



11th International Workshop on

Requirements Engineering

WER 2008

September 12-13, 2008

Barcelona, Catalonia, Spain

Carme Quer, Juan Pablo Carvallo, Lyrene Fernandez da Silva (Editors).



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Preface

The eleventh Workshop on Requirements Engineering (WER'08), continues with the tradition of previous editions, providing an open and active forum for researchers and practitioners of the iberoamerican community, to present and discuss their work, to exchange experiences and to look for prospective collaborations in the field of requirements engineering.

WER'08 was held in Barcelona, Catalonia, Spain, in September 12 to 13 of 2008. The international program committee, from 8 different countries, was composed of 35 relevant researchers coming both from the academia and the industry. 30 papers were received; 3 reviews were completed for each paper, 16 were accepted as full papers and 4 as short papers.

The selected papers cover the main activities of requirements engineering. Presentations were organized in six sessions, distributed during the two days of the workshop. The topics of the sessions included elicitation, analysis, traceability and modeling of requirements, as well as process, quality and reuse. The program included an opening session with a keynote by Roel Wieringa, entitled "Business-IT Alignment in Value Webs".

We would like to thank all the individuals and institutions who have contributed to make this workshop a reality: the authors who submitted papers; the keynote speaker for accepting our invitation; the program committee members for carefully reviewing the papers; the general chair Carme Quer and the members of the GESSI research group of the UPC, that helped in the organization; and the participants of the workshop that justify the celebration of the workshop yearly.

September 2008

Juan Pablo Carvallo
Lyrene Fernandes da Silva

11th Workshop on Requirements Engineering

WER 2008



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A Methodology for Reducing Geographical Dispersion Problems during Global Requirements Elicitation

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Abstract

Global Software Development (GSD) challenges current practices for requirements elicitation because some difficulties to achieve effective communication are aggravated by cultural diversity and the impossibility of having face-to-face meetings.

Considering that effective communication would help reduce misunderstandings among stakeholders, and therefore help achieve more committed requirements, we propose here a methodology for global requirements elicitation focused on minimizing the most frequent problems in GSD. We introduce the proposal as well as the results of a controlled experiment, which show preliminary but promissory tendencies.

1 Introduction

Developing software in scenarios where stakeholders are geographically dispersed in multiple distanced sites is becoming more common every day. Off-shoring and outsourcing have been adopted by industry easily, but even when these practices are advantageous in many ways, they are far from being a panacea for GSD [22]. According to the experiences from some real-life GSD projects, the dispersion over multiple sites can introduce several factors that negatively affect a team's performance [13, 25]. One of them, and the most important, is the lack of face-to-face interaction; but cultural diversity also introduces many issues that affect communication and that are worth of consideration. Similarly, achieving effective

communication is a well-known challenge during the requirements elicitation process [1].

So, considering that establishing a good communication is crucial during any requirements elicitation process and that, additionally, communication is seriously affected when stakeholders are distributed along many distant sites, we think a methodology for requirements elicitation in distributed scenarios must focus on minimizing the most common problems introduced by such a distance.

To do so, we have analyzed several requirements elicitation methodologies for co-located projects [12, 14, 26], we have adapted different phases to a distributed environment, and we have proposed strategies to minimize some common problems in GSD, such as communication and cultural diversity factors [3, 6]. In this paper, we introduce the resulting methodology as well as some preliminary results we have gathered by means of a controlled experiment.

The rest of the paper is organized as follows: in Section 2 we discuss the main problems that affect a distributed requirement elicitation process and propose the basis for a methodology for global requirement elicitation. In Sections 3 and 4, we describe the experiment design and we present the preliminary results of a controlled experiment we carried out to validate part of our proposal. Conclusions and future work are addressed in the last section.

