest thing would be to define the values as low, semi- or well-structured, but this is a very ambiguous classification. For this reason, the assessability of this attribute is rated as medium.

The task of assigning a value for the structuredness of the particular problem for which the software solution is being developed and about which information is still unknown at the early stage of elicitation appears to be even more difficult. It is not easy to generate a list of problems that are related to a particular degree of structuredness. Additionally, even if a domain has a given level of structuredness, the software systems to be developed in the domain can be very diverse. For this reason, the instrumentability of this attribute is rated as low.

For this reason, we decided to eliminate this attribute from the final table.
4.4.1.3.4 Tasks Type

Several studies [Dhaliwal & Benbazat 1990][Wagner, Chung & Najdawi 2003][Chao & Salvendy 1995] consider the type of tasks as an attribute. Dhaliwal and Benbazat use this attribute in their proposal but do not give a clear definition. In the other two empirical studies, tasks type is used as a moderator variable for evaluating elicitation techniques.

These studies show and provide evidence that some techniques appear to work better for capturing information about a certain type of tasks. The type of tasks refers in these cases to whether the problems dealt with are diagnostic, planning, design, etc. Therefore, yes, there can be said to be enough justification to indicate that the type of tasks influences technique selection.

As regards the values that this attribute could take, it is unclear what all the task types are and whether they are mutually exclusive. For this reason, the value for assessability would be low.

Also it would be hard to assign one of these values to a problem in a particular project. The above task types refer to knowledge-based system tasks, and there is no clear extrapolation to conventional software. Therefore, a medium value is associated with the instrumentability criterion of this attribute.

On all the above grounds, we decided to eliminate the attribute from the final set of attributes influencing technique selection.

4.4.1.3.5 Size

Problem size is an attribute often considered in software project management metrics. It is used to quantify a series of parameters that will help development. Kim and Courtney relate this attribute to elicitation techniques, although they do not explicitly define how it can be sized in practice [Kim & Courtney 1988]. There are no other works that mention size as an attribute related to elicitation techniques.

Even if we agree that techniques can, by nature and irrespective of the technique, capture a certain amount of information, this productivity rate will not vary in accordance with problem size. That is, size does not make a difference to technique effectiveness. Whereas it is likely to take two techniques a different amount of time to capture information about the same problem, this difference would be the same for another problem of a greater or lesser size. In other words, although it is logical to think that it will take longer to elicit more information, the technique will not be changed merely because the problem size increased. This change will depend on other factors. Therefore, we can say that there is not enough justification to indicate that size influences the elicitation technique selection.

In relation to the possible values for this attribute, the simplest thing is to rank it vaguely by sizes, that is, from small to large. On this ground, the assessability value would be high.

It would be harder to assign one of these values to a particular problem in a project. There would have to be a simple rule or mechanism to determine whether the problem is small or medium. This situation would complicate technique selection decision making unnecessarily. Therefore, the instrumentability of the problem size is considered low.

On the above grounds, we decided to eliminate the attribute from the final set of attributes that influence the technique selection decision.
### 4.4.1.3.6 Complexity

Complexity is a factor used by Kim and Courtney in their framework to relate some knowledge elicitation techniques and a few other features of the problem domain [Kim & Courtney 1988]. Domain complexity was defined by the authors as the number of interrelations among elements. Other researchers used this factor as a moderator variable in an experiment to compare two elicitation techniques [Holsapple & Raj 1994].

These studies show and provide evidence that some techniques appear to work better for capturing information about problems that are simpler than others. Therefore, it can be said that, yes, there is enough justification to indicate that size influences technique selection.

Relative values, like simple, medium or complex, could be considered as possible values for this attribute. On this ground, the value of assessability is high.

It would be hard, however, to assign one of these values to a problem in a particular project. There is no clear and systematic heuristic to define a value at a particular time. Therefore, the instrumentability of complexity is considered to be low.

On the above ground, we decided to eliminate the attribute from the final set of attributes influencing technique selection.

### 4.4.1.4 Solution Domain Factor

#### 4.4.1.4.1 Product Type

Product type is a factor used to compare several techniques and resources for capturing requirements in an empirical study [Keil & Carmel 1995]. Two types were considered in the study: package development, that is, products for sale, and in-house or outsourced development for internal use.

This study found some evidence that some less traditional techniques appear to work better for capturing requirements for custom-built products. The best known methods do not make a distinction between the two product types. Therefore, we can say that there is possibly enough justification to indicate that size influences technique selection.

In relation to the values that this attribute could take, although two product types are used in the study, they are by no means representative of all the products that could be built, nor do they appear to be exclusive. On this ground, the value of assessability would be low.

It would appear to be somewhat easier to assign a value for a project. The products and their general development features are easy to identify. Therefore, the instrumentability of the product type attribute is considered high.

On the above ground, we decide to eliminate the attribute from the final set of attributes influencing technique selection.

#### 4.4.1.4.2 Problem-Solving Methods

A couple of problem-solving methods are used in the framework proposed by Dhaliwal and Benbazat as a moderator variable for classifying elicitation techniques [Dhaliwal & Benbazat 1990]. However, there is no clear definition or proposal that relates techniques and methods.
Determining Influential Attributes

Being only an incomplete theoretical proposal, technique effectiveness cannot be said to differ with respect to the problem-solving methods used. Therefore, we can conclude that there is not enough justification to indicate that size influences technique selection.

There are no proposals or mature theories about the possible values for this attribute. Neither is it clear whether these values could be mutually exclusive in a development, that is, they could both be used in some cases. On this ground, the assessability value would be low.

Also it appears to be difficult to distinguish the problem-solving method to be used in a particular case. Therefore, the instrumentability of this attribute is considered low.

On the above grounds, we decided to eliminate the attribute from the final set of attributes influencing technique selection, as it does not appear to be a suitable factor in this study.

4.4.1.5 Elicitation Process Factor

4.4.1.5.1 Requirements Purpose

This attribute refers to the purpose of the software requirements specification. According to Maiden and Rugg, the only proposal that considers this attribute, it may be advisable to use different techniques for different purposes: select known commercial packages, select unknown commercial packages or provide legal contracts [Maiden & Rugg 1996].

Despite the proposal of these authors, it is unclear that the final purpose of the requirements can condition the use of one or other technique. The requirements specification could vary depending on their purpose, but this does not mean that the information to be elicited could be different, and it is this that could make a difference to the techniques. In conclusion, there is not enough justification to warrant its inclusion.

This attribute can be rated considering the universe of purposes to which the requirements process can be put, but there is a risk of it not being complete due to the wide range of directions there now are in software development. On this ground, the assessability of this candidate attribute is rated as medium.

