Towards a Model of Topic Relevance during Requirements Elicitation - Preliminary Results

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Abstract—**Requirements elicitation is the activity in requirements engineering (RE) which focuses on the collection of information about requirements of the system-to-be and its environment. One important challenge is elicitation incompleteness; it occurs when information, which may have been relevant for requirements engineering, is not elicited. This may be due to various factors, such as that the requirements engineer asked no questions about it, and the stakeholders did not consider it important. To help requirements engineers reduce elicitation incompleteness, we propose the so-called Model of Elicitation Topic Relevance (METRe). METRe is a diagram that shows topics which can be discussed during requirements elicitation, and expresses the relative importance of each topic to stakeholders and engineers. The more likely it is that a stakeholder or engineer will discuss the topic spontaneously during elicitation, the more important it is for, respectively, stakeholders or engineers. METRe was made by combining our prior work on the importance of topics to stakeholders, and a new round of empirical research. The new round consisted of data collection using a survey, in which the various topics were presented to and evaluated by 50 IT-experts in Belgium. Subjects were asked to evaluate the relative importance of the topics, that is, how relevant they find these topics when eliciting information, and how pro-active they would be in collecting them.**

I. Introduction

A. Context: Implicit Information in Requirements Elicitation

Requirements Engineering (RE) refers to collecting, documenting and analysing requirements from the stakeholders of a system-to-be, in order to design the specification of that system. Requirements elicitation (simply elicitation hereafter) is one of the activities in RE. Its purpose is to collect information which is relevant to understand the stakeholders' requirements and the environment of the system.

A recurring and critical issue during elicitation is to ensure - or at least to maximise to some feasible extent - the completeness of the collected information. Incompleteness of elicited information is common and has been recognised as a key challenge in RE [1], [2]. Incompleteness arises when engineers fail to elicit information which may be relevant to understand the requirements and system environment. One way of seeing incompleteness, is that it happens when relevant information which the stakeholders have remains implicit; it may be due, for example, to tacit knowledge [3], [4], [5] - when stakeholders cannot clearly formulate their knowledge -, implicit requirements [6], [7] - when stakeholders are not conscious of their requirements -, or to implicit assumptions [8] - when stakeholders do not know what is important to say.

Elicitation incompleteness is an important issue. It is often assumed (here and in previously cited works) that if such implicit information, or some of it, was identified and documented by engineers, then this may have helped in other RE activities such as the analysis of requirements for conflicts, requirements validation, negotiation, and so on.

There is research on how to reduce such implicit information [9]. Empirical research is scarce, however. Recently, we suggested the so-called Elicitation Topic Map (ETM) [10]. ETM is a tool used to prepare interviews with stakeholders. It identifies a set of 30 topics, and indicates the relative importance of these topics. Importance is understood as follows: the more likely it is that stakeholders discuss a topic spontaneously (without being explicitly asked by the engineers), the more important is that topic for stakeholders. This suggests that less important topics require engineers to be more proactive in order to be elicited and documented correctly. Another way to look at the ETM is to see it as a list of triggers, which can be used during elicitation to generate a discussion about what the stakeholders know, but did not manage to share spontaneously with engineers.

B. Research Question: Importance of topics to Engineers

The ETM gives the relative importance of topics to stakeholders. It does not give the relative importance of topics to requirements engineers, and therefore, it remains unknown if topics which are important to stakeholders are equally relevant to engineers, if those less important to stakeholders are more important to engineers, and so on.

Having such importance evaluation for both stakeholders and engineers is relevant; it can help estimate the omission risk associated to a given topic, and it can therefore help engineers when preparing their interactions with stakeholders. For instance, if there are topics which are of low importance to stakeholders, but of high importance to engineers, then it is important to organise elicitation in a way that reduces the risk of missing information about these topics. Alternatively, it may be that an engineer is not interested in eliciting information about a topic that stakeholders judge important. Consider a topic such as "relationships between users"; it may appear to be of little relevance to engineers, and may therefore not

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be accounted for by the engineers. Possible reasons are the strong IT background of the engineer, a lack of experience in a particular business domain, the low experience of the engineer, etc. Whatever the reason, such situation may be problematic; in practice, discussing this topic might trigger the elicitation of other pieces of information that may be valuable to engineers. For instance, it could provide valuable indications about security requirements, system connectivity, etc.

Our point with the previous example is that there is a stake in better understanding the relative importance of the different ETM topics to engineers. For the less important topics, we would need to warn engineers of the risk of omission, and give them incentives to collect the information anyway. We will argue this should happen regardless of how a topic is actually relevant to specify a system. The research question we try to address in this paper can be formulated as follows:

> *How to account, during elicitation interviews, for the importance of some elicitation topics to both stakeholders and engineers, in a simultaneous way?*

C. Contribution: Model of topic Relevance

To better understand the importance of ETM topics to engineers, we surveyed 50 Belgian IT practitioners. We asked them to evaluate how important they find the topics listed in the ETM in order to design a system, and hence how pro-active they would be in collecting these topics during elicitation. Combining these results with the data from the ETM (see [10]), we obtained METRe (Model of Elicitation Topic Relevance). METRe shows the relative importance of topics to both engineers and stakeholders. The model is interesting, because its four parts give indications of how topics which are more or less important to stakeholders are important to engineers, and vice-versa. METRe is shown in Figure 1.