2 RE-GSD: a methodology for global requirement elicitation

As we have mentioned before, the lack of face-to-face interaction makes the *loss of communication richness*

one of the most cited problems in GSD; however some other problems also appear, especially when stakeholders are spread over different countries. They are:

- **Time difference.** When time difference between sites is considerable, it can cause that timetables do not overlap or overlap just for a short period, then synchronous collaboration is not possible and some delays in the project can happen [13]. Similarly, *time separation* also refers to timetables that do not overlap enough; however time separation can happen not just because of time difference but as a result of cultural issues like different working hours, lunch breaks, weekend or holidays time [15].
- **Cultural diversity:** people from different sites in different countries may have different religions, languages, and customs. These differences can be a source of misunderstandings produced by the use of ambiguous words, expressions that can be wrongly understood, body-language that gives a wrong impression, etc. [13] [23]
- **Knowledge Management:** specially during requirement engineering there is a huge amount of information from multiple sources that needs to be appropriately shared among all the stakeholders [13]. Unfortunately, distance between sites usually makes this problem worse than in traditional requirements elicitation processes.

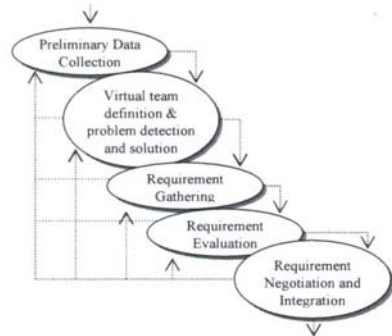


Figure 1: RE-GSD Methodology

Then, we have proposed a new methodology, called RE-GSD, specially thought to deal with the problems we have just mentioned. As a basis, we have adopted the generic model for requirements elicitation proposed by Christel [12] and we have adapted its stages considering the special characteristics of a

global software development environment. In Figure 1 we show a graphical representation of RE-GSD, and following we explain the most important characteristics of each phase.

2.1 PHASE 1: Preliminary data collection

The goal of the first phase of our methodology is knowing as much as possible about the requirements elicitation scenario. The information has been organized in categories about the domain and the system main goals, but also about the stakeholders and the environment where the requirements elicitation takes place. The main difference between this phase in RE-GSD and collocated methodologies is that RE-GSD focuses on stakeholders' cultural information as well as their distribution on the sites, and the technology they know better or they are able to use. To help in gathering this information we have provided specially designed forms. Summing up, the main information collected from the forms addresses stakeholder identification (first name, last name, nickname, birthday); site where s/he works; cultural issues (native country, cultural family influences), mother language and foreign language s/he speaks and the degree of knowledge about each one; education; groupware tools and requirements elicitation techniques they have used, as well as previous experience in GSD projects. In addition, we ask them to fill in a psychological test to have knowledge about their cognitive profile, and to have an indicator about the way they perceive and process information. We refer the reader to [16, 17] for further details.

All this information is arranged to be used during the different procedures of the following phase. For example, during the second phase this information is used to detect problems and define the strategies to be applied in order to minimize them in the rest of the phases of our methodology. Gathering this information does not take much time comparing the benefits it represents for the rest of the process. In addition, to facilitate the task, we have designed the forms easy to understand and fill in.

2.2 PHASE 2: Virtual team definition & problem detection and solution

We have specially added this phase in RE-GSD to focus on recommending strategies to minimize the problems introduced by geographical dispersion. With such an aim, we propose analyzing the information we have gathered in the previous phase, identifying the possible sources of problems, and finally,

recommending strategies to improve the requirements elicitation process. In order to perform this work, we propose two main tasks:

- Detect the factors that may be a source of future problems
- Determine the strategies to be applied in order to minimize the detected problems.

2.2.1 Factors that may cause future problems

As a part of the first task, we found out four factors, which are related to the previously explained most common problems in GSD projects, interesting to be measured in any virtual team. They are:

- **time overlap** (how much time do sites share for synchronous collaboration?);
- **cultural difference** (how different are cultures between the countries where sites are located?);
- **language difference** (which is the level of knowledge about the common language?), and
- **stakeholders' cognitive aspects** (which are stakeholders' innate characteristics that influence their behaviour when they perceive and process information?)