Having determined the values for this attribute, it should not be difficult to assign a value for a particular project. The early process activities can ascertain and classify the purpose of requirements without any major doubts. For this reason, instrumentability is high.

As no reasons were found to justify the influence of the attribute on technique selection, we decided to eliminate it from the framework.

4.4.1.5.2 Development Methodology

This attribute refers to the methodology used to develop the system. It is proposed by Dhaliwal and Benbazat in their framework to relate techniques and moderator variables [Dhaliwal & Benbazat 1990].

However, they do not establish a proposal for instantiating the effectiveness of each technique for each development case. For this reason, there is no foundation for accepting its inclusion. Some techniques probably focus on certain development methodologies (for example, prototype for prototyping), but it not absolutely clear that
they exclude other methodologies. In conclusion, there is possibly some justification for considering its final inclusion.

For this attribute, it is hard to divine the universe of methodologies that it would cover. Additionally, there may be mixture of methodologies in some cases that would make it hard to rate. On this ground, its assessability is rated as low.

Having determined the values for this attribute, if at all possible, it should not be hard to assign a value for a particular project. The decision on the methodology to be used in the development should be made before starting the elicitation. For this reason, the value for instrumentability is high.

Due to the fact that no reasons were found to justify the influence of the attribute on technique selection, we decided to eliminate it from the table.

4.4.2 Accepted/Merged/Changed Attributes

Of the 29 initial attributes, a group of 17 were accepted, has their name changed or were merged with another attribute in the scheme. This subset resulted in an input of 11 attributes to the final scheme.

4.4.2.1 Elicitor Factor

4.4.2.1.1 Requirements Engineering Experience

This attribute is related to the elicitor’s previous career in software systems development activities, mainly in the requirements stage. Dhaliwal and Benbazat [Dhaliwal & Benbazat 1990] propose this attribute in their requirements capturing model, but it is not considered in the other five theoretical proposals that we found. Other authors, [Lloyd 2002] and [Agarwal & Tanniru 1990], of the eleven empirical studies considered, used the attribute as variables in their experiments, where it was defined as participations in earlier analysis activities.

Even though only one proposal thought this attribute to be influential and the two of the eleven empirical studies that considered the attribute did not find sufficient evidence of its influence, it does not appear to be risky to claim that elicitor experience can be a target requirement for the effective application of some techniques that require greater proficiency. Operationally more complex techniques could achieve better results if the elicitor is more experienced. A novice could get into a mess with the practical development of the session and be less effective using a particular technique. On the other hand, there will be other techniques that, due to their simplicity and structure, novices will be able to apply with similar results to experienced elicitors. On the above ground, we conclude that, yes, there is some theoretical justification for the influence of experience on the use of techniques.

There are no obstacles for being able to define a rating for this attribute. Its assessability is high as a ranking of values could be prepared describing how long the elicitor has been doing requirements elicitation or quantifying the elicitation activities. This would define a range of experience from novices to experts.

With respect to instrumentability, whichever the chosen rating type, time or number of activities, it would be easy to determine elicitor experience in the case of a real software system development, as the informants’ curriculum would be accessible throughout. The above means that the instrumentability of this attribute can be considered high.
Therefore, we selected this attribute but **changed** the name to **Elicitation Experience**, as this is the activity that can provide comparative advantages with respect to other techniques. Requirement experience could correspond to another type of activities that are not related to interaction with informants, such as specification or validation, detracting validity from the attribute.

### 4.4.2.1.2 Elicitation Technique Technical Knowledge

Only in the research of Dhaliwal and Benbazat [Dhaliwal & Benbazat 1990] is this attribute considered, which is strange. But perhaps its influence is so obvious that other researchers overlook this point. According to these authors, previous elicitor knowledge of elicitation methods or techniques is an attribute to be considered in the evaluation of techniques. On the other hand, none of the empirical studies has considered technical knowledge as a study variable or factor.

Although there are no empirical indications of the influence of this attribute on the use of the techniques, a requirements elicitor who has had some previous training in elicitation techniques generally can be expected to be able to direct the sessions more self-assuredly and benefit more from those that require a basic knowledge and overview of the process and its goals. Especially if the knowledge is due to some formal training, such as having taken a specialization course or have practised using the techniques. On the other hand, it may not be advisable for someone without any previous knowledge to use certain techniques, due to the effect that the low expected performance could have on their effectiveness. For this reason, we deduce that, **yes**, there is some *theoretical justification* for its influence on technique selection.

Attribute values can be defined by classifying the type and/or level of knowledge (or training) and practice acquired previously. This way, the assessment could offer yes/no values indicating whether or not the elicitor has the knowledge or a range from zero knowledge or practice to a sizeable level of training in elicitation techniques. Therefore, the *assessability* of this attribute is **high**.

On the other hand, the educational and professional information on the elicitor in a particular development case would definitely be available, meaning that this attribute value could be determined quite quickly before starting the elicitation process. On this ground, the attribute is guaranteed to be able to be instrumented, that is, assigned a single value, and *instrumentability* is rated as **high**.

On the above grounds, we decided to maintain the attribute but **change** its name to **Elicitation Techniques Training**, as knowledge could be very basic and theoretical, which detracts from the impact on effectiveness, whereas training indicates a greater depth and solidity of the knowledge.

### 4.4.2.1.3 Domain Knowledge

Again, the researchers Dhaliwal and Benbazat [Dhaliwal & Benbazat 1990] are the only ones to propose this attribute as a parameter for selecting techniques. Neither are there any empirical works that study a possible influence of domain knowledge on technique effectiveness, perhaps because the general results can be predicted beforehand. However, it is an attribute that would make a very clear difference to technique effectiveness.

In spite of the absence of empirical results, the domain knowledge of the application is a facet that clearly influences technique selection, because an elicitor that is more familiar with the domain will give preference to the selection of some techniques over others. Some techniques require some previous knowledge of the
problem for the session to be properly prepared, the technique to be used proficiently and to get better results. If this knowledge is already available, it will prevent time being wasted in earlier sessions, sometimes using other techniques, and enrich the captured information.

This way, previous domain knowledge can enable the elicitor to optimize session productivity by properly enacting the procedure of some techniques. On the other hand, for other techniques, some familiarity with the domain will be a necessary requirement to recommend its use. Therefore, we conclude that, yes, there is justification for the influence of this attribute on the choice of elicitation techniques.

The attribute values can reflect whether or not there is domain knowledge on the problem, and, if there is, how and how much of this knowledge was gathered. This characterization appears, a priori, to be complete and clearly possible, meaning that the assessability of this attribute is high.

