INRIA

Project-Team Eiffel

Cognition and Cooperation in Design

Rocquencourt

THEME 3A

Activity Report

2003

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1. Team

Heads of project-team

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Vice-head of project-team

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Administrative assistants

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Lucy Georgeon [ITA, CNAM]

Staff members

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Françoise Darses [Maître de Conférence, CNAM]

Research scientists

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Luis Miguel Lopez [preparing a thesis in Ergonomics at CNAM]

Vanina Mollo [MENRT funded, preparing a thesis in Ergonomics at CNAM]

Kleber Pinto Silva [preparing a thesis in Ergonomics at CNAM]

Graduate Students interns

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Jamestina Pratt [DEA, CNAM]

Other Student intern

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2. Overall Objectives

Key words: *cognitive ergonomics*, *cognitive psychology*, *cognitive processes*, *collective design*, *individual design*, *cooperation*, *reuse*, *knowledge management and capitalization*, *viewpoints*, *design methodology*, *design tools*, *cooperative systems*, *argumentation*, *distant mediated cooperation*.

The Eiffel team is a joint research group comprising INRIA (National Institute for Research in Computer Science and Control) and CNAM (National Conservatory of Industrial Arts and Crafts). The objectives of the team are to model cognitive and cooperative processes involved in design activities and to assess and specify tools and methodologies that support design.

Generally, studies on reasoning in design have been carried out on individual problem-solving activities. More recent studies have shifted their focus in response to the increasing need to assist collective work in an industrial context. Major concerns in industrial modernization include: the creation of new organizations that support collective work, greater interaction between designers and manufacturers and capitalization and reuse of design knowledge.

Therefore, the methodology used in conducting design projects is thus becoming a key issue. However, models of individual and collective design activities are not taken into account in current methodologies, causing problems that are measurable in terms of cost, efficiency and productivity. Taking cognitive models of

individual and collective reasoning into consideration appears therefore to be essential in order to specify and assess the methodologies and more generally the systems that support design. The contribution of Cognitive Sciences, in particular Cognitive Psychology and Ergonomics, is becoming crucial for handling and improving the design process.

Our research topics are organized into three main axes.

- Axis 1: Functional and cooperative activities in design
  A current research topic concerns the identification and develooment of new functionalities to assist a) functional activities involved in all design tasks and b) cooperative activities involved in collective design. The objectives of this research goals are to define distributed work environments that integrate design tools (e.g. CAD) and communication tools that make use of the Internet and other means of communicating from remote locations. Our research activities focus on: modelling and assisting individual design; analyzing software reuse and service-based design; identifying viewpoints in design; analyzing cooperative design in OSS from a socio-cognitive viewpoint; analyzing web-based cooperative systems for product innovation in the automotive industry and annotation supports and tools in product design.

- Axis 2: Reflective aspects in design: knowledge management and capitalization
  An additional research objective is to identify and develop new methods and tools for knowledge capitalization and particularly knowledge relating to design. This leads us back in part to the issue of assisting reflective activities - meta-functional activities in which the operator or group of operators reflect on the work itself. This issue is given a constructive perspective (assisting the individual or the group to accumulate knowledge), as well as an integrated approach (integrating the accumulation of knowledge into their main activity, in our case design). Our research activities focus on: meta-cognition in collaborative learning; and the role of local adaptations in the evolution of rules in cancerological therapeutic decision making.

- Axis 3: Methodological aspects
  Research on this axis involves the development of two methodological aspects: analysis methodologies for researchers and user-centered methodologies for the design and assessment of new systems. Our research activities focus on: developing analysis methods of collaborative design; comparing automatic and manual protocol analysis methods; developing methods for the design of new emerging technologies and analyzing cognitive effort in collective software design from a cognitive ergonomics methodological perspective.

3. Scientific Foundations

Key words: *cognitive ergonomics*, *cognitive psychology*.

In engineering, the aim of design is to produce specifications for the technical solution that is to be implemented. Cognitive ergonomics does not identify design in relation to a social function or status, but qualifies certain situations, in which a set of formal characteristics can be identified, as "design tasks" . From the Cognitive Psychology standpoint, design problems may be considered as "ill-defined" problems [54].

The specificities of design tasks are as follows:

- A design problem has several acceptable solutions, not just one "correct" solution.

- Problems tend to be large and complex. They are not generally confined to local problems, and the variables and their interrelations are too numerous to be divided into independent sub-systems.

- One of the consequences of this complexity, is that finding a solution to these problems often requires the combination of multiple skills and abilities, leading to the development of collaboration within a single working group.

- Whatever the application domain, cognitive invariants are found in design activity: e.g. the reuse of previous designs.

Design is usually a group activity, involving and requiring a combination of skills and professions. From a socio-organizational perspective, design is a matter of communicating and integrating the various specialist skills that are involved primarily due to the difficulty of dealing with the many diverse aspects of a complex artefact, as well as all the relationships that exist between these aspects.