There are four sections in METRe. They all suggest a different elicitation approach, and can be described as follows:

- **Expected Information:** topics which were recognised as important by both engineers and stakeholders. They reflect important notions in RE research, which also appear importance to stakeholders. It is likely that stakeholders will discuss these topics spontaneously, and even more likely that the engineers will insist on discussing them;
- **Requested Information:** topics which are important to engineers, but less to stakeholders, who will not discuss these topics spontaneously. Engineers must therefore proactively request information about them. Topics in this area are more specific than in the Expected area, and are related to the scope of the system, its environment and the larger problems it will have to solve;
- **Remote Information:** topics which are of low importance to both stakeholders and engineers, so that no one is likely to discuss them spontaneously. This category is even more remote than Requested Information from the generic problem and of the immediate system environment. It gathers thinner grain, contextual, topics;

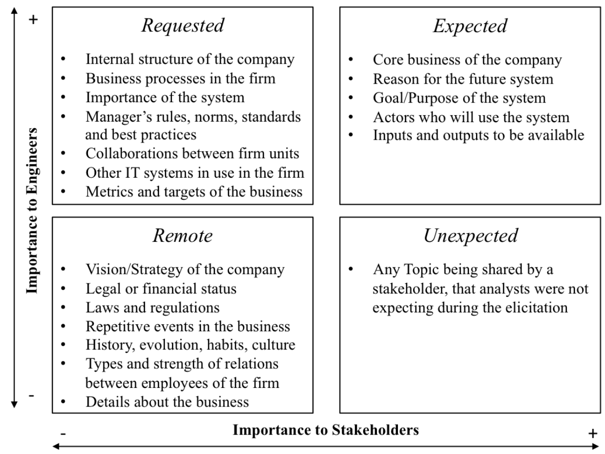

Fig. 1. The Model of Elicitation Topic Relevance - METRe

- **Unexpected Information:** topics which are important to discuss for stakeholders, but less important to engineers. There are currently no ETM topics in the Unexpected area, and this remains for future work. We discuss this aspect in more details in the remainder of this paper.

Keep in mind that a low level of importance does not imply that a topic is not interesting to elicit for engineers. Rather, it simply suggests that the topic has less chance of being discussed spontaneously; there is however a chance to trigger relevant information about the system-to-be, so that the topics should not be systematically overlooked during elicitation.

The purpose of this paper is to describe in more details the way we obtained this model, and how it can help engineers during elicitation. In addition to proposing METRe, we also relate it to two ideas. Firstly, that there is a sequence in which to elicit the different areas from METRe, if the aim of engineers is to reduce elicitation incompleteness. Secondly, that METRe can be used as a way to support the selection of an elicitation technique; we propose that, depending on the METRe category being elicited, different techniques could be used. These two latter aspects are only suggestions for future research, and are not based on any empirical results, beside the observations we made in the present study.

D. Organisation

The rest of this paper is structured as follows. In Section 2, we review the purpose of the ETM, explain how it was obtained and how it has influenced METRe. In Section 3, we describe the experimental design we used to collect data about the importance of topics to requirements engineers. Section 4 presents the different methods we used in order to build our model; we call it the empirical foundation of METRe. Section 5 provides a more detailed discussion of METRe, and how it can influence the way elicitation happens. We conclude the paper with a summary and a discussion of the limitations.

II. Baseline: The ETM

We introduced ETM - the Elicitation Topic Map - elsewhere in our prior work and we recall the main ideas here. Please refer to [10], [11] for more details about the present discussion.

ETM is a graphical representation of the relative importance of some elicitation topics to stakeholders. Importance reflects *spontaneity*: the more likely it is that stakeholders would discuss a topic spontaneously during elicitation interviews, the more important that topic is, relative to others, in the ETM. ETM's purpose is to support the preparation of elicitation interviews. The idea is that engineers may want to prepare questions about topics that are less important to stakeholders, as information about these topics is more likely to remain implicit during the interview, given that they are less important to stakeholders. In our experience, ETM topics also turned out to act as triggers during interviews; asking one question about a topic may lead stakeholders to speak about other related topics that, otherwise, would have remained implicit. ETM was produced in three phases, through a combination of both theoretical and empirical research:

1) **Candidate sets of topics were identified**: based on conceptualizations of context in different fields (in particular, refer to [12], [13] for a discussion about what context is made of), we identified a series of context dimensions. This gave us a broad perspective on the various candidate sets of topics. There are summarized as bolded text in Table I;
2) **Candidate topics were identified in each topic sets**: a topic designates an entity that several different pieces of information can refer to; for example, a time period (talking about the events in March 2013), a physical object (the companys product packaging), a position (CEO), etc. Topics were identified via semi-guided interviews with business analysts; the discussion was guided by previously discussed topic sets. The qualitative study resulted in a list of 30 topics, listed in Table I.
3) **Candidate topics were submitted to some stakeholders**: we measured the importance of topics to hundreds of stakeholders in various domains [10]. A topic is said to be important, whenever we observed that stakeholders discussed spontaneously about it during elicitation interviews. On the contrary, a topic is listed as not important if stakeholders tended to remain silent about it. This latter stage gave the x-axis in Figure 1.

