

A STRUCTURED GROUPWARE FOR A COLLECTIVE DECISION-MAKING AID

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Abstract :

We present the groupware MEMO-Net which aim is to support collective problem solving and to memorize all exchanged arguments. This groupware is based on a knowledge-structuring method (DIPA) that provides a work support for the team using the tool and that permits the exchanges' structure for a better knowledge management.

Keywords: Collective decision-making, Design Rationale, groupware, Problem-Solving Methods

1. Introduction

Links between Decision-Aid and CSCW are mostly materialized by computer-based facilities for the exploration of unstructured problems in a group setting. There are for example GDSS (Group Decision Support System) aids for decision structuring, alternative ranking and voting tools. To parallel with Bernard Roy decision-aid problematics, these tools support sort, choice or arrangement. But the tool that we will propose is referring to description problematics by helping idea generation or issue analysis.

This kind of tool has to materialize the arguments exchanged between decision-makers. Design Rationale researches are dedicated to formalization and memorization of the entire argumentative process that leads to decision in design situations. We have then studied this field and began with an empirical study in order to understand how long collective decision-making processes occur in design projects. This study permitted us to identify the limits of existing models.

We have then proposed to enrich Design Rationale models to take into account processes where solutions are not directly mentioned but rise up at different abstraction levels or took the form of constraints. In this paper, we are going to show how we enriched Design Rationale with concepts of Problem-Solving Methods in the DIPA model and how we implemented it in the MEMO-Net tool.

2. CSCW, groupware and decision-aid

Groupware offers multi-users interfaces to access electronic mail services, forum, and workflow, and to put into practice CSCW (Computer-Supported Cooperative Work) methods, or, as Malone said (quoted in Coleman, Shapiro, 1992), "information technology used to help people work together more effectively". CSCW may also be viewed as the scientific discipline that guides the thoughtful and appropriate design and development of groupware (Greenberg, 1991).

These technologies represent a paradigm changing in computer science, because they deal with problems due to human-human coordination and communication rather than with definition of human-computer dialogues for automated procedures.

There are two ways of viewing the variety of groupware, time space taxonomy and application-level taxonomy (table 1) (Ellis, Gibbs, and Rein, 1993), (Bullen, Bennett, 1993).

	Same time	Different times
Same place	<i>face to face interaction</i> Meeting Rooms GDSS (Group Decision Support System)	<i>asynchronous interaction</i> Project Management tools
Different places	<i>distributed synchronous interaction</i> Videoconferences Shared screens	<i>distributed asynchronous interaction</i> E-mail Forum Cooperative Writing

Table 1. : Groupware applications

Traditionally, decision-aid is interested by GDSS, meeting rooms, and computer conferencing, which refer to synchronous groupware. If we refer to Bernard Roy problematics (Roy, 1985), they correspond to choice, sort or arrangement. But we can't forget the description of the problem, of its context, of the whole project and the argumentation prior the decision. To understand a decision-process afterwards and to reuse its solutions, it is important to memorize all the evoked solutions and not only the ones that have been selected for the meeting. These preoccupations are closely to the fourth problematics of Bernard Roy: the description one: "*helping to describe actions and/or their consequences on a systematic and formalized way or to elaborate a cognitive procedure*" (Roy, 1985, p.88). Our interest focuses then on another kind of groupware, which enables idea generation or issue analysis.

As (Grudin, 1993) stresses, an efficient introduction of this kind of tools in organizations can not be guided by technology. One must have a good comprehension of groups' and organizations' functioning and evolution. This comprehension allows these tools to fit existing

communication flows and to crystallize organizational memory elements without penalizing users (Conklin, 1993)

But, if a groupware permits to record solutions' elaboration processes, it is not sufficient for an efficient knowledge management (Grudin, 1993). It has to be completed by a method that structures the exchanges for a better dialogue 's quality and for a management of ideas that would not be only chronological. These reflections have led to the IBIS method (Burgess-Yakemovic and Conklin, 1990), connected afterwards to Design Rationale researches.

3. Design Rationale : critics and ABRICo proposition

Design Rationale researches are interested in problems appearing through capture, articulation, representation and use of the rationale made explicit. The most known and experimented method is IBIS. IBIS and its different implementations (g-IBIS, it-IBIS...) have been experimented many times more or less successfully. In a general way, we can be reserved because of two problems (Fischer, Lemke, McCall, Morch, 1996): firstly, the non-representation of dependencies between issues, and secondly the ignorance of non-deliberated issues.