The research carried out within this team focuses on Cognitive Ergonomics and Cognitive Psychology. The main concern of Ergonomics is accumulate and apply knowledge that is likely to improve efficiency and interest in the work activity, in this case cognitive work, as opposed to purely physiological aspects, which are naturally equally as important. The traditional role of Ergonomics applied to human-computer systems, primarily focuses on the interaction between humans and their cognitive work environment (including colleagues, technical devices, their work space). Cognitive Psychology is of major importance in Cognitive Ergonomics [60], at both a theoretical and a methodological level. In a broader context, Cognitive Ergonomics and Cognitive Psychology belong to the still expanding field of Cognitive Sciences and therefore benefit from the many interactions that exist between the disciplines that constitute this domain, primarily Computer Science (particularly Artificial Intelligence), Psycholinguistics and Linguistics. Our theoretical framework refers to cognition within situations, collective cognition and developmental cognition: humans act and learn through interaction with other agents (human or not), in objective-oriented activities and in context [53].

Our methodological approach is to conduct empirical studies, either field studies or laboratory experiments:

- Field studies: our main focus is on work in a natural environment. The favoured methodology is observation from within the workplace. We collect "natural" data, such as spontaneous dialogues, written productions, drawings and information collected by individuals in the context of their activity [52].
- Laboratory experiments: we also conduct "natural" experiments, i.e. experiments in realistic conditions, that is to say with real practitioners, performing realistic tasks, using their common tools in their common environment. We also use knowledge elicitation techniques and post-hoc interviews based on observational data (e.g. videos and transcripts of dialogues).

6. New Results

6.1. Introduction

EIFFEL's research has been focusing on collective, rather than individual design [18], [17], [19] for several years. Nevertheless, for many reasons, research on individual design is still relevant to our focus. Firstly, even if many design projects are undertaken by large teams involving numerous designers, engineers and other participants and even if discussions, negotiations and cognitive and operative synchronization play a crucial role in the elaboration and selection of solutions, a large proportion of design activity remains the work of single individuals, particularly during the stages of distributed design. Secondly, even during the stages of co-design, cognitive activities in collective design are the same as those that are implemented in individual design, with in addition other activities specific to cooperative work (particularly coordination, communication, management of viewpoints, synchronization and conflict resolution, primarily in argumentative activities). We have no grounds to suppose that cooperation modifies the nature of the elementary problem-solving processes implemented in design (i.e. solution development and evaluation processes) [55]. Finally, the development of appropriate work environments, such as shared and private work spaces in computer-mediated design, requires analysis of the articulation between the different forms of reasoning implemented in both individually and collectively conducted activities.

6.2. Functional and cooperative activities in design

A current research topic concerns identifying and developing new functionalities to assist cooperation in collective design. The extended enterprise has an increasing need for tools to assist cooperation from remote locations in both synchronous and asynchronous modes and to assist the exchange and sharing of information between the various actors involved in the design process. Currently available tools have their limitations and although tools for assisting workflow do exist, there are very few that are dedicated to assisting cooperation. Therefore, research objectives are thus to define distributed work environments that integrate design tools (e.g. CAD) and communication tools that make use of the possibilities offered by Internet and other means of communication with remote locations. To tackle this research topic, we have developed a typology of collective design situations, by identifying the dimensions that characterize these situations. This strong theoretical framework serves to guide research and capitalize on our knowledge of the various collaborative aspects of design. Our research strategy is as follows:

- study cooperative modes in a situation where the actors are in the same location (co-presence): this provides us with a reference model that can lead to functional prescriptions for synchronous-mediated situations. However, some caution must be taken here, as the means of interacting in natural situations are not always relevant to mediated situations. For example, this is the case concerning visibility of others [57], which may be a disruptive rather than a helpful element [58], [56] for a complex task such as design;

- study mediated synchronous and asynchronous design situations. This involves analyzing cooperative modes, assessing the tools used, identifying how they are used and defining new user-friendlier functionalities.

These two types of studies are important at various stages of research and our work frequently uses these two approaches. The development of cooperative tools is carried out within a framework of collaboration between computer science, academic and industrial teams.

6.2.1. *Modeling and assisting individual design*

Participants: Françoise Darses, Pierre Falzon, Kleber Pinto Silva, Willemien Visser.

Even if our research focus is on collective design, there are, as mentioned above, several reasons for which data concerning individual design is particularly relevant for our modeling and assisting aims. That is why work on individual design continues. Many empirical studies of individual design concern its static aspects, analyzing knowledge that is used or that may be used in design, but not analyzing its actual use. In a review of our previous work on individual design, we analyze the modalities and conditions of the way in which design knowledge is actually used in design activities. This analysis of dynamic aspects of design focuses on actually implemented design strategies in industrial design projects. [24].

CAD systems are supposed to assist designers in their work by offering interactive tools to support their design activity. Several researchers, however, have pointed out problems with these systems. For example, in different domains, such as architecture and mechanical engineering, far from enhancing the creative aspects of design activity, these systems introduce additional difficulties, constraining the design task, which they make more complex and less innovative than if non assisted. This observation leads us to analyze existing tools based on architectural design systems, in order to face certain of the problems mentioned above. This study will be carried through construction of a constraint-based model of architectural design, which will deepen a first analysis of constraint networks and typologies performed in our MSc. Degree thesis. The model will use a QOC (Question, Option, Criteria) design rationale formalism.

