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Nelson Baloian
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Groupware: Design, Implementation, and Use

15th International Workshop, CRIWG 2009
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Preface

This volume presents the proceedings of the 15th International Workshop of Groupware (CRIWG 2009). The conference was previously held in USA, (Omaha) in 2008, Argentina (Bariloche) in 2007, Spain (Medina del Campo) in 2006, Brazil (Porto de Galinhas) in 2005, Costa Rica (San Carlos) in 2004, France (Autrans) in 2003, Chile (La Serena) in 2002, Germany (Darmstadt) in 2001, Portugal (Madeira Island) in 2000, Mexico (Cancun) in 1999, Brazil (Buzios) in 1998, Spain (El Escorial) in 1997, Chile (Puerto Varas) in 1996, and Portugal (Lisbon) in 1995.

The CRIWG workshops seek to advance theoretical, experimental, and applied technical knowledge of computer supported collaboration. In the CRIWG workshops, researchers and professionals report findings, exchange experiences, and explore concepts for improving the success of people making a joint effort toward a group goal. Topics of discussion are wide ranging, encompassing all aspects of design development, deployment, and use of groupware.

CRIWG embraces both mature works that are nearly ready for publication in peer review journals, and new, cutting-edge works in progress. A total of 30 papers were accepted for presentation this year—16 full papers and 14 works in progress. Papers were subjected to double-blind review by at least three members of the Program Committee. The papers are organized into nine sessions, on eight different themes: Mobile Collaboration, Social Aspects of Collaboration I & II, Technologies for CSCW, Groupware Evaluation, CSCW Design, Geo Collaboration, Collaborative Learning and Modeling CSCW.

CRIWG 2009 would not have been possible without the work and support of a great number of people. We thank the members of the Program Committee for their valuable reviews, the CRIWG Steering Committee for its timely and sagacious advice and support. We owe a special debt of gratitude to our Local Organizing Committee, who worked long hours to produce a fine workshop. Finally, we honor the authors and attendees for their substantial contributions that made CRIWG 2009 a valuable experience for all involved.

September 2009

Nelson Baloian
Luïs Carriço

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Analyzing Stakeholders' Satisfaction When Choosing Suitable Groupware Tools for Requirements Elicitation

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Abstract. Global software development faces a series of problems related to various aspects of communication; for example, that people feel comfortable with the technology they use. In previous papers we have analyzed strategies to choose the most suitable technology for a group of stakeholders, taking advantages of information concerning stakeholders' cognitive characteristics. In this paper we present the preliminary results of an experiment in which our strategy was applied, and analyze stakeholders' satisfaction with regard to communication so as to discover if it is actually improved by our approach.

1 Introduction

Global software development (GSD) has become a common means to develop software [12]. However, in spite of the advantages that GSD offers [6, 16], the requirements elicitation process in such environments is particularly challenged by certain aspects. One critical point is the need to count on the best communication channels during the requirements elicitation process [5], while stakeholders' communication is challenged by the lack of face-to-face interaction, time difference between different sites and cultural diversity, among other factors [8].

Since communication in GSD projects takes place through groupware tools, it is quite interesting analyzing how those tools are chosen. As communication among people involves aspects of human processing mechanisms that are analyzed by the cognitive sciences, we have searched for references in Cognitive Informatics, an interdisciplinary research area that applies concepts from cognitive sciences to improve processes in engineering disciplines such as software engineering [17]. In such a direction, cognitive styles has been used as a mechanism to prove that heterogeneous software inspection teams perform better than homogeneous ones [15], where heterogeneity concerns the cognitive style of the participants. In our case, we have used cognitive styles as a means to select groupware tools and elicitation techniques in accordance with the stakeholders' cognitive style [14]. Although both works use cognitive styles to classify people, our approach differs from [15] because, rather than attempting to say which people seem to be more suitable to work together, our goal is to choose the best strategies to improve communication for an already given group of people.

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With such an idea in mind, this paper is structured as follows: First, we provide an introduction to some basic concepts concerning learning style models, and introduce a methodology for groupware selection based on concepts from fuzzy logic. We then present a controlled experiment carried out to validate our methodology, and we describe the preliminary results related to stakeholders' satisfaction concerning communication during a distributed elicitation process.