We have made partly similar criticisms of the QOC (Questions Options Criteria) method (MacLean, Young, Bellotti, Moran, 1996) and classical Design Rationale formalisms in our previous work (Lewkowicz, Zacklad, 1998-a, 1998-b). Formalisms as QOC do not correspond to collective design situations that have to take into account the process' dynamics and the participants' roles. We had then proposed to represent these complex processes with an original formalism that we had called ABRICo (for the French words Accords, Buts, pRositions, Interprétations en Conception, that mean agreement, goals, propositions, interpretations through design).

We have tested this formalism by representing real complex collective decision-making situations. Seeing that this experimentation was conclusive, we built a first version of a tool based on these concepts, MEMO-Net, and we submitted it to professional groups for a first evaluation. Unfortunately, the model proposed to users seemed to be too abstract for an easy

comprehension, conclusion that re-opened the whole question of the ABRICo model and the first version of the tool.

One reason for the difficulty to implement ABRICo was, from our point of view, that the complex decision process formulation was too far from design situations which actors were confronted to. Where the traditional but simplistic Design Rationale models permitted an easy appropriation by actors, the ABRICo model, although more realistic from a cognitive point of view, appeared both too laconic and too far from concrete implementation's conditions in work situations for which we built it.

4. The problem-solving methods contribution : the DIPA model

In order to connect to the cognitive dimension of reasoning, we enriched ABRICo with problem-solving methods' concepts from knowledge engineering. This enrichment was translated into a new model, DIPA (for the French words Données, Interprétations, Propositions, Accord, which mean facts, interpretations, propositions, agreement) which is characterized by :

- the addition of two categories : facts which describe the problem, and constraints;
- the formalism is inspired by KADS one (Wielinga 1993) which pertinence for analysis and modeling of problem-solving methods is admitted;
- the model has two declinations according to the situations that lead the actors to give importance to analysis or synthesis processes (in the sense for example of KADS methodology) (table 2).

This link with problem-solving method is, to our point of view, a natural evolution in our researches of more realistic Design Rationale models that fit to real projects' complexity.

The requirements of our goal to present both analysis and synthesis models to designers' teams that we were confronted to may seem amazing. Actually, it may appear natural at first glance to propose only synthesis models and their variants (routine design, configuration...). But our practical experience of design meetings showed us that analysis activities are also

frequent. For example, as soon as a prototype has been developed, its functioning analysis will give important information that will be reintroduced in the process of solutions' generation.

These observations are also in accordance to cognitive ergonomic psychology results that teach us that design situations in the organizational sense in fact generate two distinct phases in activity: solutions' generation and evaluation of these solutions phases (Darses, 1994). The first corresponds to synthesis problems in KADS sense and is close to design models in this method. The second corresponds to analysis problems whose diagnosis models are the most known.

It is also in accordance with an interpretation (Zacklad, Fontaine, 1996) of the Heuristic Classification of Clancey (Clancey, 1985). These authors expose that analysis and synthesis are based on an heuristic reasoning that constructs a solution that is a justification of the possible causes of a state (analysis) or a justification of the compatibility of an outline with design constraints (synthesis).

The formalism used to describe DIPA is inspired by KADS' one (Wielinga, Schreiber, Breuker, 1993), (Schreiber, Wielinga, 1993) without strictly following these method's conventions on the way to represent inference structure (figure 1).