Similarly, determining the value of domain knowledge that an elicitor needs to have in a particular software system development project is quite a straightforward decision as the elicitor can deliver this information in a short interview or curriculum. This way, the instrumentability of this attribute will be rated as high.

Briefly, we decided to select the attribute but change its name to Domain Familiarity, as formal knowledge of the domain does not appear to be necessary to improve technique effectiveness.

4.4.2.1.4 Elicitation Methods Experience

Dhaliwal and Benbazat [Dhaliwal & Benbazat 1990] are the only authors that propose this attribute as an independent variable in their requirement techniques selection model. But this attribute appears to be related to technique training (technique knowledge) and elicitation experience, also proposed in the authors’ model. This attribute does not appear in any empirical research used to compare technique effectiveness.

Despite the above, the experience of an elicitor in a particular technique, or complex or similar techniques can help to achieve better results. Evidently, an elicitor having previous experience in a technique will use the technique more effectively than other unfamiliar or similar techniques. Additionally, however, it also means that similar techniques will be preferred over other unfamiliar techniques, as some of the benefits of previous practice are likely to rub off. This experience will make the elicitor more proficient, thereby increasing the effectiveness of the applied technique.

Without experience, simple techniques are likely to be preferable over those that require more knowledge of their procedures. On this ground, previous experience in certain techniques can be said to make a difference to effectiveness. This way, we deduce that, yes, there is justification for the impact of experience on the effectiveness of specific techniques.

Unlike elicitation experience, this attribute can be assessed by counting the previous activities performed by the elicitor using particular groups of techniques or the cumulative time spent on them. In any case, the task of defining the possible value ranges for this attribute does not appear to be complicated, meaning that its assessability can be considered high.

Moreover, it is not hard to assign a value to an elicitor experience attribute in a particular project, as all it would take is to find out the particulars from his or her curriculum. This way, attribute instrumentability would be high.
On the above ground, we decided to accept the attribute. All we did was to expediently change the name to Elicitation Technique Experience.

4.4.2.2 Informant Factor
4.4.2.2.1 Number of Users

The number of users that participate in the elicitation process is considered in Maiden and Rugg's study. In their technique selection proposal [Maiden & Rugg 1996] this attribute prescribes the use of certain techniques over others. Apart from this theoretical framework, there are no empirical works that study this attribute.

The number of people from which the information necessary to put together the software system requirements is to be gathered can vary from project to project, and this can condition the elicitation process. On the one hand, there being fewer people could simplify the task of reaching agreement on key problem aspects but would make it harder to capture detailed and richer information. On the other hand, having a lot of people giving opinions could complicate the sessions and provide inconsistent information. In this case, group-focused techniques that help to bring results into line are likely to be more recommendable than individual techniques. On the above grounds, it can be concluded that, yes, there is justification of the impact of the number of users on the selection of the technique to be applied.

With respect to the possible rating of this attribute, it is quite evident that it can be classified numerically by establishing adequate value ranges. Therefore, the definition of values should implicitly be a simple task and, therefore, its assessability is high.

When defining the attribute values numerically, this enormously simplifies the task of categorizing a particular development project case. That is, the number and type of people that own useful information for defining the requirements could be gauged quite quickly. With these data, we can establish the value for the attribute in question. Thus, the instrumentability of the attribute can be considered high.

The above constitute sufficient grounds to select the attribute with a change of name. The users are not the only roles from which we can capture key information for the requirements. There are a series of development stakeholders, meaning that the attribute has been generalized and is now referred to as Individuals per Session.

4.4.2.2.2 Number of Experts

Experts are people that have key knowledge of a domain and have mainly been used in knowledge acquisition sessions for the development of knowledge-based systems. In this context, Roth and Wood used this attribute in an empirical study to test whether certain elicitation techniques are more effective with groups of experts [Roth & Wood 1993].

We can assure that experts in a domain can be important sources of information for any other type of software system. On the other hand, the people or users of the problem-related functions under development can have acquired a level of experience similar to formal experts, where they can conduct similar sessions to capture requirements information. Conclusively, these experts can be considered as candidate individuals for the elicitation process and therefore associated with the above Individuals per Session attribute.
On the above grounds, we decided to merge this attribute with the **Individuals per Session** attribute, considering experts as particular sources of requirements information.

### 4.4.2.2.3 User Participation

The user is a major agent in the elicitation process, the cornerstone and a critical factor of process success. Without adequate participation, it would be unfeasible to successfully finish a software system development. Despite this evident tautology, there are no problem-solving proposals that suggest that the user makes a difference to technique effectiveness. Among the empirical studies, only Lloyd uses this attribute as factor in his or her study [Lloyd 2002] to differentiate technique effectiveness depending on user participation.

We might examine how motivated or interested subjects are before initiating elicitation activities to decide whether to use one or other technique. There are elicitation techniques that benefit from user talkativeness and verbal fluency, because they favour interactivity and extroversion.

On the other hand, other more structured techniques and impersonal techniques will be able to be applied where users are averse to participating in the elicitation process. That is, the user's willingness to participate has an influence on the selection of the adequate elicitation technique. For this reason, we conclude that, **yes**, there is justification for this attribute.

There are several options for defining possible values for this attribute. Participation in the process is something that cannot be measured until the session is complete, meaning that it is not advisable to directly propose values. However, participation is the direct consequence of the informant’s motivation or interest, meaning that the values of this attribute would have to be related to whether or not there is any such interest and how much. In view of the above, the **assessability** value for this attribute can be said to be **high**.

It is not very clear what means to use to determine a value for user interest in a particular case. Perhaps, the attribute could be ranked by running a simple or quick test or interview. For this reason, the **instrumentability** of this attribute is **medium**.

Therefore, we decided to select this attribute for the final scheme with a change of name. As suggested above, participation is rather a consequence of the informant’s motivation or eagerness, meaning that we renamed the attribute as **Informant Interest**.

### 4.4.2.2.4 Expertise

The quality of the expertise of the people in a domain involves different reasoning and communication mechanisms. This condition was studied by Burton and colleagues to measure the effectiveness of some techniques by different levels of subject experience [Burton et al. 1990]. Apart from this empirical study, Dhaliwal and Benbazat considered it in their theoretical framework [Dhaliwal & Benbazat 1990] as an important factor for selecting a technique.

Informants become especially skilled at doing their job through experience, which is in many cases irreplaceable. This subject characteristic can make a difference to the elicitation process. Eliciting information from someone that has a high level of expertise in a domain calls for the use of techniques that are able to retrieve his or her reasoning and knowledge with some effectiveness. Some techniques
could be useless for this case of experts and others could be oversized for people new to their jobs. For this reason, we infer that, yes, there is justification for the impact of the informant’s expertise on selecting the right elicitation technique.