6.2.2. *Software reuse and service-based design*

Participants: Jean-Marie Burkhardt, Françoise Détienne, Willemien Visser.

Previous empirical studies on design have emphasized the role of memory of past solutions. Design involves the use of generic knowledge as well as episodic knowledge about past designs for analogous problems: in

this way, it involves the reuse of past designs. We analyze this mechanism of reuse from a socio-cognitive viewpoint [15]. According to a purely cognitive approach, reuse involves cognitive mechanisms linked to the problem solving activity itself. Our socio-cognitive approach accounts for these phenomena as well as for reuse mechanisms linked to cooperation, in particular coordination, and confrontation/integration of viewpoints. This year, collaboration with the Software Engineering team at Keele University, funded by the French-British fund Alliance, aims to construct and to validate an operational framework for a Software-as-a-Service (SaaS) system, grounded, on the one hand, in the cognitive ergonomics of design activities, in particular reuse in Software Design, and in other relevant user-centered methods and approaches, and, on the other hand, in the methods and concepts of Software Engineering (architecture, function, service, etc.).

6.2.3. *Viewpoints in design*

Participants: Jean-Marie Burkhardt, Françoise Détienne.

Viewpoints of 24 designers from three specialties (computer science, training technology, and ergonomics) and two main application domains (Virtual Reality, Training Simulation) have been examined. The notion of "viewpoint" associated with design activities is here defined as the effects of designers' specialty and possibly their role in the design process on the main constraints and objects that are cognitively favored [29]. Verbal data collected through individual semi-directed interviews with the designers have been analyzed using cognitive-discursive analysis and geometric data analysis. Both content and pragmatic cues have been examined [42].

In another context, a field study was performed that aimed at analyzing the use of viewpoints in co-design meetings. A viewpoint is here defined as a collective representation characterized by the implementation of a certain combination of constraints. Three types of viewpoints are distinguished [16]: prescribed viewpoint, discipline-specific viewpoint and integrated viewpoint. The originality of our work is to characterize the viewpoints of the various stakeholders involved in co-design ("design office" disciplines, and production and maintenance disciplines), the dynamics of viewpoints confrontation and the cooperative modes that enable these different viewpoints to be integrated.

6.2.4. *A socio-cognitive approach of cooperative design in OSS*

Participants: Jean-Marie Burkhardt, Françoise Détienne.

Our research question interrogates the design processes of an OSS project devoted to the development of a programming language called Python [38]. The designers of Python engage in a particular process called Python Enhancement Proposals (PEPs). PEPs are akin to a design process, called RFCs (Request For Comments), that has been practiced for decades to define standards for the Internet (used, especially, by the Internet Engineering Task Force). PEPs are also comparable to technical review meetings as practiced in many corporate and governmental settings. Thus, our refined question is as follows: What are the structure and dynamics of PEPs and how do they differ from classical technical review meetings in traditional software development? We have identified two main directions for analysis. First, we are interested in the interaction dynamics of the software designers and implementers. Second, we want to understand what we will term the "socio-technical couplings" of the OSS project, i.e., the "statics" that accompany the interaction dynamics. The set of methodologies that we have been using are: Social network analysis methods; Corpus-based, computational linguistics and computational measures of stylistics; Discourse analysis and speech act analysis; Ethnography. This work is performed in collaboration with UC Berkeley.

6.2.5. *MAGIE: A web-based cooperative system for product innovation in the automotive industry*

Participants: Françoise Darses, Thierry Février Quesada.

During 2003, the second and last year of the MAGIE project, we have addressed the design issues of a cooperative environment, called COOPARENA [25], [44]. Our design approach is based on cognitive engineering principles, which consist in specifying the cooperative system requirements at a cognitive level but in terms that can be manipulated by the computer engineers in charge of developing the future system. From this standpoint, we first carried out a cognitive ergonomics analysis of the current collaborative situations,

either synchronous or asynchronous, in which the team members are involved. This human factor analysis resulted in COOPARENA. This cooperation space is made up of COLLECTIVE TASKS (which the partners in the innovation project must necessarily undertake to achieve the process) that are carried out using a finite number of Basic Cooperative Functions. Then our approach consisted of translating this model into UML use cases, in close interaction with the system designers. The resulting architecture of the cooperation environment was thereby able to meet the real needs of the Web-based collaborative platform's future users.

6.2.6. *MEDIANOTE: Annotation supports and tools in product design*

Participants: Françoise Darses, Françoise Détienne.

The project MEDIANOTE (notified in September 2003) is a multi-disciplinary project that brings together the following disciplines: mechanical engineering, ergonomics, psychology and computer science. It aims at investigating how the argumentation processes can be modeled and supported in collaborative design. A model of argumentation, based on the observation of cooperative activities will be elaborated. Results will be available within a few months [43].

