Lecture Notes in Computer Science

The LNCS series reports state-of-the-art results in computer science research, development, and education, at a high level and in both printed and electronic form. Enjoying tight cooperation with the R&D community, with numerous individuals, as well as with prestigious organizations and societies, LNCS has grown into the most comprehensive computer science research forum available.

The scope of LNCS, including its subseries LNAI and LNBI, spans the whole range of computer science and information technology including interdisciplinary topics in a variety of application fields. The type of material published traditionally includes

- proceedings (published in time for the respective conference)
- post-proceedings (consisting of thoroughly revised final full papers)
- research monographs (which may be based on outstanding PhD work, research projects, technical reports, etc.)

More recently, several color-cover sublines have been added featuring, beyond a collection of papers, various added-value components; these sublines include

- tutorials (textbook-like monographs or collections of lectures given at advanced courses)
- state-of-the-art surveys (offering complete and mediated coverage of a topic)
- hot topics (introducing emergent topics to the broader community)

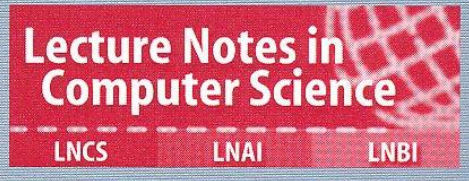
In parallel to the printed book, each new volume is published electronically in LNCS Online.

Detailed information on LNCS can be found at
www.springer.com/lncs

Proposals for publication should be sent to
LNCS Editorial, Tiergartenstr. 17, 69121 Heidelberg, Germany
E-mail: lncs@springer.com

ISSN 0302-9743

ISBN 978-3-540-74811-3



springer.com

LNCS 4715

Jörg M. Haake
Sergio F. Ochoa
Alejandra Cechich (Eds.)

Groupware: Design, Implementation, and Use

**13th International Workshop, CRIWG 2007
Bariloche, Argentina, September 2007
Proceedings**

Jörg M. Haake Sergio F. Ochoa
Alejandra Cechich (Eds.)

Groupware: Design, Implementation, and Use

13th International Workshop, CRIWG 2007
Bariloche, Argentina, September 16-20, 2007
Proceedings

Springer

Volume Editors

Jörg M. Haake
FernUniversität in Hagen
Department of Mathematics and Computer Science
Universitätsstr. 1, 58084 Hagen, Germany
E-mail: joerg.haake@fernuni-hagen.de

Sergio F. Ochoa
Universidad de Chile
Department of Computer Science
Av. Blanco Encalada, 2120, Santiago, Chile
E-mail: sochoa@dcc.uchile.cl

Alejandra Cechich
Universidad Nacional del Comahue
Computing Sciences Department
Buenos Aires 1400, 8300 Neuquén, Argentina
E-mail: achechich@uncoma.edu.ar

Library of Congress Control Number: 2007934512

CR Subject Classification (1998): H.5.2, H.5.3, H.5, K.3.1, K.4.3, C.2.4

LNCS Sublibrary: SL 3 – Information Systems and Application, incl. Internet/Web and HCI

ISSN 0302-9743
ISBN-10 3-540-74811-3 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-74811-3 Springer Berlin Heidelberg New York

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 12120192 06/3180 5 4 3 2 1 0

Preface

This volume constitutes the proceedings of the 13th International Workshop on Groupware (CRIWG 2007). The conference was held in 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 have been motivated by advances in computer-supported cooperative work (CSCW), and by the need for CSCW to meet the challenges of new application areas. This workshop aims at providing a forum for academic researchers and professionals to exchange their experiences and their ideas about problems and solutions related to the design, development and use of groupware applications. Researchers report their ideas, models, designs and experiences to CRIWG submitting full-paper contributions to present achieved or mature works, and shorter papers to report work in progress.

CRIWG 2007 received 65 submissions from 15 different countries, 49 full papers and 16 work-in-progress papers. Each article was reviewed by at least three members of the Program Committee, using a double-blind reviewing process. Based on the reviewers' recommendations 27 papers were finally accepted: 17 full papers and 10 work-in-progress papers. These papers were grouped into six tracks: group awareness and social aspects, groupware design and development, computer-supported collaborative learning, groupware applications and studies, group negotiation and knowledge management, and groupware activities and evaluation. In addition, we are pleasured to have had Jonathan Grudin from Microsoft Research, USA, as keynote speaker.

CRIWG 2007 would not have been possible without the work and support of a great number of people. First of all we want to thank the members of the Program Committee for their valuable reviews of the papers. We are grateful for the advice and support provided by the CRIWG Steering Committee. We extend a special acknowledgement to our sponsor organizations: Universidad Nacional del Comahue (Argentina), Universidad de Chile (Chile), FernUniversität in Hagen (Germany), Microsoft Research (USA) and Microsoft Chile (Chile), SADIO (Argentina).