2 Supporting Stakeholders' Cognitive Preferences

Bearing in mind that elicitation is about learning the needs of the users [13], and it is also a scenario in which users and clients learn from analysts and developers [14], we consider that during the elicitation process everybody "learns" from others. We therefore focused our research on a special case of cognitive style models called learning style models (LSMs), which classify people according to a set of behavioural characteristics concerning the ways in which people receive and process information, and aim to improve the way that people learn a given task. The model chosen was the Felder-Silverman (F-S) model [9] since, according to our analysis, it covers the categories defined by the most famous LSMs (such as the Myers-Briggs Indicator Type, the Kolb model, the Herrmann Brain Dominance Instrument, etc.) and, additionally, the F-S model has been widely and successfully used with educational purposes in engineering fields [11]. There are four categories in the F-S Model (Perception, Input, Processing and Understanding), and each of them is further decomposed into two subcategories (Sensing/Intuitive; Visual/ Verbal; Active/Reflective; Sequential/ Global) [10]. The classification is carried out by means of a multiple-choice test[1], which returns a rank for each subcategory, and in which preferences for each category are measured as strong, moderate, or mild. According to the F-S model's authors, people with a *mild* preference are balanced on the two dimensions of that scale. On the other side, people with a *moderate* preference for one dimension are supposed to learn more easily in a teaching environment, which favours that dimension. Finally, people with a *strong* preference for one dimension of the scale may have difficulty learning in an environment, which does not support that preference.

Since our goal is to allow all those involved in the requirements elicitation process in a virtual environment to feel comfortable, we propose choosing the most suitable groupware tools and elicitation techniques according to each person's learning styles.

In order to obtain useful information before proposing our approach, we designed a survey to inquire into stakeholders' personal preferences and to look for behaviour patterns. The results of the first application of this survey, and a later replication, showed that people prefer using synchronous collaboration when their preference for the visual subcategory is stronger [3]. However, the result of analysing each category separately was not conclusive, so a combination of the preferences for the four categories had to be taken into account. To do so, we employed a methodology that uses fuzzy logic and fuzzy sets [1] to obtain rules from a set of representative examples, in the manner of behaviour patterns. Such a methodology comprehends two main stages (as is shown in Figure 1), which can be summarized as follows:

[1] http://www.engr.ncsu.edu/learningstyles/ilsweb.html

- **Stage 1. The Project Independent Stage:** The main goal of this stage is to obtain the set of preference rules. In order to accomplish such goal, first, many people are interviewed in order to obtain both their cognitive profile and two sets of examples (θ_1, θ_2), which are real data with regard to stakeholders' preferences in their daily use of groupware tools and requirements elicitation techniques. Second, data is analyzed by using a machine learning algorithm [7] so as to obtain a finite set of fuzzy rules. These obtained fuzzy rules, called *preference rules*, are project independent and can be improved as long as the set of examples and knowledge about the environment grow.
- **Stage 2. The project dependent stage:** This stage consists of the application of the preferences rules (obtained during the first stage) to a specific GSD project during a requirement elicitation process. Their application is carried out in two phases: First, we obtain the cognitive profile of every person in the virtual team and store this profile in a database. Second, the technology selection process is carried out by studying and confronting the personal preferences of people that need to work together. This is done by means of an automatic tool that chooses and suggests the most appropriate technology by using the fuzzy rules obtained in the first stage. The tool also takes into account other external factors that influence distributed communication such as the time difference between sites, the degree to which a common language is shared, and the current situation in the requirements elicitation process as it was explained in [2].

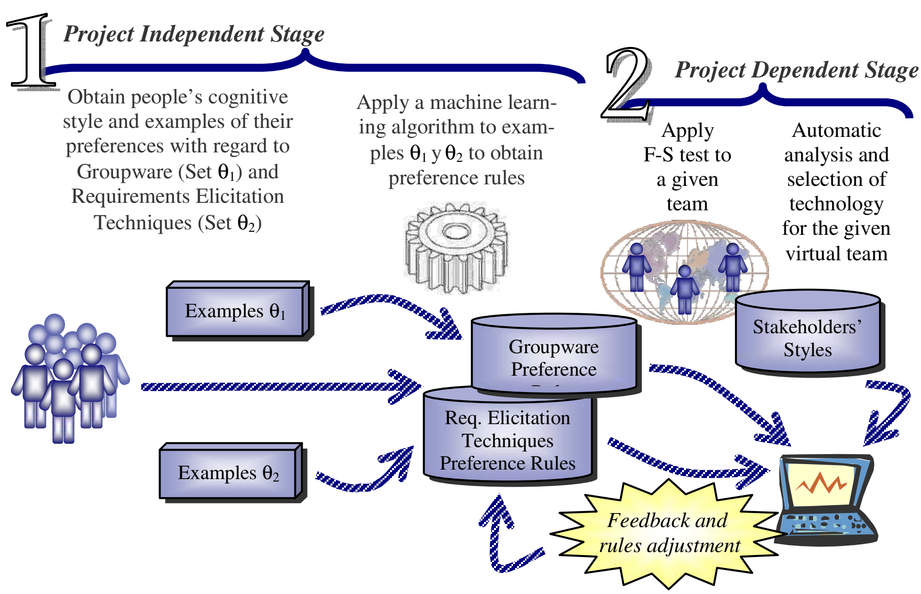

Fig. 1. Phases to define and analyze personal preferences to choose appropriate technology in Virtual Teams

3 Strategies for Cognitive Profile Combination

The previously obtained set of rules represents preferences according to people's cognitive styles, but they are used to discover the most suitable technology for only one person. This means that for each person in the virtual team, we obtain the groupware tool that is most suitable according to his or her cognitive style. However, since it is not expected that all the members of a team will be in agreement as to which groupware tool is the most suitable, it is necessary to provide strategies to combine the results.