For each factor we determined a manner to obtain a value in a set of linguistic tags, since they are easy to remember as well as to refer, and also because they give us the chance to reuse our functions among different projects. The tags we defined for each factor are:

- **Time overlap:** (low, medium, high)
To calculate it, we analyze how much time is available for synchronous interaction per day, and calculate the percentage over the daily working time.
- **Cultural difference:** (low, medium, high)
To estimate it, we use the Hofstede model [21] for cultural differences and obtain the difference for each dimension on the model. The addition of those differences gives us an indicator of cultural differences between two countries.
- **Language difference:** (low, low-intermediate, medium, high-intermediate, high)
To obtain this value, we analyze the information we gathered in the first phase concerning the knowledge about native and foreign languages for each stakeholder, and we determine a value for the whole team.

• Team type according to the stakeholders' cognitive aspects (Type 1, Type 2, Type 3)

In order to know more about stakeholders, we have analyzed some instruments from the field of cognitive psychology designed to measure human characteristics and explain differences between people [24]. Specifically, we chose a learning style model, called Felder-Silverman (F-S) [17], which analyses the way people receive and process information, with the aim of making the environment closer to their cognitive profile. Stakeholders' F-S learning styles are obtained by means of a test that catalogues their preferences about four categories (perception, input, processing, understanding) as slight, moderate and strong between two opposite subcategories. For instance, for the category "input", people are catalogued as verbal or visual on the scale (slight, moderate, strong). Then, if people are verbal they would prefer perceiving information by means of spoken words, while visual people would prefer graphics. When preferences are stronger, people may have difficulty learning in an environment that does not support their preference, so we decided to classify teams according to the occurrence of strong preferences, as follows:

- **Type 1:** There are no strong preferences in the team.
- **Type 2:** There are strong preferences but not at the opposite sides of the same category. For instance: if there are strongly visual people in the team, and there are no strongly verbal people, communication should be based on diagrams and written words that would increase the involvement of visual people. People with slight and moderate preferences can be easily accustomed to them.
- **Type 3:** There are strong preferences at the opposite sides of the same category, then there is a conflict of preferences. For example, if there are one or more strongly visual people, and also some strongly verbal people, communication should give support to both kind of styles, as we will discuss later.

2.2.2 Strategies to minimize GSD problems

According to the values obtained for time overlap, cultural difference, language difference and team type

regarding cognitive aspects, we recommend three strategies which are designed to minimize the problems introduced by such factors.

For example, regarding cultural difference, the main problems are related to people's behaviour. For instance, USA ranks high about individualism while collectivism is a common characteristic of Latin culture [21], then interaction between such countries can be problematic, giving Latin people the idea that Americans are not compromised with the group [7] or Americans thinking that Latin people spent too much time building an unnecessary social relationship. Since such kind of misunderstanding about behaviour can be a source of frustration for team members, we propose a first strategy, called A, which focuses on learning about the other cultures:

- **Strategy A: Learning about Cultural Diversity**

Cultural differences cannot be avoided, but stakeholders can learn about the differences of the other culture. Being trained about cultural diversity is crucial for stakeholders to be aware of normal behaviour in other cultures as well as being conscious of their own behaviour, especially for things that can be offensive or misunderstood. To minimize such kind of problems, stakeholders training, by means of literature review, seminars, courses, etc. is recommended [21]. Also, one of the strategies that is used in industry to improve this awareness is cultural mediation, which takes advantage of people who have visited the other site before – and therefore they know about customs and normal behaviour related to the foreign culture – so they become references for communication with people at the other site mediators (also called “bridgeheads” [10] or “liaisons” [19]).

Finally, we propose using an innovative strategy called “virtual mentoring”. This strategy is based on simulation and virtual actors and it can become an interesting way for motivating stakeholders in foreign language training and cultural familiarization [27].

In addition to cultural diversity, GSD projects also must deal with language differences. Language difference can happen in a wide variety of levels, considering if stakeholders share or not the same mother language. When people do not share the native language, English is usually the language chosen for interaction and it is crucial having a clear understanding of domain concepts and relationships. But also when people share the native language, if they come from different countries, idiomatic differences are a challenge for communication. For instance, people from Argentina and Spain share Spanish as their native language, but pronunciation and the use

many words can have different meanings in both sites. Since during the requirements elicitation process it is crucial having a common understanding about the system domain, our strategy to minimize the idiomatic differences is using ontologies to help communication, as follows:

- **Strategy B: Using Ontologies as communication facilitators**

When stakeholders are not from the same country of origin, even if they share the mother language, misunderstanding can arise because some words have more than one meaning, or different words refer to the same concept, etc. Sharing a common vocabulary, especially referring to the domain components is crucial, and to help to build it, we propose a domain ontology. In addition, ontologies play a natural role in supporting knowledge management, which is very important during requirements elicitation where a lot of data is collected from many distant sources. Then, ontologies make possible clarifying the structure of knowledge and allow a clear specification of the concepts and the terms used to represent them [11].