Last, but certainly not least, we thank the attendees for their interest in CRIWG 2007. We hope they had an enriching experience at the conference.

Please get involved!

September 2007

Joerg M. Haake
Sergio F. Ochoa
Alejandra Cechich

Conference Organization

Program Committee Chairs

Joerg M. Haake, FernUniversität in Hagen, Germany
Sergio F. Ochoa, Universidad de Chile, Chile

Program Committee

Mark S. Ackerman, University of Michigan, USA
Rosa Alarcón, Pontificia Universidad Católica de Chile, Chile
Roberto Aldunate, University of Illinois at Urbana-Champaign, USA
Analía Amandi, UNICEN, Argentina
Richard Anderson, University of Washington, USA
Pedro Antunes, Universidade de Lisboa, Portugal
Jaco Appelman, Delft University of Technology, The Netherlands
Nelson Baloian, Universidad de Chile, Chile
Jean-Paul Barthés, Université de Technologie de Compiègne, France
Marina Bers, Tufts University, USA
Marcos Borges, Universidade Federal do Rio de Janeiro, Brazil
Patrick Brézillon, Laboratoire LIP6, Université Paris 6, France
Robert O. Briggs, University of Nebraska at Omaha, USA
Traci Carte, University of Oklahoma, USA
César Collazos, Universidad del Cauca, Colombia
Gert-Jan de Vreede, University of Nebraska at Omaha, USA
Atanasi Daradoumis, Open University of Catalonia, Spain
Bertrand David, Ecole Centrale de Lyon, France
Alanah Davis, University of Nebraska at Omaha, USA
Dominique Decouchant, LIG Laboratory, Grenoble, France
Alicia Díaz, Universidad Nacional de La Plata, Argentina
Yannis Dimitriadis, Universidad de Valladolid, Spain
Tom Erickson, IBM T. J. Watson Research Center, USA
Jesus Favela, CICESE, Mexico
Alejandro Fernández, Universidad Nacional de La Plata, Argentina
Christine Ferraris, Université de Savoie, France
Hugo Fuks, Pontifícia Universidade Católica do Rio de Janeiro, Brazil
Matt Germonprez, University of Wisconsin - Eau Claire, USA
Werner Geyer, IBM T.J. Watson Research Center, USA
Eduardo Gómez-Sánchez, Universidad de Valladolid, Spain
Víctor M. González, University of Manchester, UK
Tom Gross, Bauhaus University Weimar, Germany
Luis A. Guerrero, Universidad de Chile, Chile
Andreas Harrer, University of Duisburg-Essen, Germany

Ulrich Hoppe, University of Duisburg, Germany
Ned Kock, Texas A&M International University, USA
Gwendolyn Kolfschoten, Delft University of Technology, The Netherlands
Filippo Lanubile, University of Bari, Italy
Stephan Lukosch, FernUniversität in Hagen, Germany
Gloria Mark, University of California, Irvine, USA
Alejandra Martínez, Universidad de Valladolid, Spain
Sonia Mendoza, CINVESTAV-IPN, Mexico
Alberto Morán, UABC, Mexico
Bjørn Erik Munkvold, Agder University College, Norway
Leandro Navarro, Polytechnic University of Catalonia, Spain
Miguel Nussbaum, Pontificia Universidad Católica de Chile, Chile
Álvaro Ortigoza, Universidad Autónoma de Madrid, Spain
Yvan Peter, University of Lille 1, France
José A. Pino, Universidad de Chile, Chile
Steven Poltrock, Boeing, USA
Atul Prakash, University of Michigan, USA
Nuno Preguiça, Universidade Nova de Lisboa, Portugal
Alberto Raposo, Catholic University of Rio de Janeiro, Brazil
Christoph Rensing, Technische Universität Darmstadt, Germany
Flávia Santoro, Universidade Federal do Estado do Rio de Janeiro, Brazil
Choon Ling Sia, University of Hong Kong, Hong Kong
Guillermo Simari, Universidad Nacional del Sur, Argentina
Carla Simone, University of Milan, Italy
Till Schümmer, FernUniversität in Hagen, Germany
Ralf Steinmetz, Technische Universität Darmstadt, Germany
Julita Vassileva, University of Saskatchewan, Canada
Aurora Vizcaíno-Barceló, Universidad de Castilla-La Mancha, Spain
Juergen Vogel, European Media Laboratory GMBH, Germany
Jacques Wainer, State University of Campinas, Brazil
Martin Wessner, Ludwig Maximilian University of Munich, Germany
Volker Wulf, Fraunhofer FIT, Germany
Ilze Zigurs, University of Nebraska at Omaha, USA