6.3. Reflective aspects in design: knowledge management and capitalization

An additional current research topic involves the identification and development of new methods and tools for the capitalization of design knowledge. This capitalization is implemented in organizational training and learning and case-based reasoning and is recommended in software engineering reuse activities. This subject of knowledge capitalization is often considered from a purely technical angle (technical databases) and from a static perspective (preserving existing knowledge). However, the techniques based on this approach have many limitations: loss of knowledge, high implementation costs, reluctance by users to implement, since the benefits are not instantaneous, for example, failure to using tools to collect design knowledge (IBIS, QOC) [59]. The planned solution is to move from a static viewpoint (accumulating knowledge and information) to an approach that is both constructive (assisting the individual or group process of accumulating knowledge) and integrated (integrating the accumulation of knowledge into the main activity itself, in our case design). This is the approach that is pursued in our research activities [22].

6.3.1. *Meta-cognition in collaborative learning*

Participants: Laurence Gagnière, Françoise Détienne.

This research aims to study, in computer-supported-collaborative-learning situations, the impact of reflection tools that are assumed to help students to develop and improve meta-cognitive skills. The process by which students develop problem solving, decision making and investigation activities in these situations, is determined by the relationship between collaboration, computer tools and meta-cognitive skills. This relationship stems from research from two areas, Collaborative Learning Theory and Meta-cognitive Theory. It will be studied in learning situations using a project-based-learning model. This research is performed in collaboration with the Université de Savoie and the Université de Genève.

6.3.2. *The role of local adaptations in the evolution of rules: therapeutic decision making in cancerology*

Participants: Pierre Falzon, Vanina Mollo.

In medical practice, practitioners use pre-established therapeutic protocols, which consist in a set of rules resulting from an analysis of scientific literature ("evidence-based medicine"): each set of premises (e.g., size of tumor, status of hormonal receptors) is related to a corresponding set of actions (e.g., chemotherapy, hormonotherapy). However, "real" patients do not necessarily match with "standard" patients, which makes practitioners adapt either the premises (specification of the values of the premises, addition of new premises) or the action (suppression, modulation, addition or substitution of a treatment) defined by the protocol [36]. This study tries to better understand the adaptation knowledge used by the practitioners, in order to make them participate in therapeutic knowledge evolution: rule deviation is not considered as an error, but as the first step

of a new potential rule. In an initial analysis, 19 practitioners (taken individually) were asked to think aloud while resolving 15 case studies involving one or more perturbations (factors that make the strict application of the protocol impossible). Allo-confrontations have also been conducted [37]: practitioners were presented with the decisions of their colleagues, and had to comment upon some extracts of their verbalizations. Such a method leads them to make their knowledge more explicit, and allows the researcher to formalize the various factors of adaptation.

6.4. Methodological aspects

Research on this axis involves work on two methodological aspects: methodologies for analyzing cooperative design situations for the researcher and user-centered methodologies for the design and evaluation of new systems for the designer. Progress must be made on these aspects so that the researcher is able to analyze collective design situations (whether they are mediated or not and in both synchronous and asynchronous modes), by focusing on both the functional aspects of the task and performances as well as on interaction aspects of cooperation and how it is supported through language and textual or graphical representations. Existing methodologies in this domain are generally ad hoc. Our objective is to develop methodological principles that are weighted by the aims of the analysis and that can be generalized in any collective design situation. Work must be carried out on the definition of user-centered design methodologies. The user's role in the design process is increasingly questioned. Traditionally, the user participates either as an informant, e.g. in functional analysis, or as an assessor, e.g. in prototyping and simulation phases. Faced with the partial failure of such an approach, the role of the user has been revised, notably by the influence of Scandinavian studies on collective design and by the appearance of new organizational design structures, e.g. concurrent engineering, project teams, etc. Work must also be carried out to define the socio-technical frameworks that can support these new collective design approaches. Some of our work is devoted to this activity [20], [32]. Finally, there is also a need to create methods to develop cooperative and interactive design systems. At present, our research activities are focused on innovative virtual reality-based interactive systems.

6.4.1. *Analysis methods of collaborative design*

Participants: Françoise Darses, Françoise Détienne, Raphael Tabary, Willemien Visser.

Cognitive psychologists and ergonomists have proposed various methods for the analysis of verbal individual protocols, but many fewer for dialogues in collective work settings. Many professional activities, however, are carried out by people working together through verbal interactions. In cognitive ergonomics we have developed the COMET method and other principles for the analysis of collaborative design. Dialogue analysis has long been the business of linguistics, especially in pragmatics. In task-oriented activities of design, the dialogues are said to be cooperative, since the partners share a common goal: they have to converge towards agreement concerning a solution. This differs from several other types of dialogues, such as political debates, interviews, chatting, etc., where the aim is not primarily to collaborate towards a common production. Analysis methods adopted and results obtained by researchers from cognitive ergonomics and linguistics, two disciplines collaborating in the framework of the MOSAIC project, have been compared [26], [27], [28], [39]. Collaborative activities are approached through the dialogues, and also through the generation and use of external representations and more specifically the graphico-gestural activities; graphico-gestural coding has been performed [50]. Various analysis methods have been presented, compared and discussed in the framework of a symposium "Méthodologies d'analyse pluri-sémiotique de situations coopératives de conception: "une démarche pluridisciplinaire" [31], at EPIQUE 2003.

6.4.2. *Automatic vs. manual protocol analysis methods*

Participant: Willemien Visser.