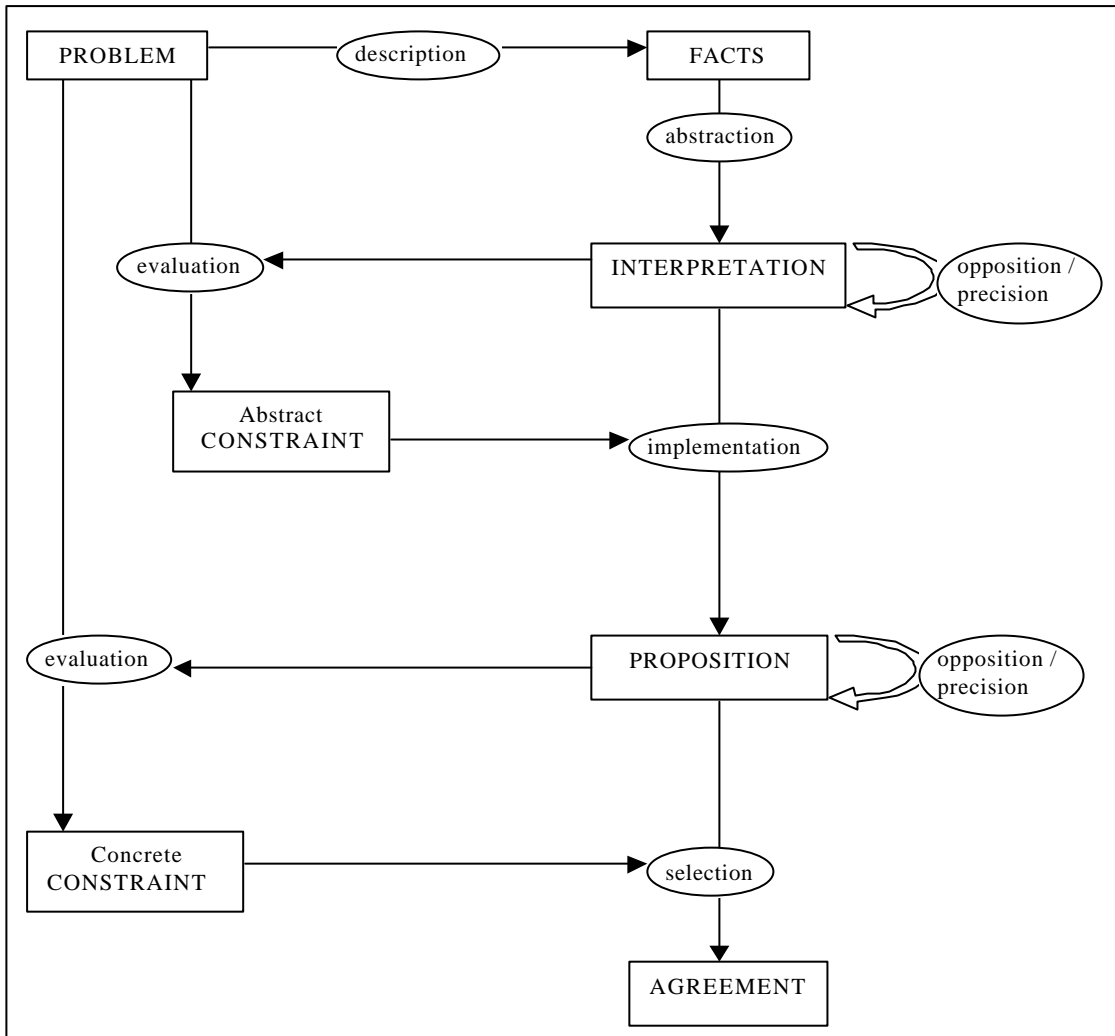


Figure 1: DIPA, an heuristic meta-model of design reasoning for analysis and synthesis

DIPA	DIPA synthesis	DIPA analysis
Problem	Goal	Dysfunction
Fact	Need	Symptom
Interpretation	Functionality	Cause
Abstract constraint	Constraint	Constraint
Proposition	Means	Repair
Concrete constraint	Constraint	Constraint
Agreement	Choice	Choice

Table 2. Implementation of DIPA meta-model for synthesis and analysis activities

5. MEMO-Net

We have implemented the DIPA model to build the MEMO-Net groupware. This system consists of two modules, one for synthesis phases (named "design" in the interface), and the other for analysis phases (named "diagnosis" in the interface). Its goal is to allow a project team to solve problems met during design by alternating the two types of activity on a cooperative way.

The exchanges' structure permits both to guide the solving process and to organize the arguments, particularly in arguments' capitalization perspective.

In the diagnosis module, actors of the project team identify a dysfunction and evoke symptoms, causes or repairs. In the design one, when the goal is expressed, the actors evoked needs, functionalities and means. To contribute, actors click on the following buttons (indicate a dysfunction, symptom, cause, repair) and then create the corresponding forms (figure 2).



Figure 2: buttons to create new forms and form to describe a dysfunction

Contributions are classified chronologically or according to DIPA model categories, or to the authors' names, their roles, or their department.

The example that we are now going to describe is about a team of designers of a trading application. The dysfunction noticed is that application's users make many mistakes when they

put in an order for some products. A first symptom seemed to be caused by interface's defaults, and improvement propositions are evoked, as well as a constraint: interface has already been modified twice. Another cause proposed is the lack of training, and two repairs are suggested: training seminars or free disposal of books with trade rules (figure 3).