Doctoral Colloquium Chairs

Pedro Antunes, Universidade de Lisboa, Portugal
Alejandro Fernández, Universidad Nacional de La Plata, Argentina

Organizing Committee Chair

Alejandra Cechich (Local Chair), Comahue National University, Argentina

Organizing Committee

Silvia Amaro, Comahue National University, Argentina
Gabriela Aranda, Comahue National University, Argentina
Agustina Buccella, Comahue National University, Argentina
Andrés Flores, Comahue National University, Argentina
Adriana Martín, Comahue National University, Argentina
Nadina Martínez, Comahue National University, Argentina
Andrés Neyem, Universidad de Chile, Chile

Table of Contents

Group Negotiation and Knowledge Management

Group Awareness and Social Aspects

Groupware Design and Development

Computer Supported Collaborative Learning (CSCL)

Groupware Applications and Studies

Groupware Activities and Evaluation

References

1. Baeza-Yates, R., Pino, J.A.: A first step to formally evaluate collaborative work. In: Proceedings of the International ACM SIGGROUP Conference on Supporting Group Work: The Integration Challenge, pp. 56–60. ACM Press, New York (1997)
2. Balabanovic, M., Shoham, Y.: FAB: Combining content-based and collaborative recommendation. Communications of the ACM 40(3), 66–72 (1997)
3. Blanzieri, E., Giorgini, P., Massa, P., Recla, S.: Implicit culture for multi-agent interaction support. In: Batini, C., Giunchiglia, F., Giorgini, P., Mecella, M. (eds.) CoopIS 2001. LNCS, vol. 2172, pp. 27–39. Springer, Heidelberg (2001)
4. Chau, M., Zeng, D., Chen, H., Huang, M., Hendriawan, D.: Design and evaluation of a multi-agent collaborative Web mining system. Decision Support Systems 35(1), 167–183 (2003)
5. Giménez-Lugo, G.A., Amandi, A., Sichman, J., Godoy, D.: Enriching information agents' knowledge by ontology comparison: A case study. In: Garijo, F.J., Riquelme, J.-C., Toro, M. (eds.) IBERAMIA 2002. LNCS (LNAI), vol. 2527, pp. 546–555. Springer, Heidelberg (2002)
6. Godoy, D., Amandi, A.: User profiling for web page filtering. IEEE Internet Computing 9(4), 56–64 (2005)
7. Mitchell, T.M.: Machine Learning. McGraw-Hill, New York (1997)
8. Rodríguez, M.A., Egenhofer, M.J.: Determining semantic similarity among entity classes from different ontologies. IEEE Transactions on Knowledge and Data Engineering 15(2), 442–456 (2003)
9. Somlo, G., Howe, A.E.: QueryTracker: An agent for tracking persistent information needs. In: Proceedings of the 3rd International Joint Conference on Autonomous Agents and Multi-agent Systems (AAMAS 2004), pp. 488–495. IEEE Computer Society, Los Alamitos (2004)
10. Turner, R.M., Turner, E.H., Wagner, T.A., Wheeler, T.J., Ogle, N.E.: Using explicit, a priori contextual knowledge in an intelligent Web search agent. In: Akman, V., Bouquet, P., Thomason, R.H., Young, R.A. (eds.) CONTEXT 2001. LNCS (LNAI), vol. 2116, pp. 343–352. Springer, Heidelberg (2001)
11. Williams, A.B., Ren, Z.: Agents teaching agents to share meaning. In: Proceedings of the 5th International Conference on Autonomous Agents, Montreal, Canada, pp. 465–472. ACM Press, New York (2001)
12. Yu, B., Singh, P.: An agent-based approach to knowledge management. In: Proceedings of the 11th International Conference on Information and Knowledge Management (CIKM'02), pp. 642–644 (2002)

How to Choose Groupware Tools Considering Stakeholders' Preferences During Requirements Elicitation?