Some users in organizations have been there for so long that they are experts at doing their job. This is an indication as to how to define the possible values for this attribute. In this case, the time the person has been doing the job appears to be an adequate metric for establishing the values that can distinguish the attribute. Therefore, assessability is high.

Considering the temporal values of the attribute, it should not be hard to rate the expertise level for an informant in a real case. All we would have to do is look up how long he or she has been performing his or her job in the domain. For this reason, instrumentability is high.

In conclusion, we decided to accept expertise level as an element of the final set of attributes.

4.4.2.2.5 Cognitive Styles

This attribute is related to people’s skill at analysing and explaining the components of their knowledge. The authors Dhaliwal and Benbazat propose this attribute in their study, albeit without any further explanation of its influence on technique selection [Dhaliwal & Benbazat 1990]. Apart from this study there are no other theoretical or empirical studies that examine this attribute in relation to techniques.

Despite this minor reference in elicitation technique research, this characteristic of the people that are to participate in the elicitation process appears to be relevant. In this process, where the elicitor wants to retrieve information stored in people’s brains, it is necessary to build an expeditious communication bridge. This is more straightforward if subjects are well able to articulate their reasoning.

More impersonal or structured techniques will be able to capture information from informants that are less able to put their thoughts into words. On the other hand, other more interactive techniques require subjects to be skilful at clearly thinking aloud. For this reason, we can deduce that, yes, there is justification for the articulation of reasoning influencing the choice of an elicitation technique.

The task of determining values for informant articulability appears to be quite complicated, as it would be no good just to describe it as low, medium or high, for example, because that would not be self-explanatory enough. Alternatives have to be examined for clearly defining each possible value. On this ground, the assessability criterion of the attribute would be medium.

Similarly, when trying to rate this attribute for an informant in a real development project, the challenge would be to decide which instrument to use to be able to measure articulability. A possible medium would be some sort of test for determining the respective value. For this reason, the value of the instrumentability criterion for this attribute is rated as medium.

From the above, and in view of the fact that it is practicable, we conclude that this attribute is selected for the final table with a change of name. To improve the understandability of the attribute and make it self-explanatory, it will be renamed as Articulability.
4.4.2.2.6 Cognitive Problems

This attribute is related to the cognitive deficiencies of human beings as information processors and communicators. In particular, the authors Byrd, Cossick and Zmud proposed this attribute in their approach as an obstacle to the requirement process. In their proposal [Byrd et al. 1992] present three types of problems that affect the process: individual (cognitive problems of each person as problem solvers), one-to-one (cognitive problems between two people that do not speak a common language) and many-to-many (problems within a group of people to agree on requirements). There are no other theoretical or empirical works that consider this facet.

The first type of problems, of people as individuals, was already considered in the articulability attribute, meaning that it is automatically discarded. Problems between the elicitor and informant can be represented as the communication between the two. This can be analysed separately for each participating agent, meaning that we could be replicating an attribute that has already been examined for each participant separately. Additionally, such an attribute would appear, a priori, to be hard to rate and instrument.

The third type of problem, that is, the problem of balancing the requirements of multiple people, leading to competition and clashes of interest, can have an important link to the choice of an adequate technique. Some elicitation techniques are able to help a group of informants stating their viewpoints about the problem to reach a satisfactory agreement. Other techniques will require such agreement beforehand to be able to be applied effectively. For this reason, we agree that, yes, there is enough justification for how much agreement there is among informants influencing technique selection.

If we want to determine the values associated with this attribute, we have to establish certain levels of consensus. This task does not appear to be easy, although it could be simplified by defining yes/no values to indicate whether or not there is consensus. For this reason, attribute assessability is established as medium.

Equally, the task of establishing a value for this attribute for a particular development case is complicated. Establishing whether or not there is consensus requires a quick and clear instrument. Otherwise, it is impracticable. For this reason, we consider a medium value for the instrumentability of the attribute.

On the above grounds, we decided to change the attribute, focusing on only one type of cognitive problem and renaming it as Consensus among Informants.

4.4.2.2.7 Cognitive Skills

In the experiment run by Chao and Salvendy to test the relation between informant cognitive characteristics and the elicitation techniques used, they ranked skills [Chao & Salvendy 1995]. Skills related to people’s ability to express their ideas are prominent. These conditions were already analysed in another attribute.

On the above ground, we decided to merge this attribute with Articulability.

4.4.2.3 Problem Domain Factor

4.4.2.3.1 Type of Information

This attribute is related to the description of the information to be gathered in the domain to put together the requirements. There are three theoretical studies that deal with this attribute. Maiden and Rugg propose this attribute as a key facet for
applying some techniques, that is, they prescribe a particular group of techniques depending on the information type [Maiden & Rugg 1996]. Kim and Courtney also consider this attribute and relate it to the recommendation to use certain techniques [Kim & Courtney 1988]. Lauesen defines how effective each technique is for capturing different types of information [Lauesen 2002]. Apart from these theoretical works, there are two empirical studies that tried to establish whether some techniques are more effective than others at capturing a certain type of information [Browne & Rogich 2001] [McCloskey et al. 1991].

It is evident that there must be a relation between technique effectiveness and the information that it captures. That is, each technique will be better at extracting a certain type of knowledge from the domain. Some techniques may be unacceptable for gathering a particular type of information. Based on this argument, we can say that, yes, there is justification for the type of information to be captured influencing the elicitation technique selection.

To define the values of this attribute there is an overwhelming set of alternatives depending on the ontology used. In this case, it is not a problem of finding values, but of the multiple possible viewpoints to be taken into account. The attribute does not, therefore, appear easy to rate. For this reason, the assessability of the attribute is considered to be medium.

Similarly, whatever the values of the defined attribute, it does not appear to be simple to determine what information is or should be captured at a particular time in an elicitation process. For this reason, the instrumentability of this attribute is rated as medium.

On the above grounds, we decided to keep the attribute but change its name slightly. To clarify which type of information it is that we are going to elicit using the technique, it is renamed as Type of Information to be Elicited.

**4.4.2.3.2 Type of Heuristics**

The type of heuristics refers to the rules of the domain that are captured. Gabrowski uses this attribute in his empirical study that confirmed some differences in the type of rules that some techniques captured [Gabrowski 1988].

Heuristics are also proposed as a type of information to be captured by Kim and Courtney in the above attribute. For this reason, we decided to merge this attribute with Type of Information to be Elicited.