According to the Felder and Silverman model, if some stakeholders' preferences are strong and the remaining stakeholders' preferences are moderate or mild, the choices that should be primarily considered are those of the people with strong preferences, since these people perform better when the technology is closer to the way they receive and process information [10]. Bearing this in mind, we have classified 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 on 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, which would increase the involvement of visual people. People with slight and moderate preferences can easily become accustomed to them.
- **Type 3:** There are strong preferences on the opposite sides of the same category, so 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 support both kinds of styles, as we shall discuss later.

For each type of group we have proposed strategies for rules combinations. For example, the strategy for groups with a strong preference but no conflict (Type 2 groups), is represented as follows:

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

where GS_i represents the groupware tool that fits the *i-th* stakeholder's preferences, 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.

An example of this strategy is shown in Figure 2: according to the preference rules, Chat is the groupware tool recommended for P1 and P2, while Email is recommended for P3. Since P3 has strong preferences, the recommended groupware tool for the group is Email, since this stakeholder will feel more comfortable with this groupware tool and the other stakeholders will not object because they have slight and moderate preferences.

As we explained, strategy S_2 is applicable in type 2 groups (with strong preferences but no conflict). In a similar way we have proposed a strategy S_1 for type 1 groups (without strong preferences) and a strategy S_3 for type 3 groups (with strong preferences on the opposite sides of the same category). Such strategies are widely explained by means of examples in [4].

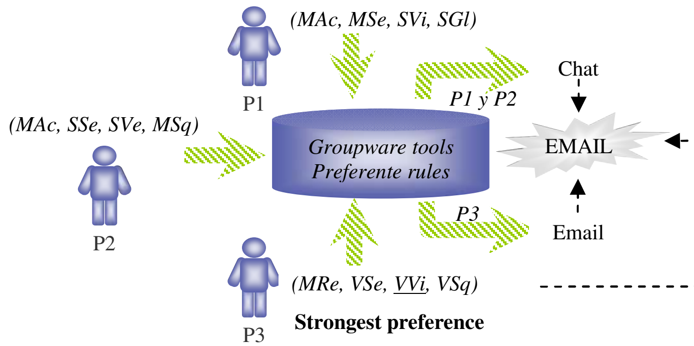

Fig. 2. Strategy for cognitive profile combination represented for 3 stakeholders with strong preferences without conflict

4 Applying Our Strategy S_2 in a Case Study

In order to validate our proposal, we carried out an experiment in which 24 computer science post-graduate students from Argentina and Spain took part. We attempted to simulate global development teams. The teams were therefore formed of three people in which two members played the role of analysts and the other played the role of client. The 'client' had to describe to the 'analysts' the requirements of a software product that the analysts would supposedly have to implement. The analysts then had to use the information obtained from the client's explanations to write a software requirements specification report. As the team members were geographically distributed they had to use a groupware tool to communicate.

After analysing the teams we realised that in each team there was at least one strongly visual person and there were no strongly verbal people; therefore, we applied the strategy for groupware selection for teams with strong preferences without conflict (S_2), explained in Section 3. Table 1 shows the most suitable tool for each team (second column).

Once obtained, each group was assigned a tool, in some cases according to their preferences and in other cases not, with the goal of testing whether there was any difference when they worked with the tool recommended by our approach.

Table 1. Groupware tools assigned to each team

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

The teams were later divided into two groups: those which used the best groupware tool according to our preference rules, and those which used a less suitable (according to our approach) groupware tool. The team that had to use the groupware tools that were not suitable for them (G1, G2, G5, G7), was referred to as Group 0; and the team that had to use the most suitable groupware tools according to our set of preference rules (G3, G4, G6, G8), was referred to as Group 1. The teams in Group 1 and Group 0 always had to use the tool assigned to their team. The resulting selection for each group is shown in the fourth column of Table 1.