Gabriela N. Aranda[1], Aurora Vizcaíno[2], Alejandra Cechich[1], and Mario Piattini[2]

[1] GIISCo Research Group, Universidad Nacional del Comahue
Computing Sciences Department, Buenos Aires 1400 - 8300 Neuquén, Argentina
{garanda,acechich}@uncoma.edu.ar
[2] ALARCOS Research Group, Information Systems and Technologies Department
UCLM-INDRA Research and Development Institute, Escuela de Informática, Universidad de Castilla-La Mancha, Paseo de la Universidad 4 - 13071 Ciudad Real, Spain
{aurora.vizcaíno,mario.piattini}@uclm.es

Abstract. The main challenges during global software development projects are related to the lack of face-to-face communication and the need of people feeling comfortable with the technology they use. In this paper we introduce an approach that proposes a way of choosing the most suitable technology for a given group of people, taking advantage of information about stakeholders' cognitive characteristics. As our research focuses on the importance of communication during the global requirements elicitation process, we present preliminary results of two surveys that analyze stakeholders' preferences in such environments.

1 Introduction

Communication is a common problem during requirement elicitation [5], and is even more important for Global Software Development (GSD) projects. The need of counting with the best communication channels during a collocated requirements elicitation process is aggravated when stakeholders are distributed over many distanced sites, due to the lack of face to face interaction, as well as the time difference between different sites and the cultural diversity of stakeholders [8].

One of the most common ways of classifying groupware is according to their synchronous or asynchronous characteristics (depending on if the users have to work at the same time or not) [9]. According to GSD literature, both categories are important during requirement elicitation – asynchronous collaboration allows team members to construct requirements individually and contribute to the collective activity of the group for later discussion (especially when groups are distributed across time zones), and real time collaboration and discussions are necessary components of group Requirements Elicitation (RE) sessions to give stakeholders the chance of having instant feedback [12]. However, is also true that sometimes people are keener on one kind of collaboration than the other. So, as communication among people involves aspects of human processing mechanisms that are analyzed by the

J.M. Haake, S.F. Ochoa, and A. Cechich (Eds.): CRIWG 2007, LNCS 4715, pp. 319–327, 2007.

cognitive sciences, we decided to look for references into the Cognitive Informatics, an interdisciplinary research area that applies concepts from psychology and other cognitive sciences to improve processes in engineering disciplines like software engineering [17].

After analyzing varied psychological issues, we set our interest in the Learning Style Models (LSMs), which may be useful to select groupware tools and elicitation techniques according to the cognitive style of stakeholders [15]. Most of related works using LSMs in informatics concern educational purposes like [4], and only one work can be cited where cognitive styles are used as a mechanism for improving Software Engineering tasks. In [16] a controlled experiment proves that heterogeneous software inspection teams have better performance than homogeneous ones, where heterogeneity concerns the cognitive style of the participants. However, our approach differ from this one because, instead of trying to say which people seem to be more suitable to work together, our goal is choosing the best strategies to improve communication for an already given group of people.

Having this in mind, we will give an introduction to some basic concepts about cognitive informatics and learning styles models, and we will introduce a methodology, based on concepts from fuzzy logic, to select groupware tools and requirement elicitation techniques. The last sections will compare results from two different surveys we have carried out in order to get examples to validate our methodology and we will present some conclusions and guidelines for future work.

2 Cognitive Aspects of Requirement Elicitation

Cognitive Informatics relates cognitive sciences and informatics by using cognitive theories to investigate and look for solutions to software engineering problems [7]. In this sense cognitive styles are a part of cognitive psychology theories that classify people's preferences about perception, judgment and processing of information [16], and try to explain differences in human behaviour. Similarly, learning styles models (LSMs) classify people according to a set of behavioural characteristics that concern the ways people receive and process information, while their goal is improving the way people learn a given task. Considering that elicitation is about learning the needs of the users [13], and also an scenario where users and clients learn from analysts and developers [15], we can consider that during the elicitation process everybody "learns" from others. Then, even when LSMs have been discussed in the context of analyzing relationships between instructors and students, we propose taking advantage of LSMs by adapting it to virtual teams that deal with distributed elicitation processes.

After studying different LSMs, we have chosen the Felder-Silverman (F-S) Model., since according to our analysis, it covers the categories defined by the most famous LSMs (like 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]. The F-S Model introduces four categories (Perception, Input, Processing and Understanding), each of them further decomposed into two subcategories (Sensing/Intuitive; Visual/Verbal; Active/Reflective; Sequential/Global). For details see [10].

Classification into the different categories is obtained by filling a multiple-choice test, available on the WWW (http://www.engr.ncsu.edu/learningstyles/ilsweb.html),

which returns a rank for each subcategory. Depending on the circumstances, people may fit into one category or the other; so preference for each category is measured as strong, moderate, or mild. According with their authors, people with a mild preference are balanced on the two dimensions of that scale. People with a moderated 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. With the goal of making everybody feel comfortable in the virtual environment, we propose choosing groupware tools and elicitation techniques more according to their learning styles, as we explain in the next section.