Finally, but not less important, we have considered the fact that people in GSD projects apply requirements elicitation techniques by means of groupware tools. Then, in order to improve people communication, we have focused on analyzing how technology selection can influence people performance. Based on such analysis we propose a third strategy:

- **Strategy C: Selection of suitable technology**

There are two types of technology that are used during requirements elicitation: groupware and requirements elicitation techniques. By analysing the factors we measured, we aim at choosing the most suitable technology according to the characteristics of the virtual team.

There are different points of views to select technology. The first one is time overlap. In this case, it is obvious that when time overlap is low synchronous interaction will be difficult, so we recommend using asynchronous groupware tools and avoiding requirements elicitation techniques based on synchronous interaction (like brainstorming). Also when the stakeholders' mother language is not the same, and the degree of knowledge of a common language is intermediate or less, we propose restricting communication to asynchronous tools, in order to give people the chance to read and write with greater care.

Finally we propose using knowledge about the stakeholders' cognitive characteristics for technology selection. As we explained before, one of the factors

that it is possible to know in a virtual team is the cognitive characteristics that are innate to people and are related to the way people perceive the information and understand it. Since communication in GSD projects is done by means of groupware tools and requirements elicitation techniques, we have proposed a model to obtain preference rules at the individual level [2] and after applying the model on a number of surveys, we obtained a preliminary set of preferences rules [6]. In addition, we proposed a set of strategies to combine the technology according to the type of virtual team (type 1, 2, or 3), which are called strategies C1, C2 and C3, depending on the occurrences of people with strong preferences in the given virtual team.

To illustrate strategies C1, C2 and C3, let us suppose we have a group of stakeholders and we know their cognitive profile (according to the F-S model). By means of the preference rules we have obtained, we can define the most suitable groupware tool for each stakeholder, but we need to combine such preferences for the whole team. How many combinations we have?

If there are no strong preferences in the team (**Group type 1**), according to the F-S model definition, people with slight and moderate preferences can get accustomed to different media easily; then we suggest selecting the groupware tool that appear more times as the most suitable (**Strategy C1**). The strategy can be expressed as follows:

$$S_1(\{g\}, GS_1, GS_2, \dots, GS_n) \rightarrow g_i \in \{g\}$$

where GS_i represents the groupware tool that fit the i -th stakeholder's preferences, and $g_i \in \{g\}$ is the tool that appears more times.

However, if some stakeholders' preferences are strong and the rest of the stakeholders are moderate or mild, the preferences that should be primarily considered are those of the first group of stakeholders. This is because people with strong preferences perform better when the technology is closer to the way they receive and process information [17]. Then, we first considered groups where there are strong preferences for a subcategory but not on the opposite one (**Group type 2**), and introduce the **strategy C2**:

$$S_2(\{g\}, (\{GS_1\}, ws_1), (\{GS_2\}, ws_2), \dots, (\{GS_n\}, ws_n)) \rightarrow g_i \in \{g\} \wedge g_i \in \{GS_j\} \\ \wedge ws_j = \max(ws_1, ws_2, \dots, ws_n)$$

where GS_i represents the groupware tool that fit the i -th stakeholder's preferences and ws_i is the weight – meaning how strong the preferences are – and the resulting g_i is a tool that is appropriate for the

stakeholder whose personal preferences are the strongest.

Finally, when there are people with strong preference at opposite subcategories (**Group type 3**), we need to use the **strategy C3**. To do so, we propose to improve the process by changing the machine-learning algorithm for an algorithm that for each rule returns a ranking of output variables, instead of only one. Then, as we have a ranking of preferences for each person, we can look through the ranking for people with the strongest preferences and choose the groupware tool that is located higher for all of them. That will be the best choice for the team, even though it would not be the first choice for some, or even none of them. However, this strategy is currently under study since we need to analyse the existing algorithms that fit the kind of result we need to implement.