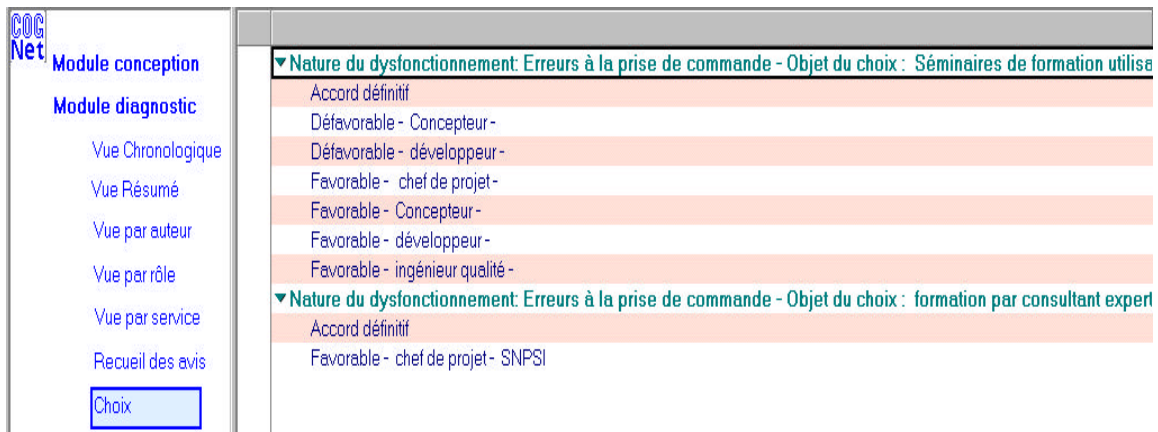


Figure 3: Chronological view of a diagnosis problem-solving method

When users have debated, it is possible to submit one of their propositions to the others for agreement, in order to collect their opinion and take a decision. This last step corresponds to "selection" inference of DIPA model, which permits to reach a definitive agreement on the advisable proposition (figure 4).

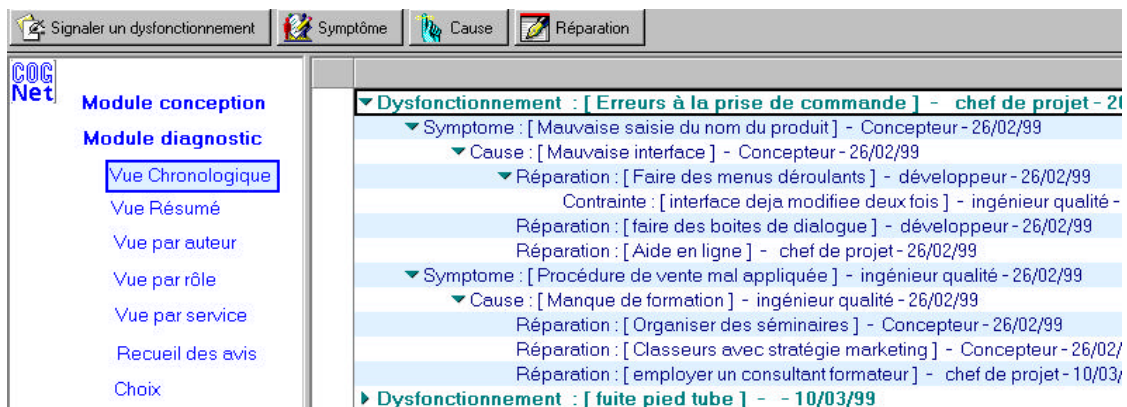


Figure 4: The "choice" view where one can see opinions gathered on a proposition

6. Evaluations

We have conducted a first experimentation of MEMO-Net with engineer students. They have used MEMO-Net synchronously to solve a familiar problem in their university: the choice of the courses each year. Some groups have solved the problem with a forum and other groups with MEMO-Net. All the students have filled in a questionnaire at the end of the experimentation. We try to prove that MEMO-Net improve collective cognitive performances. That means that the collective building of answers and solutions to a problem with MEMO-Net will be of better quality than with a forum. We are going to :

- compare the number of proposed solutions,
- compare the understanding of the reasoning by experts,
- evaluate the quality of the solutions by showing them to experts.

We are also going to experiment soon MEMO-Net in crises meetings where quality experts debate on problems coming from Information System defaults. We will lead the problem solving process by using MEMO-Net.