3 A Systematic Process to Support Personal Preferences in Distributed Requirement Elicitation

In order to support personal preferences when selecting technologies for virtual teams, we propose a methodology that uses fuzzy logic and fuzzy sets [1] to obtain rules from a set of representative examples, in the way of patterns of behaviour.

The methodology is divided into two stages: the first one is independent of any project and comprehends phases 1 to 4, and the second one is dependent of a given project and covers phases 5 and 6, as it is shown in Figure 1.

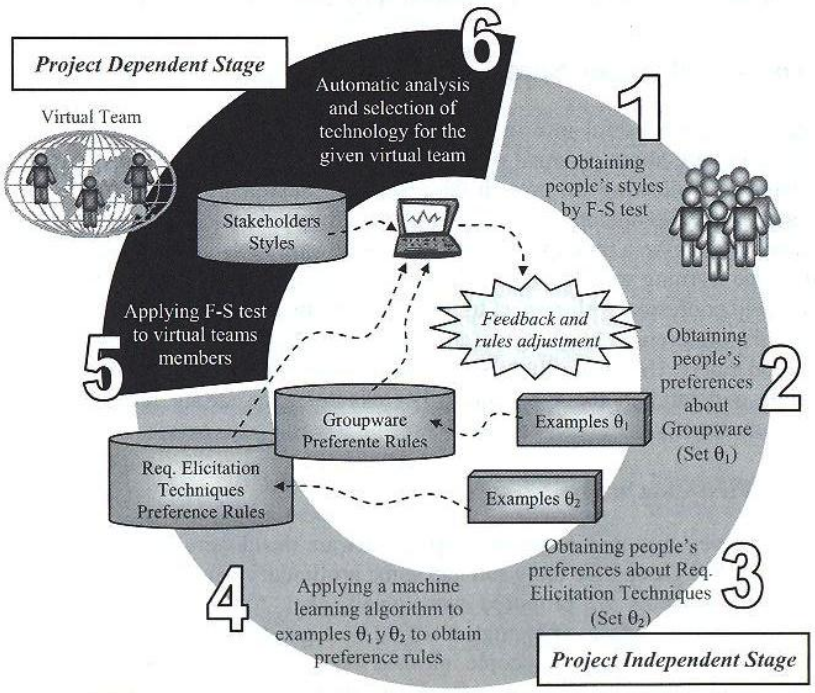


Fig. 1. Phases to define and analyze personal preferences to choose appropriate technology in Virtual Teams

Phases 1 to 3 are about looking for a set of examples, which are real data about preferences of stakeholders in their daily use of groupware tools and requirements elicitation techniques. Then, we analyse the data by using the machine learning algorithm proposed in [6], where each example is turned into an initial rule and iteratively it is found a finite set of fuzzy rules that reproduce the input-output system's behaviour (*Phase 4*). This algorithm was designed to obtain rules with a maximum degree of generality, and then it reduces the antecedent part as much as possible so as to obtain rules that can be easily understood and highly approximated to real-life examples. As we mentioned before, phases 1 to 4 constitute the *project independent* part where the example and preference rule databases can be improved along surveys and applied on different GSD projects.

The remaining phases consist of the application of our methodology to a specific GSD project during a requirement elicitation process, so that it is called the *project dependent stage*. In this stage, we obtain the personal preferences of every person who will work in a given virtual team (*Phase 5*) and stored it in a database that can be accessed every time people need to communicate to each other. The technology selection process is done by studying and confronting the personal preferences of the people that need to work together. This is done by means of an automatic tool that chooses and suggests the most appropriated technology (*Phase 6*). As we have explained in [2] such strategies must take into account other factors besides cognitive profiles of stakeholders, like time difference between sites, the degree of sharing of a common language, and the current situation at the requirement elicitation process.

4 Analysis of a Case Study

In order to obtain useful information for illustrating our approach, we designed a survey to inquire about personal preferences of stakeholders and to look for patterns of behaviour. Following we present the results we obtained in two different surveys that deal with stakeholders' preferences about groupware tools. In both surveys we asked people to give a rank to a given set of groupware tools and then we asked them to fill in the learning style test available on the web site and send us the results.

To avoid confusion with respect to the use of the first letter, in the next sections we identify the preferences by using the adverbs (and corresponding abbreviations): Very (V), Moderately (M) and Slightly (S), which correspond respectively to strong, moderate and mild in the F-S model. For example, the strong preference for the Active subcategory is represented by "VAc".