5 Preliminary Results

Once the groupware tools had been assigned to each team, the team members were asked to simulate a requirements elicitation process for a given problem, using only the suggested groupware tool for analyst-client communication. As a result of this process they were asked to write an appropriate software requirement specification (SRS), and then they were asked to fill in a post-experiment questionnaire and rate their satisfaction with regard to communication with their partners during the requirements elicitation process. Satisfaction was scored by using a scale of 0-4 (0=very bad, 1=bad, 2=acceptable, 3=good, 4=very good).

According to the analysis of data collected by means of this post-experiment questionnaire, we obtained that most people in Group 1 ranked their satisfaction as 4="very good", while most people in Group 0 ranked their satisfaction as 3="good" (as it is shown in Figure 3). This difference between both groups would indicate that: *Stakeholders' satisfaction with regard to communication seems to be better in the groups that used the most suitable groupware tool according to our set of preference rules.*

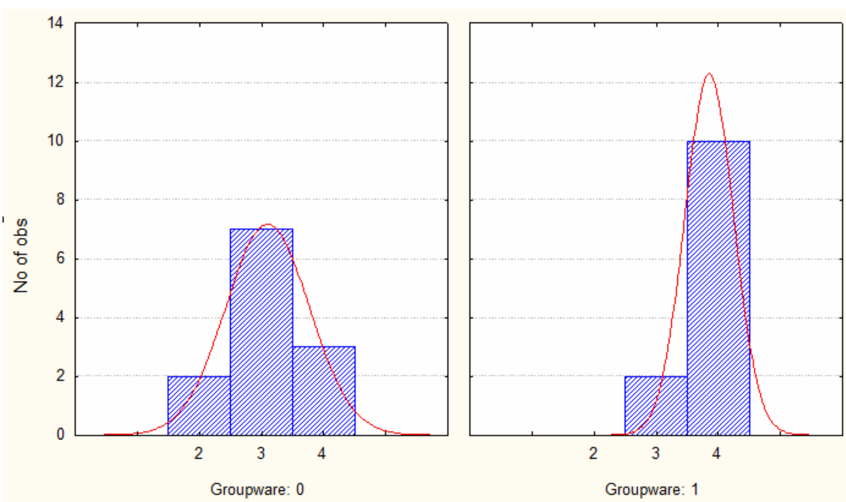

Fig. 3. Stakeholders' satisfaction with regard to communication during the requirements elicitation process

Finally, taking into consideration only the stakeholders with strong preferences (as it is shown in Figure 4), we noticed that satisfaction is clearly higher in the group that used the most suitable tool according to our proposal (Group 1).

This difference would indicate that: *Stakeholders' satisfaction with regard to communication seems to be better in the groups that used the most suitable groupware tool according to our set of preference rules, especially when cognitive style preferences were stronger.*

The results obtained are close to our previous expectations, and we believe that they will assist us to evaluate the strengths and weakness of our proposal. We are currently working on the analysis of the quality of the written software requirements specifications, and its correlation with the use of the cognitive–based process for technology selection in order to discover whether the groups with the most suitable tools wrote a better requirements specification report. If this is proved to be so, we shall be able to state that working with a suitable groupware tool not only helps members to feel more comfortable but also helps to improve the results of their work.

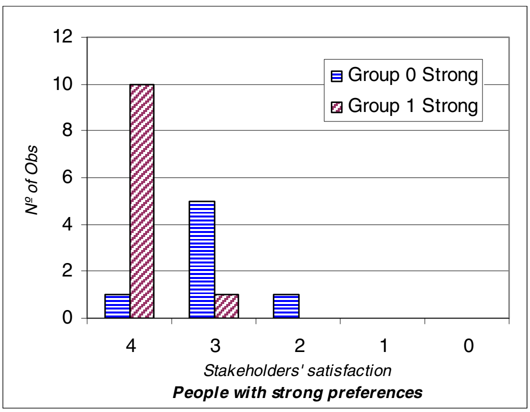

Fig. 4. Stakeholders' satisfaction with regard to communication according to cognitive style level of preferences

6 Conclusions and Future Work

When stakeholders are distributed throughout many distanced sites they must communicate with groupware tools. Choosing the appropriate technology for communication is thus crucial in such environments. We have therefore developed a methodology for technology selection based on the learning styles of the members of a virtual team.

In this paper we present the basis for the application of a strategy that combines the preferences of all the team members, searching for the best solution for the group as a whole, and detecting the strongest preferences in a team without conflicts. We also show the preliminary results of a controlled experiment in which this strategy was applied. As regards stakeholders' satisfaction with communication during the experiment, preliminary results indicate that the stakeholders from those teams that used the most suitable groupware tools suggested according to our proposal, perceived a better degree of communication. In other words, they felt more comfortable in the communication process than those who worked with another tool, especially in the case of those people with the strongest cognitive preferences. We plan to replicate the experiment in order to contrast these results in a similar environment.

Acknowledgements

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