We observed a clear limitation when putting the ETM in practice; the ETM only gives the relative topic importance for stakeholders, and does not account for the relevance of a given topic to the engineers. At first sight, this might appear contradicting with the second stage described above, which suggests all topics inside the ETM are somehow relevant. Still, our idea is that in practice, some engineers might be more proactive in collecting information about some topics than others, which also suggests there are topics with different importance to requirements engineers, regardless of how relevant these topics may be for designing a system. This paper is our response to this issue. We replicated the third step of the ETM research with requirements engineers this time, which led to METRe as shown in Figure 1.

TABLE II
Some Details about our Sample of Requirements Engineers

	Gender	Age	Experience[1]
Round 1	*Men*:13	*25 or less*:4	*Never*: 2
	Women:10	*From 26 to 34*: 10	*1 to 3*: 8
		From 35 to 54: 8	*4 to 10*: 6
		55 and over: 1	*More than 10*: 7
Round 2	*Men*:21	*25 or less*:5	*Never*: 11
	Women:6	*From 26 to 34*: 14	*1 to 3*: 8
		From 35 to 54: 8	*4 to 10*: 6
		55 and over: 0	*More than 10*: 2

III. Experimental Design

To measure the importance of elicitation topics to engineers and build METRe, we replicated the quantitative part of the ETM study (third part, as presented in Section 2) with different subjects. Our approach remains unchanged regarding the procedure and the data treatment. These aspects are discussed in more details in the next paragraphs.

A. Subjects

Our target profiles in this study are business analysts and professions with similar responsibilities, namely those in charge of collecting business requirements for an information system. To collect data, we initially planned to sample subjects based on a probabilistic approach, as recommended in [14]. This approach however lead to a too small sample to be of real significance (see below). We therefore performed a second round of data collection, using non-probabilistic - purposive - sampling. We resorted to this method because the target profiles are difficult to access, and we wanted to avoid working on one single RE project, so as to survey engineers from various companies and domains. A summary of our final sample is provided in Table II.

1) Round 1: The first round was performed using a random sampling method, on a database of 5000 Alumni of the Business Administration department of the University of Namur. From this list, we picked people whose function was fitting with at least one of the previous target profiles. This gave us a basis of around 200 people. From this list, we randomly selected 100 subjects to who we submitted our questionnaire. From these, we collected only 23 answers.

2) Round 2: The second round was held in collaboration with the non-profit organization Technofutur TIC (TTIC), a competence center located in Belgium which proposes high quality training on advanced ICT topics to professionals desiring to improve their IT skills. TTIC is partially funded by the European Union FEDER-FSE funds and the Walloon region, and provided training to more than 11000 people in 2014. Trainees we surveyed had at least a three year business experience, and most of them were following the training to get a certification for an activity they were already

TABLE I
THE LIST OF 30 ETM TOPICS USED TO BUILD METRE

Items	**Activities**
I1. Actors who are going to use the system	A1. Core business of the company
I2. Objects in the environment that relates to the system	A2. Reason why the company needs the system
I3. Other systems that are in use in the company	A3. Purpose of the system, what it is going to do
I4. Inputs and outputs expected of the system	A4. Goals assigned to the employees
I5. Units/structure that compose the company	A5. Vision and strategy of the company
Localization	**Connections**
L1. Place where the system will be used	C1. Type of relations between employees
L2. Repetitive trends in the company	C2. Respective power of agents who are going to use the IS
L3. Frequency of important events that occur in the company	C3. Importance of the system for the employees
L4. Events occurring at regular intervals in the company	C4. Strength of relationships between the employees
L5. History and evolution of the company	C5. Connection between the company and yours
Rules	**Granularities**
R1. Laws or regulations applying to the company	G1. Atmosphere in the company
R2. Norms, guidelines or standards applying to the company	G2. Legal or financial status of the company
R3. Habits, traditions or culture of the company	G3. Metrics that are relevant to monitor the company
R4. Recommendations from the management team	G4. Synergies inside the company
R5. Best practices that apply to the company	G5. Special facts about the company

doing informally in their companies, namely business analysis, project management, and so forth. It is worthy noticing that these people are not proper requirements engineers; this is not their profession. The combination of business experience with strong IT-background however makes them good candidates for our study. In this second round, we collected 27 answers.