Previously collected route descriptions have been submitted to two types of analyses, a manual analysis [23], and an automatic analysis [40], [41], [51], [42]. Both analyses have been focussing on the semantico-pragmatic aspects of the cognitive descriptive devices used by the locutors to convey spatial indications to their interlocutor. We analyzed the differential use of these devices depending on the locutors' model of their

interlocutor (who could be with -K- or without -NK- knowledge of the environment traversed by the route described). Initially aiming to use automatic analysis to simply validate results of the manual analysis, we ended up using the two approaches in a complementary way. Indeed, each analysis has its specific contribution and strengths. Introducing a distinction between levels of descriptive segments that would have been difficult to implement in automatic analysis, manual analysis revealed a differential specification of goals and means in these procedural descriptions for K and NK interlocutors. Automatic analysis first served to refine a result of manual analysis, i.e. the differential use of different types of spatial references according to interlocutors' knowledge of the environment. It furthermore revealed the use of different Discursive Styles adopted by locutors for addressing K and NK interlocutors.

6.4.3. *Methods for the design of new emerging technologies*

Participants: Margarita Anastasova, Jean-Marie Burkhardt.

A first line of research was done within the framework of an industrial cooperation between the French Atomic Energy Commission (CEA) and Renault S.A.S. We studied automobile mechanics' activity in the context of recent design evolutions in order to assess the applicability of Augmented Reality (AR) as assistance and/or to orient design activities by a user-centered approach. This research, based on the critical incident technique, showed that difficulties were mainly related to the diagnosis of vehicle electronics. Further to this, several AR applications and research perspectives were suggested [46], [45]. A second line of research addressed the integration of aging criteria to the design of Internet-like applications. For this purpose, we carried out empirical studies of elderly persons using and learning Internet. In an initial study, we ran an experimentally constructed training situation to analyze the difficulties faced by the elderly people and to propose ergonomic criteria for designing web sites. Real interactions between elderly persons and the Internet have been analyzed related to the impact of aging, human characteristics and the Internet's technical attributes [34]. We have also investigated an actual training situation [33].

6.4.4. *Cognitive effort in collective software design: methodological perspectives in cognitive ergonomics*

Participants: Jean-Marie Burkhardt, Françoise Détienne, Willemien Visser.

Empirical software engineering (ESE) is concerned with measuring, or estimating, both the effort put into the software process and the quality of its product. We defend the idea that measuring process effort and product quality, and establishing a relation between the two cannot be performed without a model of cognitive and collective activities involved in software design, and without measurement of these activities. This is the object of our field, i.e. Cognitive Ergonomics of design. We discuss a cognitive approach to design activities and its potential to provide new directions in ESE and we discuss an illustration of the methodological directions [30], that we have proposed for the analysis and measurement of cognitive activities in the context of collective software design. The two situations analyzed are technical review meetings [14], and Request For Comments-like procedures in Open Source Software design.

7. Contracts and Grants with Industry

7.1. Grant for PhD Student

M. Anastassova is starting a PhD on Methods for the design of new emerging technologies, funded by CEA.

8. Other Grants and Activities

8.1. International Collaboration

Participants: J-M. Burkhardt, F. Détienne.

- UC Berkeley, UC Santa Cruz: Collaboration on "Social and Cognitive Analyses of Collaborative Design for Open Source Software", funded by France Berkeley Fund, is currently in progress with Warren Sack (UC Berkeley, UC Santa Cruz).

Participants: F. Détienne, W. Visser.

- Ecole Polytechnique de Montréal: Collaboration on "Modeling and supporting collaborative activities in software technical review meetings" is currently in progress with Prof. Pierre Robillard et Patrick D'Astous (Ecole Polytechnique de Montréal).

8.2. European Collaboration

Participants: J.M. Burkhardt, F. Détienne, W. Visser.

- Collaboration on "Applying user-centered design to the designers' activity: the case of reusing SW through service-based engineering tools", funded by the French-British Alliance program, is currently in progress with the Software Engineering team at Keele University (D. Budgen, P. Brereton, S. Owen, M. Turner). The project aims to apply user-centered design in the case of SW reuse through service-based engineering tools.

Participants: F. Détienne, L. Gagnière .

- University of Geneva: Collaboration on "Meta-cognition in distant collaborative learning" is currently in progress with Mireille Bétrancourt (TECFA, University of Genéve) and Ghislaine Chabert (Université de Savoie).

8.3. National Collaboration

- Project "MOSAIC: Méthodologie d'analyse pour la modélisation de situations coopératives en conception de produit". "Cognitique" program, Thème: "Cognition, Interactions sociales, Modélisation"
  Participants: F. Darses, F. Détienne, W. Visser.
  This project, headed by F. Détienne (November 2001-2003), concerns methodologies to analyze collaborative design situations. It is currently in progress with ICARE-CNRS-Lyon2 (was: GRIC, Groupe de recherches sur les interactions communicatives).