To sum up, the strategy to be applied in each case depends on the cognitive profile of stakeholders, and the existence of strong preferences with or without conflicts. Examples that illustrate each strategy and further details can be found in [4]

Strategy application

Strategies A, B, and C, are specially related to the problems introduced by geographical dispersion. They can be applied in any project, but we strongly recommend doing it when factors indicate they are necessary. For instance, as it is shown in Figure 2, training about cultural difference is suggested when cultural difference is medium or high, while the use of domain ontologies is recommended when people from different countries take part in the global requirements elicitation process. The technology selection strategy is recommended in most of the cases, but specially when virtual teams are type 2 or 3, which means that people with strong cognitive preferences can increase their performance. We show a graphical representation for the decision process in Figure 2.

- **PHASE 3: Requirement gathering**

Once strategies to help communication in GSD have been defined for the current project, it is time to apply the requirements elicitation techniques and obtain a list of requirements that answer “what” is to be built [12]. For this phase we have adapted the requirements elicitation model proposed by Hickey and Davis [20], including factors introduced by geographical dispersion as well as the stakeholders preferences regarding their cognitive styles.

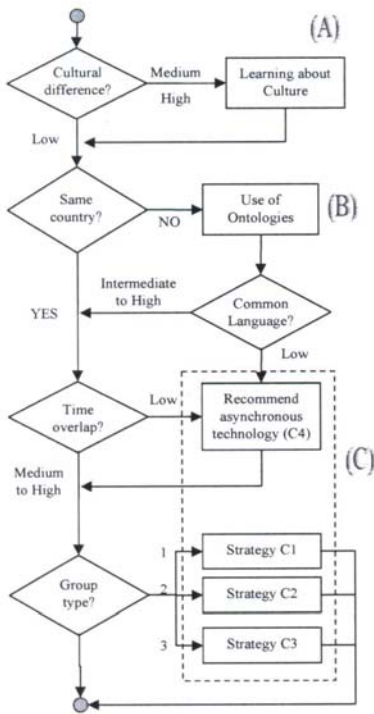


Figure 2: Applying strategies according to factors measured in virtual teams

As it is shown in Figure 3, the gathering phase starts looking for a set of requirements elicitation techniques (RET) t_i , that are applicable in the current situation S_i and when the current state of requirements is R_i . In a GSD project, we also take into account factors T_i and L_i , which represent the time overlap and the language difference as we explained before. Following, one of those techniques is chosen (t_i), taking into account the RET preference rules and the virtual team type (1, 2, or 3). Next, a groupware tool, suitable to apply t_i , is chosen regarding groupware tools (GW) preference rules. Finally t_i is applied and a new state of requirements (R_{i+1}) and a new project situation (S_{i+1}) is reached.

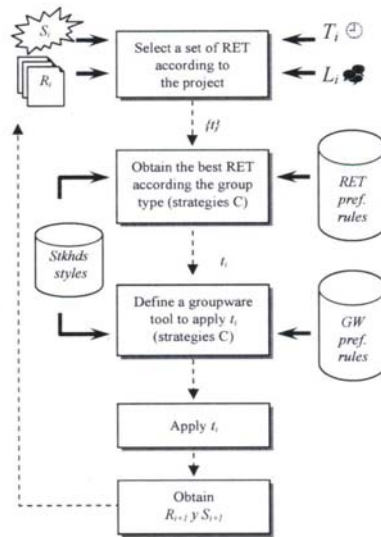


Figure 3: Requirements gathering model for GSD projects

- **PHASE 4: Requirement evaluation**
In this stage, requirements lists is analyzed in order to determine consistency between the different statements. This phase in GSD projects is not different from collocated projects referring the list of attributes that requirements must to fulfil (completeness, consistency, correctness, etc.), while requirements that do not accomplish the rules must returned to previous phases to be discussed until they are well defined. The main difference is the environment needed to keep the requirements information available to the different evaluators. Then, we propose having a shared space where evaluation forms can be stored and accessible for stakeholders. To discussion or any other interaction among people in charge of evaluation, we propose using the groupware tools recommended for every evaluator by the GW preference rules, and combine them according to strategy C, as we explained for the previous phase, in order to make stakeholders feel more comfortable with technology.
- **PHASE 5: Requirement negotiation and integration**