B. Procedure

Data collection took the form of an online survey. Subjects were contacted via email to take part to the survey. A short description of the project was available, to explain the motivations behind the study. In the survey, subjects were asked to consider the following situation: they have to interview a stakeholder to collect business requirements, and they are given several topics that they could discuss in order to guide such discussion. The topics listed in the survey are those presented in Table I, verbatim. Examples were given in addition to each topic, to ensure topics were clearly understood by engineers. For example, topic I2 - objects that can connect to the system - was illustrated with examples like smartphones, tablets, printers, scanners, camera, display. For each of the 30 topics, subjects were asked to tell whether they would be proactive or not in eliciting the topic. This resulted in what we call in the rest of this paper the *importance measure*. A scale with the two following levels was provided, under the form of radio-buttons:

1) **Important**: “I am pro-active and will ask stakeholders about that topic”;
2) **Unimportant**: “I am passive, and will wait for the stakeholder to speak about that topic”.

Note that the decision to provide only a two-level scale is based on two main reasons. Firstly, we submitted the questionnaire on LinkedIn for a preliminary collection of data. This enabled us to identify some unclear questions in our questionnaire, and collect some feedback about the overall clarity of our survey. Among others, subjects mentioned the survey was quite complex and long. The previous lead us to revise our initial survey design and use only a two levels scale. Besides, a binary scale had already been used in the ETM study; as our objective was to merge the two studies, it appeared important to us to use the same scales. This makes the survey a simple list of 30 topic evaluations, which is simple and rapid to answer. We consider this option is reasonable, as we are only interested in what engineers do; what they can do is ask question about the topic, or not ask, and there cannot be intermediate situations such as “I will moderately ask”.

IV. RESULTS

METRe (as in Figure 1) is a model representing what information can be discussed during elicitation interviews, and of the omission risk related to this information. This section describes with more details the way the model was build; first, we represent the data we collected on a graph to observe how data are distributed. Then, based on some standard exploratory data-mining methods, we identify in a more systematic way the different groupings that can be made, and which topics can be associated to the latter.

A. Plotting the Elicitation Topics

As discussed in our introduction, METRe was build on actual empirical observations, originating from two different sources; (i) the ETM itself, as described in [10] and recalled in Section 2 and (ii) the empirical study described in Section 3. When combined, the two previous axes give a plane, in which the 30 topics listed in Table I can be plotted. We plot the latter topics using their respective *Hit Rate* (HR) values. The rate is computed as follows:

$$HR = 100 * \frac{\#Important_A^T}{\#Important_A^T + \#Unimportant_A^T}$$

where # designates a number of observations, A is one sort of elicitation actor - stakeholder or engineer - and T is one given topic among the thirty listed in Table I. This results in thirty pairs of HR values (that is, 60 HRs) which are used to

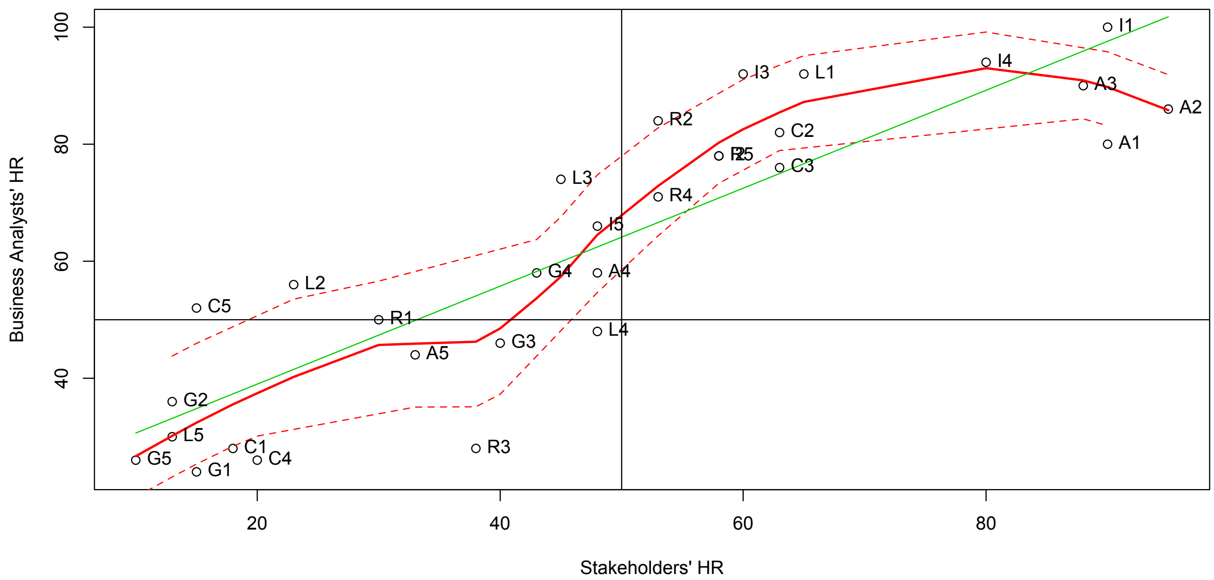

Fig. 2. Scatter Plot of Topics by Hit Rates

map the topics in the plane. The rate is to be read as follows: it reflects the percentage of subjects, in one group of actors - either stakeholders or engineers - that claimed they would be pro-active in discussing the topic during elicitation interviews. For example, a hit rate of 100% for engineers on topic I1 suggests that all engineers asserted they would ask directly question about what actors are going to use the system-to-be, and will not stay passive about that topic.