- PERF-RV (RNTL)
  Participant: J.M Burkhardt.
  Collaboration with the Ecole Nationale Supérieure des Mines in Paris (CAO & Robotics group), AFPA (Association pour la formation professionnelle des adultes) and Université Paris Sud XI (CRESS). This work generally focuses on the integration of user-centered, cognitive and sensory-motor parameters within an engineering method devoted to designing virtual environments. This work enables us to clarify some theoretical and methodological implications of the notion of realism [11], [21], to review the contribution of ergonomics [12] and to propose a design method devoted to Training applications [13], [35].

- ACI "School and Cognitive Science". Ministry of National Education and Research
  Participant: A. Bisseret.
  "School and Cognitive Science" is a research program funded by the "Fonds National de la Science" ("National Science Fund"). In this framework, André Bisseret is a member of a group in charge of writing a state of the art report on "The Effects of Animated graphics on Learning" (Director: Jean-Michel Boucheix, Bourgogne University). The group is composed of international specialists (France, Germany and Australia). The report is due at the end of 2003.

- Project "Supervised and automatic acquisition of adaptation knowledge". Interdisciplinary TCAN program "Knowledge processing, learning and NTIC"
  Participants: P. Falzon, V. Mollo, C. Sauvagnac.
  This TCAN project is conducted under the responsibility of A. Napoli (LORIA, Nancy). In addition to AI researchers, it also involves ergonomists (EIFFEL-CNAM) and oncologists (CAV, Nancy). This collaboration, established several years ago, deals with the acquisition, the implementation and the evolution of medical knowledge. The objective is to acquire adaptation knowledge in order to develop a case-based reasoning system designed to propose adaptations of therapeutic rules for particular cases

- MEDIANOTE: Annotation supports and tools in product design. Interdisciplinary TCAN program "Knowledge processing, learning and NTIC"
  Participants: F. Darses, F. Détienne.
  The pre-project MEDIAPRO, funded by CNRS/STIC in 2002, has been submitted and accepted by the TCAN-CNRS program as a full project, named MEDIANOTE. Four disciplines are represented in this project: mechanical engineering, ergonomics, psychology and computer science. It aims at investigating how the argumentation processes can be modelled and supported in collaborative design. The project, notified in September 2003, will end in 2004.

- MAGIE: Cooperative environment for product innovation. RNTL project
  Participants: F. Darses, T. Février Quesada.
  The MAGIE research project is funded by the RNTL program of the French Ministry of Industry. RENAULT leads the project, with the participation of CNAM, LAMIH-CNRS, JALIOS-BULL and ILOG. These stakeholders aim at designing a portal, named MAGIE, to support the technological innovation process in the automotive industry. This upstream process takes place in an extended firm, which is characterized by collaborative work by geographically distributed team members. These teams need to get access, through a web platform, to a collaborative environment that allows the multiple collective tasks of the project to be performed [48], [49].

- Collaboration with IMARA (INRIA-Rocq)
  Participants: J.M. Burkhardt, W. Visser.
  Since 1998, we have been collaborating with IMARA (Informatique, Mathématiques et Automatique pour "La Route Automatisée"). This year, our goal has been to participate in the elaboration of design requirements for the future users of automatic vehicles. An ergonomics study prior to the experimental implementation of an automatic vehicle service was carried out at INRIA [47].

- Novafiches (self financing)
  Participant: A. Bisseret.
  Novafiches is an on-line bulletin, published monthly on the Internet and devoted to the domain of multimedia documents and interface design. Thirty reviews or journals are regularly examined. Each issue presents short papers that summarize research results and provide practical recommendations. The issues' contents are available on the Internet. A subscription provides the bulletin by e-mail. A complementary section indicates papers likely to be of interest to practitioners in more specific areas. The current writers are André Bisseret (DR emeritus Inria), Mireille Bétrancourt (Professor at Geneva University), Anne Pellegrin and Nathalie Lépy (Consultants at Novadis-Services).

- Novadis-Services. Eurocontrol
  Participant: A. Bisseret.
  Novadis-Services is a team of consultants in ergonomics, located in Grenoble. André Bisseret served as scientific adviser for a second study carried out by Novadis under contract with Eurocontrol. Two air traffic control strategies were compared by means of an eye-tracking technique. André Bisseret participated in the debriefing meeting.

- Clips-Multicom – CNRS-Grenoble University
  Participant: A. Bisseret.
  Clips is a research center in Grenoble specialized in language communication and person-computer interfaces. Part of Clips, Multicom, is a laboratory devoted to the evaluation of interfaces (Director: Jean Caelen). André Bisseret is collaborating with Clips and Multicom as a scientific adviser in cognitive psychology and ergonomics. Starting from January 2004, Novafiches (see above) became "MultiFiches" and is now published on the Clips' site.
- Design of technical document bases. GRESEC Stendhal University, Grenoble
  Participant: A. Bisseret.
  André Bisseret participated as a scientific adviser in research carried out by Evelyne Mounier and Céline Paganelli (Cristal team) at GRESEC (a research group on communication issues) on information retrieval from large technical document bases. The current studies attempt to define linguistic features that will allow automatic distinction between text units describing objects and text units describing procedures.
- Thematic networks and actions
  Participants: F. Darses, F. Détienne, P. Falzon, W. Visser.