**4.4.2.3.3 Domain Entities**

This attribute refers to a classification of information that can be captured, such as information requirements, process understanding, behaviour understanding or problem frame understanding. Byrd, Cossick and Zmud suggest this attribute in their proposal [Byrd et al. 1992], where they associate techniques that would be recommended for capturing these categories of information.

As the type of information has already been proposed as an attribute above, we decided to merge this attribute with Type of Information to be Elicited.

**4.4.2.3.4 Uncertainty**

This attribute is mentioned in two theoretical proposals [Dhaliwal & Benbazat 1990][Fazlollahi & Tanniru 1991]. They both refer generally to indisputable knowledge of the overall features of the problem and its domain.
As this type of characteristics is considered in another added attribute, we decided to merge this attribute with the **Problem Definedness** attribute.

### 4.4.2.3.5 Confusedness

This attribute is mentioned in the theoretical proposal by Fazlollahi and Tanniru, where it is defined as the extent to which the information is contradictory or ambiguous [Fazlollahi & Tanniru 1991].

As in the above case, this type of characteristic is related to another added attribute. For this reason, we decided to merge this attribute with the **Problem Definedness** attribute.

### 4.4.2.4 Solution Domain Factor

None of the attributes of the Solution Domain factor proposed in the literature has been accepted, changed or merged to become part of the solution proposed here.

### 4.4.2.5 Elicitation Process Factor

#### 4.4.2.5.1 Constraints

This attribute is proposed by Maiden and Rugg in their proposal technique recommendation proposal [Maiden & Rugg 1996]. These constraints cover necessary meetings, preparation time, acquisition time, analysis time and expenditure on technology. However, these constraints tend to be characteristics of the techniques, and not of the elicitation process agents. In a particular case, it would be very difficult to find out how many meetings are necessary or the time it takes to prepare and equate techniques. However, if the constraints refer to the project, then they could be associated with techniques that meet the constraint in question. For this reason, we propose refocusing the attribute on the actual the process. We redefine the attribute as the time available to complete the project.

The existence of the time constraint on a project, which can apply from its very conception, will be a factor for using techniques that are more productive in detriment, perhaps, to other process aspects. Some techniques take a long time to prepare and run the session, meaning that they can be rejected outright if time is limited. From this argument we deduce that, **yes**, there is enough justification to consider this attribute.

With respect to the possible values for time constraint, it should be ranked from low to high, for example, or by a percentage constraint on the scheduled time. In any case, it does not appear to be complex task, for which reason the assessability for this attribute is considered to be **high**.

To assign an attribute value to a particular project, some initial information on project management and, particularly, cost estimates would be necessary, from which to gather the datum for finding the constraint value. This way, instrumentability is considered to be **high**.

On the above grounds, we decided to select the attribute but with the above mentioned changes. Thus, the name of the new attribute will be **Project Time Constraint**.
4.4.3 Added Attributes

In addition to the attributes taken from the literature, this research suggests adding a further five new attributes not proposed so far in the literature. The need to add these new attributes to the framework is dictated by our experience. Based on this experience, these new attributes influence technique selection.

4.4.3.1 Elicitor Factor

No attribute of the elicitor factor proposed in the literature has been added to form part of the solution proposed here.

4.4.3.2 Informant Factor

4.4.3.2.1 Location/Accessibility

The location of the people of interest as requirements information agents can be diverse. Proximity, perhaps within the same physical place where the elicitor is, can ease access to this source of requirements. We have found no theoretical or empirical studies that consider this facet of the process as relevant for achieving a more efficient elicitation.

Even though it does not appear in other proposals, we consider that this attribute is of utmost relevance for the elicitation technique selection problem. The modus operandi of some techniques requires informants to meet face to face, which is bound to condition their use. Others are beneficial when the informants are far away from the elicitor or spread around, meaning that they will be a mandatory recommendation for some cases. The use of the internet affords the possibility of eliciting information from subjects that do not meet personally, meaning that some techniques that used to be rejected due to the collection time become more preferable. For this reason, we deduce that, yes, there is enough justification for considering this attribute as having an influence on technique differentiation.

Clearly the possible values for location/accessibility should be related to the geographical location of the informants. That is, it could be measured by the distance or distance range with respect to the elicitor’s physical position. Under these circumstances, it would not be difficult to define value ranges for the attribute, meaning that its assessability is considered high.

Having rated the attribute considering the geographical location of the informant, there is not obstacle to a value being assigned to the attribute for an informant in any project whatsoever. For this reason, instrumentability is considered high.

In view of the above, we decided to add this attribute to the final set of attributes owing to its relevance for the technique selection problem.

4.4.3.2.2 Availability of Time

Like the above attribute, the meeting of subjects holding the information that is relevant for requirements also depends on how much time they have. There are no theoretical works proposing this attribute as relevant for deciding between techniques, neither do any empirical studies examine this attribute.

However, there does appear to be some support for there being techniques that work better when the elicitor is freer and others that will be recommendable when the informant has limited time to spend on the elicitation sessions, irrespective even of
their geographical location. Additionally, some techniques may necessarily require a set amount of time to be effective. On this ground, we conclude that, yes, there is justification enough for this attribute making a difference between techniques.

The rating of the attribute will be linked precisely to the time ratio. These values should define ranges from limited time to unrestricted informant availability. This ranking is not complex, meaning that assessability can be considered high.

In a real development case, a value should be assigned to this attribute of the informant from which information is to be elicited in the session. The type of rating proposed for this attribute does not appear to be hard to determine insofar as it is sufficient to question the informant, or his or her immediate superior, about how much time he or she would be able to spend on the process. Therefore, instrumentability is high.

We conclude that the location/accessibility attribute of the informant is added to the final set of attributes.

4.4.3.3 Problem Domain Factor

4.4.3.3.1 Level of Available Information

In the Type of Information to be Elicited attribute, we discussed a set of previous works that propose different categories of information that the techniques can elicit.

Another issue related to the target information emerged from the above analysis. The techniques aim to capture information that can then be transformed into software system requirements. But, in many cases, a precondition for the techniques to be able to be used properly is that certain information should be available. That is, the technique uses previously captured information as input to be able to generate new information during the session with the informant. For example, the structured interview uses general information about the domain captured in earlier sessions to be able to seek out more detailed information about specific areas.

Just as the type of information to be elicited influences the selection of techniques, the information available at any time also appears to condition their use. For this reason, we deduce that, yes, there is justification for considering that the level of available information influences the decision to use the techniques.

To establish the possible values for this attribute, we have to consider how the values are ranked for the type of information to be elicited. In this manner, the proposal would be kept consistent with a view to the analysis of adequacy.

Generally, a technique could capture information I2 from information I1. The definition of values has the above drawback of there being many available alternatives. Based on this, a medium value is assigned to attribute assessability.