The data underlying METRe are given in synthetic form, as a scatter plot, in Figure 2. The straight line is a simple linear regression, while the curved line is a nonparametric-regression smooth. Dashed line above and below the smooth line are the spreads, and can be read as a representation of the variance of point clouds around the nonparametric-regression. All together, these regressions give indications about the relationship between stakeholders and engineers HRs. More precisely, the following observations can be made:

- The plot clearly suggests three different regions; the top-right corner (important topics to engineers and stakeholders), the bottom-left corner (unimportant topics) and the top-middle region, with mitigated importance scores;
- There is a fourth region (bottom-right) which is empty; this is due to the fact that topics have initially been determined based on interviews with engineers, so that there is a bias in the topic list toward RE (see [10]);
- *Most of the points are situated above the y-coordinate 0.5 but cover the entire set of possible x-coordinates*. This means that, on average, engineers have a much higher hit rate than stakeholders, i.e., they tend to be pro-active on more topics than stakeholders;
- The spread is not too large around the regressions, which indicates some consistency between the importance of topics to engineers and to stakeholders.

B. Clustering Elicitation Topics

The scatter plot in Figure 2 gives some ideas of what grouping of topics could be considered, and hence of how areas could be defined in METRe. The main drawback of the scatter plot however is that there is no way systematic way to attribute some topics to one area rather than another, especially for those topics which appear to be borderline, i.e., between two different groups of topics. In other words, the scatter plot in Figure 2 clearly shows that there likely are different ways to groups topics, yet does not provide any clear-cut criteria to attach one topic to one area rather than another; take for example the case of topics R1 or A5, which are in-middle between two well distinct regions of the plot.

As a way to build METRe on a more objective and systematic basis, we therefore resort to clustering methods. Clustering is the "*generic term for a wide range of numerical methods for examining multivariate data with a view to uncovering or discovering groups or clusters of observations that are homogeneous and separated from other groups*" [15]. More precisely, we will be using the K-Means algorithm. Roughly stated, the latter computes K different means which are then used as prototypes for grouping observations, i.e., the observations are associated to the mean that is the closest to them. K-Means algorithm therefore offers a nice way to attribute each topic to one group, using some objective criteria.

Note that the arrangement of points in the cluster graph will be similar to the one in the scatter plot; this is due to the fact that we only work with two variables; HR of stakeholders and of engineers. As a consequence the clustering may appear to be redundant. What we are interested, however, is not the graphical representation of topics, but rather the actual grouping of the points in some clusters, which as already discussed is not clear enough in the scatter plot graph.