Several membres of the project are involved in the following thematic networks and actions:

- "Action Spécifique" of CNRS-STIC "Conception Participative et Systèmes Orientés Agents" (CP-SOA) (dir. A. Drogoul, LIP6) (start June 2003)
- "Réseau Thématique Pluridisciplinaire" "Acceptabilité ergonomie et usages" (RTP STIC). F. Détienne and P. Falzon are members of the executive committee of this network (RTP).
- "Réseau Thématique Européen" "Langage et Cognition"

9. Dissemination
9.1. Roles in the scientific community
9.1.1. Organizing scientific events

- COOP 04 "Scenario-Based Design of Collaborative Systems". Co-chair: F. Darses
- Ecole d'été 2005 INRIA-EDF-CEA-CNES on Distant work. Co-organizer: F. Détienne
- EPIQUE 2003, 2-3 October, Boulogne (France). Doctoral symposium chair: F. Darses. Symposia Chair: F. Détienne. Members of the Program committee: F. Darses, F. Détienne, W. Visser
- Symposium "Méthodologies d'analyse pluri-sémiotique de situations coopératives de conception: une démarche pluridisciplinaire", October 2, at EPIQUE 2003, 2-3 October, Boulogne (France). Chair: F. Détienne.
- Psychologie Française, No spécial sur la Psychologie Ergonomique. A. Tricot, F. Détienne & C. Bastien (Eds.) (2003).

9.1.2. Journals' editorial boards

- Cognitive Science Quarterly: W. Visser (reviewing)
- Design Studies: W. Visser (reviewing)
- Document Numérique: F. Détienne (reviewing)
- European Review of Applied Psychology: F. Darses (reviewing)
- Interacting with Computers (IWC): Member of the editorial board: F. Détienne
- International Journal of Human Computer Studies (IJHCS): J.-M. Burkhardt (reviewing)
- Psychologie Française: F. Darses (reviewing)
- Le Travail Humain: Member of the editorial board: F. Darses. Member of the board of consultants: A. Bisseret

9.1.3. Conferences' Program committees

- CITE 2003, November, Troyes (France). Members of the Program committee: F. Darses, F. Détienne.
- EASE 2003, 7th International Conference on Empirical Assessment in Software Engineering, April 8-10, Keele (U.K.). Members of the Program committee: F. Détienne, W. Visser.
- EPIQUE 2003, Deuxièmes Journées d'étude en Psychologie ergonomique, Boulogne-Billancourt, 2-3 October 2003: Members of the Program committee: J.-M. Burkhardt, F. Darses, F. Détienne, W. Visser.
- ESEIW on Empirical studies in Software Engineering. September 29, Roman Castles (Rome, Italy). Member of the Program committee: F. Détienne.
- GROUP 2003, International Conference on Supporting Group Work, November 9-12, 2003, Sanibel Island (Florida, USA). Member of the Program committee: F. Darses.
- IEEE VR–4, International Virtual Reality Conference. Member of the Program committee: J.-M. Burkhardt
- Ingénierie des Connaissances 2003, IC 03 Conference, Laval (France), 1-3 July 2003. Member of the Program committee: F. Darses.
- PPIG-15, 15th Annual Workshop of the Psychology of Programming Interest Group, April 8-10, Keele (U.K.). Members of the Program committee: F. Détienne, W. Visser.
- VRIC 2003 - International Virtual Reality Conference, May 14-16, 2003, Laval (France). Co-chair of the Ergonomics session and Member of the Program committee: J.-M. Burkhardt.
- XXXVIII-ème Congrès de la SELF, "Modèles et pratiques de l'analyse du travail: 1988-2003, 15 ans d'évolution". September 24 - 26, 2003, Paris. Member of the Program committee: F. Darses.

9.1.4. Other expert activities

- 6th PRCD (NEST): Expert: F. Détienne.
- CNRS program TCAN "Traitement des Connaissances, Apprentissage et NTIC" (dir. G. Sabah): Member of the Executive board: F. Darses; Expert: F. Détienne.
- Ecole d'été du CNRS Environnement Informatique d'Apprentissage Humain (EIAH 2004). Member du Comité scientifique et pédagogique: J.-M. Burkhardt
- Examining members for HDR (L. Karsenty): P. Falzon, F. Détienne.
- Expert for "Région Champagne Ardennes" postdoctoral applications: F. Détienne.
- Expert for a research project for the Université de Liège (Belgium): F. Darses.
- Experts for INRIA doctoral applications: F. Détienne, W. Visser.
- Invited member of CNRS Evaluation committee (for UMR LACO): F. Détienne.
- Member and expert for "Réseau Thématique Pluridisciplinaire Acceptabilité, ergonomie et usages" RTP STIC-CNRS: F. Détienne.
- Member of INRIA Evaluation committee: F. Détienne.
- Member of the Comité de suivi du Département Homme au Travail de l'INRS: F. Darses (since April 2003).
- Member of the Commission thématique No 5 "Interaction Homme-Machine" du RNRT: F. Darses.
- Member of the Executive board of the Action Transversale INRA "Aide à la Décision" (dir. B. Hubert & E. de Turkheim): F. Darses.