It is quite difficult to rate the information available at any time to determine the value for a particular situation. For this reason, the instrumentability of the level of available information is rated as medium.

From the above, we decide to add this attribute as part of the final table of factors influencing technique selection.

4.4.3.3.2 Problem Definedness

Setting the goals and scope of a software system development project is the first task of the development team. This information is gathered from the senior directors or managers of the organization and the main users of the future system.
However, sometimes not even the stakeholders are clear about their problem or need or what solution they require.

It is logical to think that elicitation strategies may vary if there is not a clear definition of the problem or the solution. It would be a good idea in these cases to use techniques that can help to consistently define the objectives. Techniques recommended for each level of structuredness can therefore be grouped. In this respect, **yes**, there can be said to be theoretical **justification** for the problem definition having an influence on technique selection.

Possible values could be defined by simply ranking them as low or high definedness. That is, attribute **assessability** can be said to be **high**.

To rate problem definedness, some mechanism or test has to be set up to determine the definedness for a particular development case. This instrument should be simple and fast so as not to unnecessarily increase the cost. On this ground, the **instrumentability** of this attribute is rated as **medium**.

Therefore, we decided to **add** this attribute to the final set.

### 4.4.3.4 Solution Domain Factor

No Solution Domain factor attribute proposed in the literature has been added to form part of the solution proposed here.

### 4.4.3.5 Elicitation Process Factor

#### 4.4.3.5.1 Process Time

Process time refers to the chronological project development stage. The information requirements will be different depending on this stage. At the start it is necessary to define expected breadths and depths, which is nothing like the information required when the project has moved forward.

There are techniques that are necessary and even almost mandatory for the different process times. For example, repertory grid cannot be applied at the start of the project. That is, we can say that, **yes**, there is **justification** for this attribute making a difference between techniques.

When trying to rate this attribute, either chronological milestones or information types should be set, provided that they are linked to the requirements types and do not overlap with the Type of Information to be Elicited attribute. In this respect, the task of determining the values is not altogether straightforward, as it is not very clear how to delimit each value, either chronologically or in terms of requirements types. For this reason, the **assessability** criterion is defined as **medium**.

The task of assigning one of the established values for a project case is not hard, as an analysis of the situation would indicate which to choose. Therefore, the **instrumentability** of this attribute is rated as **high**.

From the above, we decided to **add** the attribute to the final table.

### 4.5 Attribute Definition

The proposed attributes were analysed in Section 4.4, leading to the selection of a set of attributes as candidates for inclusion in the solution that we are looking for. In the following sections, we detail this scheme, presenting a formal definition and an analysis to establish the proposed values for each selected attribute.
Based on the analysis for determining the attributes that influence the selection of the appropriate techniques, many of the baseline attributes were retained, most with a fitting change of name, and others that appeared to be applicable were added. This final scheme of attributes is presented in Table 4.3, together with a description of the attributes. Briefly, we added five new attributes to another 11 accepted and changed attributes, totalling 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.

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>ATTRIBUTES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELICITOR</td>
<td>Training in Elicitation Techniques</td>
<td>Type of training and practice that the elicitor has previously received in each elicitation technique.</td>
</tr>
<tr>
<td></td>
<td>Elicitation Experience</td>
<td>Number of previous projects on which the elicitor has performed elicitation activities.</td>
</tr>
<tr>
<td></td>
<td>Elicitation Technique Experience</td>
<td>Number of previous elicitation activities in which the elicitor has applied each technique.</td>
</tr>
<tr>
<td></td>
<td>Familiarity with the Domain</td>
<td>Number of previous projects or knowledge acquired in the domain by the elicitor.</td>
</tr>
<tr>
<td>INFORMANT</td>
<td>Individuals per Session</td>
<td>Number of individuals that can participate simultaneously in the elicitation session.</td>
</tr>
<tr>
<td></td>
<td>Consensus among Informants</td>
<td>Level of agreement among informants at the outset.</td>
</tr>
<tr>
<td></td>
<td>Informant Interest</td>
<td>Motivation shown by the informant about participating in the elicitation sessions.</td>
</tr>
<tr>
<td></td>
<td>Expertise</td>
<td>Informant experience in the problem or work domain.</td>
</tr>
<tr>
<td></td>
<td>Articulability</td>
<td>How easy the informant finds it to explain his or her knowledge.</td>
</tr>
<tr>
<td></td>
<td>Availability of Time</td>
<td>Time that the informant has to spend on elicitation sessions.</td>
</tr>
<tr>
<td></td>
<td>Location/Accessibility</td>
<td>Physical location of the informant with respect to the elicitor.</td>
</tr>
<tr>
<td>PROBLEM DOMAIN</td>
<td>Type of Information to beElicited</td>
<td>Type of categorized information that the technique can elicit.</td>
</tr>
<tr>
<td></td>
<td>Level of Available Information</td>
<td>Type of categorized information that is available prior to the session before applying the technique.</td>
</tr>
<tr>
<td></td>
<td>Problem Definedness</td>
<td>Clarity of the project goals and scope.</td>
</tr>
<tr>
<td>ELICITATION PROCESS</td>
<td>Project Time Constraint</td>
<td>Relative availability of time for applying the technique in a project.</td>
</tr>
<tr>
<td></td>
<td>Process Time</td>
<td>Stage at which the elicitation process is prior to the session.</td>
</tr>
</tbody>
</table>

Table 4.3. Defined Attributes.
4.6 Attribute Rating

Each attribute selected for the contextual scheme must be rated, that is, two or more exclusive values must be established to satisfactorily rank the universe of possible values. This categorization will relate values to elicitation technique adequacy under particular circumstances. In the following, we run an analysis to determine the final values of the attributes relevant to elicitation technique selection.

4.5.1 Training in Elicitation Techniques

Dhaliwal and Benbazat propose this attribute as a measure of the knowledge of the requirements engineering process, but do not define associated values [Dhaliwal & Benbazat 1990].

As explained during the attribute analysis, it is the knowledge of the elicitation techniques, and even more so practice, rather than knowledge of the requirements process that can influence elicitation technique selection. For this reason, we give preference to practical training in the techniques to define the values of this attribute:

- **High**: The elicitor has received formal training, that is, taught by some official institution, in the technique, where preference was given to its practice.
- **Low**: The elicitor has received training in the technique, but without practice or has acquired knowledge from self-study by reading books, etc.
- **Zero**: The elicitor has no knowledge whatsoever of the technique.