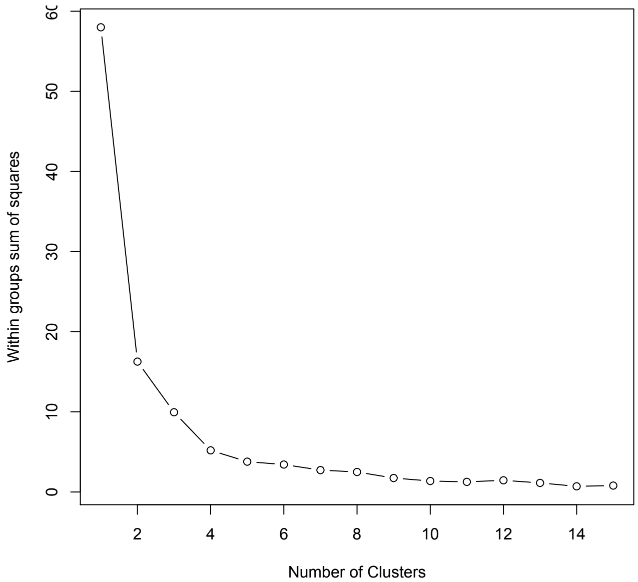

Fig. 3. Optimal Number of Clusters

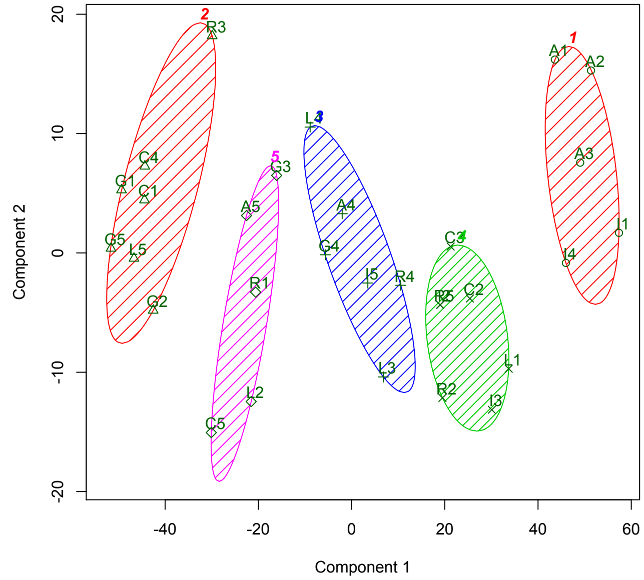

Fig. 4. Clustering using K-Mean with 5 Clusters

C. Running the K-Means Algorithm on Elicitation Topics

A first important question when doing K-Means clustering is to decide about the number of clusters that should actually be used. There is no systematic way to find that number. In this paper, we therefore use the "elbow" rule of thumb. It consists in finding, in a graph representing the within groups sum of squares as a function of the number of clusters, the inflexion point where the addition of a new cluster does not bring more explanation to the variance of the cloud of points [15]. In Figure 3, this occurs for the fifth cluster. This leads us to make only use of five clusters in the rest of this analysis.

Starting from the observation that five clusters is the best number of cluster to group relevantly most of our topics, we then proceed with the actual clustering of topics via the K-Means algorithm. The graphical output of this algorithm is visible in Figure 4. Note that the two axes in the graph are no more representing hit rates (as in Figure 2), but are the result of a principle component analysis. Therefore, they have no clear meaning, beside the one we can give them through interpretation. Notice also that principal components have a null average, because we standardised data. There are several observations that can be made from the clustering process:

- The five clusters have similar sizes; they all count between 5 and 7 Topics. This suggest there are no outliers, but real clusters of topics;
- The first principal component explains 94% of the variance (the relevance of the second is therefore negligible), and reflects the risk of omission of a topic; the smaller it is, the higher is the risk of a topic to be overlooked;
- Cluster 1 becomes the Expected area of METRe;
- Cluster 2 and 5 become the Remote area of METRe;
- Cluster 3 and 4 become the Requested information area of METRe.

V. Discussion and Future Research

This section discusses the possible impacts of the METRe model on the practice of requirements elicitation. It focuses mainly on two ideas; that METRe could help in deciding which elicitation technique to apply, and that METRe could be used to define the timing of an elicitation process. The discussion here is inspired by our observations, and aims to suggest new ways for research. The elicitation techniques we consider here are those surveyed in [16]. It is important to insist on the fact that the present discussion is a suggestion for future research. The propositions made in this section of the paper are inspired by some of our empirical observations and comments we collected from our subjects, but have not been validated in any way.

A. METRe and Elicitation Sequence

The link between the sequence of elicitation in relation to METRe is a first promising way of research. It starts from the simple idea that some topics may be easier to discuss - some techniques might be more efficient - at the beginning of the elicitation, while some others could be more evident to discuss as other related information has already been surfaced. There has been research on the effectiveness of elicitation techniques. For example, it has been shown that the active participation of stakeholders [17] or the geographical distribution of an RE project [18] influences the effectiveness of elicitation techniques. Our idea mainly differs from previous works in that it suggests the efficiency of an elicitation technique might also depend on the moment when it is used during the elicitation process.

1) Expected Information: Collecting expected information should be an easy activity; both stakeholders and engineers are willing to share information about topics they judge central for the project, so that discussion is likely to be interactive and fluid. This category of information is likely to be elicited at the beginning of the elicitation process, even during kick-off meetings, and may not require too much preparation from the engineers in order to be collected.

2) Requested Information: Collecting requested information would be a less spontaneous activity. It suggests to have a global understanding of what is expected from the system, and hence some preparation in order to be collected effectively. As a consequence, it could be more relevant to deal with this category of METRe after a first discussion about expected information has occurred. The focus in this stage of the elicitation would be the refinement of Expected information. It would require the engineers to ask more specific questions about topics stakeholders seem to care less about.

3) Remote Information: Collecting remote information is a more challenge process, as it would aim to collect information that, at first sight, seem irrelevant to engineers and stakeholders. It suggests that most of the other important topics have already been discussed, so that Remote information would come as a last stage in the elicitation process.

4) Unexpected Information: Collecting unexpected information would not be the responsibility of engineers; they find the topics unimportant, even if these could be valuable to them when designing a system. As a consequence, this type of information will be provided by the stakeholders, who will probably be pro-active in sharing them, i.e., it would then be the duty of stakeholders to mention those aspects, and the duty of the engineer to understand the latter. This suggests that there is no strict sequence to elicit Unexpected information; it may occur at any time during the elicitation.