7. Conclusion

We have shown in this paper that GDSS, meeting rooms and computer conferencing are useful groupware for a decision-aid based on sort, choice or arrangement problematics, but if we are interested in description problematics, we have to look at groupware that permits a memorization of the whole communication process. In order to allow the management of this memorized knowledge, it has to be structured. We then proposed the DIPA formalism to represent collective decision-making processes, inspired by Problem-Solving Methods in order to connect to cognitive dimension of actors' reasoning. The enrichment of groupware with a knowledge structuring method could permit both to guide collective work processes and to obtain useful knowledge.

8. References

Bullen, C.V., Bennett, J.L. (1993). Groupware in practice: An interpretation of work experiences, in Baecker, R. M. (Ed.) *Readings in Groupware and Computer-Supported Cooperative Work*, Morgan Kaufmann Publishers, Inc.

Burgess-Yakemovic, K.C. and Conklin, E.J. (1990). Report on a Development Project Use of an Issue-Based Information System, in Halasz, F. (Ed.) (1990). *CSCW 90: Proceedings of the Conference on Computer-Supported Cooperative Work*. Los Angeles, Oct. 7-10, 1990. Association for Computing Machinery.

Clancey, W. (1985). *Heuristic Classification*, Artificial Intelligence Journal, 27, pp. 289-350, 1985.

Coleman, D. and Shapiro, R. (1992). Defining Groupware. Special Advertising Section to *Network World*, June 22, 1992

Conklin, E.J. (1993). Capturing Organizational Memory, in Baecker, R. M. (Ed.) *Readings in Groupware and Computer-Supported Cooperative Work*, Morgan Kaufmann Publishers, Inc.

Darses, F. (1994). *Gestion des contraintes dans la résolution des problèmes de conception*. Thèse de doctorat, Spécialité Psychologie Cognitive. Paris, Université de Paris 8.

Ellis, C.A., Gibbs, S.J., and Rein, G.L. (1993). Groupware some issues and experiences, in Baecker, R. M. (Ed.) *Readings in Groupware and Computer-Supported Cooperative Work*, Morgan Kaufmann Publishers, Inc.

Fischer, G., Lemke, A.C., McCall, R., Morch, A.I. (1996). Making Argumentation Serve Design, in Moran, T. P. and Carroll, J. M. (Ed.) *Design Rationale Concepts, Techniques and Use*, Lawrence Erlbaum Associates.

Greenberg, S. (Ed.) (1991). *Computer-Supported Work and Groupware*. Academic Press

Grudin, J. (1993). Groupware and Cooperative Work: Problems and Prospects, in Baecker, R. M. (Ed.) *Readings in Groupware and Computer-Supported Cooperative Work*, Morgan Kaufmann Publishers, Inc.

Lewkowicz, M., Zacklad, M. (1998-a). La capitalisation des connaissances tacites de conception à partir des traces des processus de prise de décision collective, *Actes de la conférence Ingénierie des Connaissances*. Pont-à-Mousson, mai 1998.

Lewkowicz, M., Zacklad, M. (1998-b). A formalism for the rationalization of decision-making processes in complex collective design situations, *Proceedings of COOP*. Cannes, may 1998.

MacLean, A., Young, R.M., Bellotti, V.M.E., Moran P. (1996). *Questions, Options and Criteria : Elements of Design Space Analysis*, in Moran, T. P. and Carroll, J. M. (Ed.) *Design Rationale Concepts, Techniques and Use*, Lawrence Erlbaum Associates.

Roy, B. (1985). *Méthodologie Multicritère d'Aide à la Décision*, Economica.

Schreiber, G., Wielinga, B. (1993). *Model Construction*, in Schreiber, G., Wielinga, B., Breuker, J. (Eds.) *KADS a principled approach to knowledge-based system development*, Academic Press.

Wielinga, B., Schreiber, G., Breuker, J. (1993). *Modelling Expertise*, in Schreiber, G., Wielinga, B., Breuker, J. (Eds.) *KADS a principled approach to knowledge-based system development*, Academic Press.

Zacklad, M., Fontaine, D. (1996). *L'acquisition des connaissances classificatoires pour les systèmes à bases de connaissances*, in Aussenac-Gilles, N., Laublet, P., Reynaud, C. (Eds.) *Acquisition et Ingenierie des Connaissances*, Cepadues-Editions.