4.5.2 Elicitation Experience

Two types of metrics have been used in earlier research to rate experience in elicitation activities: quantifying previous activities or quantifying the time spent performing these activities [Lloyd 2002] by numerically accounting for every requirements engineering activity in which the elicitor has participated. In their experiment, Agarwal and Tanniru [Agarwal & Tanniru 1990] define two values based on earlier participation and length of experience: novices and experts. Novices have never participated in a development project or have worked as analysts for less than three years. Experts have participated in at least one software development projects or have worked in analysis for over three years. Other authors, Dahliwal and Benbazat, propose this attribute in their model as a measure of previous experience but do not define values for it [Dhaliwal & Benbazat 1990].

In our view, the measure of previous experience is more related to counting earlier participations than to the time spent in any professional capacity. The number of years working as an analyst does not imply that they have performed elicitation activities, for which reason we reject this alternative definition.

This way, we propose to define the values based on the number of elicitation activities completed, considering that less than two activities is not yet enough to reap rewards, whereas over five participations provide the benefits of acquired proficiency. Therefore, the values of this attribute are:

- **High**: The elicitor has previously participated in over five projects performing elicitation tasks.
• Medium: The elicitor has previously participated in from two to five projects performing elicitation tasks.
• Low: The elicitor has participated in fewer than two projects on elicitation activities.

### 4.5.3 Experience in Elicitation Techniques

Previous experience in elicitation techniques is an attribute proposed by Dhaliwal and Benbazat, but they do not suggest attribute values [Dhaliwal & Benbazat 1990].

Experience in each particular technique makes it more likely for it to be chosen. This experience, which we propose to measure by the number of previous activities in which it was used, is especially beneficial as of five sessions. For this reason, the proposed values for this attribute are:

- High: The elicitor has led over five previous sessions using the technique.
- Low: The elicitor has led from one to five previous sessions using the technique.
- Zero: The elicitor has never applied the technique.

### 4.5.4 Familiarity with the Domain

As in the above case, only Dhaliwal and Benbazat propose this attribute as a measure of the knowledge of the requirements engineering application domain, although they do not propose any particular values [Dhaliwal & Benbazat 1990].

Domain knowledge can be acquired by previous training or by experience in developments in the domain. For this reason, the values proposed for this attribute are:

- High: The elicitor has previously participated in over two projects in the same domain or has formal training in the domain.
- Low: The elicitor has participated in one or two projects in the same domain or has informal training in the domain.
- Zero: The domain is completely unknown to the elicitor.

### 4.5.5 Individuals per Session

In their technique selection framework, Maiden and Rugg propose an absolute numerical value for this attribute that represents the number of people that are to participate in the process [Maiden & Rugg 1996]. In another empirical study [Roth & Wood 1993], Roth and Wood define two values for this attribute: individual and group.

Likewise we propose to rate the attribute numerically but by ranking participant ranges. Some techniques will be more recommendable than others depending on these particular ranges. The attribute values will be:

- Individual: One individual.
- Small Group: From two to five individuals.
- Large Group: Over five individuals.
4.5.6 Consensus among Informants

In their problem-solving framework, Byrd, Cossick and Zmud present this attribute as difficulties among informants to balance their interests [Byrd et al. 1992]. Along these lines, our proposal defines two values to rate whether or not informants agree. Hence, the values defined in this research for this attribute are:

- High: Consensus
- Low: No consensus

4.5.7 Informant Interest

Lloyd used this attribute in his empirical study [Lloyd 2002] by defining a subjective rating of user participation in the session. In his study, he gives values of from one to five, ranging from low to high participation. But, in our view, as these values are not known until the end of the session, they are not useful for previous prescription.

For this reason, we propose a three-point rating ranging from lack of interest to highly motivated to participate in the elicitation session. As the definition of the values is somewhat imprecise, a clear instrument or heuristic should be used for ranking. This way, the values defined for the attribute are:

- High: Very interested.
- Low: Not very interested.
- Zero: Uninterested.

4.5.8 Expertise

Burton and colleagues used this attribute in one of their experiments [Burton et al. 1990], establishing two types of subject that participate in elicitation: novices and experts. Experts are people that have over ten years of experience.

Other authors [Dhaliwal & Benbazat 1990] defined the values of this attribute in their model depending on people’s learning phase. Dhaliwal and Benbazat propose three values: declarative phase, where individuals learn the instruction or observation to perform the actions; knowledge-gathering phase, where individuals convert the slow declarative knowledge into a faster compiled procedure and models; and procedural phase, where individuals refine the models where they become automatic or unconscious.

To be able to facilitate the instrumentation of the attribute, we are going to consider only the one based on experience time in our proposal. The expertise levels will be defined according to the time informants have been working in their job or in the domain of their profession. This way, for this research, the values defined for this attribute will be:

- Expert: Over five years working in the domain or job.
- Knowledgeable: From two to five years working in the domain or job.
- Novice: Less than two years working in the domain or job.

4.5.9 Articulability
In Dhaliwal and Benbazat’s model, this attribute is defined as a measure of the informants’ skill to analyse and explain the components of their knowledge, although they do not propose discrete values.

In our proposal, the values are defined based on how clearly the informant explains his or her knowledge. Thus, the values are:

- **High:** Explains his or her knowledge excellently
- **Medium:** Is able to explain his or her knowledge satisfactorily
- **Low:** Does not explain his or her knowledge clearly

### 4.5.10 Availability of Time

This attribute was not proposed by any authors. It is true, however, that the length of elicitation sessions varies depending on the techniques used, meaning that they will not be able to be applied unless informants are available for a minimum amount of time. This way, the values must guarantee that the informants can set aside a period of time for the elicitation process. On this ground, the attribute values will be:

- **High:** Has enough time.
- **Low:** Has less than required time.

### 4.5.11 Location/Accessibility

This attribute was not proposed by any authors, and, therefore, there are no proposed values. However, based on the attribute definition, the values should consider the physical location of the informant or group of informants with respect to the elicitor.

As the distance between the participants can make a difference to which techniques are best and even rule some out, the values established are:

- **Far:** In a different town to the elicitor.
- **Near:** In the same town as the elicitor.

### 4.5.12 Type of Information to be Elicited

There are many works defining values for this attribute. They all differ as to the viewpoint and type of information that the elicitation process deals with.