B. METRe and Elicitation Technique Selection

The link between Elicitation Techniques and METRe is another aspect that deserves to be investigated in future works. There has already been work on the selection of elicitation techniques, depending on some characteristics of the engineers [2], [19], the project [20], or depending on which type of information the engineer wants to collect [21]. Our idea mainly differs from these previous works in that it suggests that different subjects - METRe categories - may require different approaches in order to be effectively elicited. Consider for example a stakeholder being asked during an interview about a topic she finds difficult to discuss, e.g. a Remote topic such as the frequent events that occur in the business and that may be related to the system-to-be. The interview settings imply of-memory speech, no time for preparation, etc. so that the stakeholder may have troubles in actually and relevantly speak about the topic through interviews. On the contrary, it may be more straightforward to elicit such topic using indirect elicitation techniques, which are more practical, like prototyping.

1) Expected Information: The goal when discussing expected information would be to settle the borders of the system, and get a first raw idea of what it should do. This category could be elicited easily (relative to other categories), based for example on interactive techniques such as unguided interviews, requirements workshops and group works. Scenarios, use cases and brainstorming offer other possible tools that could be well adapted for supporting such discussion.

2) Requested Information: The objective when collecting requested information would be to better understand the already identified requirements, and get better insight into the reasons for these requirements. This discussion inherently requires more pro-activity from the engineers; engineers may have to ask questions to stakeholders in order to arouse the discussion. Semi-guided interviews, as well as protocol analysis and observation could be valuable techniques in that regard. JAD workshops - which imply to discuss both problems and solutions related to the system - and laddering could be other possible techniques.

3) Remote Information: The goal in this stage would not be to broaden the scope of identified requirements, but rather to make sure no information has been omitted about the latter; the challenge here would be on the granularity of collected information, i.e., focus on depth rather than on scope. Remote information is important neither to the engineer nor to the stakeholder, so that the engineer has to find some way to render the information visible. Guided interviews, prototyping and apprenticing could be possible ways to collect such Remote information, as they confront stakeholders and engineers to the real world, and thereby generate accurate suggestions, remarks, questions, etc.

4) Unexpected Information: The result of unexpected information might be either a change of scope, or depth. There likely are no techniques to be used in order to systematically elicited unexpected information. At best, could the engineers put the stakeholders in a context that arouse discussion about the topics. Some techniques may help the engineers in that regard; ethnography could be a solution, as well as observation and viewpoints, which enable to study people in their natural settings. Introspection could be another useful way to uncover some Unexpected Information.

VI. Threats to Validity

The empirical design we used in this research is pretty simple, and takes the form of a survey. We perform no comparisons between different groups, we do not observe the same subjects repetitively over time, and we use only one single binary scale. In that regard, the list of possible threats to internal and external validity appears to be limited. Some deserve however to be discussed.

One threat to internal validity, to which we paid particular attention, is the experimental arrangements effect. This is the risk of bias due to some topics being presented systematically at the same place in the survey - typically at the end - so that the risk of subjects being systematically bored or distracted when evaluating the latter topics is higher. We dealt with such threat by randomizing the position of questions within our survey, so that the combination of topics is always different for different subjects. Another threat to internal validity of our study is confounding, i.e., there is a risk of bias due to a variable that has not been accounted for by the experimenters.

We gave subjects a real-world scenario and clear instructions so as to how to reduce this risk. Beside, we selected subjects from different horizons and area of expertize in order to reduce the impact of domain-specific factors. Finally, there is some risks related to the use of a binary scale, as it may lead engineers to favour the positive answer by default of any intermediary scale level. This aspect has however been discussed and justified in the previous section, and is not considered as a major threat to the validity of the survey.

Regarding the threats to external validity, we used a mix of random and non-probabilistic sampling methods, in order to reduce as much as possible the risk of selection bias. It is important however to note that external validity is threatened by the relative small size of our sample, and potentially by the profile of subjects who have been surveyed during our second round of data collection. It is worthy to remind that our subjects are IT-experts (they all have a significant background in IT) but not strictly speaking requirements engineers; in practice, they might form a sample that is not representative of the requirements engineers population. Overall, cautiousness is therefore required when applying these results to other contexts or other populations.

VII. Conclusion and Limitations

In this paper, we describe METRe, a Model of Elicitation Topic Relevance. METRe identifies four important categories of information. We argue these categories are relevant to distinguish, because they are more or less likely to be discussed during elicitation interviews, and hence to be omitted in the resulting elicitation document. We therefore argue that some categories of METRe could require specific treatment during elicitation; for instance, they may be elicited in a particular sequence, may require specific techniques in order to be elicited correctly, or may require different levels of resource in order to be documented.

There are two limitations in the application of our results that are worthy to discuss. Firstly, the study is a survey research, and works on what subjects claim they would do in an situation of elicitation, not what we observed they actually did, i.e., we did not go on actual RE projects - as our goal was to collect answers from a sufficiently large set of engineers - so that questions were somehow generic, and lacking of real context. This reduces the ecological validity of our study. Secondly, and related to previous issue, it appears that some engineers found it sometimes difficult to decide about their pro-activity toward a given topic, not being provided a more specific class of system. For example, one explained that she would be much more concerned in eliciting “I2. Objects that could connect to the system” in the case of a reporting or planning tool than in the case of an accounting system or a CRM. We made the same observation in our research about the ETM. This problem is due to our objective to provide a generic METRe model; it however suggests that there is not one METRe model, but probably several domain-specific models. Overall, we believe these two limitations do not hold us back from drawing relevant conclusions about the engineers behaviours during elicitation interviews. They however define promising paths for future research.