9.1.5. *Professional and academic societies*

- ARCo (Association pour la Recherche Cognitive). Member: W. Visser
- EACE (European Association of Cognitive Ergonomics). Executive board: F. Détienne, (responsable of legal affairs). Members: J.-M. Burkhardt, F. Darses, W. Visser.
- Groupe de Travail en Psychologie Ergonomique (GRAPE) de la SFP: Secretary: F. Darses. Members: J.-M. Burkhardt, F. Détienne.
- SELF. Members: F. Darses, J.-M. Burkhardt.
- SFP (French Psychology Association). Member: A. Bisseret

9.2. University teaching

- P. Falzon teaches Ergonomics at the CNAM, and is responsable for the DEA in this subject (CNAM–Paris V-Paris VIII).
- F. Darses is senior lecturer at the CNAM.
- F. Détienne is research director for DEA students in Ergonomics (CNAM–Paris V-Paris VIII) and Cognitive Processes (Paris VIII). The Eiffel laboratory receives students from these departments.
- V. Mollo (monitrice d'enseignement) teaches at the CNAM (64 h/year)
- J.-M. Burkhardt teaches Ergonomics at the DESS of Paris 8 University (6 h/year)

9.3. Other teaching

- ENSAM, a course on the design of new products: F. Darses (3 hours, November 2003)

9.4. Invited talks and Scientific popularization

- Symposium Human Behaviour in Design, Schloss Hohenkammer (Munich, Germany), 9-11 March. Invited talk: W. Visser: "Dynamic aspects of individual design activities. A cognitive ergonomics viewpoint" [24].
- 2nd Workshop "The future of empirical studies in Software Engineering", September 29, Roman Castles (Rome, Italy). Invited talk at the panel session: F. Détienne.
- Atelier "Langage et cognition: contraintes pragmatiques", Réseau Thématique Européen "Langage et Cognition", September 5, Toulouse. Invited talk: F. Détienne.
- Ecole thématique pluridisciplinaire du CNRS "Réalité Virtuelle & Sciences du comportement", Université de la Méditérannée, May, 19-23, Marseille (France). Invited talk: J.-M. Burkhardt: "Réalité Virtuelle et Ergonomie Cognitive: apports et perspectives".
- INRA seminar "Aide à la décision", 23 June 2003, Paris. Invited talk: F. Darses: "Introduction à la conception participative" (unpublished).
- Virtual Concept'03, 5-7 November, Biarritz (France). Invited talk: J.-M. Burkhardt [35]: "Potentialities of Virtual Reality for Pedagogical Assistance".
- Virtual Concept'03, 5-7 November, Biarritz (France). Invited talk in the panel on "Contributions and stakes of Virtual Reality for training": J.M. Burkhardt.
- F. Darses (2003, 9-15 septembre). "Les DRH doivent promouvoir la conception participative. *Entreprise & Carrières*, No 682, 32-33.

9.5. Participation in scientific events

- 2nd Workshop in the Workshop Series on Empirical Software Engineering "The Future of Empirical Studies in Software Engineering", Monte Porzio Catone (Rome, Italy). Talks: J.-M. Burkhardt, F. Détienne, W. Visser

- Action Spécifique du CNRS "Réalité Virtuelle & Cognition". Ecole des Mines, Paris, 9 January 2003. Participation: J.M. Burkhardt

- Atelier "Langage et cognition: contraintes pragmatiques", Réseau Thématique Européen "Langage et Cognition", September 5, Toulouse. Participation: F. Détienne, W. Visser

- Ecole thématique CNRS, "Technologies de l'information et de la communication et structuration des collectifs", September 7 - 12, 2003, Carry-le Rouet (France). Participation: T. Février Quesada

- EPIQUE 2003, Deuxièmes Journées d'Etude en Psychologie ergonomique, Boulogne-Billancourt, 2-3 October. Invited discusssant: P. Falzon. Talks: J.-M. Burkhardt, F. Darses, F. Détienne, W. Visser. Participation: M. Anastassova, M. Cerf, T. Février Quesada, V. Mollo, K. Pinto Silva, R. Tabary

- EuroCogSci03, European Cognitive Science Society Conference, Osnabrück (Germany), September 10 - 13, 2003. Session chair: W. Visser. Talk: W. Visser

- IEA'2003 Congress, Seoul (Korea), 24-29 August. Talks: P. Falzon, V. Mollo

- PPIG-15, 15th Annual Workshop of the Psychology of Programming Interest Group, April 8-10, Keele (U.K.). Participation: J.-M. Burkhardt, F. Détienne.

- Thirteenth Annual Meeting of The Society for Text and Discourse, Madrid (Spain), June 25-28 2003. Poster: W. Visser

- Virtual Concept'03, 5-7 November, Biarritz (France). Participation: J.-M. Burkhardt

- Workshop "Practice-based studies: current trends and future developments", Trento (Italy), 6-7 November 2003. Participation: V. Mollo.

- XXXVIII-ème Congrès de la SELF, "Modèles et pratiques de l'analyse du travail: 1988-2003, 15 ans d'évolution", Paris, 24-26 September. Talks: F. Darses, P. Falzon, T. Février Quesada, V. Mollo. Participation: F. Détienne.

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