4.1 The First Case Study

The first survey was applied to 48 people; software developers and users who were accustom to use groupware tools and had some proficiency using at least two of them. The groupware tools we proposed were email, chat, forum, videoconference and shared whiteboard, which we though it would be a good set of groupware to interact among more than 2 people. 43 people returned the survey. 14 interviewees worked for private organizations that develop software for third parts; 23 were academic staff of universities that cooperate with software development projects and the rest were users of software systems at different organizations.

As the number of examples was not large enough to analyze each tool separately, we decided to analyze preferences taking into account two broader groups – asynchronous and synchronous groupware tools [9] – which are usually taken into account in literature [8, 14] to analyze their effect on GSD projects. Firstly, we analyzed the preferences of stakeholders respect to their gender and age; and we ensured that data was independent of such factors. Later we analyzed preferences of stakeholders in relation with their learning style. Then, we found out that there were no significant differences for slight or moderated preferences, but when preferences were stronger, the number of stakeholders who chose between synchronous and asynchronous tools was not similar. Especially for the Visual-Verbal category, the difference between preferences for both types of tools was about 15% for asynchronous against 85% for synchronous tools. Unfortunately, for the rest of strong preferences we did not have enough examples to obtain conclusions. For further details see [3].

4.2 The second Case Study

In order to validate the first case study we decided to run a second case study. In this case we asked 63 people to answer the questionnaires. They were also software developers and users that are accustom to use groupware tools. We changed the list of groupware tools and proposed them email, instant messaging, audio conference and videoconference. The changes obeyed to suggestions from other researchers in GSD that consider audio conference should be included because it is widely used in GSD projects. In addition, we decided to get out shared whiteboard and forums because nobody had chosen them as his or her favourite one in the first study.

This time 51 people returned the survey. 12 interviewees worked for private organizations that develop software for third parts; 25 were academic staff of universities that cooperate with software development projects and the rest were users of software systems at different organizations.

As we did previously, firstly, we analyzed the preferences of stakeholders respect to their gender and age. This time we found out a small difference between male and female answers: female percentage per synchronous tools was higher than male percentage. Also we found out (as we have supposed previously) that 40-49 people preferred asynchronous tools in a higher degree than younger people (Figure 2).

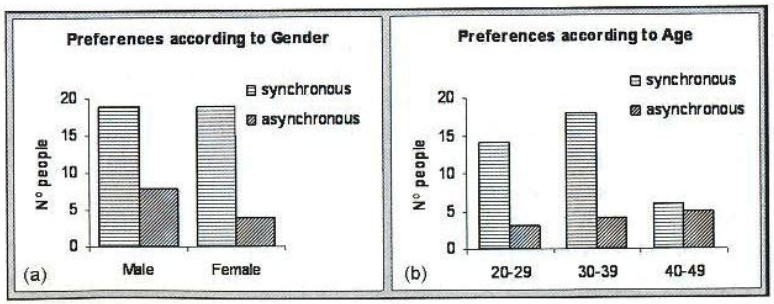


Fig. 2. Second survey results according to gender and age

When we analyzed preferences of stakeholders in relation with their learning style (which is shown in Figure 3), we found out a tendency to prefer synchronous tools over asynchronous tools in most of the subcategories, except for the SRe which represent the slightly reflexive preference (Figure 3a). This is an expected result because reflexive people prefer thinking quietly about the information they receive. The rest of the tendencies are similar in both case studies, except when the visual subcategory is strong (Figure 3c), where the difference between synchronous and asynchronous does not seem as wide as before.

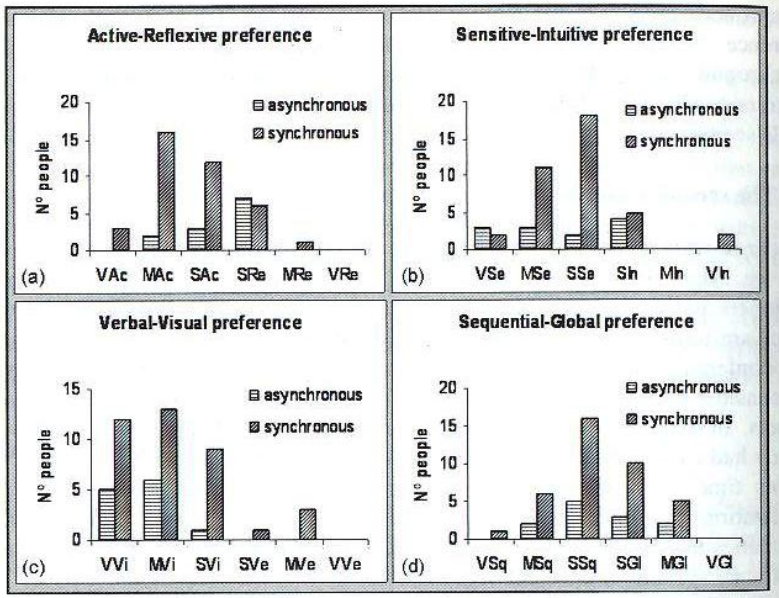


Fig. 3. Second survey results relating F-S categories to groupware type

Analyzing each F-S category regarding the tools, we can also observe something to remark. Figure 4 shows the percentages of appearance for each tool and F-S preferences. We must say that percentages must be analyzed carefully, because for some preferences we count with just one or two examples so we cannot generalize conclusions for all the preferences except for those where there are more examples.