References

[1] M. G. Christel and K. C. Kang, “Issues in requirements elicitation,” *Technical Report CMU/SEI-92-TR-12 ESC-TR-92-012*, 1992.

[2] A. M. Hickey and A. M. Davis, “A unified model of requirements elicitation,” *Journal of Management Information Systems*, vol. 20, no. 4, pp. 65–84, 2004.

[3] J. A. Goguen, “Formality and Informality in Requirements Engineering.” in *Proc. 4th International Conference on Requirements Engineering*, 1996, pp. 102–108.

[4] P. Grunbacher and R. O. Briggs, “Surfacing tacit knowledge in requirements negotiation: experiences using EasyWinWin,” in *Proc. 34th Hawaiian International Conference on System Sciences*, 2001.

[5] W. R. Friedrich and J. A. van der Poll, “Towards a Methodology to Elicit Tacit Domain Knowledge from Users,” *Interdisciplinary Journal of Information, Knowledge and Management*, vol. 2, no. 1996, 2007.

[6] L. Singer, O. Brill, S. Meyer, and K. Schneider, “Utilizing Rule Deviations in IT Ecosystems for Implicit Requirements Elicitation,” in *Managing Requirements Knowledge (MARK)*, 2009, pp. 22–26.

[7] O. Daramola, T. Moser, G. Sindre, and S. Biffl, “Managing Implicit Requirements Using Semantic Case-Based Reasoning Research Preview,” in *Requirements Engineering: Foundation for Software Quality*, 2012, pp. 172–178.

[8] A. Miranskyy, N. Madhavji, M. Davison, and M. Reesor, “Modelling assumptions and requirements in the context of project risk,” in *Proc. 13th IEEE International Conference on Requirements Engineering*. Ieee, 2005, pp. 471–472.

[9] A. Sutcliffe and P. Sawyer, “Requirements elicitation: Towards the unknown unknowns,” in *Proc. 21st IEEE International Requirements Engineering Conference (RE)*. IEEE, Jul. 2013, pp. 92–104.

[10] C. Burnay, I. J. Jureta, and S. Faulkner, “What stakeholders will or will not say: A theoretical and empirical study of topic importance in Requirements Engineering elicitation interviews,” *Information Systems*, vol. 46, pp. 61–81, Nov. 2014.

[11] ——, “An Exploratory Study of Topic Importance in Requirements Elicitation Interviews,” in *Proc. 26th International Conference on Advanced Information Systems Engineering (CAiSE’14)*, 2014, pp. 180–195.

[12] P. Dourish, “What we talk about when we talk about context,” *Personal and Ubiquitous Computing*, vol. 8, no. 1, pp. 19–30, Feb. 2004.

[13] M. Baldauf, “A survey on context-aware systems,” *International Journal of Ad Hoc and Ubiquitous Computing*, vol. 2, no. 4, pp. 263–277, 2007.

[14] B. L. Berg, *Qualitative Research Methods for the Social Sciences*, 4th ed. Boston Pearson, 2004.

[15] B. S. Everitt and T. Hothorn, *A Handbook of Statistical Analyses Using R*, 2nd ed. CRC Press, 2009.

[16] D. Zowghi and C. Coulin, “Requirements Elicitation : A Survey of Techniques , Approaches , and Tools,” in *Engineering and managing software requirements*, C. Aurum, Aybüke and Wohlin, Ed. Springer Berlin Heidelberg, 2005, pp. 19–46.

[17] A. M. Davis, O. Dieste, A. M. Hickey, N. Juristo, A. Moreno, and M., “Effectiveness of requirements elicitation techniques: Empirical results derived from a systematic review,” in *Proc. 14th IEEE International Conference on Requirements Engineering*, 2006, pp. 179–188.

[18] W. J. Lloyd, M. B. Rosson, and J. D. Arthur, “Effectiveness of elicitation techniques in distributed requirements engineering,” in *Proc. IEEE International Conference on Requirements Engineering*, 2002, pp. 311–318.

[19] A. M. Hickey and A. M. Davis, “Elicitation technique selection: how do experts do it?” in *Proc. 11th IEEE International Conference on Requirements Engineering*. IEEE Comput. Soc, 2003, pp. 169–178.

[20] T. Tsumaki and T. Tamai, “Framework for matching requirements elicitation techniques to project characteristics,” *Software Process: Improvement and Practice*, vol. 11, no. 5, pp. 505–519, Sep. 2006.

[21] N. Maiden and G. Rugg, “ACRE: selecting methods for requirements acquisition,” *Software Engineering Journal*, vol. 11, no. 3, pp. 183–192., 1996.