Browne and Rogich divided the information to be captured by set techniques in their experiment into four types: goals, process, task and behaviour [Browne & Rogich 2001]. Maiden and Rugg make a similar distinction in their technique selection model: data, processes and behaviour [Maiden & Rugg 1996]. Although these authors also rank the knowledge to be elicited by techniques: future system knowledge, non-tacit knowledge and tacit knowledge. McCloskey and colleagues also define values related to the type of knowledge but divided into just two types: declarative and procedural [McCloskey et al. 1991]. On the other hand, Kim and Courtney define three values in their framework for the type of information that elicitation techniques can elicit: concepts, heuristics and reasoning [Kim & Courtney 1988]. Finally, Grabowski defines three types of rules for his experiment to rank the elicited information: conceptual, operational and logistic [Grabowski 1988].
For our proposal, we try to characterize the universe of information that can be captured in the elicitation process. To do this, we consider a division into three levels of importance and depth that aims to consider the information processed by both conventional systems and knowledge-based systems. From this viewpoint, the values defined in this research for this attribute are:

- **Strategic**: Elicit strategies, control, higher directives, objectives, project scope.
- **Tactical**: Elicit procedures, processes, functions, heuristics.
- **Basic**: Elicit domain concepts, attributes, elemental data.

### 4.5.13 Level of Available Information

The type of information to be elicited by a technique is related to the level of information available at the time of application. That is, depending on the type of information available, a technique can capture information of the same or a higher level. In the information level pyramid, there is an information elicitation logic that determines previous information requirements. Each technique manages, by nature, to capture information of one type whenever it has either previously captured or available information. Based on this foundation, the values of this attribute are related to those defined in the Type of Information to be Elicited attribute:

- **Higher**: Higher strategies or directives are available, as are procedures, processes, functions and/or heuristics, that is, tactical/strategic information.
- **Lower**: Concepts, attributes and other elemental domain information are available, that is, basic information.
- **Zero**: There is no information.

### 4.5.14 Problem Definedness

The definition of the goals and scope of the project is not always clear. In these cases, the aim of the early sessions is to further define general development aspects. This way, the proposal of the values is related to this clarity of global project aspects. However, it would be preferable to have defined an instrument that is able to determine a value in a particular case.

The values are:

- **High**: Well defined
- **Low**: Poorly defined

### 4.5.15 Project Time Constraint

There are no earlier works with proposals of values for this attribute in particular. The project time is the estimated normal and full development time according to the organization’s defined work methodologies. The project can get ahead of schedule if the task is finished early or behind schedule if an activity is delayed. Under these circumstances, it can be decided to use one or other technique to help to get back on schedule.

In this respect, we defined the following values for this attribute:

- **High**: Time is short
• Medium: Time is tight
• Low: There is plenty of time

### 4.5.16 Process Time

The process time defines milestones within the activity that can prescribe suitable techniques. These milestones are not necessarily related to a time or percentage of time, but rather to the period of the elicitation sessions for particular information-gathering purposes. This way, the different elicitation process times are:

- **Start:** Elicitation of general definitions
- **Middle:** Elicitation of key requirements
- **End:** Elicitation of final information.

Table 4.4 summarizes the key attribute values for elicitation technique selection.

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>ATTRIBUTES</th>
<th>VALUES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELICITOR</td>
<td>Training in Elicitation Techniques</td>
<td>High</td>
<td>Formal and practical training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>Training without practice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zero</td>
<td>Unfamiliar with techniques</td>
</tr>
<tr>
<td>Elicitation Experience</td>
<td>High</td>
<td></td>
<td>Over five elicitation projects</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td></td>
<td>From two to five elicitation projects</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>Less than two elicitation projects</td>
</tr>
<tr>
<td>Experience with Elicitation Techniques</td>
<td>High</td>
<td></td>
<td>More than five technique applications</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>From one to five technique applications</td>
</tr>
<tr>
<td></td>
<td>Zero</td>
<td></td>
<td>Has never applied the technique</td>
</tr>
<tr>
<td>Familiarity with Domain</td>
<td>High</td>
<td></td>
<td>Over two projects or formal knowledge</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>From one to two projects or informal knowledge</td>
</tr>
<tr>
<td></td>
<td>Zero</td>
<td></td>
<td>No knowledge whatsoever</td>
</tr>
<tr>
<td>INFORMANT</td>
<td>Individuals per Session</td>
<td>Individual</td>
<td>One individual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Group</td>
<td>From two to five individuals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Large Group</td>
<td>Over five individuals</td>
</tr>
<tr>
<td>Consensus among Informants</td>
<td>High</td>
<td></td>
<td>Consensus</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>No consensus</td>
</tr>
<tr>
<td>Informant Interest</td>
<td>High</td>
<td></td>
<td>Very interested</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>Not very interested</td>
</tr>
<tr>
<td></td>
<td>Zero</td>
<td></td>
<td>Uninterested</td>
</tr>
<tr>
<td>Expertise</td>
<td>Expert</td>
<td></td>
<td>Over five years in the domain or job</td>
</tr>
<tr>
<td></td>
<td>Knowledgeable</td>
<td></td>
<td>From two to five years in the domain or job</td>
</tr>
<tr>
<td></td>
<td>Novice</td>
<td></td>
<td>Less than two years in the domain or job</td>
</tr>
<tr>
<td>Articulability</td>
<td>High</td>
<td></td>
<td>Explains knowledge excellently</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td></td>
<td>Is able to explain knowledge satisfactorily</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>Does not explain knowledge clearly</td>
</tr>
<tr>
<td>Availability of Time</td>
<td>High</td>
<td></td>
<td>Has enough time</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td></td>
<td>Has less than recommended time</td>
</tr>
<tr>
<td>Location/Accessibility</td>
<td>Far</td>
<td></td>
<td>In a different town to the elicitor</td>
</tr>
<tr>
<td></td>
<td>Near</td>
<td></td>
<td>In the same town as the elicitor</td>
</tr>
<tr>
<td>PROBLEM DOMAIN</td>
<td>Type of Information to be Elicited</td>
<td>Strategic</td>
<td>Elicits strategies, control, directives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tactical</td>
<td>Elicits processes, functions, heuristics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic</td>
<td>Elicits concepts, attributes, basic elements</td>
</tr>
<tr>
<td>Availability of Information</td>
<td>More</td>
<td></td>
<td>There is tactical/strategic information</td>
</tr>
<tr>
<td></td>
<td>Less</td>
<td></td>
<td>There is basic/tactical knowledge</td>
</tr>
<tr>
<td></td>
<td>Zero</td>
<td></td>
<td>There is no information</td>
</tr>
<tr>
<td></td>
<td>Problem Definedness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Well defined</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Poorly defined</td>
<td></td>
</tr>
<tr>
<td>ELICITATION PROCESS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Time Constraint</td>
<td>High</td>
<td>Time is short</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Time is tight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>There is plenty of time</td>
<td></td>
</tr>
<tr>
<td>Process Time</td>
<td>Start</td>
<td>Elicitation of general definitions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>Elicitation of key requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>End</td>
<td>Elicitation of final information</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4. Scheme Attribute Values.