For instance, the moderated preference for the verbal subcategory (MVe) is the one where audio conference has more adherents in proportion (Figure 4c). Also, as we expected, people with stronger preferences for the visual subcategory have chosen visual tools (videoconference, email and IM) except one single case (Figure 4c). In addition, as long as preference for active subcategory grows, people choose videoconference, which is expected because active people like having immediate feedback (Figure 4c). With respect to the Sensing-Intuitive category, when preference for sensing subcategory is stronger we notice more people prefer email over other tools and, on the contrary, very intuitive people prefer synchronous tools. This can be due to the fact that sensing people like well-organized information, which is more

possible using email or other asynchronous tools, and intuitive people like acting freely, which is more compatible with synchronous tools like instant messaging and videoconference (Figure 4b). Finally, Sequential-Global category is not expected to have incidence on groupware tool preferences, and we cannot find a pattern of behaviour in the distribution of preferences (Figure 4d).

Unfortunately we do not have a wide number of examples about the strongest preferences for some subcategories. We think we need to continue looking for examples from people working on real requirements elicitation process to obtain more results about strong preferences.

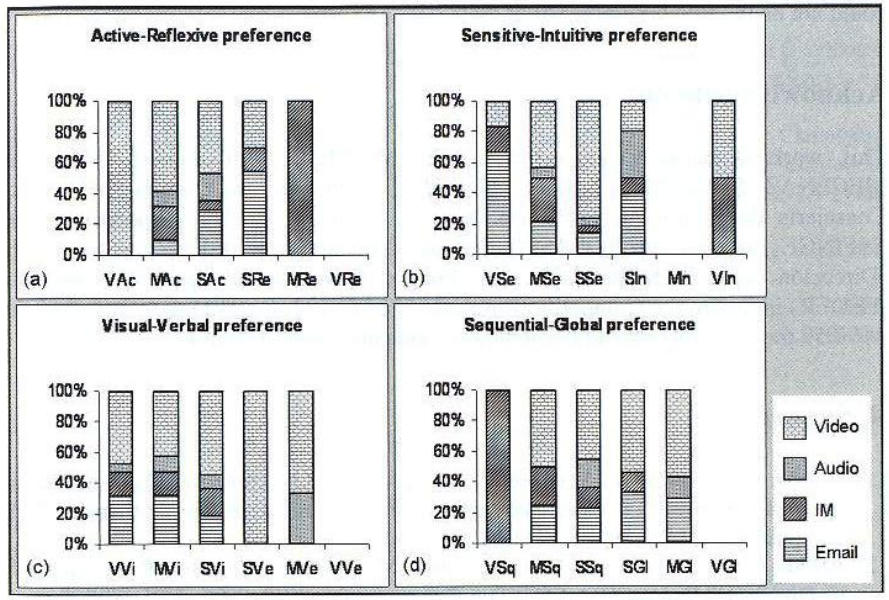


Fig. 4. Second survey results relating F-S categories to groupware tools

5 Conclusions and Future Work

Why can be important knowing the cognitive impact of human preferences? As we have explained before, when people feel uncomfortable with the technology, it is possible that their lack of motivation would lead the group to a poor collaboration. Since managers or analysts, commonly choose groupware tools, as well as elicitation techniques, in an arbitrary way, our intention is offering a strategy that takes into account information from all the stakeholders.

In a first approach to validate part of our proposal, we designed a survey whose results showed that people prefer using synchronous collaboration when their preference for the visual subcategory is stronger. In a replication of this survey we could obtain similar results for all the subcategories. However, the separated analysis of each category cannot be conclusive, and the combination of the preferences for the four categories must be taken into account. To do so we propose taking advantage of

the fuzzy sets theory to find patterns of behaviour in real life projects that use groupware tools. With such an idea we have implemented a machine-learning algorithm, which is being tested, to obtain rules that combine different values for each category. We are also working on defining preferences about requirement elicitation techniques, but these results are currently under analysis, and are not shown here.