Once requirements have passed the evaluation phase, it is important to give them an order of relative importance so as to know when they should be addressed in relation to other requirements [12]. To do so, one of the most common choices is the Win-Win approach that has been specially designed for distributed environments [8, 9]. Furthermore, applying the Win-Win approach, the goals of the last phase of the Christel model, called Integration and Validation [12], naturally happen at the same time that requirements negotiation takes place. That is because during the Win-Win negotiation many stakeholders participate and discuss about each requirement, then different points of view are taken into account, as well as requirements are discussed in a environment where requirements from previous iterations are also presented.

3 Experiment design

In order to validate the first part of our methodology, specifically the use of factor measurements and strategies definition, we have carried out a controlled experiment performed by computer sciences post-graduated students from the University of Castilla-La Mancha (Spain) and the University of Comahue (Argentina). As we did not count on a wide number of subjects, we designed the experiment to test only two strategies (B and C), and we proposed 4 treatments, combining the existence or not of a domain ontology and the use or not of a suitable groupware tool, according to their cognitive style, as follows:

- T1: using appropriate groupware tool and a domain ontology
- T2: using appropriate groupware tool without using a domain ontology
- T3: using non-appropriate groupware tool and a domain ontology
- T4: using non-appropriate groupware tool without using a domain ontology

In addition, we did take care of fixing the rest of the variables for all the treatments. For instance, requirements elicitation techniques were reduced to interviews and use case models for all the teams, and more experienced people was assigned first to avoid them to be in the same team. Students were divided into eight teams, with three people in each. We chose having two analysts and one user per team, as we considered that such distribution gave us the chance to analyze not just the user-analyst relationship, but also the analyst-analyst relationship. Additionally, to avoid

educational differences, we assigned the same roles to people from the same country, then Spanish students played the role of analysts and Argentinean students played the role of users. Finally, we assure that each team had the same challenges to overcome: they had 4 hours of time difference, they had the same difference in timetables, the cultural difference was the same (low according to the Hofstede model [21]) and they had the same idiomatic differences about pronunciation and vocabulary.

Previously to start the experiment, students were asked to fill in a pre-experiment test to know about their prior experience in requirements elicitation processes, the groupware tools they had used before, and also they were asked to fill in the Felder-Silverman test [17] available on the WWW¹. As we noticed there were a great percentage of strongly visual people and there were no strongly verbal people, we assigned people to teams in order to have Type 2 teams. To do so, we assigned strongly visual people first, using random criteria (using a dice), and later we assigned not strongly visual people using the same random criteria. Next, teams were randomly assigned to one of the four treatments (as it is shown in Figure 4).

	Using a Domain Ontology	Not Using a Domain Ontology
Appropriate groupware tool	G4 G8 T1	G6 G3 T2
Non-Appropriate groupware tool	G1 G7 T3	G2 G5 T4

Figure 4: Teams distribution over treatments

Once teams were formed, we applied the rules we have previously defined by means of a machine learning algorithm, and we obtained the most suitable tool for each stakeholder. Next, we obtained the most suitable groupware tool for each team using the strategy C2 previously explained (since all the teams were Type 2). Following, for teams in treatments T1 and T2 we assigned the groupware tool suggested by our preference rules, but for teams in treatments T3 and T4 we assigned a different groupware tool. Table 1 shows the most suitable groupware tool for each team (according to their members' cognitive characteristics), and the groupware tool effectively assigned to each team.