We are aware that our model faces a challenge regarding the possibility of having people in a virtual group whose preferences are the opposite, so we are currently designing strategies that take into account not just a "unique" appropriate technology, but a ranking for each style, so as when conflicts between personal preferences appear, they could be solved by looking for the technology to all the participants, that could not be the first option for all of them.

Acknowledgements

This work is partially supported by the MISTICO (PBC06-0082-8542), and MECENAS (PBI06-0024) projects, Junta de Comunidades de Castilla-La Mancha, Consejería de Educación y Ciencia, both in Spain. It is also supported by the ESFINGE project (TIN2006-15175-C05-05) Ministerio de Educación y Ciencia (Dirección General de Investigación)/ Fondos Europeos de Desarrollo Regional (FEDER) in Spain; the CompetiSoft project (506AC0287, CYTED program); and the 04/E059 project, Universidad Nacional del Comahue, from Argentina.

References

1. Aranda, G., Cechich, A., Vizcaíno, A., Castro-Schez, J.J.: Using fuzzy sets to analyse personal preferences on groupware tools. In: X Congreso Argentino de Ciencias de la Computación, CACIC 2004, San Justo, Argentina (2004)
2. Aranda, G., Vizcaíno, A., Cechich, A., Piattini, M.: Towards a Cognitive-Based Approach to Distributed Requirement Elicitation Processes. In: WER 2005, VIII Workshop on Requirements Engineering, Porto, Portugal (2005)
3. Aranda, G., Vizcaíno, A., Cechich, A., Piattini, M.: Technology Selection to Improve Global Collaboration. In: ICGSE 2006, IEEE International Conference on Global Software Engineering, Florianopolis, Brazil (2006)
4. Blank, G.D., Roy, S., Sahasrabudhe, S., Pottenger, W.M., Kessler, G.D.: Adapting Multimedia for Diverse Student Learning Styles. Journal of Computing in Small Colleges 18(3), 45–58 (2003)
5. Brooks, F.P.: No Silver Bullet: Essence and accidents of Software Engineering. IEEE Computer 20(4), 10–19 (1987)
6. Castro, J.L., Castro-Schez, J.J., Zurita, J.M.: Learning Maximal Structure Rules in Fuzzy Logic for Knowledge Acquisition in Expert Systems. Fuzzy Sets and Systems 101(3), 331–342 (1999)
7. Chiew, V., Wang, Y.: From Cognitive Psychology to Cognitive Informatics. In: Second IEEE International Conference on Cognitive Informatics, ICCI'03, London, UK (2003)
8. Damian, D., Zowghi, D.: The impact of stakeholders geographical distribution on managing requirements in a multi-site organization. In: IEEE Joint International Conference on Requirements Engineering, RE'02, Essen, Germany (2002)

9. Ellis, C.A., Gibbs, S.J., Rein, G.L.: Groupware: Some Issues and Experiences. Communications of ACM 34(1), 38–58 (1991)
10. Felder, R., Silverman, L.: Learning and Teaching Styles in Engineering Education. Engineering Education 78(7), 674–681 (1988) (and author preface written in 2002)
11. Felder, R., Spurlin, J.: Applications, Reliability and Validity of the Index of Learning Styles. International Journal of Engineering Education 21(1), 103–112 (2005)
12. Herlea, D., Greenberg, S.: Using a Groupware Space for Distributed Requirements Engineering. In: 7th IEEE Int'l. Workshop on Coordinating Distributed Software Development Projects, Stanford, California, USA (1998)
13. Hickey, A.M., Davis, A.: Elicitation Technique Selection: How do experts do it. In: International Joint Conference on Requirements Engineering (RE03), Los Alamitos, California (2003)
14. Lloyd, W., Rosson, M.B., Arthur, J.: Effectiveness of Elicitation Techniques in Distributed Requirements Engineering. In: 10th Anniversary IEEE Joint International Conference on Requirements Engineering, RE'02, Essen, Germany (2002)
15. Martín, A., Martínez, C., Martínez Carod, N., Aranda, G., Cechich, A.: Classifying Groupware Tools to Improve Communication in Geographically Distributed Elicitation. In: IX Congreso Argentino de Ciencias de la Computación, CACIC 2003, La Plata, Argentina (2003)
16. Miller, J., Yin, Z.: A Cognitive-Based Mechanism for Constructing Software Inspection Teams. IEEE Transactions on Software Engineering 30(11), 811–825 (2004)
17. Wang, Y.: On the Cognitive Informatics Foundations of Software Engineering. In: Third IEEE International Conference on Cognitive Informatics, ICCI'04, Victoria, Canada (2004)