¹ <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

Table 1: Groupware tools used for each team

Team	Suitable GW tool	Assigned GW tool	Suitability
G1	IM	Email	-
G2	Audio	IM	-
G3	Audio	Audio	+
G4	IM	IM	+
G5	IM	Email	-
G6	IM	IM	+
G7	Audio	IM	-
G8	Audio	Audio	+

Team members were told to use a unique groupware tool (email, instant messaging or audio-conference), and only that, during the time the experiment lasted. However, they were not advised that groupware tools were assigned considering their cognitive profiles, so they did not know what groupware tool was appropriate or not for them. Similarly, team members in treatments T2 and T4 did not know that other teams were able to consult a domain ontology, since that information was revealed only for teams that had to use it.

At the moment of implementing the experiment, each client was provided with a document with general indications about a system (the same for all the teams), and he/she communicated with the analysts by means of the recommended groupware tool, and transmitted the system requirements. Team members were able to communicate freely during a week, and after that time, each team gave us the requirements specification that analysts had written with the client approval. To avoid the subjectivity that may arise if the specifications were reviewed by the same people who carried out the experiment, we asked five professors, who teach software engineering topics at the University of Castilla-La Mancha, to evaluate the requirements specifications written during the experiment. Our current work focuses on analyzing the quality of the requirements specifications in relation with the treatment applied to each team.

Finally, at the moment we received the requirements specification, we asked the team members to fill in a post-experiment questionnaire in order to obtain their personal opinion about the requirements elicitation process and the requirements specification they had written. In the following section we will present preliminary results from the analysis of such post-experiment questionnaires.

4 Preliminary results

The post-experiment questionnaire was designed to gather team members satisfaction about the requirements elicitation process they were involved and the requirements specification they produced.

The data from the 24 questionnaires was analyzed using the Multiple Correspondence Analysis (MCA) test [18], by means of the statistical software Spad 4.01.

Figure 5 shows a graphic that represents the distribution of the subjects. Most of the points that represent the subjects under study are accumulated on the right side of the graphic. That means that those are the subjects who have the most typical values in the sample, in other words, the measures closer to the central tendency (mean and median), while the subjects whose answers differentiate from the rest are those that are disseminated on the left. Following we will focus on these subjects in order to study why these differences came up.

To identify the subjects in the graphic we must understand the labels that represent them. In this case, labels are formed as follows: they start with the letter "G" (group), the second character is a digit that represent the team (1-8), the third is a digit that represent the subject into the team (1, 2, 3), and an underscore ("_"). Following the underscore, the first one or two letters represents the groupware tool (E=Email, IM=Instant Messaging, S=audio-conference) and the last letter represents the role in the team (A=Analyst, C=Client). For instance, the label G41_IMA represents the subject 1 in the team G4, that has used Instant Messaging and played the analyst role.

As we previously explained, we had determined a set of preference rules by means of analyzing data we obtained in previous surveys [5]; then, we expected that people using the groupware tool suggested by our rules would feel more comfortable than those who did not.

Though, when the team members finished the software requirements specification, we asked the to fill in a post-experiment questionnaire and rate their satisfaction about the communication with their partners during the requirements elicitation process, as well as their satisfaction with the requirements specification they have written. Satisfaction for both concepts was defined as an ordinal variable in the scale 0-4 (0=very bad, 1=bad, 2=acceptable, 3=good, 4=very good).

Analyzing the graphic in Figure 5, we detect that answers that are more separated from the rest are

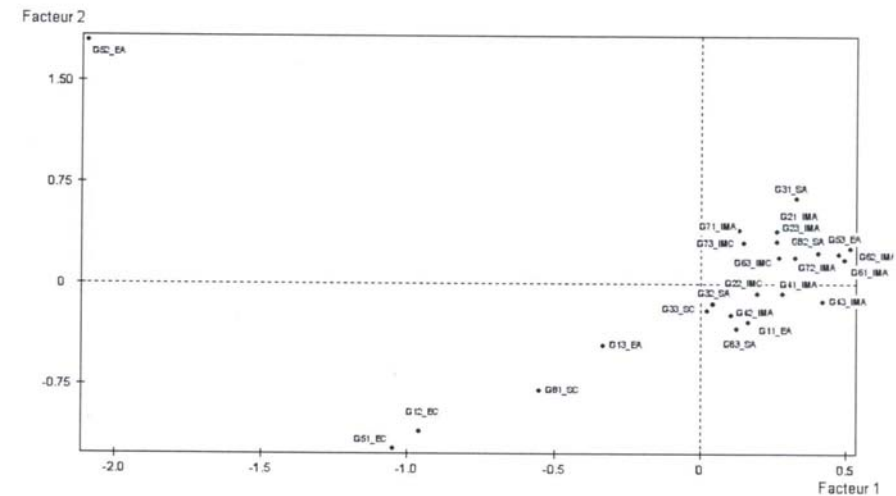


Figure 5: Multiple Correspondence Analysis (MCA)

G52_EA, G51_EC, G12_EC, which correspond to groups that used email for communication, and they were assigned to treatments T3 and T4 which used a not suitable groupware tool according to the cognitive characteristics of people in such groups. By analysing the answers of the questionnaires, we noticed that subjects G52_EA, G51_EC, G12_EC are those that have rated their satisfaction as "low" with respect to communication during the requirements elicitation process and also about the software requirements specification they wrote. Since they used email, which is a groupware tool we considered unsuitable for them, this result fits with our expectations.

Following appear the subjects G81_SC, G13_EA, G83_SA, G33_SC, G32_SA, and G11_EA. By analysing answers for people using email (G13_EA, G11_EA), we confirmed the tendency, because they also rated their satisfaction as "lower" about communication. However, for people using audio-conference (G81_SC, G83_SA, G33_SC, G32_SA) we noticed the difference is related to their satisfaction about the capacity of audio-conference to carry out the different requirements elicitation activities.

As a complement, we have analyzed stakeholders' satisfaction about the communication and the written

specification, by grouping the data for each team and treatment (as it can be seen in Table 2).

Table 2: Media values for satisfaction about communication and written specifications

Treat ment	Team	Process Satisfaction (1)	Treat ment Media (1)	Product Satisfaction (2)	Treat ment Media (2)
T1	G8	3,66667	3,667	3,33333	3,333
	G4	3,66667		3,33333	
T2	G2	3,66667	3,667	3,33333	3,333
	G3	3,66667		3,33333	
T3	G1	3	3,333	2,66667	3,167
	G7	3,66667		3	
T4	G5	2,66667	3,167	3	3
	G6	3,66667		3	

Comparing the answers for people who used email (G1, G5), we observed they were more satisfied about communication when they used the domain ontology (G1) than when they did not. On the contrary, groups that have used audio-conference (G3, G8) rated communication equally in both groups. Comparing groups that used email (G1, G5) and those that used

audio-conference (G3, G8) the satisfaction was higher for the last ones, which is according to our expectations. In the case of satisfaction about the product, which is the requirements specification, groups in treatment T2 (G1, G8), who used the domain ontology rated their satisfaction higher than those on treatment T4 (G3, G5).

We are aware that these results cannot be generalized because of the small size of the sample, but this experiment can be seen as a first step of a series of experiments, focusing on different parts of our proposed methodology.

Our current work focuses on analyzing the results with more detail, to prove that differences between treatments are significant, as well as analyzing their correlation with the quality of the specifications according to the judgment of experts.

5 Conclusions

In order to save costs, many organisations have adopted a distributed structure for software development where members communicate through groupware tools, which is called global software development or GSD. In such environments, software development projects are affected by many factors that complicate communication, so as new methodologies need to be developed to improve the requirement elicitation and development processes by considering the main difficulties they have to deal with.

Bearing this in mind, in this paper we have presented a methodology based on previous generic models for requirement elicitation processes, that focuses on predicting problems and proposes different strategies to avoid or decrease their impact on the GSD project performance. Strategies suggested are centred on characteristics about the environment where the requirements elicitation process takes place, and specially on stakeholders cognitive characteristics for technology selection.

To evaluate the first phases of our methodology we have performed a controlled experiment whose preliminary results are shown here. Although few teams participated in the experiment, and considerations cannot be generalized, we believe its results will let us know about the strengths and weakness of our proposal. Our current work is centred on analyzing the quality of the written software requirements specifications, and its correlation with the use of domain ontologies and the cognitive-based process for technology selection. In future we plan replicating this experiment in other academic

environment before applying it in an industrial scenario.

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